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Science and Politics.

SOME months ago the British Science Guild committed itself to the important task of producing, on behalf of the scientific community, a volume which would assist the people of Great Britain, including its statesmen, politicians, administrators, financiers, and industrialists, to realise the value of the contributions which science has already made to our progress as a nation, and the potentialities of science in the evolution of a better order of society. This volume, when completed, will contain a survey of the results hitherto obtained by the application of science in all departments of national life: a survey of our existing industries and a comparison between them and the corresponding industries of certain other countries: a survey of the possible effects of the further application of science to our older basic industries and our newer industries; the possibility of creating new industries; and finally, how our industrial development is affected by legislative restrictions, our system of taxation, our banking and financial methods, the attitude of professional and manual workers' organisations towards the application of science, and political theory.

The compilation of such a work is a task to which those scientific workers who are conscious that they are also citizens must apply themselves, as much for the education of the scientific community as for the body politic. It cannot be denied that the scientific community has lost opportunity after opportunity since the War to take a more active part in the framing of national and imperial policy. The temptation leading its members into a narrow professionalism of outlook militates against their effectiveness in any sphere outside their own. They rightly charge others with the neglect of science, but the failure of the nation adequately to appreciate science and the scientific outlook is to some extent attributable to their own indifference to public opinion, to their own failure to make their work intelligible to the uninitiated, and to their scorn of, or at least indifference to, the efforts of some of their own fellow-workers to interpret their work to the lay community.

The pity is that this habit of mind is inculcated in most undergraduates studying science in our universities. Instead of being encouraged to regard a training in science as an indispensable qualification for the responsibilities of leadership in any field of national activity, they are led to believe that their studies in any particular branch of science unfit them for any occupations other than

those of teacher, research worker, or technologist in that branch. The consequence is that few graduates in science in Great Britain seek administrative or commercial posts with the large industrial and commercial corporations, take up posts with the banks, financial houses, or insurance companies; few apply for entry to the home or overseas administrative civil services: practically none find an outlet in the administrative services of local government bodies: they rarely turn their attention to the Bar or politics, or the diplomatic and consular services. In other words, although our civilisation is based on science, those trained in science leave to those who have not had this advantage most of the key positions in industry, finance, politics, and the various central and local government services of the Empire. May not this be the root cause of our present parlous economic position?

It will take time to remedy this state of affairs. Nevertheless, it must be remedied, and it is well that a start should be made now, when the nation is ready to listen to any authoritative diagnosis of its troubles and to give careful consideration to any suggested remedy or even palliative for them. It is dissatisfied with its statesmen, politicians, financiers, and industrialists. It has a religious faith in the efficacy of science. It is not impossible that the whole force of public opinion could be mobilised in support of a well-thought-out and comprehensive scheme, prepared by men of science, economists, and industrialists, for the effective utilisation of the resources of the British Empire. The first essential is that this scheme should be in the main the contribution of scientific workers with an interest in the economic and social implications of their work, and industrialists and others with a sincere belief in science and understanding of the scientific outlook. Another essential is that it should represent the collective views of the scientific community.

In his recent article on "National Needs" in NATURE of Dec. 26, "H. E. A." suggests that the Royal Society is the only body which can undertake this responsibility. We, however, do not hold this view. The Royal Society is not constituted to engage in the campaign required, or even to act as a focus. Having been consulted by the central Government for many years past, and being in receipt of Government grants, the Society is not in the position of independence essential for the consideration or criticism of public offices or affairs. Moreover, the fellowship of the Royal Society is not sufficiently catholic to embrace many of those whose co-operation is essential for the production of a practical scheme for national and imperial reorganisation and reconstruction. Nevertheless, it is to be hoped that the Royal Society will be able to assist in this great task, whatever body undertakes it.

It is true that the British Science Guild by itself, because of the character of its membership, could produce a scheme which would command the attention of the country. But it is obvious that a scheme produced by and published with the authority of duly accredited representatives of all the various scientific and technical societies in Great Britain would carry more weight. The British Science Guild would welcome their co-operation, first, because it would show that the scientific societies had not lost all contact with the realities of modern life, and secondly, that they realised the need for a body to perform certain necessary and important tasks for which they lack both the funds and the machinery to undertake themselves individually. The industrialists have the Federation of British Industries as well as associations in each industry to safeguard their interests and, whenever circumstances demand, to express their collective views to Government and the general public. The same is true of the banks, financial houses, and trade unions. Industrialists, financiers, traders, and trade unions see to it that their interests are well represented in Parliament. Up to now, the scientific community has neither built up a strong representative body nor collectively assisted any of its members to enter the House of Commons, where the influence of ten or twelve members qualified to speak for science and backed by science would be disproportionately great in comparison with their numerical strength.

We suggest ten or twelve representatives of the scientific interest advisedly. One member cannot undertake the whole responsibility. On practically every subject of discussion in Parliament science has an important contribution to make, a point of view which should be expressed in the public way for which Parliament provides facilities, and which ministers of the Crown cannot ignore in the same way as they can ignore advice tendered through their departmental officials. Apart altogether from those matters which directly affect the scientific community, such as grants for research and for the training of research students, the efficiency of State scientific departments and the status of their expert staffs, patent law, the future of industrial research associations, where

the emphasis is on the duty of the general community to science, there is a wide range of subjects on which the emphasis is on the duty and service of science to the general community. These subjects include the effect of the maldistribution of gold and silver on our present trade and financial position, the question of the restriction of imports of manufactured goods and agricultural products, housing, health services, disarmament, imperial development (with which is linked the questions of emigration to the Dominions and the acclimatisation of whites in our tropical dependencies), the need for factory legislation in connexion with dangerous trades, and the development of our home resources, both industrial and agricultural.

When Parliament meets again in February, much of its time will be occupied in discussing the estimates of the various departments of State. Here, again, a critical survey by a group of representatives of science would be invaluable. That it will not be made is certain, first, because there is no such group in Parliament, and secondly, because the scientific societies have been slow to respond to the invitation of the British Science Guild to create a body competent to collect the necessary data as the basis of such activities.

Ant-Lions and Worm-Lions.

Demons of the Dust: a Study in Insect Behaviour. By Prof. William Morton Wheeler. Pp. xviii + 378. (London: Kegan Paul and Co., Ltd., n.d.) 21*s.* net.

A STUDY of parallel development in behaviour between the worm-lions and ant-lions must be interesting and important. "A legless maggot and a six-legged Neuropteran larva equipped with powerful sucking mandibles, carry on, though by somewhat different methods, one and the same industry for the purpose of obtaining their food." These are termed respectively the worm- and ant-lions. Their feeding is predatory, craters being made in loose sand, a larva lying partially hidden at the basal point of each. Ants and other small wanderers which stumble into these pits, slide in the sand and are at once grasped and sucked.

The ant-lion is a classical beast and is probably identical with the Myrmecoleon of Job, being referred to in the medieval commentaries thereon. Albert the Great (*c.* 1250) gave a description based on his own observations, and Poupart an adequate account in 1704. The anthropomorphism evidently attracted authors, for Vallisnieri brings into a dialogue between Malpighi and Pliny in the Netherworld (*c.* 1700) the habits of the larva and its transformation to the imago. The Abbé Pluche in his "Spectacle de la Nature" also adopts the same form and humanises the ant-lion as combining "the traits of an expert huntsman, an able geometrician and a miscreant with barbarous and bloody inclinations". This gave the ant-lion a reputation, which attracted the great personalities of zoology of the eighteenth century.

Réaumur's memoir was followed by Bonnet's, both founded on the living insects; the latter described how the larva pushes pebbles, many times its own weight, out of its funnel, placing the tip of its abdomen under them and backing. The pit is made by the larva marking a groove of the requisite diameter by moving backwards and tossing the sand from the inner border of the same to the outside by means of its head and closed jaws. The direction is clockwise or counter-clockwise. A cone is left in the centre, the process being continued within the circle, usually in the same direction, until the crater is completed. But even in the same species a direct method of digging has been observed, so that "the insect cannot be regarded as a pure reflex automaton, especially as a like variability also characterises all the remaining activities of its feeding cycle". The prey is automatically precipitated to the almost hidden larva; it is seized, smothered in sand, bitten and paralysed, partially digested by the injected saliva, and its juices imbibed; lastly, its carcass is thrown out, and the crater is repaired before the ant-lion resumes its quiescent wait for the next prey.

The Mediterranean worm-lion is the maggot of a fly and was known to Poupart; it formed the subject of the last of Réaumur's memoirs. This together with a report by De Geer on specimens sent by Réaumur to the Queen of Sweden are advantageously reprinted (translated) in appendices to the present volume. The further accounts of the worm-lions are mainly a product of the present century and are largely illuminated by our author's own observations on the animals, which he reared himself. Here, as throughout the book, the advance made is shown to be due partially to wider knowledge, especially of the fauna of the sands, and partially to improved technique, backed by the broader considerations of modern biology. Wheeler obtained his insects in the Balearic Islands and, feeding them mainly on white ants, transported them to Boston, where the last flies emerged about a year later. The pupal period extends through two or three weeks, the insect lying below the bottom of its burrow; in this stage it is sticky,

so that sand grains adhere firmly to it. Unfortunately, the emergent flies were delicate and would not mate, so that the eggs and first larval stage are still unknown.

A California subalpine species, the Sierra worm-lion, was described by Wheeler in 1918, but the reference is lacking. It occurs up to 9000 ft., at this height in quite unsheltered situations, whereas at 4000–5000 ft. in the Yosemite it is always in dust that is rarely wetted and little exposed to the sun's rays, the maggot evidently not being strongly thermotactic. Hundreds of larvæ were transported to Harvard and reared. Their pronounced annulation and marked mobility of the anterior segments form a useful comparison with similar features in many of the leeches. It would, however, be too technical to refer here to the excellent morphological descriptions given of this and of the other insects considered—especially, perhaps, that of the stomach and gut, the physiology of which is also of great interest. They lead to the general conclusion that the singular characters of this worm-lion "developed in specific adaptation to its own peculiar environment"; critical adjustment here is in the larval stage, whereas in the Hymenoptera this is best seen in the imago. The study of the behaviour and development of the larvæ in Wheeler's laboratory and the deductions therefrom form a delightfully interesting chapter, of high scientific value and of literary excellence.

While the above species of worm-lions and two others from the western States and Cuba belong to *Vermileo*, another allied genus, *Lampromyia*, is found in Africa. One species was collected by Wheeler in the Canary Islands, being transported as usual to his laboratory, fed, observed, and reared. Later, he was sent live specimens from Sarawak of yet a third genus, which he terms the "worm-tiger".

The concluding chapter summarises the whole question of the astonishing conformity of behaviour between the larvæ of the ant-lion and of the worm-lion, the differences to us appearing much less striking, though fully emphasised in the text. The behaviour pattern of either insect is so complicated that its evolution could only have been built up very gradually. This appears likely, the ant-lions being partially traced back to Permian and the worm-lions to Jurassic forms. The present distribution of both and other considerations lead to the suggestion that they developed their larval behaviour in some semi-arid Mesozoic period. The term 'lochesis' is suggested for the ambushing of prey by many organisms instead of actively seeking it. We certainly would not apply this term to plants, and would hesitate to do so to most marine animals other than Antennulata, especially sedentary colonial forms. The discussion which follows is illuminating, as emphasising the rôle of the environment in the behaviour of animals. The insect here makes a portion of its surroundings into a collecting crater, while many animals use flowers and other objects as traps; in the case of web-formers, we find 'exteriorised' portions of an animal's own body employed to the same end.

As compared with Wheeler's previous works, we may say of this book, as he himself remarks of Réaumur, that it "reveals no impairment of his unusual powers of observation". Indeed, it shows development, mature literary form, and such a nice biological delight in his pets that he interests his readers in every phase of his subject. A book like this does much to break down the arbitrary and most undesirable separation of 'entomology' from 'zoology'; we hold that the greatest curse from which zoology suffers is the dividing off from it of many 'ologies', which, it is imagined, can be pursued by professional scientific men without an understanding of basal facts relating to living matter. J. STANLEY GARDINER.

Organic Chemistry: General and Specialised.

(1) *The Principles of Organic Chemistry.* By Prof. James F. Norris. (International Chemical Series.) Third edition. Pp. xii + 595. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 15*s.* net.

(2) *Theoretische Grundlagen der organischen Chemie.* Von Prof. Walter Hückel. Band 1. Pp. xi + 410. 24 gold marks. Band 2. Pp. iv + 352. 20 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1931.)

(3) *Die Polysaccharide.* Von Hans Pringsheim. Dritte vollständig veränderte Auflage. Pp. ix + 393. (Berlin: Julius Springer, 1931.) 26·80 gold marks.

(4) *Die Alkaloide: eine Monographie der natürlichen Basen.* Von Winterstein. Zweite neue bearbeitete Auflage von Dr. Georg Trier. Teil 2. Pp. xi + 357-1061. (Berlin: Gebrüder Borntraeger, 1931.) 42 gold marks.

(1) PROF. J. F. NORRIS is well known to organic chemists as an original investigator and a teacher of wide experience. His mode of introduction to the fundamental principles of the science is unusual, but deserving of consideration by other

teachers of the subject. Probably many teachers would prefer an arrangement different from that adopted, and, indeed, Prof. Norris's arrangement involves at times a considerable amount of reference to different parts of the book in connexion with the treatment of particular classes of compounds or individual substances. Few other authors of such a textbook have indicated more clearly the wide ambit of organic chemistry and its bearing on our knowledge of biological processes; and although the book may be regarded as somewhat encyclopædic for beginners, the perspective between different branches is well maintained.

It is unusual for such a textbook to be lacking in illustrations and to contain so few references by name to outstanding investigators. The absence of illustrations renders some descriptions rather lengthy and somewhat vague, and although the name of an investigator means little when the personality is obscured, it may be a convenient 'peg' on which to hang facts or principles. A unique feature of the book is the chapter devoted to the identification of organic compounds and the determination of their structure. This is extremely well done and is valuable for systematising the reader's knowledge. The book is attractively written, and has so many things to recommend it that it is almost a shock to find that the nomenclature used for the simple monosaccharides is not more systematic.

(2) Prof. W. Hückel's "Theoretical Principles" is deserving of the closest study as a statement by an authority who has carefully considered the present conceptions and their development both as regards structure and the mechanism of reaction of organic compounds. The treatment of some parts of the subject is highly condensed, but the author has kept his treatise within reasonable dimensions without omitting the discussion of any modern method for investigating the structure and behaviour of organic substances.

A comprehensive criticism of the author's opinions would involve far more space than can be available in an ordinary review. It is certain that these will be criticised, but this criticism will serve to stimulate further investigation on organic compounds by methods which have been made available in recent years. Already, Hückel's views are being quoted in original communications, and the author is to be congratulated on the production of a comprehensive work of outstanding value to present-day organic chemistry.

(3) During the last seven years the developments in carbohydrate chemistry have been fundamentally important, primarily as a result of W. N. Haworth's investigations of the simple sugars, and the third edition of Prof. Pringsheim's monograph is a useful résumé of our present knowledge of the more complex portion of this section of organic chemistry. The book is well printed and the formulæ particularly well set out.

The simple polysaccharides from the maltose type to the tetrasaccharides are discussed for the most part in tabular form in the first section of the book, the remainder being devoted to the complex polysaccharides, cellulose, starches, etc. It might be pointed out that the references to the literature on the constitution of the simple polysaccharides in the tabular list are not complete in themselves, but are supplemented by others appearing later in the same section of the book. This indicates that the book requires detailed study, otherwise it might appear that important references had been omitted. A little fuller critical treatment in this section would have been advantageous.

The second section contains an exhaustive treatment of cellulose, starches, and inulin with regard to the properties of their different forms and their bacterial and fermentative decomposition, and, after discussing modern methods for the determination of the constitution of these highly complex substances, present views regarding the actual constitutions are particularly well stated. Although the book is somewhat expensive—a not unusual feature of modern German works on chemistry—it is a most useful contribution to the literature of the subject.

(4) All workers in alkaloid chemistry must be familiar with Dr. Trier's comprehensive and excellent monograph generally known as Winterstein and Trier's "Die Alkaloide". The special portion of this second part contains a well-written account of the history, the determination of the chemical constitution, the biochemistry, pharmacology, toxicology, the therapeutic uses, etc., of the lupin and lobelia alkaloids and those of the indole, quinoline, and isoquinoline groups which include the alkaloids of the strychnine, morphine, papaverine, and cryptopine groups. The author's connotation of the term 'alkaloid' has made it possible for him to include an account of the two interesting bacterial colouring matters, pyocyanin and prodigiosin, together with the ptomaines, vitamins, and hormones. In view of the rapid growth of our knowledge of the vitamins and hormones in consequence of the work of so many investigators at the present time, this section will become out of date very rapidly.

The general portion deals with such general problems as the relationship between constitution and sources of the alkaloids, the relationship between pharmacological action and chemical constitution, the methods of analysis and outlines of methods of determination of the constitution of the alkaloids. The value of the book depends not only on the detailed information it contains, but also on the many indications as to materials which need further investigation both by the chemist and the pharmacologist.

C. S. GIBSON.

The Philosophy of Science.

Du cheminement de la pensée. Par Émile Meyerson. (Bibliothèque de philosophie contemporaine.) Tome 1. Pp. xxvii + 294. Tome 2. Pp. 295-716. Tome 3. Pp. 717-1036. (Paris: Félix Alcan, 1931.) 130 francs.

THE last work of M. Émile Meyerson is a noble completion of those which have preceded it. It is marked by the same thoroughness and impartiality in examining the views of others, the same steadiness in presenting his own, the same confidence in the progress of science and the growing unity of thought. Coming last, and being written with due care and leisure, it contains a full review of the philosophical bearing of relativity and the quantum theory, as well as a recapitulation of the argument of the earlier books. The third volume of this work, which consists entirely of extracts from the writers whom he quotes from all ages, is alone well worth the trouble of publication; and the whole three volumes, sold at little more than £1 (gold currency !), are indispensable for anyone interested in the nature and history of scientific thinking. The excellent French, the invariable politeness, the flashes of humour, make the book as delightful as it is enlightening.

The general thesis remains the same as that developed in " L'explication dans la Science " and " Identité et Réalité ". The author sums it himself in a phrase which deserves to live: " L'Homme sait le divers et veut l'identique ". This essential process of seeking constantly fresh identifications in a real which presses upon us in growing richness and variety, is traced from the Greeks to the present time.

The book is so convincing that it is worth while to examine in some detail the reasons why it leaves this impression on the mind. The main reason is that M. Meyerson never allows himself to take absolutely one side in any of the sharp oppositions of thought which have marked the ' cheminement de la pensée " throughout the ages. He is frankly a dualist, and shows how at every stage of thought a fresh combination of the real of experience is offered to the inquiring mind of man; and at each stage the mind adds something to it from its own creating and synthesising power. Thus, even in the simplest form of identification, Kant's numerical ' equation ', $5+7=12$, something is added; the result is not a pure tautology. So, with an algebraical identity, $(a+b)(a-b)=a^2-b^2$, there is much more than mere identity.

Something new is gained from every experience. The case is even clearer in the origins of geometry. Meyerson has no doubts, and leaves none in our minds, that the foundation of this science is the work of the creative genius of the Greeks, and he goes on to show that the Aristotelian syllogism, unjustly condemned as tautological by a dominant modern school, conforms also to his ideal of actually enlarging our thought in the guise of expressing another identity. Thought never advances either by pure extension or pure analysis. At each step we take in some new fact and then proceed to see its essential connexion with an identity which we have previously established. No general idea, whether in mathematics or in non-mathematical thinking, is purely a collection of objects or of notions ' externally brought together '. In every case we imply, or seek for, some coherence of the attributes in the essence or nature of the genus or general idea.

This is the act of identification which M. Meyerson finds to be common to all forms of scientific thinking. All thought is movement and all phenomena are change. What M. Meyerson means by ' identity ' is really the result of the constant effort of the mind to seize the common element in the passing show. The difference between mathematical and other kinds of reasoning is not in essence but in the fact that in mathematics the identification is more precise.

The other fundamental aspect of the subject is the fact that there must be identity between diverse minds before any general judgment can be passed on the diverse real. *Nolenti non fit demonstratio.* On this side again we may go back to Aristotle, who declared that both in the syllogism and other forms of reasoning there must be assent as well as formal demonstration. M. Meyerson's attitude throughout is the best possible for inducing this frame of mind in others. He always seeks first for what he can accept in the views of those whom he criticises. He scarcely

mentions anyone from whom we may not gain some enlightenment; and the total effect of this method of approach in the gradual unfolding of the human spirit in the history of science is most inspiring. He rightly regrets the limited interest taken in this supreme subject, and the highest recommendation of the book is that it is bound to send some of its readers to study the material on which it is based.

Apart from this, it contains the most admirable and convincing criticism—convincing because so temperate as well as searching—of Bergson, Bradley, Brunschvig, and many other workers in the field.

F. S. MARVIN.

Short Reviews.

A History of Geographical Discovery and Exploration. By J. N. L. Baker. (Harrap's New Geographical Series.) Pp. 544. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1931.) 12*s.* 6*d.* net.

MR. BAKER'S pioneer effort to survey the whole field of geographical discovery throughout the centuries fills a long-felt need. There is an embarrassing wealth of original accounts of voyages of discovery, and there are a few outstanding studies of particular periods or regions. With remarkable skill and accuracy the author has here gathered together all the essentials of our knowledge of the obtaining of the data on which modern charts and maps are based. A short bibliographical study precedes the volume; for each chapter a main source list is given and, in addition, there are numerous text references to authorities. The author frequently points out that the more spectacular voyages were by no means always the most fruitful in scientific results; his thoughtful appraisement of the ultimate geographical importance of many little-known voyages should help to stimulate the student's critical faculty.

There are fifty line maps, some of them arranged on a folder method which makes it easy to consult them when reading other pages. The frontispiece shows the world according to Behaim (1492) superimposed upon a map of the world as known to-day.

In a brief summary the author directs attention to an important, but too often forgotten, fact—the very small proportion of the world which has been scientifically surveyed in detail. Students need to be reminded that the printed map frequently gives a deceptive suggestion that all is known of a region. S. Obruchev's work in north-east Siberia (1926) shows how misleading are all available maps of that region. A further edition of this volume will inevitably be called for, since it is indispensable for all serious students of geography; in it we hope there may be added a map indicating the extent of fully surveyed country. The publishers have done geography a service by issuing so full and detailed a book at such a reasonable price.

The Sturge Collection: an Illustrated Selection of Flints from Britain bequeathed in 1919 by William Allen Sturge. By Reginald A. Smith. Pp. xii + 136 + 12 plates. (London: British Museum, 1931.) 25*s.* net.

IN 1919 the archæological collections of the British Museum were much enriched by the bequest of the large and valuable collections of the late Dr. Allen Sturge. He had amassed specimens on his visits to England from Nice, where he was in practice, and on his retirement, when he settled at Ickling-ham in Suffolk, he became an assiduous collector, with the assistance of his wife, in that happy hunting ground of the student of the stone age implement. To his own collections he added others by purchase from time to time, those belonging to Canon Greenwell, Allen Brown, and Worthington Smith, among others, passing into his possession. Nor was his interest confined solely to the specimens from Britain, which are dealt with in the work under notice. The implements from other parts of the world which he collected have gone to the Ethnographical Department of the British Museum.

In this descriptive catalogue of a selection from the British implements now in the Department of British and Mediæval Antiquities, geographical distribution has been followed in preference to typology, in accordance with the arrangement for exhibition purposes. Dr. Sturge's home at Ickling-ham has been taken as the centre, and the various sites are grouped according to their distance from it. The list is very fully illustrated, so that in addition to being a tribute to the testator's generosity, which is its primary purpose, it is also an album which, while indicating the richness of the bequest, may also serve, as its author hopes, to fix types and nomenclature for the benefit of the student. There is no discussion, but ample references are made to the relevant literature.

Spencer's Last Journey: being the Journal of an Expedition to Tierra del Fuego by the late Sir Baldwin Spencer; with a Memoir. Edited by R. R. Marett and T. K. Penniman. With Contributions by Sir James Frazer and H. Balfour. Pp. xii + 153 + 14 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 12*s.* 6*d.* net.

A SENSE of tragedy is inseparable from this volume commemorating Baldwin Spencer's last journey, the expedition to Tierra del Fuego in 1929, on which he died. Although he himself would, no doubt, have chosen to end his life in harness, his work was unfinished. His intercourse with the few Yahgans with whom he came into touch was not without result. He collected implements, which are described by Mr. Balfour in an appendix, and he recorded some of their kinship terms and a small vocabulary which will be of service to science: but anthropologists must forgo the light of his unrivalled first-hand knowledge on the problem which has been raised by the suggested affinities between Fuegian and Australian culture.

Baldwin Spencer's journal, which is here printed in full, and his note-books exemplify the care with

which he worked. They show, too, the skilfully exercised powers of observation of Nature which always lay behind his work, and were unimpaired with the passing of years. Sir James Frazer's eloquent appreciation of Baldwin Spencer's work, which places it in true perspective as a unique record of which time will enhance the value, Dr. Marett's sympathetic memoir, and Miss Jean Hamilton's account of the last few days before his death and her perilous journey in conveying his body to its last resting-place, make this a volume which all admirers of Spencer's work will treasure.

Nucleic Acids. By P. A. Levene and Lawrence W. Bass. (American Chemical Society Monograph Series, No. 56.) Pp. 337. (New York: The Chemical Catalog Co., Inc., 1931.) 4.50 dollars.

SPECIALIST knowledge grows apace, though sometimes after great difficulty, along the paths of error and controversy, by the combined labours of many workers. This is particularly true of the chemistry of the nucleic acids, about which there are already two monographs by English and German authors, now supplemented by one from an American writer whose own researches in the field have been of prime importance. The plan adopted by Drs. Levene and Bass is to deal first with the components of the nucleic acids, then with the nucleosides and nucleotides, and finally with the nucleic acids and the enzymes which decompose them. In part the subject is treated in historical sequence: there are ample references and two indexes.

The nucleic acids are established in structure as phosphoric esters of glucosides, the organic radical being a pyrimidine or purine derivative. By their very structure such complex compounds are liable to reversible intramolecular rearrangements which it is fair to assume will alter both their chemical and biological function.

Chemists are beginning to gain an idea of the importance of phosphorus compounds in the living cell, especially as factors in facilitating molecular rearrangements and transformations as witnessed by their function in fermentation and in muscular changes. It is probable that we are on the eve of striking advances in our interpretation of intracellular reactions, and it is essential that the whole existing knowledge of the subject should be adequately presented in monograph form, as is done here.

Plane Trigonometry. By B. B. Bagi. Pp. vii + 248. (Dharwar: The Author, Reddy Housing Society, 1931.) n.p.

THIS volume has been written essentially to suit conditions in Indian colleges. The author claims that his treatment has greater vigour and comprehensiveness than is to be found in many of the existing textbooks written for use in English schools. It is a little difficult to see precisely wherein the real divergence lies, for the book begins, as usual, with the measurement of angles, the use of signs in geometry and orthogonal projection. It then covers the customary groundwork up to the properties of triangles and quadrilaterals. There are also short chapters on finite series and products, elimination and limits. It seems strange to divorce elimination from equations, yet the latter comes roughly in the middle of the book, whilst the former is relegated to Chap. xx.—the last but one!

The relations between the sides and angles of a triangle are established by a uniform method founded upon projection, whilst in solving triangles the older method of using tabular logarithms is used to avoid the negative characteristic. Seven-figure tables with the necessary work in proportional parts are employed, and on p. 126 a reproduction of a page from Chambers's "Tables" is given.

There are many examples taken from recent examination papers fully worked out to illustrate the text, and each chapter ends with a good selection for the student to solve.

Il passato e il presente delle principali teorie geometriche; storia e bibliografia. Per Prof. Gino Loria. Quarta edizione totalmente rifatta. Pp. xxiii + 467. (Padova: Casa Editrice Dott. Antonio Milani, 1931.) 60 lire.

THE first edition of Prof. Loria's treatise on the history and bibliography of geometry was an expansion of a course of lectures delivered at Genoa in 1886. After an introductory chapter on geometry up to 1850, there followed eleven more dealing respectively with higher plane curves, surfaces, space curves, differential geometry, analysis situs, line geometry, correspondences and transformations, enumerative geometry, non-Euclidean geometry, hyperspace, and miscellaneous topics. This was translated into German and Polish. The second edition added references up to 1896. The fourth edition is doubled in size, the extra matter forming a second part, on a similar plan to the first, but dealing with contributions since 1896. It is remarkable that so much good work has been done in this period, which includes the War years. The book will be a most valuable aid to geometrical research. H. T. H. P.

Storia delle matematiche. Per Prof. Gino Loria. Vol. 2: *I secoli XVI e XVII.* Pp. 595. (Torino: Società Tipografico-Editrice Nazionale, 1931.) 25 lire.

THIS admirable work continues the history of mathematics into the sixteenth and seventeenth centuries. This period, which includes such great names as Tartaglia, Napier, Descartes, Galileo, Fermat, Leibniz, and Newton, to cite only a few, presents to the historian a difficult task of discrimination. Prof. Loria has approached the subject on the lines laid down by Montucla: "L'histoire d'une science n'est pas celle de tous les auteurs qui en ont écrit, mais seulement de ceux qui ont contribué par leur travaux à en reculer les bornes". Nevertheless, he has chosen the matter with such care that very little which is of historical importance seems to have escaped the net. Each chapter is accompanied by a very full bibliography which permits a more detailed study of any particular point on which further information may be required.

Metallurgical Researches of Michael Faraday.

PRIOR to 1819, when Faraday published a paper on the composition of Indian Wootz steel, his contributions to knowledge had been represented by comparatively short communications, with no very obvious connexion. His first research of any magnitude was, therefore, the one on the alloys of steel with other metals, on which he was engaged for the next five years. This work, carried out in collaboration with a Mr. James Stodart, a manufacturer of cutlery and surgical instruments, led to the publication of two further papers in 1820 and 1822. Of these, the former is an account of small scale experiments made in the laboratory of the Royal Institution, and the latter, on ingots, 10 lb.-20 lb. in weight, melted in Sheffield. The cause of this interest in steel cannot now with certainty be determined, but Faraday's association with Stodart, and a decision of the Board of Management of the Royal Institution of 1812 that it was desirable that experiments should be undertaken on the alloys of metals, may both have played important parts.

That Stodart's influence was probably considerable is indicated both by the subject of Faraday's first metallurgical contribution and by the fact that after Stodart's death, in 1823, no further paper on this subject appeared. Faraday's diary contains but three further references to steel, the last of which is dated June 28, 1824. That Stodart was much impressed by the Wootz steel is shown by his trade card, preserved in the British Museum, which reads: "J. Stodart, at 401, Strand, London, Surgeons Instruments, Razors and other Cutlery made from Wootz, a steel from India, preferred by Mr. Stodart to the best steel in Europe after years of comparative trial". The desire to imitate this steel for surgical and other cutlery was clearly one of the main objects of Faraday's research, the other to prepare an alloy suitable for mirrors which would not corrode.

Before discussing the results to which this work led, it is not without interest to attempt to discover why it came to such a sudden and untimely end. For this, Stodart's death must in some measure be held responsible; for after giving Faraday every credit for his (in all probability very large) share in the work, the practical experience and keen interest of his collaborator must have exercised a considerable influence. This, probably, with a growing enthusiasm for other lines of research, and a feeling of disappointment with the results obtained from his work on steel, evidently caused his interest to wane. The opinions of his scientific contemporaries are well indicated by the following extract from the obituary notice to Faraday in the *Proceedings of the Royal Society*: "The results of the paper on steel by Stodart and Faraday to the Royal Society in 1822, were of no practical value, and this, one of his first and most laborious investigations, is strikingly distinguished from all his other works by ending in nothing".

That the research was laborious is well shown by one of Faraday's own letters, in which he says: "Pray, pity us that, after two years' experiments, we have got no further; but I am sure, if you knew the labour of the experiments, you would applaud us for our perseverance at least".

What, then, were the fruits, if any, of this five years of continued research? It is to Faraday's credit that, for the first time, a series of steels were examined with sixteen different metallic additions and of varying concentrations. Secondly, he determined, in all probability as accurately as has been done even to the present day, the solid solubility, which he gives as 0·2 per cent, of silver in steel. This was, the writer believes, the first time that such a determination had ever been made. He further showed that both platinum and rhodium dissolve in steel in all proportions; for the former metal this was confirmed in 1907, whilst for the latter it still remains the only research ever carried out.

Faraday prepared the first of the 'stainless steels'. That the alloy contained 50 per cent of platinum, and hence found no useful application, does not detract from a scientific discovery of first-rate importance. Next, by treatment of a steel with acid, he prepared from it a "soft, grey, plumbaginous powder" which, he says, "appears to be a carburet of iron". Priestley, it is believed, had done this at an even earlier date, but Faraday's rediscovery of iron carbide in steel appears to have been entirely independent. By heating a polished surface of his chromium steel, Faraday developed its structure; the very first use of the process now known as 'heat-tinting'. In considering the effect of titanium on steel, he came to the conclusion, which is most generally accepted to-day, that this element does exert a distinctly beneficial effect, but that it finds no permanent place in the steel to which it is added. Considering his experiments on the rusting of the special steels, he points out that nickel reduces the tendency to corrode, and that, other things being equal, a high carbon steel rusts more rapidly than does one of lower carbon content. Finally, he observes that his rhodium steel is more resistant to softening by tempering than a plain carbon alloy is, a conclusion which, if followed up, might well have led to the production of steels of the high-speed type long before they were actually devised.

This, then, is part of the fruit of a research which "ended in nothing". If, however, both Faraday and his scientific contemporaries failed to realise the importance of the results which had been obtained, and to build upon the foundations which he had laid, there are clear indications that a certain section of the producers of steel were greatly impressed. The one steel which Faraday picks out from all he produced was that containing a small percentage of silver. In his own words, "its alloy with steel is the most valuable of those which we have made. To enumerate its applications would be to name almost every edge-tool. It is also probable that it will prove valuable for making dies,

especially with the best Indian steel." In the later paper, dealing with the large scale experiments, he again says that it " was harder than the best cast steel or even than the Indian Wootz, with no disposition whatever to crack either under the hammer or in hardening—its application will probably be extended not only to the manufacture of cutlery, but also to various descriptions of tools; the trifling addition of price cannot operate against its very general introduction. The silver alloy may result of Faraday's work, and provide some indication of the esteem in which it was held by the actual steel-makers.

What has become of the ingots cast in Sheffield will in all probability never be known, but of the steels prepared in the Royal Institution we have now a most interesting and detailed knowledge. A wooden box labelled 'Faraday' and 'Steel and Alloys', the former probably, and the latter almost certainly, in his own writing, has recently

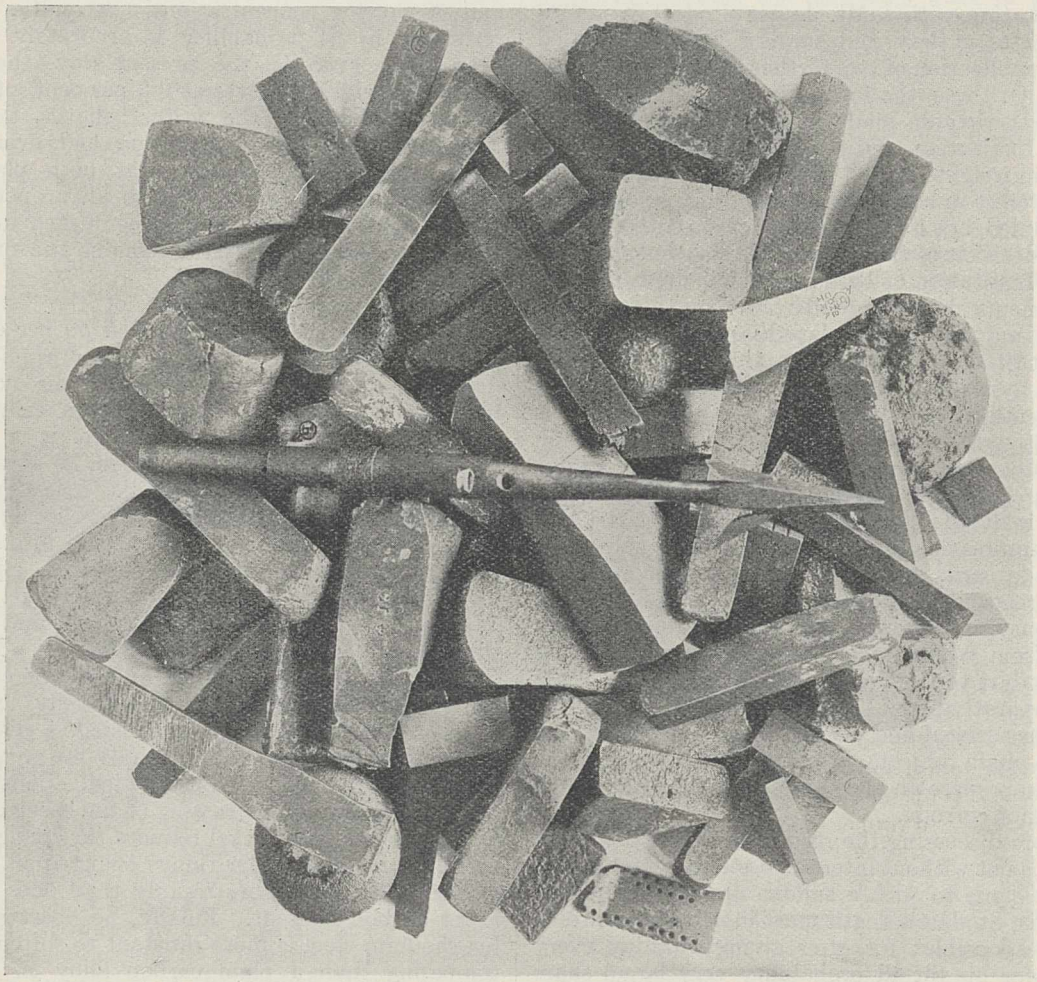

FIG. 1.—The seventy-nine steel specimens taken from Faraday's box. Reproduced by courtesy of the Royal Society from *Phil. Trans.*, A, vol. 230.

be advantageously used for almost every purpose for which good steel is required."

Even to-day there is on the market the so-called 'silver-steel', which, in general, is quite free from that metal, the name referring merely to a high-class, high-carbon crucible alloy. The writer well remembers a visit to a crucible steel works in Sheffield some twenty-five years ago, and seeing the head-melter, with much ostentation, dropping a sixpenny piece into the 'pot' containing some sixty pounds of liquid steel, which addition he was assured would confer on the metal superlative qualities. There can be very little doubt that both the name and the practice are the direct

come to light. This contained seventy-nine specimens, which were handed over to Sir Robert Hadfield for investigation. An account by him of an examination of these, which historically is of the very first importance, has now been published (*Phil. Trans.*, A, vol. 230, p. 221, and British Assoc., Sept. 24, 1931). The scrupulous care taken of this unique material is indicated by the fact that although about 430 separate chemical estimations have been made, with 210 other determinations of structure, hardness, specific gravity, resistance to corrosion, magnetic and electrical characteristics, etc., more than $6\frac{1}{2}$ lb. of the steel still remains, from an original weight of less than 8 lb., representing more than

seventy-five per cent of the total. The samples themselves are shown in Fig. 1.

Broadly, the samples fall into the following categories: In group *A* are three 'buttons', evidently the original melts as they solidified from the furnace. These, like the samples in group *B*, weigh at most 4-5 oz., the latter section, however, consisting of roughly hammered 'blooms'. In group *C* these small 'blooms' have been further hammered into bars. One such bar, however, is far more regularly fashioned, and from its analysis Sir Robert Hadfield draws the perfectly logical deduction that it may well have formed a portion of the steel which Faraday used as the raw material for some of his melts. The other type of basis metal appears to have been an English wrought iron of low carbon and considerable purity for a material of such origin. That a low carbon base must have been employed for some of the melts is shown by the fact that among the samples which have already been analysed is one which contains only 0·07 per cent of carbon and 2·25 per cent of platinum. Some idea of the quality of this achievement, bearing in mind the primitive apparatus available, will, perhaps, be better appreciated if it is pointed out that when, some seventy years later in 1894, Arnold carried out his classical research on "The Influence of Elements on Iron" with an equipment vastly more complete and satisfactory than anything which Faraday had at his disposal, in three cases only out of ten was a smaller amount of carbon present in the alloy than in this remarkable material which Faraday turned out in his simple 'blast-furnace'.

The importance of the production of an untarnishable steel for mirrors in this research is shown by a whole group of other samples with one or more highly polished surface. Among the samples from the Royal Institution, the high platinum-metal alloys were not represented. The steel noted by Faraday which, as a result of the large proportion of platinum it contained, did not corrode, was not, therefore, examined. Quite recently, however, a further series of samples, the property of Mr. A. Evelyn Barnard, has been discovered by Sir Henry Lyons. These also have been placed at Sir Robert Hadfield's disposal for examination, and in a preliminary note in the paper read before Section G (Engineering) of the British Association, high platinum, rhodium, and palladium steels, of such a composition that they can only represent Faraday's alloys, have been found. To all interested in metallurgy, in Faraday himself, and in the history of scientific discovery, the investigation of these alloys will be a matter of the greatest interest. F. C. T.

Xeromorphic Adaptations of Plants.

THE leaves of plants which are found growing in dry situations often show certain structural characteristics in common — thick-walled tissues, thick cuticles, stomata sunken below the surface, etc. These structural features seemed likely to cut down the loss of water from the leaf, and therefore, with little experimental investigation, they have been classed as adaptational mechanisms against water loss and spoken of as 'xeromorphic'. Of recent years the experiments have been carried out which should properly have preceded the adoption of any such interpretation of these characteristic structures.

The result has been considerable misgiving as to the soundness of a view that had long held its place in the elementary textbooks and a great recrudescence of interest in the problem, as is well illustrated by the symposium on xeromorphy at the International Botanical Congress at Cambridge in 1930. Papers by Maximow, Huber, Schratz, and Thoday, which were read at this symposium, have now appeared,[1] whilst an interesting résumé of some aspects of the subject has been published by E. G. Pringsheim.[2]

It is by no means easy to obtain good comparative figures of evaporation rates from different leafy shoots. It is dangerous to assume that twigs removed from the plant will give values indicative of the behaviour of the same shoots upon the tree, and Schratz points out also that the comparative rates of evaporation determined for different severed shoots will vary with the duration of time employed in making the observation.

Results with the shoots still growing upon the plant would therefore appear more valuable, but the difficulty now lies in finding a practicable method for determining the comparable rates of water loss, whilst at the same time it is clear that the structural features of the shoot tissues immediately in question, are only one amongst many variables determining the evaporation from the plant. Seybold's method [3] of treating the evaporating surface as a wet bulb hygrometer seems a step in the right direction and is applicable with the growing plant, but, as Maximow points out, the real temperature of the transpiring surface is still in doubt.

In view of the experimental difficulties, it is not surprising that there is still considerable difference of opinion as to the significance of xeromorphic structures, but a certain general measure of agreement seems to emerge when these recent papers are examined. Thus it seems to be generally agreed that xeromorphic leaves have about the same proportion of stomata to epidermal cells as less xeromorphic leaves of the same species. As the cells of the xeromorphic leaf are usually smaller, this means that the xeromorphic leaf has a larger number of stomata per unit surface, so that it is not surprising to find that, when the stomata are open and the leaves freely supplied with water, xeromorphic leaves lose water more rapidly than less xeromorphic leaves of the same plant. The point is made very clearly by Huber in his comparison of 'sun' and 'shade' leaves, where the sun leaves, borne near the top of the leafy crown of the tree, are xeromorphic as compared with the shade leaves of the lower branches. Such

sun leaves under equal experimental conditions, upon detached shoots given a liberal water supply, evaporate relatively more water than the shade leaves.

On the other hand, under conditions of water deficit, such as will occur more frequently to 'sun' leaves or plants of dry habitats, whilst the adjustment of stomatal aperture is usually more sluggish in such leaves—so that the shade leaves and the plants of normal, mesophytic habitats restrict their water loss more rapidly with diminishing water supply—when once the stomata are closed the loss of water from the xeromorphic leaves is much slower and they do not dry out and wilt like the mesomorphic leaves. Maximow emphasises the fact that they recover more readily after such exposure to drought, and regards this as perhaps the outstanding factor in their resistance to drought,[3] but most contributors to the recent discussions on this subject could agree with his recasting of Schimper's original definition to read that "xerophytes are plants of dry habitats which are able to decrease the transpiration rate to a minimum when under conditions of water deficiency".

From the new point of view, many of the structural features of these xerophytes may come to be regarded rather as natural consequences of growth in a dry habitat than as direct biological adaptations to minimise water loss. Thicker cuticles and thicker walls may be natural results of growth under conditions which repeatedly favour excessive water loss—and therefore processes of deposition from solution and of chemical condensation—during the growing period.

Pringsheim's paper, as also an interesting footnote to Thoday's paper, suggests that a re-examination of 'water-storage' tissues will also become necessary as the water relations of the cell are better understood. The work of Ursprung and Blum has created the impression that volume changes of the cell are mainly governed by the elastic properties of the cellulose wall, but most of the increase in cell volume during growth is irreversible, and Oppenheimer has recently criticised very effectively[4] the experimental basis of this work. He has shown that reversible alterations in volume of about twenty per cent may be seen in thin-walled cells but not in typical thick-walled cells. On the other hand, as Pringsheim points out, the wall may follow alterations in volume of the cell, due directly or indirectly to water loss upon evaporation, although not a stretched elastic membrane. Upon the possibility of such volume changes, in which cell size and shape and tissue configuration will play an important rôle, will largely depend the availability of the water in the cell to supply the needs of other tissues. Thus a large-celled, thick-walled parenchyma may lose water to a thin-walled small-celled meristematic tissue in which volume changes are less easily induced as the result of water loss.

[1] *Journal of Ecology*, vol. 19, Aug. 1931.
[2] *Die Naturwissenschaften*, Aug. 14, 1931.
[3] "Die physikalische Komponente der pflanzlichen Transpiration", 1929. See NATURE, **124**, 293, Aug. 24, 1929.
[4] *Ber. Deutsch. Bot. Ges.*, **48**, 130-140; 1930.

Problems of Filterable Viruses.

THE frequency in recent years of viruses and virus diseases as subjects for discussion at international congresses testifies alike to the wide interest manifested in the biological problems that await solution and to the far-reaching economic importance of this type of infection in the animal and plant worlds. In NATURE of Oct. 10 appeared the main part of Dr. H. H. Dale's presidential address to Section I of the British Association. This address dealt strictly with the biological nature of viruses, an aspect of the general virus problem which, in spite of intensive research in many countries, is likely to offer for some considerable time yet abundant scope for speculation. Dr. Dale's careful analysis of the available information led him, on the whole, to favour as the best working hypothesis one which postulates that the viruses are independent living entities and not of the nature of intrinsic cell ferments or catalysts.

The address was followed by a well-maintained discussion in which a number of active workers in the virus field took part. Dr. Rivers (Rockefeller Institute) emphasised the intimate relation that appeared to exist between the viruses and their host cells as evidenced by the occurrence in certain host cells of inclusion bodies one type of which, notably the Bollinger body of fowlpox, undoubtedly contains virus, and by the fact that positive results in the course of attempts to cultivate viruses *in vitro* had been obtained only when living cells were present. He and his co-workers had failed to demonstrate growth of vaccinia virus in purely artificial media free of tissue cells. It was fairly obvious from the blackboard schemata which Dr. Rivers had prepared in order to illustrate certain possible ways in which viruses could be explained on an intrinsic or semi-intrinsic basis, that he treated perhaps with unmerited seriousness the opinions of certain pathologists who have recently expressed themselves in a similar strain. Subsequent speakers, from their experience in the plant and animal virus fields, were overwhelmingly of opinion that, for the time being at any rate, the hypothesis that viruses are extrinsic living entities is good enough to work on, seeing that no fact yet established in regard to the features of viruses in general and their reactions both in the body and in the test-tube is incompatible with such hypothesis.

This view was stressed particularly by Dr. Henderson Smith (Rothamsted) from the plant virus side, while in the animal virus field Dr. Bedson (London Hospital) and Dr. C. H. Andrewes (National Institute) emphasised the entire incompatibility of an intrinsic origin with the known facts which have been ascertained with regard to the antigenic individuality of viruses. In no essential particular is their serological behaviour—whether in the body or in the test-tube—different from that of the visible bacteria, and the acceptance of an intrinsic origin would involve assumptions as to

antigen-antibody relationships which run counter to all our accumulated knowledge of serology. As pointed out by Dr. W. E. Gye (National Institute), however, there appeared to be some experimental evidence derived from his work on transmissible fowl tumours that the induction of a tumour by means of a cell-free filtrate is brought about by the co-operative action of two elements, one arising intrinsically and the other (most probably the virus) extrinsically.

Dr. G. H. Eagles (Lister Institute), who has recently reported success in the cultivation of the virus of vaccinia on artificial media free from cells (centrifuged kidney extracts), pointed out that if criticism was directed to these experiments on the ground that the centrifugalisation was incomplete, the very notable multiplication of the virus would have to be accounted for by the presence of such a minimal amount of intact cell substance as could scarcely play any decisive rôle in facilitating growth.

Important evidence was given bearing on the well-founded assumption that, below the smallest visible bacteria, another range of living entities begins, going down, so far as we can judge, to degrees of smallness which, at the moment perhaps, it is difficult to conceive as capable of association with an independent life process.

Prof. Ledingham (Lister Institute) discussed the evidence in support of the belief that the large inclusion bodies met with in the epithelial cells in fowlpox are made up of elementary bodies (Borrel bodies) about 0·2 μ diam., and that these latter are the actual infective agents. He stated that he had recently been able, by a special process of extraction, to secure pure suspensions of the elementary bodies (Paschen bodies and Borrel bodies) present in the lesions of vaccinia and fowlpox respectively. These suspensions were found to be agglutinated by the sera of animals (rabbits and fowls) in the course of infection with, and after recovery from, vaccinia and fowlpox. This new evidence supported the view that the elementary bodies were of etiological importance.

Mr. J. E. Barnard and Dr. W. J. Elford (National Institute) discussed their recent work on the microscopy of the elementary bodies present in the lesions of ectromelia, the recently discovered disease of mice which, like fowlpox, is associated with the presence of characteristic large inclusion bodies in the epithelial cells of the infected mouse skin. They showed that, as in fowlpox, the inclusion body in this disease is similarly made up of elementary bodies which are also to be found in great numbers in infected organs such as the liver.

The diameter of the elementary body (about 0·15 μ), as determined by microscopical methods, agreed closely with that determined from differential filtration methods in which collodion membranes of varying porosity were used. The diameter of the foot and mouth virus particle, on the other hand, when determined by similar filtration methods, in conjunction with biological tests of the filtrates, appeared to be of the order of 25-30 $\mu\mu$, and thus only some three times larger than the diameter of a hæmoglobin molecule.

The discussion as a whole brought to a focus a number of the more important lines on which virus research is at present concentrating, and the outlook for the future was distinctly optimistic.

Obituary.

DR. GUSTAVE LE BON.

THE death of Dr. Gustave Le Bon, at the age of ninety-two years, removes one of the most brilliant and versatile of French savants. Ethnology, sociology, psychology, history, philosophy, and experimental science occupied his attention in turn, and often simultaneously.

Le Bon began his professional career as medical officer of a military ambulance in 1870. His early publications refer to experimental work in physics and chemistry, including a study of the alkaloids of tobacco smoke (1880). An adventurous nature led Le Bon to take part in many explorations and scientific missions, which supplied him with material for several ethnographical and sociological studies, such as "La Civilisation des Arabes" (1884), "Les Civilisations de l'Inde" (1887), "Les Premières Civilisations de l'Orient" (1889). Le Bon came to the conclusion that races differ from one another in the proportion of higher types of individuals that they contain, and that the difference between the sexes becomes greater in the more advanced civilisations.

The writings by which Le Bon was best known are his psychological works. The "Psychology of Crowds", "Psychology of Education", "Psychology of Socialism", etc., have been very widely read, and have exerted a wide influence on contemporary thought. Le Bon was also known for his pioneer work in connexion with the relation between matter and energy. In 1897, in a communication to the Paris Academy of Sciences, Le Bon declared that all bodies under the influence of light emit radiation capable of rendering the air a conductor of electricity. He pointed out that this radiation was probably related to the cathode rays and to the newly discovered Becquerel radiation from uranium. His opinion that "matter is only a stable form of energy" was considered at the time highly unorthodox and met with vehement opposition. These speculations were brought together in his "L'Évolution de la Matière" (1905) and "L'Évolution des Forces" (1907), the latter of which was translated into English.

Le Bon counted among his friends some of the most distinguished French savants, including Henri Poincaré, Painlevé, and Ribot, and had perhaps more admirers outside France than in his own country. He was born in 1841 at Nogent-le-Rotrou, and died at Marnes-la-Coquette of bronchopneumonia, after a short illness. As director of the Library of the Philosophy of Science, he remained active in scientific matters until the end.

News and Views.

New Year Honours.

THE New Year Honours list contains the names of the following scientific workers and others associated with scientific work :—*K.C.M.G.* : Sir James Kingston Fowler, member of the Colonial Advisory Medical Committee. *K.B.E.* : Dr. F. N. K. Menzies, chief medical officer of the London County Council. *D.B.E.* : Miss Margaret Tuke, formerly principal of Bedford College for Women ; Miss Edith Mary Brown, principal of the Women's Hospital and Christian Medical College, Ludhiana, Punjab. *Knights* : Mr. George Buckston Browne, who purchased the house at Downe, Kent, where Charles Darwin lived, restored and endowed it, and gave it to the British Association in custody for the nation ; Dr. H. H. Dale, director-in-chief of the National Institute for Medical Research, Hampstead ; Prof. P. Geddes, emeritus professor of botany in the University of St. Andrews and formerly professor of sociology and civics, University of Bombay ; Dr. H. S. Wellcome, founder of the Wellcome Research Institution and of the Wellcome Tropical Research Laboratories, Khartoum. *C.B.* : Mr. F. W. C. Dean, formerly superintendent of the Royal Gun and Carriage Factories, Royal Ordnance Factories. *C.M.G.* : Dr. E. J. Butler, director of the Imperial Mycological Institute. *C.I.E.* : Lieut.-Col. J. Morison, director of the King Edward VII. Pasteur Institute and Medical Research Institute, Shillong, Assam ; Dr. N. L. Sheldon, chief inspector of explosives in India. *C.B.E.* : Dr. Harriette Chick, for services to the Medical Research Council in connexion with research on vitamins and the science of nutrition ; Maj. T. J. Hallinan, inspector-general of health services, Ministry of the Interior, Iraq ; Mr. H. H. Humphries, city engineer and surveyor, Birmingham ; Mr. V. A. Löwinger, surveyor-general in the Straits Settlements and Federated Malay States ; Mr. G. K. Menzies, secretary to the Royal Society of Arts ; Mr. R. J. Mitchell, director and chief designer, Supermarine Aviation Works (Vickers), Limited, for services in connexion with the Schneider Trophy contest ; Dr. H. Moore, director of metallurgical research, War Office ; Mr. H. E. Stilgoe, chief engineer Metropolitan Water Board ; Mr. J. M. Thomson, secretary for native affairs, Northern Rhodesia ; Mr. C. Weatherill, assistant secretary and acting deputy secretary, Department of Agriculture for Scotland. *O.B.E.* : Capt. B. S. Cohen, staff engineer, Research Section, General Post Office ; Mr. A. Harker, for services to the Committee for Research in the Dependencies of the Falkland Islands (Discovery Committee) ; Mr. F. A. Innes, medical officer of health, Gambia ; Mr. R. Withycombe, director of the Electricity Department, Zanzibar. *M.B.E.* : Mr. W. N. Booth, assistant mechanical engineer, Royal Ordnance Factories, Woolwich ; Mr. C. J. Colvin, assistant engineer, Irrigation, Ministry of Economics and Communications, Iraq ; Mr. W. W. D. Dale, engineering assistant to the Director of Dockyards, Admiralty ; Mr. J. E. Lesslar, formerly senior deputy pathologist, Institute for Medical Research, Federated Malay States.

Dr. D. H. Scott.

DR. D. H. SCOTT has recently received a diploma of congratulation from the Bavarian Academy of Science, through its president, Prof. K. Ritter von Goebel, on the jubilee of his degree of Ph.D. of the University of Würzburg. The degree was conferred on Dr. Scott on July 20, 1881. Dr. Scott is known chiefly for his work in palæobotany and in this field he has earned a world-wide reputation. He was elected a fellow of the Royal Society in 1894, and was awarded a Royal Medal in 1906 for his investigation and discoveries in connexion with the structure and relationships of fossil plants, and the Darwin Medal in 1926 for his work on the Pteridosperms. Prof. von Goebel, through whom the congratulatory diploma was sent, was elected a foreign member of the Royal Society in 1926. He is well known for his studies in plant organography, and is an authority on the Bryophyta. This recent further recognition of one of the leading British botanists by his German colleagues is a graceful tribute which will be widely appreciated.

Synthesis of Vitamin D.

THE announcement appeared in NATURE of Oct. 31, 1931, p. 758, of the preparation of 'calciferol', a crystalline compound of the highest known vitamin D activity, by a team of workers at the National Institute for Medical Research, under the leadership of Dr. Bourdillon. Calciferol is probably the pure vitamin, although this is not quite certain : members of this group of compounds, in mixtures of varying composition, frequently form crystals which cannot be separated into their components by simple recrystallisation but only by the formation of derivatives. Calciferol is formed from ergosterol by the action of ultra-violet rays, and up to the present no other method of conversion of ergosterol into vitamin D has been successfully used. It is now reported in the *Times* of Jan. 1 that C. E. Bills and F. G. McDonald, of Evansville, Indiana, U.S.A., have claimed the first chemical synthesis of this vitamin, in a paper at the recent meeting of the American Association for the Advancement of Science. They treated ergosterol with methyl alcohol, ether, and ethylacetate under low temperature, with a rigid exclusion of oxygen, and obtained the vitamin, but in less pure form than by the irradiation of ergosterol.

SYNTHESIS of vitamin D without the use of ultra-violet rays is of very great interest : the fact that the product is of only low activity indicates that it is impure. This work suggests a number of further problems for elucidation. Will the vitamin so prepared, when isolated in pure form, be the same as 'calciferol' ? *A priori*, this might be expected.

Again, will the method be simpler to use than that involving the use of ultra-violet rays, and will the conversion be more quantitative as the method is improved? It will also be of interest to observe whether the methods used by Bourdillon and his collaborators in England and by Windaus at Göttingen in the separation of the vitamin from its accompanying impurities in irradiated ergosterol are applicable to 'chemically treated' ergosterol. Further details of Bills and McDonald's process will be awaited with interest.

Power Stations and Air Pollution.

DURING the past two years, public attention in Great Britain has been focused on the question of air pollution due to the operation of super-power electric stations. In his recent presidential address to the Junior Institution of Engineers, Dr. S. L. Pearce, engineer-in-chief of the London Power Company, discusses this problem and others of great importance at the present time owing to the practice of concentrating more and more power in single generating stations. Efficient measures are available for preventing the pollution of the atmosphere by the smoke and ash from chimney-stacks when stoker-fired boilers are used, but when pulverised fuel is adopted the problem becomes more difficult, owing to the fineness of the dust content of the ash. The recent controversy about the new Battersea power station had reference to the much more difficult problem of arresting the possible damage to buildings and vegetation, and the alleged danger to life, due to the sulphur oxides contained in the products of combustion issuing from the chimneys.

MOST of those who discussed this problem attributed the pollution of the atmosphere mainly to the power stations. That some of it is due to this cause every one admits, but the great bulk is due to the many industrial power plants and the hundreds of thousands of domestic chimneys. Effective measures are now available for eliminating smoke and the ash and dust content of flue gases. Cyclone plants, spray and film washers, and electrofilters all find a place in modern power stations. In conjunction with these, however, it is necessary to erect chimneys at least 300 ft. in height. During the last three years, by the collaboration of engineers and chemists, much research work has been carried out by the London Power Company, experimental plants have been erected, and the results obtained have proved conclusively that the emission of sulphur fumes can be reduced to a negligible quantity.

Akhenaton's Mummy.

THE consternation aroused a few weeks ago by the reported discovery that the mummy of Akhenaton exhibited in the Cairo Museum was not that of the famous monarch, and the suggestion that a substitution had taken place, has now been allayed in some degree by the announcement that it is the identity of the mummy that is in question. Dr. D. E. Derry and Mr. Rex Engelbach, curator of the Egyptian Museum, in a joint lecture at Cairo, as reported in the *Times* of Jan. 2, have now put forward the view that the mummy hitherto regarded as that of Akhenaton is really that of Smenkara, a son-in-law of Akhenaton, who used the royal name in his cartouche; hence the confusion. This mummy has presented some elements of doubt from the time of its discovery. It was found in 1907 in the Valley of the Kings, in a tomb supposed to be that of Queen Tiyi. When it was examined by Prof. Elliot Smith, the condition of the bones was such as to suggest that they belonged to a young man who, at the time of his death, was not more than twenty-five years of age. As this seemed difficult to reconcile with the known facts that Akhenaton had reigned for seventeen years and had six daughters, Prof. Elliot Smith suggested that the king might have suffered from a rare affection which would have delayed the consolidation of the bones perhaps for as much as ten years beyond the normal ("The Royal Mummies", pp. 52-53). Dr. Derry, as a result of experience in the examination of the modern Egyptian youth, now thinks that the mummy may be that of an individual of even less than twenty-five years of age, in view of the early age at which maturity is attained in Egypt. Further, the bulbous head, well known in the representations of Akhenaton and taken by Prof. Elliot Smith in the actual skull to be due to a slight degree of hydrocephalus, is regarded by Dr. Derry as a characteristic of Egyptian royalties.

Exhibition by the Royal Meteorological Society.

AN exhibition is being arranged by the Royal Meteorological Society, to be held in the Geophysical Gallery of the Science Museum, South Kensington, by permission of the director, Sir Henry Lyons. The exhibits will include modern types of observing instruments approved by the Meteorological Office, such as the latest type of thermometer screen with steel stand, equipped with sheath thermometers; the sunshine recorder Mark II, with adjustments for level and azimuth; a new form of mountain rain-gauge which has been named the 'octapent' mountain rain-gauge; and a stream-lined wind-vane which embodies a number of new features—these are being lent by the director. Several stands of instruments of special interest will be shown by some of the leading British makers, among which will be a model anemometer, a new form of automatic pollution gauge, and examples of 'distant-reading' thermometers. A number of historic instruments will be shown, and another exhibit will illustrate the development of lightning conductors.

OTHER features of the exhibition will be a magnificent collection of cloud photographs, including a series arranged by Sir Gilbert Walker, showing recent work on the artificial production of cloud forms. There will be a small exhibit illustrating the teaching of weather study in schools. The exhibition will be opened at 5 P.M., on Jan. 11, when a short inaugural address will be given by Sir Napier Shaw in the lecture theatre. The exhibition will remain open for one month, during which public lectures will be given on Thursdays at 4.30 P.M. The programme as provisionally arranged is as follows: Jan. 14—Mr. D.

Brunt, on "Meteorology in History"; Jan. 21—Dr. G. C. Simpson, on "Weather Forecasting"; Jan. 28—Capt. C. J. P. Cave, on "Clouds"; and Feb. 4—Sir Henry Lyons, on "Historic Meteorological Instruments".

Blind Reading Print by Sound.

ACCORDING to a report in the *Times* of Jan. 1, two French inventors, MM. Thomas and Conland, have devised an apparatus by which ordinary print can be made legible for the blind. The apparatus is called the photoelectrograph. A ray of light is made to pass over the printed page, and as each letter is illuminated the corresponding letter is presented in relief and in magnified form in another part of the machine, where the blind reader identifies it by touch. Not only ordinary print, but also Braille can be read with the machine; in the latter case it has the advantage that the Braille characters can be printed with ink on a smooth page, and need be no larger than ordinary type, thus reducing Braille types to a convenient size and making them cheaper and easier to produce than hitherto. Any reduction in the size of the present Braille publications in embossed type must be a boon; but institutions for the blind in Great Britain will probably continue to use an instrument which involves no special printing, and—like Dr. Fournier d'Albe's 'optophone' or Prof. F. C. Browne's 'phonopticon'—directly converts ordinary type into sound signals. Moreover, experience has shown that ordinary type, even after enlargement, is unsuitable for reading by touch with any speed.

Scientific Research and the Electrical Industry.

WE learn from *A.E.G. Progress* for October that owing to the present trade depression, the German electrical industry is being compelled to exercise the most rigid economy. On the other hand, it is doing its utmost to explore the possibilities of new sources of revenue. To achieve this, it is relying on scientific research and on utilising the results obtained in industry and agriculture. It is recognised that many of the benefits conferred on the civilised world during the last two generations have been due to the close co-operation between the research worker and the engineer. The Research Institute of the A.E.G., which commenced work as a private institute several years ago, has now opened its doors to a wider public and to the Press. Prof. Ramsauer is the head of the Institute and has forty scientific workers under him, the problems investigated covering a wide field in physics, chemistry, and engineering. The field of purely scientific research is the field in which the Institute is least fettered, as the question of technical application is of secondary importance. In fact, technical considerations may be a drawback, as a predetermined purpose cramps scientific research and may even lead it astray. Only when the investigations have been carried to a conclusion, uninfluenced by preconceived ideas, is the possible use of the technical applications of the results considered. In this way the nature of the electron was investigated in the physical laboratory and the conclusion arrived at that its behaviour is similar to that of a wave. It is stated that the use of electron waves for surface structure analysis represents a valued and important application of the knowledge thus obtained.

Soap Plants.

ETYMOLOGY, pharmaceutical lore, and wide knowledge of ancient herbals and modern systematic botany are combined in the fascinating series of articles contributed by Mr. Hilderic Friend to the *Gardeners' Chronicle* under the general title of "Horticulture in relation to Commerce". The article in the issue for Nov. 28 points out how varied are the plants and parts of plants that have been used by native races as soap materials. As a result, the identification of a plant simply named a soap plant or soapwort is not an easy matter. One tropical family, the Sapindaceæ, represented commonly in Great Britain by the horse-chestnut, contains a number of soap plants, including the soap-tree of China, *Sapindus chinensis*; the fruit of another species is used in India under the name of soap nut, whilst Humboldt describes the natives on the river Cariaco washing their linen with the fruit of the parapara (*Sapindus Saponaria*). In California is found a large bulb, *Chlorogalum pomeridianum*, of which the mucilage provides a lather, whilst the root of *Gypsophila Struthium*, a native of Spain, lathers in water. In fact, decoctions, roots, barks, fruits, and seeds have all been utilised, whilst the modern soap industry probably had its origin in the value, very early discovered, of certain plant ashes as cleansing agents. Thus, Pliny states that soap was first prepared by boiling goat's fat with ashes from the beech tree.

Strength of Burmese Timbers.

A PAPER comparing timbers of Burma with those of Europe and America, by Mr. C. W. Scott, of the Indian Forest Service, was recently presented to the Association of Engineers in Burma (Paper No. 3, July 23, 1931, Session 1931). Timber testing is now an economic art practised in many countries either anxious to place new untried timbers on the markets or to procure cheaper ones to replace more expensive types. Most of the important timbers of Burma have now been tested for strength on standard scientific lines at the Forest Research Institute, Dehra Dun, India. The data obtained there are readily comparable with those recorded by similar apparatus and procedure in the United States, Canada, and Great Britain. Timber testing has indeed become a highly organised branch of science in the last twenty years. It is conducted under the supervision of trained engineers well acquainted with engineering practice and requirements in metal and other materials as well as in wood. In France and Germany a certain amount of special timber testing has been done in connexion with aircraft, but apparently no standard procedure for general timber testing has been evolved. The standard methods used at Dehra Dun are being followed also in Australia, New Zealand, South Africa, the Malay States, the Philippines, and Java. Mr. Scott's paper is of value, since the data of comparison have been collected from the laboratories of Dehra Dun (India), Madison (U.S.), Princes Risborough

(England), and the Forest Products Laboratories of Canada. From the point of view of Burma, it places that country in a position to answer inquiries on the subject of strengths, etc., of her more important timbers, information on the subject being obtainable from the Forest Economist, Rangoon.

American Museum of Natural History.

THE standing and the progress of the American Museum of Natural History illustrate what can be attained by effort over a relatively limited field so long as public interest approves and lends its support. On the common ground of the great public educational purposes served by the museum, the City and State of New York have combined in granting appropriations for building alone of 16,000,000 dollars; and the increasing extent of the services rendered may be judged from the jump which is foreshadowed in annual expenditure, from the "inadequate sum" of 15,000,000 dollars in January 1931 to an amount of 22,500,000 dollars in 1933, when the building programme will be completed, and the exhibition halls, laboratories, and lecture halls will be in full operation (Sixty-second Annual Report of the Trustees for the Year 1930). A new feature of the museum's educational programme is the development of the training of teachers, for whom three special courses have been instituted. But the school services also increase by leaps and bounds, so that the 23,000,000 contacts with school children in 1930 almost double those of the year before. The lantern slides loaned to public schools well exceeded a million, and it is interesting to find that the growth of the film service shows that for class purposes the narrow width film (16 mm.) is more appreciated as an aid in teaching than the standard (35 mm.) film, the real place of which is the assembly hall.

National Museum of Canada.

THE National Museum of Canada, the Annual Report of which for 1929 has just been published, attains a happy balance in its combination of field and indoor work. During the summer months the members of the staff are engaged in field work broadly distributed throughout Canada, a tradition doubtless derived from the Museum's close connexion with the Geological Survey. The result is of value scientifically and educationally. Ethnological expeditions in many areas, the investigation of the mammals of British Columbia and of the plants of Wood Buffalo Park, add material to the collections and valuable experience to the collectors, who take the opportunity of delivering popular lectures in the districts they visit. In the Museum itself great stress is laid upon the need for making a reasonable contribution to the interests of the community, and the variety of the titles in the list of the two popular lecture courses, delivered during the winter in the auditorium, indicate one way in which that contribution is successfully made. Nearly 9000 children attended the Saturday morning lectures and 3323 adults those on Wednesday evenings.

Literature of Nutrition.

THE scientific investigation of nutritional problems has attracted so many workers to this field that it is difficult for anyone to keep in touch with advances made in directions other than those in which he is immediately engaged. We therefore welcome the appearance of the first two parts of vol. 1 of *Nutrition Abstracts and Reviews*. This new journal is issued under the auspices of the Imperial Agricultural Bureaux Council, the Medical Research Council, and the Reid Library of the Rowett Institute, Aberdeen. The editors are Dr. J. B. Orr, Prof. J. J. R. Macleod, and Dr. Harriette Chick. The first number, a double one, contains 351 pages and 1334 abstracts. Reviews are contributed by Sir F. Gowland Hopkins on nutrition and human welfare, Prof. E. P. Cathcart on some of the difficulties in the quantitative assessment of human diets, and Dr. J. B. Orr on the qualitative aspects of nutrition, with special reference to farm animals. The journal will appear quarterly. Abstracts will be made from some 450 periodicals, and the reviews will be of two types, those of a general nature, stating a point of view, as in the present number, and others dealing exhaustively with the present state of knowledge of different aspects of the subject, giving a bibliography of the literature. A hearty welcome may be extended to the new journal, which will be invaluable to workers in this science and of great use as a work of reference.

British Salmon Fisheries in 1930.

THE Ministry of Agriculture and Fisheries Report on the Salmon and Freshwater Fisheries for the year 1930 brings to our notice that that year was characterised throughout Great Britain by the marked shortage of salmon from our rivers. Furthermore, this had followed on from a shortage that was already apparent in 1929. In both years it was the four-year-old fish which failed to come up to number, which indicates that for some reason the smolt crop of two successive seasons, in 1927 and 1928, has not returned from the sea. All available evidence goes to show no reason that would cause the smolt run from the rivers to the sea in those years to have been a failure, and one is left to conjecture that "unfavourable factors in the sea caused the destruction of the main body of smolts which descended". With most of our food fish from the sea, the abundance of future stocks is probably determined at a very early stage of the fish's life—during the first year at any rate, as shown by the successive predomination of one-year's stock from year to year in the catches. It is easy to imagine factors which may bring about heavy mortality when the fish are at a young and delicate stage, or that may even curtail spawning efforts; but the salmon are already sturdy grown fish by the time they enter the sea, and, barring excessive depredation by enemies, it is difficult to suggest a reason for their non-return.

Cattle Diseases in Australia.

AFTER considerable delay, arrangements have now been completed by the Australian Council for Scientific and Industrial Research for the carrying out of research work into cattle diseases in northern Australia. The Empire Marketing Board is generously meeting half the cost, up to a maximum of £5000 per annum; the Queensland Government is providing £1000 annually

and is making available its station at Townsville; the cattle industry of the State will provide £2000, to be raised by a compulsory annual levy of 1*s.* on every hundred head of cattle other than dairy herds; the Queensland Council of Agriculture has offered £300, and it is hoped that the meat exporters will provide the balance. Dr. A. W. Turner will be in charge of the station, with Dr. John Legg as chief assistant. In pursuance of the policy of linking together work in different parts of the Empire by personal contact between investigators, Dr. Legg is at present in South Africa studying the problems and organisation of the Veterinary Research Institute at Onderstepoort.

Germ of Infantile Paralysis.

PROF. FREDERICK EBERSON, director of clinical laboratories and research at the Mount Zion Hospital, San Francisco, announced at the recent meeting of the American Association for the Advancement of Science that he has succeeded in cultivating the virus of poliomyelitis (infantile paralysis) in a special culture medium, and in reproducing the disease in the monkey by inoculation of the culture. The virus has long been known as an invisible and filterable one, in which state it is present in the brain and spinal cord of the patient, but in the culture it is claimed that it becomes larger and assumes a form which is just visible microscopically.

Announcements.

WITH the year 1931, Prof. Luigi Palazzo closed his long and valued service as director of the Central Office of Meteorology and Geophysics at Rome, in which he followed the late Prof. Pietro Tacchini thirty years ago. With his work as director, he also combined the guidance of the Italian Seismological Society. He is succeeded by Prof. Emilio Oddone, until lately the head of the Geophysical Section of the Central Office. Two months earlier, Prof. G. Agamennone also retired from the directorship of the Royal Geophysical Institute of Rocca di Papa, to which he was appointed thirty-two years ago after the death of Prof. M. S. de Rossi.

IN view of the disturbed economic and financial conditions that prevail in Europe and America, the Council of the Institute of Metals has found it necessary to postpone this year's meeting, which was to have been held in the United States and Canada next autumn. The meeting had been planned with the close co-operation of the American Institute of Mining and Metallurgical Engineers. The Council's suggestion that the meeting be postponed was sympathetically received in America, and the assurance has been made that the members will be welcome at such later time as may suit their convenience.

MESSRS. Watson and Sons (Electro-Medical), Ltd., Sunic House, 43 Parker Street, Kingsway, W.C.2, have issued a booklet containing a description of their apparatus for, and full details of, 'surgical diathermy'. This is a procedure by which a high-frequency alternating current is concentrated at a small electrode in the form of a short knife edge, so that a small 'cutting' arc is produced, which takes the place of the scalpel or knife ordinarily used in surgical operations, burning instead of cutting through the tissues.

A COLLECTION of collotype reproductions of early English county maps is announced for immediate publication by the Royal Geographical Society. Twenty-one sheets from the collections of the Society have been chosen to represent the chief cartographers and the engravers employed by them. The reproductions will include specimens of the work of Saxton, Symonson, Camden, Speed, and others, with notes by Mr. E. Heawood.

MESSRS. G. Bell and Sons, Ltd., announce the forthcoming publication, in a limited edition, of the diary of Michael Faraday, covering Faraday's experimental work between the years 1820 and 1862. The diary will be issued in seven volumes. Messrs. Bell also promise an account of Prof. Donnan's experiments with membrane equilibria, and the discoveries resulting from them. The author is Dr. T. R. Bolam, and the title of the volume "The Donnan Equilibria".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in electrical engineering at the Swindon Technical College—The Principal, College, Swindon (Jan. 12). A Goldsmiths' professor of metallurgy in the University of Cambridge—The Vice-Chancellor, The University, Cambridge (Jan. 16). An assistant master at the Bolton Municipal Technical College, for chemistry and physics—The Director of Education, Education Office, Nelson Square, Bolton (Jan. 16). An assistant lecturer in engineering at the Brighton Technical College—The Secretary, Education Offices, 54 Old Steine, Brighton (Jan. 16). An advisory officer in agricultural economics at the Edinburgh and East of Scotland College of Agriculture—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (Jan. 18). An assistant curator in the Raffles Museum and Library, Singapore—The Director of Recruitment (Colonial Service), 2 Richmond Terrace, Whitehall, S.W.1 (Jan. 30). A works superintendent and chief engineer at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (Jan. 30). A pathologist in the Public Health Department of the Corporation of Glasgow—The Town Clerk, City Chambers, Glasgow (Feb. 1). A medical man for research work under the British Empire Leprosy Relief Association (Indian Council), in collaboration with the Calcutta School of Tropical Medicine and the All-India Institute of Hygiene—The Honorary Secretary, British Empire Leprosy Relief Association (Indian Council), Talkatora Road, New Delhi, India (Feb. 29). A male assistant superintendent of traffic in the London Telephone Service, and a male assistant traffic superintendent in the Provinces, G.P.O.—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (March 3).

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.*]

Thermoclines in Tropical Lakes.

THE thermocline is a feature of most temperate lakes during the summer months, and is normally destroyed during the winter by a complete overturn of the water, due to cooling at the surface. Little work has been done, however, on such conditions in equatorial lakes, where there is no marked seasonal difference in temperature.

F. Ruttner [1,2] has recently published detailed work on a series of lakes in Java, Sumatra, and Bali. As a general rule, in the smaller lakes of the order of 1-2 square km. (surface area) he found well-marked thermoclines at depths of 2-8 metres. In larger lakes, layering of the water was less marked. In Lake Toba, in area about 1000 square km., the largest lake examined, he found no layering in the upper 20 metres, but a thermocline of a more gentle gradient at a depth of 25-70 metres was detectable. Ruttner concludes that wind is the important factor in preventing the development of thermoclines, and that therefore in the larger lakes, where winds have greater effect, thermoclines are less evident, their presence or absence being quite independent of the depth of the

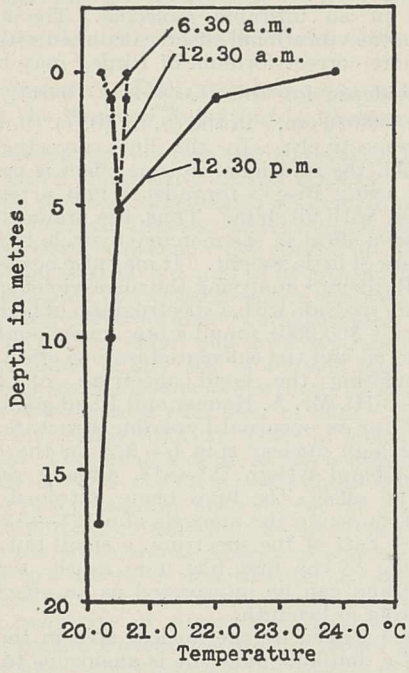

FIG. 1.

lakes. In a few cases he was able to observe the development of a thermocline during the course of a few days in lakes which were previously mixed by heavy winds. He considers such mixing by wind to be comparatively rare, the stable condition being that of layering with a well-marked thermocline near the surface.

After two expeditions studying limnological problems in the African equatorial regions, we can say that no thermoclines are developed in the following lakes, all of which are deep enough to produce either of the types described by Ruttner: Lakes Rudolf and Naivasha in Kenya, Lake Bunyoni in Uganda, and the Victoria Nyanza. Our conclusions are derived from a large number of observations on temperature, alkalinity, hydrogen ion concentration, and phosphate content at different times of the day and night. As a general rule, the water from surface to a depth of two or three metres heats up several degrees during the day, and complete mixing takes place at night, so that from midnight onwards the temperature curve

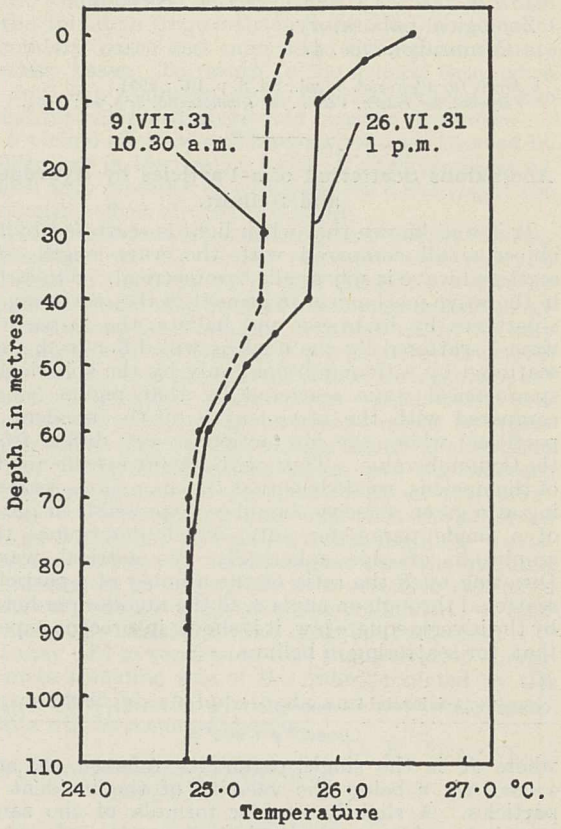

FIG. 2.

is vertical or even reversed in the upper few metres, as illustrated in Fig. 1 for Lake Naivasha.

These results confirm Ruttner's conclusions with regard to area and wind mixing, since all of those lakes mentioned are of the large type, with areas of more than ten square km., and range up to the enormous area of Lake Victoria: but the wind effect, if responsible, produces even greater mixing, in that no thermoclines were detected at any depth.

In Lake Edward, however, a large rift lake in Uganda with a depth of 117 metres, a very marked thermocline was found at the considerable depth of 40-60 metres. This is illustrated in Fig. 2. Lake Edward has an area of about 1500 square km., and its surface is much disturbed by winds, so that there seems no reason why a thermocline should develop there and not in Lake Rudolf or Lake Victoria. Fig. 2 shows that the upper 40 metres of Lake Edward would constitute a lake similar to Lake Naivasha with a regular heating and cooling of the upper three or four metres, suggesting that the thermocline from 40 metres to 60 metres is not due to the ordinary sun-heating at the surface. The water below the thermocline smelt strongly of hydrogen sulphide; that of the epilimnion

was odourless. The only explanation that we are able to offer for this remarkable thermocline of Lake Edward is that the heavy layer of more saline water in the hypolimnion has been introduced by rivers from the surrounding volcanic regions or from underground sources, and is prevented from mixing with the epilimnion owing to its greater density. We should suggest that the thermocline found by Ruttner in large lakes, such as Lake Toba, may also be of this nature and not a true temperature thermocline.

E. B. WORTHINGTON.
L. C. BEADLE.

Zoological Laboratory,
Cambridge, Dec. 4.

[1] *Archiv für Hydrobiol.* Suppl., Bd. 8, p. 197; 1931.
[2] *Verhandl. der Intern. Verein. für Limnol.*, Bd. 5, p. 44; 1931.

Anomalous Scattering of α-Particles by Hydrogen and Helium.

IT is well known that when light is scattered by an object small compared with the wave-length, the scattered wave is spherically symmetrical. Similarly, in the wave mechanical treatment of the scattering of α-particles by hydrogen and helium, the 'α-particle wave' scattered by the nucleus will differ from that scattered by a Coulomb field only by the spherically symmetrical wave scattered by that region (small compared with the wave-length of the incident α-particles) where the interaction energy differs from the Coulomb value. Thus, without any specific model of the nucleus, we deduce that the anomalous scattering at a given velocity should be expressible in terms of a single parameter only, which determines the amplitude of this spherically symmetrical wave. Denoting by R the ratio of the number of α-particles scattered through an angle ϕ, to the number predicted by the inverse square law, it is shown in a recent paper[1] that, for scattering in helium,

$$R = \frac{|\operatorname{cosec}^2\phi.e^{-i\alpha\log\sin^2\phi} + \sec^2\phi.e^{-i\alpha\log\cos^2\phi} + 2i(e^{2iK}-1)/\alpha|^2}{\operatorname{cosec}^4\phi + \sec^4\phi},$$

where K is the single parameter referred to, and $\alpha = 8\pi e^2/vh$, v being the velocity of the incident α-particles. A slightly simpler formula of the same type is found for scattering in hydrogen.

The experimental value for R at one given value of ϕ and v determines K for that velocity, and the formula will then predict R for other angles. It has been found that the formula gives good agreement for the angle distribution in both helium and hydrogen, accounting even for the anomalous scattering at small angles, as is illustrated in the accompanying tables.

SCATTERING IN HELIUM.

$v = 1{\cdot}73 \times 10^9$ cm./sec. $K = 1{\cdot}65$.

Angle (ϕ) .	10°	34°	45°
R (calculated) .	0·62	3·8	8·0
R (observed)[2] .	0·56	3·6	8·0 *

SCATTERING IN HYDROGEN.

$v = 1{\cdot}84 \times 10^9$ cm./sec. $K = 0{\cdot}96$.

Angle (ϕ) .	0°-10°	10°-15°	15°-20°	21·4°-31·2°	30°-40°	40°-50°	50°-60°
R (calculated)	42	43	39	29	17	7·8	2·4
R (observed)[3]	44	50	48	29*	13	7	1·4

* The values marked with an asterisk were used to determine K.

If the values of K are calculated for two or more different velocities, they can be used to determine a model for the nuclear field. This model is spherically symmetrical and is of the type already postulated by Gamow to account for radioactive phenomena. Thus the wave mechanical solution of the scattering problem avoids the difficulty encountered by classical mechanics whereby the anomalous scattering at small angles required a nucleus with different properties in different directions. H. M. TAYLOR.

Clare College, Cambridge,
Dec. 3.

[1] Taylor, *Proc. Roy. Soc.*, A, vol. 134, p. 103; 1931.
[2] Rutherford and Chadwick, *Phil. Mag.*, vol. 4, p. 605; 1927.
[3] Chadwick and Bieler, *Phil. Mag.*, vol. 42, p. 923; 1921.

Nuclear Spin and Hyperfine Structure in Band Spectra.

RECENTLY, S. Mrozowski[1] has found that the band lines in the spectrum of mercury hydride (HgH) are split into several narrow components of constant or nearly constant separation (~0·02 A.). The bands investigated belong to a sequence $v' = 0$, $v'' = 0, 1, 2, 3$ in the transition $^2\Pi_{\frac{1}{2}} \rightarrow {}^2\Sigma$. Apparently the approximate formula for the isotope effect in band spectra, $\Delta\nu_1 = \delta(\frac{1}{2}\nu_{\text{osc.}} \pm \nu_{\text{rot.}})$, fails completely to explain this case, and so Mrozowski concludes that the separation may be interpreted as a hyperfine structure in a more restricted sense, that is, it is caused by the magnetic or electric constitution of the atomic nuclei.

The isotope formula above, however, is not applicable to this case, the normal state $^2\Sigma$ forming a unique example of an unstable molecule. The following figures on the vibrational effect, calculated with the aid of the more correct formula of Birge,[2] may be taken as an evidence for this: $\Delta\nu_{\text{osc.}}\binom{2\,0\,0}{2\,0\,2} = +0{\cdot}017, -0{\cdot}031, -0{\cdot}049, -0{\cdot}026$ cm.$^{-1}$ in the (0, 0), (0, 1), (0, 2), (0, 3) bands respectively. In the lines investigated by Mrozowski, the rotational isotope effect is predominant, but using Birge's formulæ, I find a reasonable agreement with his data. Thus, the arguments for a nuclear spin effect in the mercury hydride bands considered are of little weight. It may also be mentioned that R. Rydberg,[3] analysing the ultra-violet spectrum of mercury hydride with a spectrograph of high resolving power (~300,000), found a fair agreement between the observed and the calculated isotope effect.

Investigating the band spectrum of bismuth hydride (BiH), Mr. A. Heimer and I had good reasons to search for an eventual hyperfine structure, arising from the high nuclear spin ($i = 9/2$) in the bismuth atom. A band system $^1\Sigma^* \rightarrow {}^1\Sigma$, already reported,[4] showed no effect, the lines being extremely sharp. However, pursuing the analysis of a $^1\Sigma^* \rightarrow {}^1\Pi$ system in the red part of the spectrum, a small but distinct broadening of the first few lines in the series was observed and can be interpreted as an effect of the nuclear spin in bismuth.

The rôle played by the nuclear spin in the vector model of a diatomic molecule is analogous to that of the spinning electron in Hund's cases *a* and *b*. The energy of interaction between nuclear spins and the electronic system in the model of fixed centre is then given by $(a_1\iota_1 + a_2\iota_2)\Lambda$, a_s and ι_s denoting the coupling factor and the spin component along the figure axis of the molecule, while the mutual interaction between both spins, $a_{12}\, i_1 i_2 \cos(i_1 i_2)$, is omitted on account of its smallness. Accordingly, the hyperfine structure of electronic terms is limited to the cases $\Lambda > 0$ (Π, Δ, Γ . . . terms), Σ-terms showing no effect. In the rotating model this coupling will break down as K, the quantum number of rotation, increases.

From the observed doublet separation in terms of one-electron molecules (ZnH, CdH, HgH) the strength of the magnetic field, induced by the rotation in BiH, may be estimated, and it was found that a complete Paschen-Back effect appeared already for $K>3$, causing the disappearance of the hyperfine structure. This behaviour of the model corresponds to the observations noted above. For large K-values (case b', also including $^1\Sigma$-terms) a kind of rotational hyperfine structure should appear, due to an orientation of the nuclear spin to the axis of rotation. In $^1\Sigma^* \rightarrow {}^1\Sigma$ the calculated width of lines due to this effect, $\sigma i_K g_i$ ($i_K = +i, i-1, \ldots -i$), amounts to ~0·02 A., which, however, is still too small to be distinguished from other factors governing the line width. It would appear from what is said above, that the BiH molecule is not a favourable one for such observations; lighter molecules are to be preferred. I also wish to emphasise that my interpretation of the effect is not observed, the hyperfine structure of the band lines not being resolved.

In addition, we must take into consideration that in some atoms deviating properties in the electric field of their isotopes have been observed, as clearly indicated in the case of neon. It is difficult to overlook the molecular effect resulting from this factor. Investigations are being pursued on both sides of this problem.

E. HULTHÉN.

Laboratory of Physics,
University of Stockholm,
Dec. 4.

[1] S. Mrozowski, *Zeit. für Phys.*, **72**, 776; 1931.
[2] B. A. Brice, *Phys. Rev.*, **35**, 966; 1930.
[3] R. Rydberg, *Zeit. für Phys.*, **73**, 74; 1931.
[4] A. Heimer and E. Hulthén, NATURE, **127**, 557; 1931.

Significance of Velocity Measurements in Relation to the Benzene Substitution Problem.

FROM the results obtained by Holleman,[1] Hückel [2] has calculated the relative action constants and the differences between the energies of activation for the nitration of certain benzene derivatives in the ortho, meta, and para positions. The energy of activation for the ortho position is found to be greater than that for the para, and at the temperature used the amount of ortho derivative formed is smaller than that of para in the case of chlor- and brom-benzene, and the exception found in the case of toluene may be met by allowing for the double opportunity of ortho substitution as compared with that of para. These results are interesting from the point of view of steric hindrance. The equality of the action constants taken in conjunction with the facts given above shows that the lower rate of reaction observed for the ortho position is not due to steric hindrance acting on an activated molecule but to an actual paucity of activated molecules due to a difference in activation energy.

The close connexion between substitution problems and the reactivity of substituents attached to the benzene nucleus encourages me to report here the results of some experiments on the velocity of reaction between ortho, meta, and para toluidines and benzyl chloride. I have found that the energy of activation of the ortho compound is distinctly higher than that for the para compound, so that here, as in the case of direct substitution, the lower rate of reaction is not due to steric hindrance acting on activated molecules but to a paucity of active molecules. The steric effect, then, of the methyl group in the above case acts directly on the nitrogen atom by increasing the value of the energy necessary to bring it to the activated state. There is thus apparently a sort of co-ordination between the methyl group and the amino group, of a kind possibly similar to that postulated by Sidgwick in similar cases.

Where three atoms or groups, A, B, and C, are present in the vicinal or 1 : 2 : 3 positions, then if B is exerting an effect of this kind on C the presence of A—if its demand is greater than that of hydrogen—by sharing and so reducing the effect of B may raise the reactivity of C; this kind of effect was observed by Menschutkin in the case of vicinal *o*-xylidine. Other evidence of something in the nature of direct chemical interaction between the methyl and amino groups in ortho toluidine and its derivatives is the way in which ortho toluidine frequently imitates the behaviour of secondary bases and monoalkyl derivatives imitate tertiary bases. To return to the general case, when A or C is a hydrogen atom, the case reduces to the substitution of a disubstituted benzene derivative.

A vicinal effect of a different kind was observed by Holleman [3] in the case of 1 nitro 2 : 6 dichlorbenzene, which may possibly be explained by a sharing of the activating effect of the nitro group.

There is, however, another point worthy of consideration. If the action constant were really a function of the form $ae^{-b/T}$ then the effect of a variation in b would only be shown in the so-called energy of activation, the variation in which might be only partially due to a change in the real energy of activation. In the case of ortho toluidine, for example, the life of the activated amino group—which would presumably affect the action constant—might be appreciably affected by the ease of interchange of activation energy between the amino group and the adjacent methyl group, and if the probability of this interchange were of the required form then the observed energy of activation would contain a disguised 'action constant' term. It would appear that the question of the factors governing the lives of active molecules is one of primary interest in this connexion; a kind of molecular insurance office is, in fact, required.

I may add in conclusion that the activation energy of meta toluidine was of the order predicted by the Lapworth-Robinson hypothesis, and that these experiments will be resumed shortly.

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[1] *Rev. Tran. Chim.*, **18**, 267, *et seq.*; 1899.
[2] "Theoretische Grundlagen der organischen Chemie", vol. 2, p. 255.
[3] *Rev. Tran. Chim.*, **35**, 1; 1915.

Hall Effect and Superconductivity.

THE Hall effect of the so-called electronic semiconductors is usually found to be comparatively very large. All the semiconductors investigated up to the present time obey this rule, with the exception of lead sulphide (PbS), for which the experimental data vary from one sample to another. For example, according to van Aubel [1] and Heaps,[2] chemically pure lead sulphide has a very small Hall coefficient, while the Hall constant of the natural lead sulphide (galena) may (according to investigations by A. Smith [3] and Heaps [2]) reach values as large as 254.

We have studied the Hall effect of copper sulphide (CuS) prepared by exposing a copper plate to sulphur vapour.[4, 5]. The Hall coefficient was found to be less than 10^{-3} c.g.s. units.

It is well known that copper and lead sulphides are semiconductors which belong to the class of superconductors. It was natural to consider the question *whether the small values of the Hall coefficient may be related to the existence of superconductivity.*

The experimental data on the Hall effect in superconductors seem to show that this correlation really

exists. In the accompanying table, the experimental values of the Hall coefficient R for superconductors at room temperatures are recorded. In the last column the products $R\sigma$ (where σ is the conductivity at the same temperature) are given; the figures here are not very precise, because the corresponding quantities were not always measured on the same sample. We include in this table similar data for a lead-bismuth alloy (20 per cent bismuth) investigated recently in this laboratory.

		Transition point.	$R \times 10^5$.	$R\sigma$.
Metals: super-conductors	Hg (solid)	4·22	<2	<1
	Sn	3·71	2	15·3
	Pb	7·2	9	4·5
	In	3·37	7·3	8·4
	Tl	2·37	24	13·6
	Ta	4·4	100 (?)	60·0 (?)
Metals: non-super-conductors	Na		250	550
	Cu		52	320
	Ag		80	536
	Au		70	315
	Mg		90	207
	Zn		104	181
	W		118	225
Super-conductor	Pb-Bi (20% Bi)		<20	<5
Compounds: super-conductors	CuS	1·6	<100	<30
	PbS	4·1	800	8·5
Compounds: non-super-conductors	Mo_2S		$2·6 \times 10^8$	1400
	Ag_2S		$0·6\text{-}50 \times 10^5$	50-275

As can be seen from these data, *the superconductors show usually a relatively small value of R and especially of Rσ.*

We are investigating now the validity of this rule for other superconductors. We reserve the discussion of the figures given in this note and the consideration of the theoretical conclusions which follow from this correlation for a detailed account which will be published soon in a new periodical entitled *The Physics of the Soviet Union.*

We have to thank Dr. Dorfman for his helpful discussion of our work.

I. KIKOIN.
BORIS LASAREW.

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Physical-Technical Institute,
Sosnovka 2, Leningrad (21).

[1] *Phys. Zeit.*, **4**, 551; 1913.
[2] *Phil. Mag.*, **6**, 1283; 1928.
[3] *Phys. Rev.* (2), **1**, 339; 1913.
[4] Meissner, *Zeit. für Phys.*, **58**, 570; 1930.
[5] K. Fischbeck und O. Dorner, *Zeit. für anorg. und alg. Chemie*, **181**, 372; 1929.

Reactions of Horizons in Tropical Soils.

THE reactions of a large number of samples carefully taken at different depths in the profiles of red soils which cover such large areas of south-central Africa have been determined in this laboratory. When the *p*H values of samples taken from a pit dug in undisturbed virgin soil are plotted against the depth, almost perfect curves are invariably obtained, there being generally a depth of from two to three feet at which the maximum acidity is obtained. This is generally coincident with the depth at which there is a tendency to form a pan both in lateritic, true red, and immature red loams, and also in the ferruginous red loams described by Marbut and Shantz. In the latter soils, indeed, the pan is associated with definite concretions of hydrated sesquioxides.

Further results with samples from older cultivated lands generally show the highest point of acidity to be much nearer the surface. This is not surprising when the erosivity of red loam soils is considered and that often a quarter of an inch of soil has been removed in a season by surface run-off and collected in large pits in Nyasaland.

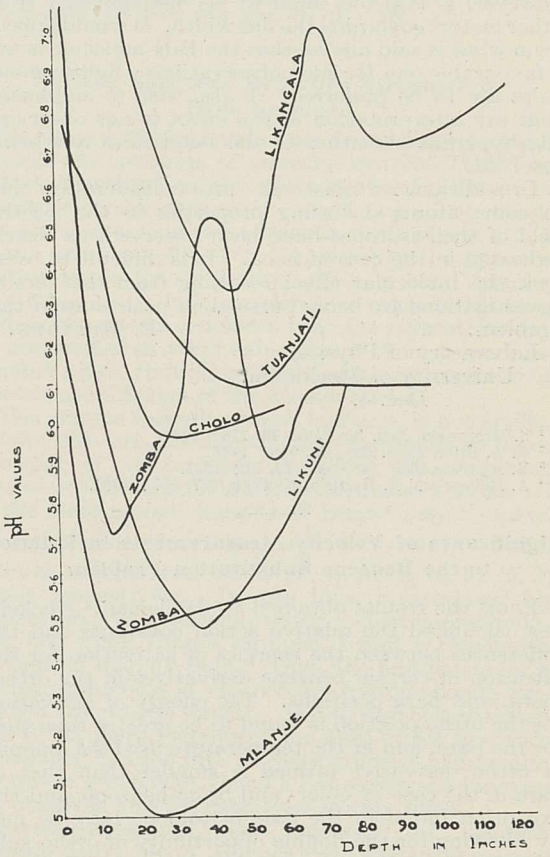

FIG. 1.

There has been found in these studies a general correlation between *p*H values and figures for average rainfall, the highest acidity being found in the tea belt of Mlanje.

It has been further noticed in lower horizons of certain soils that a second point of maximum acidity is reached. This may, however, be associated with abnormal movement of underground water during the wet season.

It is suggested that these studies have a distinct bearing on the accumulation of compounds of iron, alumina, and manganese at certain horizons in tropical soils. There are strong indications that iron bacteria play an important part in the movements of such compounds and in the formation of pans.

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and Agricultural Chemist.

Department of Agriculture,
Zomba, Nyasaland, Nov. 4.

Liquid Drops on the Same Liquid Surface.

DR. M. KATALINIĆ has described a method of producing floating drops of clean water on a water surface by delivery from a suitably situated jet.[1] Such drops must owe their existence to the stability of the film immediately beneath them, that is, the thickness-coefficient of the surface tension of the film over a suitable range must be negative, a characteristic of all stable films such as those of soap. Therefore a drop of soap solution should be stable on a water surface, the hydrophobic ends of the soap ions in the surface being directed outwards, and we were able last August to produce such drops of any diameter up to about 1 cm. by simply dipping a piece of soap (any kind) in water and allowing the drops to fall off it on to the surface from a height of about 1 cm. It is best to draw the soap down in a sweeping curve into the water and then out. In this way the floating drops are propelled forward and travel for distances up to quite 1 metre, if they are not too large. The very large drops last for scarcely one second, but the smaller ones for much longer. We experimented in a large tank of rain water illuminated by the sun, and interference colours were easily observed in the film beneath the drops. Later we obtained the same results in a beaker of distilled water, or even in tap water. The observations we made were, in the main, the same as those recorded by Dr. Katalinić.

Our main object in this communication, however, is to record an observation which to us is new, namely, that in addition to the floating drops, there are often produced, but in much smaller numbers, drops of about 1-4 mm. diameter which sink to a considerable depth and slowly rise again, coming to rest immediately underneath the surface. The soap film surrounding these drops is evident by the interference colours observed. They are stable for at least a minute, although they immediately burst on being touched, for example, with a clean platinum wire. They occasionally contain a minute air bubble of about 0·1 mm. diameter.

We are of the opinion that these submerged drops are formed by the drop of soap solution sinking into and getting encased entirely in the main bulk of the water, because occasionally, on slowly arriving upwards at the surface, they break through and eject their own contents some millimetres above the surface, in the form of a drop which bounces several times on the surface before coming to rest and ultimately coalescing. We recently found that these submerged drops are easiest obtained in tap water.

WILLIAM HUGHES.
ALUN R. HUGHES.

King Edward VI. School,
Southampton,
Dec. 11.

[1] NATURE, **127**, 627, April 25, 1931.

A New Method of Investigating the Modes of Vibration of Quartz Crystals.

A NEW method of investigating the modes of vibration of quartz crystals has arisen out of the use of E. P. Tawil's [1] development of Töpler's *Schlieren* method. Tawil was able, by utilising variations of refractive index, to photograph stationary or progressive supersonic waves in air.

In this experiment, if an accurately worked quartz crystal is set up in the incident light-beam, it is possible to orientate the crystal so that the light transmitted through it is undeviated; consequently, if the crystal is not oscillating, the whole of the field will appear dark when viewed through the telescope.

As soon as the crystal is set oscillating it will be found that certain parts of the crystal will light up, leaving in most cases a pattern of dark bands. If a fundamental mode is used, the appearance of the system will be as shown in Fig. 1, A; if a more complex vibration is obtained, a correspondingly complex pattern results, as shown in Fig. 1, B.

It is clear that those parts remaining dark are not giving any deviation of the incident light, and consequently represent nodal lines. However, the interpretation of the results will be complicated by the

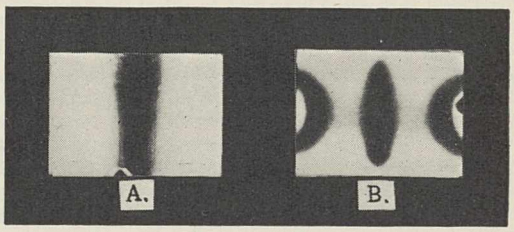

FIG. 1.

fact that the pattern is probably the mean result of all figures in all planes perpendicular to the light-beam.

The method appears to possess these advantages:

(1) The effect is easily obtained even with low intensities of oscillation.

(2) The result is readily photographed.

(3) The effect is one of black-and-white contrast and consequently stands out well in cases where a coloured field might confuse the result.

In short, it seems that this additional method of examining the modes of vibration of quartz plates will, when combined with a polarised light method, give very useful results.

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Victoria University College,
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Nov. 3.

[1] *Comptes rendus*, **191**, pp. 998-1000; 1930.

An Electrostatic Explanation of the Phenomenon of Flotation.

THE explanation of the flotation processes with the aid of the cataphoretic and electroendosmotic potentials has failed completely. These potentials play an important part at a distance from the geometrical interface of the phase only.[1] There are, however, suggestions in the literature [2] that ideal chemical electrodes should have a positive electrostatic potential in water and the dielectrics a negative one. This suggestion has important consequences. Emulsions of dielectrics in water will wet unattackable electrodes immersed in water but not attackable electrodes which are coated with dielectric oxides (hydroxides) in water. The wetting must, however, reduce the positive charge of the unattackable electrode, and it is expected that the wetting will not take place on attackable electrodes coated with a dielectric hydroxide, as for example, zinc. This is actually observed.

The irreversible electrostatic potential on the interface solid-liquid was measured with the aid of a Lindemann, or Leiss Perucca electrometer of small capacity. A platinum electrode, a galena electrode, an Acheson graphite electrode for spectroscopic purposes made by Messrs. Adam Hilger, Ltd., and a zinc electrode, were immersed successively in 50 c.c. of 0·002 *N* potassium chloride of *p*H 7·5 and their potential was measured against a 0·002 *N* calomel

electrode. Adding to the 50 c.c. of 0·002 *N* potassium chloride an emulsion of 4 gm. terpineol and 4 gm. potassium xantogenicum in 1000 c.c. of 0·002 *N* potassium chloride of the same *p*H, namely, 7·5, there was found a remarkable difference in the behaviour between the unattackable electrodes, platinum, galena, and graphite and the attackable zinc. Zinc changes its potential very little; the indifferent electrodes mentioned above, however, show a very marked fall of the potential as is shown in Fig. 1.

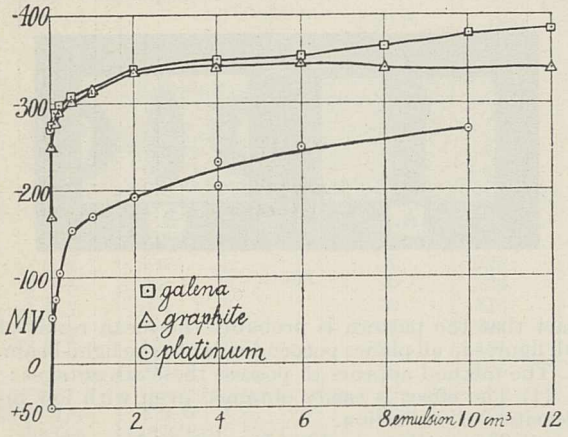

FIG. 1.

The first portion of 0·02 c.c. of the terpineol and potassium xantogenicum emulsion has a great influence on the potential of the electrode in spite of the fact that the emulsion loses its character at that dilution, and at 1 c.c. of these weak solutions has a maximum effect. Solutions of that strength are used in practice for flotation most frequently. It should be added that the electrometric measuring of the hydrogen ion concentration of physiological yeasts may be entirely spoiled if such a minute concentration as 1 in 500,000 by weight of an organic compound changes the potential of platinum so markedly.

B. KAMIENSKI.

Institute of Physical Chemistry,
Politechnika, Lwow,
Nov. 17.

[1] Freundlich, H., Ettisch, G., *Zeit. für phys. Chem.*, **116**, 401-419; 1925.
[2] Kamienski, B., *Zeit. für phys. Chem.*, **138**, 345; 1928: **145**, 48; 1929: **147**, 288; 1930: *Przemyst chemiczny*, 201; 1931.

Nature of Liquids.

PROF. G. W. STEWART [1] and Prof. E. N. da C. Andrade [2] have agreed, one in the light of X-ray diffraction experiments, and the other in the light of theoretical considerations of viscosity, that a liquid is, especially near the melting point, more akin to a solid than a gas.

It is perhaps worth while to point out that this view is consistent with what is observed concerning the specific heats of elements in the solid and liquid phases near the melting point. It is, in fact, the case that for the majority of monatomic elements hitherto investigated, the atomic heat of the liquid at constant volume is within about ten per cent of the value for the solid immediately below the melting point, and that this value is approximately $3N_0k$ (that is, $3R$), where N_0 is Avogadro's number and k is Boltzmann's constant.

The value $3R$ for the solid may be explained in terms of the three degrees of freedom of an atom, each degree of freedom contributing on the average $\frac{1}{2}\,kT$ to the energy as kinetic energy, together with (if the oscillation is simple harmonic in character) a further $\frac{1}{2}\,kT$ as potential energy.

The fact that the variation of energy content with temperature in the liquid is approximately the same as in the solid, is consistent with the view that in a liquid, at temperatures not too far above its melting point, the atoms continue to execute motions which may be described as approximately simple harmonic, the contribution per degree of freedom of the potential energy to the total being still approximately equal to that of the kinetic energy, which, since it depends on squares of velocities, must have the equipartition value of $\frac{1}{2}\,kT$.

If, on the other hand, the potential energy of atomic motion in a liquid were negligible compared with the kinetic energy, the atomic heat at constant volume would fall to the value appropriate to a monatomic gas, namely, $\frac{3}{2}R$. L. G. CARPENTER.

Physical Laboratory, University College,
Southampton,
Dec. 3.

[1] NATURE, **128**, 727, Oct. 24, 1931.
[2] NATURE, **128**, 835, Nov. 14, 1931.

Freshwater Eels in British India.

FOR some ten years now I have been collecting data regarding the occurrence or absence of freshwater eels—of the genus *Anguilla*—in the fresh waters of the world, and we seem on the whole to have cleared up this matter. Yet there are two regions where some uncertainty still reigns and, curiously enough, British India is one of them.

I have seen specimens of freshwater eels from the greater part of India, from Burma to Bombay, but whether they occur north of Bombay, and especially in the River Indus, I have not succeeded in determining, neither through the available literature nor through questions. Yet it would be astonishing, it seems to me, if there were no information on this subject from one of the principal river systems of the Old World.

The question is of considerable importance for the understanding of the distribution of the freshwater eels, which spawn in the Indian Ocean. It would be of interest, therefore, if Indian zoologists, or others concerned with the fisheries there, could take up this question and discover whether freshwater eels of the genus *Anguilla* are really present or wanting in the River Indus. JOHS. SCHMIDT.

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The Raman Band of Water.

THE peculiar feature of the Raman band of water which I observed during my experimental researches [1] may be produced, or at least essentially modified, by a particular and unexpected action of the spectrograph.

The Hilger *E*1 spectrograph used by me being provided, immediately behind the slit, with a total-reflecting prism of crystalline quartz, that is, with a double-refracting system, we are making use of an optical arrangement that may cause interferential phenomena, if the incident light is even partially polarised.

Under such conditions the use of the above-mentioned spectrograph is unadvisable. G. BOLLA.

Physical Institute of the Royal University,
Milan, Dec. 10.

[1] NATURE, Sept. 26, 1931.

Research Items.

Prehistoric Sind and Sumeria.—Mr. Ernest Mackay publishes in *Antiquity* for December some further links between Mohenjo-daro and ancient Sumeria, which he is able to add to those given in the recently published "Mohenjo-daro", edited by Sir John Marshall, as a result of the examination of material added to the Baghdad Museum since he left Iraq. Red carnelian beads with a white design found in graves at Ur are identical with those from Sind, the latter probably being a local copy of an imported bead. Other examples of decorated carnelian beads link the two civilisations, but at Mohenjo-daro they were probably imported and were greatly valued, as is shown by the fact that they were copied in steatite, the red ground being produced by a burnished hæmatite paint. Persia may have been the original source and may also have supplied Russia. A peculiar bead, rhomboidal in section, of which the long sides are notched, is also found at Ur and Kish, where it is dated at about 3100 B.C. They may be copied from sickle flints, and in Sind were probably imported from Sumeria. Terminals in gold, copper, or faience are frequently found at Mohenjo-daro. Though not yet found in Sumeria, they occur at Byblos, dating from the Fourth Dynasty of Egypt. Hollow gold terminals exactly resembling these have recently been found at Gizeh (2900–2750 B.C.). A copper blade found at Mohenjo-daro in one of the upper layers exactly resembles one from Kish, except that the latter has a longer tang. Cubical dice, tetrahedral gamesmen, and pottery rings, thought to belong to a game, have been found at Mohenjo-daro and in Sumeria. The framed Greek cross and the swastika occur in both areas, though a swastika found at Kish may have been made locally for an Indian resident. Other resemblances noted are feeding-cups with projecting spouts, beads capped with gold, perforated vessels, hollow animal masks in pottery and metal, and the narrowing of the eyes in certain human figures.

Rhythmisation in a Motor Task.—At the meeting of the British Association on Sept. 28 a very interesting paper was given to Section J (Psychology), by Mr. D. W. Harding, on the part played by rhythm in learning typewriting. Observations were made on experienced typists practising an unfamiliar word until they could type it at their normal high speed. In typing, owing to the nature of the keyboard, the rhythms that may occur are more complex than those hitherto studied in G. E. Müller's experiments in memorising. The experiments were carried out with an ordinary portable typewriter, but in place of the usual paper for receiving the impressions, a paper tape moving through the machine at a constant rate was substituted. The subjects typed in the usual way, but, as the tape moved continuously, any difference in the time intervals between letter-strokes was recorded as a difference in spacing on the tape. Each subject's work was measured for uniformity by estimating the deviation from uniformity of the time-interval between each letter-stroke and the next, and for consistency, as represented by the coefficient of variability, from repetition to repetition of the ratios in the word. This allowed the sameness of the rhythm to be measured even though the tempo might not be the same. The most striking result that appeared was the relation between rhythmisation and capacity for speed, those subjects who tended to maintain uniform time-intervals between successive letters being the slowest. As the learning of movements plays such an important part in education and also in many industrial processes, this very careful and original study is of considerable value and deserves to be carried further.

Sexual Selection and External Appearance.—O. L. Tinklepaugh, in the *Journal of Mammalogy* for November (p. 430), records a case in which a male of the rhesus macaque (*Macaca mulatta*), kept along with a female crab-eating macaque (*M. irus*), plucked and bit off the long hairs of the eyebrows and cheek-tufts of his companion, often leaning back and surveying her as if evaluating results. The suggestion is made that he was modifying her appearance to suit his taste, and it may be noted that the rhesus is far less hairy about the face than the crab-eating macaque, so that it would appear that the male was here trying to make his alien mate conform to the appearance of females of his own species. A similar case in birds occurred at the London Zoological Gardens during this century, in which a male ocellated turkey (*Meleagris ocellata*) plucked out the crest of a Burmese peahen (*Pavo muticus*) which had become attached to him in spite of the presence of a male of her own kind, thus reducing her head to the unadorned state of that of a hen turkey.

Abnormalities in the Frog's Blood-vessels.—Dr. C. H. O'Donoghue (*Trans. Roy. Soc. Edin.*, vol. 57, pp. 179-224; 1931) describes forty-eight hitherto unrecorded abnormalities in the blood vascular system of *Rana temporaria*, summarises the abnormalities previously recorded, and discusses the general significance of each type of abnormality. One example of an imperfectly flexed heart is described, which, it is suggested, results from the retention of the dorsal mesocardium. In one frog the right systemic aorta was absent, posterior to the point of origin of the subclavian artery; in four other frogs accessory pulmonary arteries were present as branches of the cœliaco-mesenteric artery to one or both of the lungs. In each of nine examples a transverse anastomosis was present between the two external jugular veins, and in the majority of these the right anterior caval vein was missing. Six abnormalities of the anterior abdominal vein and seventeen abnormalities in the posterior cardinal, posterior caval, and renal-portal veins are noticed, which are explicable in the light of the embryonic history of the respective veins. Abnormal accessory pulmonary veins arising in the lungs and emptying into some factor of the hepatic portal system are described in six specimens. A consideration of some of the abnormalities reveals homologies between certain of the main veins in the Anura and in the elasmobranchs. This paper will be very useful for reference in all laboratories where the blood vessels of *Rana temporaria* are examined in any detail and where, therefore, abnormalities are almost certain to come under observation.

Indian Horse Flies.—Part 3, Vol. 1 (September 1931), of the new *Indian Journal of Veterinary Science and Animal Husbandry*, among other articles, contains part 14 of a "Veterinary Entomology for India", by T. B. Fletcher and S. K. Sen. It deals with the Tabanidæ or horse flies, of which about 135 Indian species have been described. The article is illustrated with an admirable coloured plate depicting twenty-four species of various genera. One of the most remarkable insects figured is *Corizoneura longirostris*, in which the 'proboscis' is one and a half times the length of the body. This fly has been observed to suck nectar from flowers, and the long

proboscis, which is actually the labium, is well adapted for scooping up nectar. The true piercing stylets are much shorter and are hidden away in the labium.

Cultivation of Sisal.—Sisal (*Agave sisalana*) is a fibre-yielding plant of great and increasing importance in East Africa, and some account of the problems in connexion with its cultivation are given by F. J. Nutman of the Amani Research Station (*Bulletin of the Imperial Institute*, vol. 29, p. 299). Up to the present, scarcely any research has been carried out with this crop, as it has been possible to grow it profitably with a minimum of scientific knowledge, and since the plant is not an annual, field experiments are necessarily long and expensive. One of the most important physiological questions is a proper understanding of the factors influencing flowering, for after the production of the inflorescence the plant dies and no more leaves, the source of the fibre, are developed. The suggestion that flowering, or 'poling' as it is termed, occurs after the formation of a given number of leaves is rejected, but it is still uncertain whether, and in what way, soil, climate, and water relations can be correlated with this fundamental change in the plant's development. Fruiting, on the other hand, appears to be influenced by quite different factors, for although flowering is a universal phenomenon, fruit formation is confined to the highlands of Kenya. Propagation is in consequence entirely vegetative by means of bulbils and suckers, and further investigations are needed to determine if treatment of the parent can influence the after behaviour of the suckers. Other important problems arise in connexion with the drought-resisting properties exhibited by sisal, for there is a tendency to extend its culture into the more arid parts of East Africa, and under semi-desert conditions special cultivation operations appear to be necessary. In addition to physiological problems such as these, questions of agronomy and genetical interest abound, and if the sisal industry is to survive the critical period through which it is at present passing, further research is of fundamental importance.

Origin of Witwatersrand Gold.—Dr. L. C. Graton's recent advocacy of a hydrothermal origin for the gold deposits of the Rand has stimulated a vigorous discussion, which is published in an 'Annexure' to the *Trans. Geol. Soc. South Africa*, for 1931. In all ten papers the conclusion is reached that the hydrothermal hypothesis is untenable. R. B. Young shows clearly that the distribution of gold is related to the sedimentary characters of the beds, whereas the metasomatism that has undoubtedly occurred bears no relation to that distribution. This contrast is confirmed by E. Homersham, E. T. Mellor, and J. W. Gregory. The last two of these authors and A. W. Rogers, F. E. Keep, E. H. A. Joseph, and W. S. F. Cameron give conclusive evidence that the banket could not have been accumulated in the off-shore marine environment postulated by Graton; they favour deltaic or littoral conditions, and record many instances of contemporaneous erosion. F. E. Keep makes a good point in comparing the gold occurrences with those of genuine hydrothermal origin. E. T. Mellor, E. P. Cowles, and P. Macadam present assay results demonstrating that the amount of gold carried by the quartz veins is negligible compared with that in the pay reefs. P. Macadam also shows that the basic dykes are free from gold or contain only minute traces, and W. S. F. Cameron considers, with justification, that the gold in the quartz-veins may well have been derived from that present in the placer deposits through which they have passed. (See also NATURE, **127**, 536, April 4, 1931.)

Acoustic Sounding.—Commander J. A. Slee read an important paper on reflexion methods of measuring the depth of the sea to the Institution of Electrical Engineers on Dec. 2. Navigators of big ships are very anxious to read depths up to a hundred fathoms and are particularly interested in depths from two to twenty fathoms of water under the keel. Trawlers, on the other hand, need to measure much greater depths, at least as great as 350 fathoms. The vast majority of fish are bottom feeders—the surface and midwater feeders are comparatively rare. For a given locality and time of year, the best depths for various kinds of fish are known, and so it is a great boon for the fishermen to know the depth within an accuracy of about one or two per cent. The author describes the various methods of signalling, that is, of setting up an elastic wave in the water; the methods of detecting the return of the echo, the methods of disentangling the unwanted signals, and the methods of measuring the time which gives the required depth. The rate of propagation of the elastic wave varies according to the salinity and temperature of the water; the accepted extremes being 4750 ft. per second for the Baltic, which is nearly fresh, and 5100 ft. per second for the Red Sea, which is saturated. The velocity usually adopted is the average of the Atlantic Ocean, which is 4900 ft. per second. The best methods of measuring are to use some form of oscillographic device. Aural methods are not so successful, as the rush of water past the ship's skin sets up noises in any kind of receiver and, in addition, there is the question of turbulence eddies. The water is thrown out by the ship's bows and returns again at some point along her hull, where the water noises are redoubled. It is known that the position of these turbulence areas varies with the speed of the ship, with her draught and trim, but in any given case the boundaries of the patches are quite sharply defined.

The Spin of the Photon.—The work referred to by Sir C. V. Raman and S. Bhagavantam in their recent communications to NATURE (Oct. 3, p. 576; Oct. 24, p. 727), from which it was concluded that light quanta had a Bohr unit of angular momentum, is described with more detail in the issue of the *Indian Journal of Physics* for Oct. 31. It appears that up to a certain point quantum theory and classical theory agree in their predictions with regard to the scattering of light, but that the finer details of polarisation and intensity can only be accounted for by means of quantum theory, with the special feature now emphasised. The experimental method which has been employed is simple in principle, the separation of the effects of the various close components of the radiation scattered from gases and liquids being made by varying the width of the slit of the spectroscope (see NATURE, Jan. 2, p. 22). The references in this paper to liquids, although not an obvious sequel to Sir C. V. Raman's later letter (NATURE, Nov. 7, p. 795), are very interesting in showing that molecules in certain types of liquids apparently have considerable rotational freedom. At the same time, in another paper in the same issue of the *Journal*, Mr. Bhagavantam has shown that the rotational fine structure of the Raman bands from a number of gases becomes diffuse above a certain rather critical pressure in each gas, and interprets this as a disturbance of the molecular spin by collisions when the frequency of rotational motion of a molecule is no longer greater than the average frequency of collisions between molecules.

Conical Diaphragms and Sound Reproduction.—The scientific aspect of the problem of sound reproduction by means of conical diaphragms is one of commercial importance at the present time. In the *Philosophical*

Magazine for October, Dr. N. W. McLachlan and G. A. V. Sowter give the results of a fairly complete experimental research on this type of apparatus for reproducing speech and music. They have found that when the edge of a diaphragm is reinforced so as to prevent radial modes of vibration at low frequencies, the lower register appears to be missing. This is due to the enhanced output in the upper register. Thus, although the diaphragm behaves as a rigid structure at low frequencies, it breaks up at the higher frequencies. To equalise the output, therefore, it is necessary to introduce a resonant member to assist the lower register. One method of doing this is to suspend the diaphragm from an annulus of suitable material and dimensions. The annulus acts as an auxiliary diaphragm at low frequencies and improves the reproduction. The upper register can be increased by the use of coils of small mass. This suggested the use of thin sheet metal; but experiments with aluminium sheet were not successful, as a large fraction of the register lying above 200 cycles per second was relatively weak. The reproduction lacked volume and was unpleasant to listen to. This shows the difficulty in obtaining a uniform register of wide compass owing to the load on the acoustic system being small and the acoustic resonances being numerous. In the exponential horn type the acoustic loading is relatively high and gives large damping. The horn is a scientific but not at the moment an economical solution of the problem of sound reproduction.

Rhenium Compounds.—Briscoe, Robinson, and Stoddart, in the November *Journal of the Chemical Society*, give details of some experiments on the supposed thallous thioper-rhenate, $TlReS_4$, recently described by Feit. They show that the product so described is not a thioper-rhenate but either a mixture of thallous per-rhenate and rhenium sulphide, or almost pure per-rhenate, according to the method of preparation. The same issue gives an account, by Briscoe, Robinson, and Rudge, of a new oxide of rhenium, the pentoxide, Re_2O_5, obtained by heating rhenium heptoxide with the metal in a sealed tube. It is a purplish-red crystalline powder, being bottle-green in thin flakes with transmitted light and showing a green streak. The new oxide is insoluble in dilute or concentrated sulphuric or hydrochloric acid and in caustic potash solution, but dissolves in warm dilute nitric acid and in fused caustic potash.

The Glass Electrode.—The *Journal of the Chemical Society* for November contains two papers by C. Morton on the use of valve electrometers and valve potentiometers with the glass electrode. The arrangements of the circuits are shown and the accuracy of the instruments has been increased. The application of the valve potentiometer to differential potentiometric titration with the glass electrode is described, with some experimental details. The new feature of the valve potentiometer is an increase of sensitivity with increasing resistance of the source of electromotive force, which makes it particularly suitable for use with the glass electrode. A sensitivity of 38 microamperes per millivolt was obtained. The null ballistic valve galvanometer described had complete zero stability and high sensitivity. The sensitivity was such that an electromotive force of 0·01 millivolt operating through 1000 megohms could be detected.

Astronomical Topics.

Great Meteor in Southern Europe.—The daily papers reported that a meteor of unusual size was seen in Portugal on the night between Dec. 28 and 29. No exact details are yet to hand; the reports describe it as greenish, three times the apparent diameter of the moon, and suggest that it may have fallen into the sea, as its light vanished with startling suddenness. It is to be hoped that it was seen by some trained observers.

Observations of the Leonids in England.—The fact that a fair display of these meteors was seen in England by Mr. J. P. M. Prentice at Stowmarket, Suffolk, and Mr. A. King at Ashby, Lincs, has been already noted in this column. Fuller details are given by Mr. King in the *Observatory* for December. The maximum, according to both observers, occurred rather late on the night between Nov. 16 and 17. None were seen on Nov. 9 and 11, one early on Nov. 14, while Mr. King saw eight early on Nov. 18; a fair shower was seen in Iowa early on Nov. 16, so that the earth takes more than two days in traversing a tolerably rich region of the swarm, though it takes only six hours in crossing the extremely crowded 'ortho-stream'.

The position of the radiant for the night Nov. 16-17 is given as R.A. 153·0°, Decl. +21·7°, by Mr. Prentice and R.A. 152°, Decl. +22·2°, by Mr. King. Prof. J. C. Adams adopted 149·2° +23·0° (the mean of six observers) for the 1866 display. Precession accounts for a change of +0·9°, -0·3°; the remainder is due to the perturbations of the meteors. The longitude of their ascending node, given by the above observations, is near 233·9°, which agrees exactly with the value of the node of Tempel's comet predicted in the B.A.A. Handbook for 1932.

Cepheids and Long-Period Variable Stars.—*Scientia* for December contains an article on these stars by Mr. P. Doig. The two classes differ chiefly in temperature; the red stars of long period have temperatures of the order of 2000°, while the Cepheids range from 4000° (type *G*) to 10,000° (type *A*). The extreme rarity of these stars in space is pointed out; one star in a hundred thousand is a long-period variable, and the distances between them are of the order of 500 light years. The Cepheids are rarer still; accepting Shapley's distances (which are now thought to be somewhat too large), there is only one Cepheid in two million stars, and the distance between them averages 1500 light years. These figures suggest that variation of either kind lasts only for a small fraction of the whole life of a star.

Mr. Doig considers that the ordinary long-period stars vary from a similar cause to the Cepheid stars, but that the super-giant Betelgeux stands outside them, probably because of its excessively low density. He favours the theory of Sir James Jeans that the Cepheids are rotating stars on the point of dividing into two. This causes a wave to travel round the star's surface, and its shape is supposed to be steeper in front than in the rear, thus accounting for the steeper rise than fall in the light curve. The long-period stars are supposed to be at an earlier and less condensed stage than the Cepheids; in both of them a liquid or quasi-liquid core is postulated: it is suggested that in Betelgeux the density may be too low for the formation of such a core: in its case the variation arises from pulsation alone, in the other cases from a combination of pulsation with the phenomena arising from an elongated nucleus in the process of dividing.

University of Leeds: New Physics Building.

THE new physics building of the University of Leeds represents part of the rebuilding scheme made possible by generous donations from the public during the past several years. It replaces the old 'sheds', a temporary glass-roofed structure put up some twenty years ago, and part of one of the original wings in the occupation of the Department of Physics, but under the new scheme destined for demolition. These old laboratories had long been inadequate for their purpose and more than uncomfortable in use. The lecture room accommodation was scanty, the teaching laboratories weather-swept, and the research rooms unfortunately placed.

The new building occupies a quiet and unobtrusive site which is likely to be detached for some time to come, though it will eventually form architecturally an end link of the projected chain of stone-fronted buildings of which the chemical building and the Brotherton Library will shortly be prominent features. The cost of the physics building itself with equipment will approximate to £60,000. The architects were Lanchester, Lucas, and Lodge, of London.

So far as present needs are concerned, the Department caters for two hundred and fifty to three hundred undergraduates, including a total honours school of thirty to forty, with a research group of ten to fifteen working mostly on experimental topics. Allowing for expansion of these numbers on a conservative basis, a building of red brick, of about 35,000 square feet floor space, has been put up, comprising three floors and basement; Portland stone facing is used only on that small part which will be visible in the distance from the main road. The steel framework is specially oversize, and particular care has been taken that no internal walls support any appreciable part of the weight. Inside rearrangement can therefore be carried out in the future, if necessary, with no serious difficulty.

The workshop has been placed in a far corner of the basement, lit by an overhead glass roof and ventilated by a fan. The basement also contains certain research rooms, battery and store rooms, a special instrument test room, an acoustics laboratory, and a museum.

The entrance hall on the ground floor has been arranged to lead directly to the two main lecture rooms on one side and to the elementary laboratory on the other. This arrangement makes it unnecessary for the large numbers of students attending elementary lectures and laboratories to penetrate more than a few paces into the building, thus minimising the effects of wear, dirt, and noise.

The first floor carries a large L-shaped laboratory capable of accommodating a hundred students of the second and third year in individual work. On this floor there is also the honours laboratory with a capacity of about twenty students and a small lecture room capable of holding fifty.

The top floor contains a few rooms at the stair-head for general departmental use, the main floor space being given over to small research rooms, seventeen in number. In addition to the electrical and other services, a certain number of steady wall-supports consisting of monoliths built into the wall have been provided. Also horizontal sliding steel window shutters have been installed, similar to those in the lecture rooms but hand operated.

The simplest possible internal style has been adopted throughout the building, although a most pleasing effect has been attained in entrance, stairway, and corridors by clever arrangement of pillars, well-designed balustrades, and simple arches. The stairways and the floors of main corridors are in terazzo, but elsewhere Australian jarrow wood block has been generally chosen, the result being excellent in respect of cleanliness and comfort as well as appearance.

For convenience of upkeep and ease of replacement, all services have been placed so far as possible on wall and ceiling surfaces and have been coloured distinctively. For example, lighting electricity is yellow, town supply of water is aluminium, gas is black, and so on. Electrical services comprise 200 volts alternating supply at 50 cycles single phase and two-phase from the city mains for lighting and power, together with 110 volts d.c. from a generator set in the basement. In addition, there are two large capacity batteries each giving up to 120 volts and two smaller ones giving up to 1000 volts each. These supplies are taken to the lecture rooms and to the research rooms on both top floor and basement. For convenience in running temporary leads about the building, a vertical duct runs through the building in close proximity to the battery rooms. A small compressor in the basement supplies compressed air to research rooms and lecture rooms for blowpipes, small motors, cooling, and the like. Heating throughout the building is by radiators supplied with hot water from the University boiler house. A lift and the adequately equipped workshop complete the laboratory services.

There are three lecture rooms, seating 230, 120, and 50 respectively, the two larger ones being fitted with electrically operated steel window shutters of a simple type. Ventilation is by distant-control fan, and the fittings include specially designed roller blind blackboards; air-cooled projection lanterns sunk in the lecture tables, with inclined screens built permanently into the wall and facing the audience; floodlights (motor head lamps) for blackboards and lecture tables, and an adequate supply of electricity, gas, water, and compressed air. The control of all lecture room services has been centralised on the lecture bench itself, so that the lecturer or his assistant can deal on the spot with lantern, ventilation, shutters, and lighting.

In the teaching laboratories, simplicity of arrangement and fittings has been achieved by the provision of ordinary movable tables of a standard size, and fixing all water services to outside walls wherever possible.

In place of dark rooms for optical and other experiments requiring darkness, several sets of dark cells have been provided (similar to horse 'loose boxes'), so that numbers of students can work in close proximity to each other without mutual interference. In the main laboratories, vibration-free supports for galvanometers and other apparatus requiring steadiness have been provided by casting wide ferroconcrete collars round such pillars as have their foundations in the basement. Round these collars are fitted insulated stainless steel busbars connected to 25 volts alternating electric supply. This supply is taken through a new type of electric plug which adheres to the busbars by means of small permanent magnet contacts.

Although, at the date of writing, workmen are not yet out of the building, experience has shown the great convenience and effectiveness of the arrangements.

An opening function will take place on Feb. 18, when Sir William Bragg, one time occupant of the Cavendish chair of physics in the University, will be the principal speaker.

Annual Meeting of the Science Masters' Association.

THE thirty-second annual meeting of the Science Masters' Association was held in the Imperial College of Science, London, on Dec. 29–Jan. 1, with evening meetings in the hall of King's College for Household and Social Science. The trade exhibition of apparatus and books, and also the exhibition of apparatus and experiments by the members themselves, was the largest in the history of the Association.

In the course of his presidential address, Dr. Cyril Norwood, headmaster of Harrow School, pointed out that modern science has produced an upheaval in man's intellectual and spiritual outlook comparable to that produced by the Renaissance, and, in its material aspects, has led to a rapidly increasing mechanisation of modern life. The one effective shield against this mechanisation will be found in a remodelling of our system of education, so that it will satisfy the creative instinct of the child to do and to make, and also develop his faculty of æsthetic appreciation.

The Renaissance produced a system of education, culminating in the universities, which has persisted until recently, despite the fact that only one-tenth of the secondary school population now proceeds to the universities. The object of the older type of education was to produce specialists and to train for the professions, but in future the schools must aim at becoming training grounds for democracy. Whereas in the past the schools produced the great individual, they must now aim at the wider task of producing the great community, and our educational system must be remodelled to that end. This requires the freeing of the school certificate from the demands of university entrance.

An elementary study of any subject should result, in average pupils, in the acquirement of a sense of fact and a sense of law. Dr. Norwood stated that there is nothing better for this purpose than the study of elementary science, which is admirable for training the mind in the power of discovering facts and reasoning from them, and, properly taught, should result in a clear grasp of the difference between fact and opinion, which difference, even as in Plato's time, is not apparent to the majority of people. Dr. Norwood recommended the *universal* teaching of science as a necessary part of a preparation for citizenship. He suggested a course in chemistry, physics, and biology, with excursions into geography, geology, and astronomy, which should include simple elementary nature study and exact and simple measurement. Such a course would open a lot of windows in the mind of the pupil.

In welcoming the Association to the Imperial College, the rector, Mr. H. T. Tizard, stated that the scientific equipment and also the general education of boys has improved beyond all bounds during the last few years. This period has seen the disappearance of both the dogmatism of the scientific man and the arrogance of the classicist. Mr. Tizard is a great believer in general science as a subject for the school curriculum. The difficulty is that scientific men have not yet been able to agree upon the lines this should take, and he urged that the solution of this problem should be the most important work of the Association in the near future. He hoped that they would produce a scheme which would appeal to intelligent laymen.

Prof. Jocelyn Thorpe, in his address on "The Schools and Research", directed attention to the great work which has been accomplished by such men as Shenstone, H. B. Baker, Francis Jones, R. L. Taylor, and Tilden, all of whom commenced their researches as science masters in schools. If a science master can find time to do research in his school, it is bound to have a stimulating effect on his pupils. He invited attention specially to the advances made in biochemistry during the last few years, which have resulted in the isolation of definite organic compounds controlling the processes of life. Some of these are introduced into the body by the food we eat, others are manufactured in the body itself, but all are essential to life and health. Sometime in the future, much ill-health and disease will be eliminated by the administration of the required organic substance in the quantity necessary to correct the maladjustment. Prof. Thorpe went on to discuss the importance of hormones and vitamins, and he showed specimens of the anti-scorbutic vitamin E, which has only recently been isolated from orange juice. Calciferol (vitamin D) has also been isolated after twelve years of patient research.

Dr. G. C. Simpson addressed the Association on "Modern Weather Forecasting", in the course of which he gave a most lucid account of the mechanism which produces a 'warm front' and a 'cold front'.

On New Year's eve, Prof. E. W. MacBride's lecture on "The Inheritance of Acquired Characters" provoked a stimulating discussion, which was continued in the Common Room, until the approach of midnight reminded Prof. MacBride that he had promised to attend a New Year party.

The Television Society arranged a most valuable lecture-demonstration, in which experiments, many suitable for school use, were shown. Mr. J. J. Denton, honorary secretary of the Television Society, lectured, and the experiments were shown by Capt. R. Wilson, Mr. A. A. Waters, and Mr. R. W. Corkling.

In the trade exhibition, the exhibit of colour photography, given by the Finlay Photographic Processes, Ltd., is worthy of special notice. The most interesting feature illustrated the application of the Finlay colour process in the teaching of biology. Eighty-one lantern slides were exhibited to illustrate a first year's course in biology, the zoological subjects having been selected by Prof. E. W. MacBride, and the botanical subjects by Mr. J. S. Gilmour, assistant director at the Royal Botanic Gardens, Kew. Many of the slides are micrographic, the colour is remarkably accurate, and there is no doubt that the utility of these slides for teaching purposes is greatly enhanced by their being in colour. We understand that if the company meets with sufficient encouragement in its effort to furnish accurate colour slides of this description, a further series of scientific subjects will be prepared. The process itself is one that can be worked quite easily by the amateur with any size and make of plate camera. Apart from the fact that it is an entirely British process, it has certain definite advantages over any other known method of colour photography. It gives a brilliant result with a single exposure at a very high speed, and it is capable of unlimited duplication. Many of the outdoor scenes shown were taken with an aperture of 4·5 at speeds which varied from one-fiftieth to one-half of a second. It can be applied, therefore, to subjects involving movement or stay of movement.

In the members' exhibition, Mr. E. G. Savage gave fascinating demonstrations of experiments on colour. These were described in detail in the *School Science Review* for October and December 1931. Mr. F. A. Meier, of Rugby School, exhibited a remarkable selection of apparatus made in the Rugby School

workshops. His ingenious devices are worth an article in themselves. We were greatly impressed by his method of doing Kundt's experiment, using a brass tube with two thick circular plates of brass soldered at nodes a quarter of the length of the tube from each end; these plates fit between two blocks of wood on a rigid stand. The cork at one end of the brass tube is stuck on by resin, so as not to constrain the vibration of the tube, and the resonance tube of glass contains no visible lycopodium until the note is obtained, when the nodes are evident as very fine lines, the position of which can be read to 0·02 cm. by a travelling microscope. Mr. Meier said that a few degrees difference in temperature, such as results from turning out a gas fire in the room, produces a measurable displacement of the nodes.

The retiring chairman of the Association, Mr. W. H. Barrett, of Harrow School, handled the annual business meeting with skill. A resolution was passed assuring the president that the Association would support him in any steps he may take to initiate a reform of our educational system on the lines laid down in the course of his presidential address.

The next meeting of the Association is to be held at the University of Bristol, on Jan. 3–5, 1933, and the new president will be Prof. A. M. Tyndall. E. N.

Form and Height of Clouds.

THE Central Meteorological Observatory at Tokyo has recently published an illustrated account of a thorough photometric study of clouds made at the Meteorological Observatory at Mera. Mera lies at the southern extremity of the Bôsô peninsula, in the south-east of Japan proper, at no great distance from Tokyo. The observations cover the period of two years ending on Mar. 31, 1929, and were made by three members of the staff of the Mera Observatory.

Although the work does not appear to have been undertaken with the solution of any particular problem in view, and might be adversely criticised on the ground that we have already too many such bulky statistical compilations relating to the weather of temperate latitudes, such criticism should be qualified in view of the fact that the information about the heights of various forms of cloud in this work is rarely based on measurements of single points in the cloud, but on so many points that an idea is given of the vertical extent of the cloud as well as of its height above the ground. For example, a photograph numbered 217 in the section devoted to stratocumulus clouds, portrays a group of these clouds and alongside a key diagram with numbered points. In a table underneath, the measured heights of these points are shown. One of the larger fragments of cloud contains five such points, and the table shows that the lowest height was 1489 metres and the highest 1587 metres, whence we deduce a minimum of 89 metres for the vertical extent of this particular cloud. The table further informs us that the mean height of the whole group was 1534 metres and the range 117 metres.

The heights were obtained by two photo-theodolites of German manufacture set up at the ends of a base line 1161 metres in length—a length that should ensure a fair degree of accuracy even in the measurement of cirrus clouds, which normally occur at heights equal to about seven times the length of the base line.

There is another aspect of the work which calls for favourable criticism, and that is that the quality of the photographs and the complete range of form illustrated justifies the authors in describing section viii. as a "Cloud Atlas". It is an atlas in which the full information about the heights of the clouds just described is supplemented by figures giving the mean amount of cloud on each occasion, its speed and direction of movement, and the speed and direction of the wind near the ground. When telephotographic representations of cloud are given and no terrestrial object appears in the field of view, the reader is likely to have a difficulty in imagining the true appearance of the clouds, unless some device is adopted for giving the scale of the photograph. In this event, a circular line might with advantage have been added in one corner of each photograph, the diameter of the circle being equivalent to about half a degree, that is, to about the diameter of the sun or moon, so that the clouds could be compared with either of these luminaries.

It should be noted that in addition to the section described as a cloud atlas, there are numerous tables relating to the heights of the different clouds, and the seasonal variations of these are shown by graphs, as well as being given in tabular form.

E. V. N.

Photocells: the Valves which operate by Light.*

ONCE the potentialities of devices in which the action of light produces or changes the magnitude of an electric current are properly appreciated, they are likely to become very widely employed. At least four types of these are now available: the selenium cell and its congeners, the alkali metal cell —operating on the external photoelectric effect, and often called a photoelectric cell to the exclusion of the others—the electrolytic cell, and the dry plate rectifier cell. Of these, the electrolytic cell, in which the electromotive force is changed when the electrodes are exposed to light, is as yet little understood, although it is likely to be of value for some purposes. More attention is being paid to the rectifier cell, which is the development of a crystal rectifier which has been found recently to be sensitive to light and is going to be very important. Selenium cells employ a half conductor of a similar type to the crystal, but work simply by its change in resistance when illuminated, Ohm's law being obeyed, which is not true of rectifiers.

Choice of cell for any particular purpose depends upon exactly what is required of it, but the answer that an engineer wants in most of the less complicated industrial applications can be illustrated by performing an experiment, in which the current through an incandescent lamp is altered until it produces a current of a few microamperes in the circuits of various cells exposed to its light. Selenium cells are found in this way to be the most sensitive, then electrolytic cells, gas-filled alkali cells, and rectifier cells, and the vacuum alkali cells come last. On the other hand, vacuum alkali cells give a response proportional to the intensity of the light, provided its colour is not altered, and have the great advantage of having an effectively instantaneous response, whereas the response of the selenium cells bears a less simple relation to the intensity of the light and may not reach a

* Substance of a lecture-demonstration given by Mr. C. C. Paterson on Jan. 5 at the Physical and Optical Societies' Annual Exhibition of Scientific Instruments and Apparatus at the Imperial College of Science, South Kensington.

steady state for several seconds. Again, the selenium cell is most sensitive to red light and the potassium vacuum cell to green light, although to a green which is well to the short wave-length side of the region of maximum visual acuity. With a vacuum cell in which the sensitive cathode is a very thin film of cæsium on a base of cæsium oxide the maximum is in the infra-red. No one of these cells agrees with the eye about colour in giving a maximum in the yellow which appears brightest to the eye.

The different sensitivity of different alkali cells to light of different colours is applied in modern lamp photometry to determine accurately whether the light from two incandescent lamps is of the same colour, and therefore whether the two filaments are at the same temperature, on the principle that if two cells of different colour sensitivity are adjusted to give the same current when exposed to light of some definite colour, they will give the same current when similarly exposed to light of the same colour even if its intensity is different, but will not give the same current if the colour is different.

Amongst the laboratory uses of photoelectric cells may be mentioned the demonstration by one of the modern forms, that photoelectric emission is independent of temperature whereas thermionic emission is not. This has already been accomplished in several ways, but can be shown rather prettily with a cæsium cell, which has a readily measured thermionic current below 200° C. One of these cells is mounted in a small oven and the thermionic current from it (if any) found by the ordinary direct method, whilst light which produces a photoelectric current too small to deflect the thermionic galvanometer is allowed to fall on the cell simultaneously and is rendered intermittent by passing it through a rotating disc. The photoelectric current through the cell is then also intermittent and may be amplified independently of the thermionic current and fed to a loud speaker, the sound from which is a measure of its magnitude. When the cell is cold there is a photoelectric current but no thermionic emission, but, when the oven is heated, a thermionic current develops rapidly, whilst the sound from the loud speaker, and hence the photoelectric current, is not appreciably changed.

Physiological Basis of Sensation.

IF we are to regard a sensation as a change in consciousness in response to a stimulus applied to a sense-organ, then the sensation evoked by a given stimulus will depend on the complexity of the consciousness of the particular individual. This will vary enormously from person to person, depending on heredity, education, experience, and so on and will differ enormously in man and in animal. This variation, however, is no justification for the abandonment of investigation, but is rather a guide to the choice of the most elementary species and the most fundamental processes for experiment.

Prof. E. D. Adrian, for the purposes of the discussion which he opened on Sept. 24 in Section I (Physiology) of the British Association, presented the view that the structural organs involved—namely, the sense-organs, sensory nerve-fibres, and the collection of nerve cells with their interlacing fibres in the brain—work in a fairly simple way. At any rate, the messages or nerve impulses which pass from the sense-organs are fairly simple; each consists of a very brief wave of activity—in the larger fibres each point remains in the active state for only a few thousandths of a second and the wave travels at a speed of 30 metres a second or more. The passage of an impulse involves a very small expenditure of energy, but fortunately some of it can be easily detected, for it appears as an electric current flowing between the active and inactive parts.

By amplifying these electric changes, Adrian has been able to record the passage of impulses in each nerve-fibre, and has found that a succession of impulses passes up to the brain whenever a sense-organ comes into action. An active sensory ending usually discharges a rhythmical series of impulses with a frequency in the neighbourhood of 20-100 a second, and the sense-organ, like the nerve-fibre, behaves with machine-like regularity, giving always the same discharge of impulses for the same stimulus provided that other conditions are unaltered.

Adrian has recorded similar electrical changes in the optic nerve, which developmentally is a part of the brain, and there is no reason to suppose that changes do not occur in the brain itself similar to those in the sense-organs and their nerve-fibres.

Prof. Frank Allen, of the University of Manitoba, brought forward evidence of a quantitative character in support of the elementary and fundamental physiological basis of sensation. The same law is found to connect the magnitude of the response elicited by a definite adequate stimulus of a sensory organ irrespective of what the sensory organ may be.

Sir John Parsons also contributed to the discussion, pointing out, among other things, the valuable data derived from clinical examination of patients afflicted with such partial deficiencies as colour-blindness.

University and Educational Intelligence.

CAMBRIDGE.—Candidates for the recently established Goldsmiths' professorship of metallurgy are requested to communicate with the vice-chancellor on or before Jan. 16. The salary attached to the chair is £1200 per annum.

The Raymond Horton-Smith prize for the present session has been awarded to Dr. W. D. Newcomb for his thesis on the relationship between peptic ulceration and gastric ulceration and gastric carcinoma.

LONDON.—Mr. O. L. V. de Wesselow has been appointed as from Dec. 1, 1931, to the University chair of medicine tenable at St. Thomas's Hospital Medical School. Since 1920 he has been chemical pathologist to St. Thomas's Hospital.

ST. ANDREWS.—The last examination for the diploma of L.L.A. has been held, and the scheme has now been wound up. Begun in 1877, when there was no opportunity for women to enter the universities and when the L.L.A. examination afforded them an opportunity of obtaining a diploma attesting their attainments in literature, science, and philosophy, the scheme grew gradually up to the year 1909, when there were as many as 1090 candidates in one year. By that time the effect of the admission to the universities of women had diminished to some extent the usefulness of the examination and the numbers gradually decreased. During its existence the L.L.A. has attracted 36,017 candidates and 5119 diplomas have been conferred.

THE sixth World Conference of the New Education Fellowship will be held at Nice on July 29–Aug, 12, under the presidency of Prof. P. Langevin, professor of experimental physics in the École Normale Supérieure, Paris. The theme for the Conference is "Education and Changing Society". Main lectures on the general theme have been arranged, also sectional lectures on special subjects and on progress within national systems of education, and study courses. Further information can be obtained from the Conference Secretary, New Education Fellowship, 11 Tavistock Square, London, W.C.1.

Calendar of Geographical Exploration.

Jan. 10, 1811.—The Rocky Mountains.

David Thompson discovered the Athabaska Pass, along the main route over the Rockies to Columbia. Thompson was one of the greatest land explorers, covering at least 50,000 miles of mainly unknown country and recording his surveys accurately and fully. For twenty-seven years he made innumerable astronomical observations on long journeys. The result was a survey of south-western Canada from Lake Superior to the mouth of the Columbia river, making possible the accurate mapping of its mountains, rivers, and lakes. Regions of the 'muskrat' country, north-east of Cumberland House, have never been visited since his time. Later, Thompson worked on the boundary survey after the Anglo-American war. Recognition of the importance of his work was tardy, for poverty prevented him from publishing either a map of his explorations or his "Narrative" or "Journals".

Jan. 11, 1930.—The South Arabian Desert.

Bertram Thomas set out on his second journey into the Rub'al Khali, when he penetrated almost to the centre of that arid waste. His journeys covered ground practically unvisited previously by any European, though Wellstedt, from the crest of Jebel Akhdar in 1836, had seen the great desert in the distance. Much new scientific information is now available about the region, including the first account of its drainage system.

Jan. 12, 1878.—The Heart of Arabia.

Wilfrid Scawen Blunt and his wife left Meskakeh to cross the Nafud desert southwards to Jabal Shammar. The poet and his wife, who was a granddaughter of Byron, had developed a romantic sympathy with bedouin society, and had been initiated into desert life among the Anaze and Shammar tribesmen of the Hamad and the Mesopotamian steppes. Blunt journeyed to Jauf in quest of a bride for his 'blood-brother', a young Arab of the Palmyrene oasis. Thence he and Lady Anne decided to visit the Emir of the Shammar as European guests. Their achievement in travelling openly, with a woman in the party, through the strongholds of Arabian fanaticism is remarkable. Their records proved of the utmost value for the geography of this little-known region.

Jan. 13, 1772.—Marion and Crozet Islands.

N. T. Marion du Fresne discovered the islands now bearing the above names. Bougainville, on his voyage round the world, 1767–69, had brought back with him a native of Tahiti as a 'human curiosity'. The French Government wished to return the native to his home. Marion volunteered to take him to Tahiti, and sailed from Ile de France (Mauritius) in October 1771 with two vessels. The unfortunate native contracted small-pox and died while the ships were anchored off Madagascar. Marion thereupon decided to go southwards to search for the antarctic continent. He named the island which he discovered on Jan. 13 Terre de Espérance, because it gave him the hope that he was near the southern continent. The islands are bare and rocky, but the weather was foggy, and a multitude of white spots led the discoverers to think that there were flocks of sheep upon them. The *Challenger* expedition, 1872–76, explored the islands and found these spots to be moss patches. Marion's expedition went on to New Holland (Australia) and New Zealand. It made a stay of some duration in the latter, but Marion was murdered by the natives, and his lieutenant, Crozet, brought the vessels home. The account of the voyage, with its full descriptions of Maori life, was compiled from Crozet's log.

Jan. 14, 1699.—Australia and the East Indies.

William Dampier sailed from the Downs on H.M.S. *Roebuck*, one of the earliest government expeditions sent out from Great Britain purely for discovery. Dampier's account of his former voyage in the *Cygnet*, when he had observed the shores and natives of New Holland (Australia), had roused the interest of the Earl of Pembroke, then Lord High Admiral, and Dampier was commissioned to explore the southern seas. He anchored in Shark's Bay, on the western coast of Australia, on July 7, 1699, and thence surveyed the coast for 900 miles. Leaving Australia, he discovered Dampier Strait, between New Guinea and Waigiu. He also proved that New Britain is an island separate from New Guinea, and surveyed much of its coast.

Jan. 16, 1772.—Kerguelen Island.

Yves Joseph de Kerguelen-Trémarec, a Breton noble, sailed from the Île de France (Mauritius) commissioned by the French Government to search for "a very large continent to the south of the islands of St. Paul and Amsterdam", a land on which the Sieur de Gonneville was supposed to have stayed in 1504. He found a land which he named South France. He thought it formed the central mass of the antarctic continent, and held out high hopes of its commercial importance. But on a second expedition in 1773 he discovered it to be bleak and barren, and Cook had in the meantime sailed far to the south of it in open seas, so that Kerguelen now knew it to be an island. He renamed it the Land of Desolation. It is to-day called Kerguelen Island in honour of its discoverer, and has from time to time been used as a base for valuable scientific observations.

Societies and Academies.

LONDON.

Royal Meteorological Society, Dec. 16.—**W. C. Kaye** and **C. S. Durst**: Some examples of the development of depressions which affect the Atlantic. Three typical cases show examples of: (1) a polar depression being intensified by the introduction of warm air from the Gulf of Mexico; (2) the formation of a family of depressions between Pacific maritime polar air and warm Gulf air; (3) the formation of depressions on a quasi-stationary front. A majority of the families of depressions which cross the Atlantic originate in one or other of these ways.—**Alfred A. Barnes**: (1) Rain-gaugings near Belper and Duffield, Derbyshire. A complete analysis of the yearly readings taken at 19 rain-gauges at the southern end of the Pennine Chain during a period of 66 years from 1865 to 1930 inclusive.—(2) Rainfall reviewed: a common long-average period for each country of the British Isles. A new survey during a period of 68 years from 1863 to 1930 inclusive.—**W. H. Pick**: Visibility with saturated air. The horizontal visibilities at Worthy Down and Felixstowe, over a period of four years, whenever the air was saturated are examined. All degrees of visibility (except the very best) were well represented. A large percentage of the cases of saturated air were unaccompanied by either fog or mist. The effect of wind force upon the visibility accompanying saturated air is also examined.

PARIS.

Academy of Sciences, Nov. 30.—**G. Bigourdan**: An influence of the moon.—Lucien Cuénot was elected a non-resident member in succession to the late Eugène

Cosserat.—A. Marchaud: Correction of an earlier communication.—Alexandre Wundheiler: Conditions for an inextensible flexible surface.—Georges Bouligand: A new extension of a theorem of Émile Picard.—Mandelbrojt: The generalisation of a theorem on holomorph functions in a demi-plane.—W. K. Turkin: A generalisation of the theorem of Frobenius.—Georges Ranque and Pierre Henry: The determination of the characteristics of the viscous elongation of hot metals. A modification of Kohn's method, in which the reversible extensions of the test-piece are utilised to regulate the temperature, the extension remaining constant. The decreasing temperatures under constant load can be expressed as a linear function of the logarithm of the time.—Emile Sevin: Concerning binary systems.—A. Guillet: Application of the deviation method and the zero method to the electromagnetic measurement of small deformations.—M. Pauthenier and Mme. Moreau-Hanot: The adsorption of ions by spherical conducting particles in an ionised field.—Ch. Sadron: Ferromagnetic moments and the periodic system. From the experiments described the author concludes that the atomic moments, in Weiss magnetons, of elements in the same column of the periodic table are identical.—Antonio Rostagni: Oscillations maintained by valves with positive grid.—A. Kastler: The circular polarisation of the Raman radiation.—A. Cotton: Remarks on the preceding communication. A preliminary account of the action of a magnetic field of 46,300 gauss on the Raman lines.—J. P. Mathieu: The influence of the nature of the chemical linkages on the production of circular dichroism. A solution of chromium hydroxide dissolved in tartaric acid contains a normally ionised salt: it slowly changes into a complex salt from which ammonia fails to precipitate chromium hydroxide. Facts are given which render very probable the hypothesis that the circular dichroism is proportional to the concentration of the complex compound formed in the reaction.—Henri Muraour and G. Aunis: The variation of $fpdt$ with the density of charge for a vaseline powder B and a centralite powder B. The phenomenon previously described for nitroglycerine powders is repeated with nitrocellulose powders.—Guichard, Clausmann, Billon, and Lanthony: The experimental method suitable for establishing the independence of the amount of hydrogen present and the hardness of electrolytic iron. Reply to a criticism by Guillet, Roux, and Cournot.—G. Rumeau: The velocity of crystallisation of the different forms of dimethyl tartrate.—R. Lespieau, M. Bourguel, and R. Wakemann: The Raman effect and chemistry. The cyclopropane nucleus. The nucleus of a cyclopropane compound is characterised by (1) a very strong line near 1200 corresponding to the C-C linkage, and (2) by two strong lines at 3000 and 3065 corresponding to the C-H linkages. The spectrum of the nucleus differs entirely from that of saturated open fatty chains.—R. Tréhin: The absorption of aqueous solutions of some chlorides in the ultra-violet. Solutions of the chlorides of sodium, potassium, barium, and strontium were studied: details of the methods of purification are given. Absorption of very dilute solutions of these chlorides is due entirely to the presence of chlorine ions.—Jean Cournot: Results of corrosion tests on rustless steels.—J. Bougault and E. Cattelain: The elimination of the phosphate ion as lead phosphate in the analysis of salts by the wet method.—André Meyer and Robert Vittenet: The phthalone imides and their derivatives.—André Demay: The conditions of orogenesis and of Hercynian metamorphism in the southern edge of the Rodez massif.—Georges Corroy: The variations of facies and thickness of the Argovian in the eastern border of the Paris basin.—E. Aubert de La Rüe: The presence of a Tertiary fossil flora in the Kerguelen Archipelago.—R. Lambert: The tectonic of the western flank of the mountain of Néron, near Grenoble.—J. Dufay: The emission bands of the aurora borealis in the spectrum of the nocturnal sky.—Ladislas Gorczynski: Maximum of intensity of solar radiation observed at Nice and Thorenc in the Maritime Alps.—Octave Mengel: The rôle of the condensation of water vapour in supplying springs.—Pierre Lesage: *Lepidium sativum* at different latitudes.—Aug. Chevalier: The extension and propagation of the rosette disease in *Arachis* in Senegal.—R. Legroux and Kemal Djemil: Lysis of the glanders bacillus and of the pyocyanic bacillus.—Jean Régnier and Robert David: Contribution to the study of microbial multiplication. The influence of the composition of the liquid media usually employed in laboratories on the value of the microbial growth (*Pyocyanic bacillus*). A table showing the comparative results with seven media is given. The microbial growth follows practically the same course with all the media.—Remlinger, Manouélian, and Bailly: Researches on the nerve centres of the tortoise inoculated with the rabies bacillus. The virus of rabies, inoculated in the brain of *Testudo mauritanica*, preserves its virulence for at least six months. This virulence occurs with the presence of Negri corpuscles and the formations described by Manouélian and Viala in all forms of rabies. No apparent symptom develops in the reptile.—C. Levaditi and A. Vaisman: The curative action of liposoluble bismuth in experimental syphilis without external symptoms. Liposoluble bismuth (bivatol) exerts a strong and durable curative action on latent syphilis in mice.—Ugo Lumbroso: The inoculation of man with bacterial strains isolated from Tunisian trachomatous subjects.

ROME.

Royal National Academy of the Lincei, June 5.—F. Severi: General resolution of Dirichlet's problem for biharmonic functions.—C. Somigliana: Variability of mass. A system of dynamics is deduced which preserves the general lineaments of classical dynamics without prescribing *a priori* a definite form of dependence of the mass on the velocity.—L. Cambi and A. Cagnasso: Dithiocarbamates and nitrosodithiocarbamates of iron.—E. Bompiani: Integral surfaces of two or more equations with partial derivatives of the third order.—Ugo Broggi: A problem of interpolation.—L. Laboccetta: The fundamental forms of discontinuous constants as circular functions.—T. Viola: The dextro derivative of a function continuous towards the right and derivable towards the right.—Miron Nicolesco: An equation with partial derivatives characterising the means of Picone.—Pia Nalli: Rigid transports and relativity.—G. Sansone: The partial convergence of the developments in series of orthogonal functions. Extension of Kolmogoroff's theorem to developments in Fourier's series.—G. Mammana: The product of series capable of summation by Cesaro's method (2).—G. Krall: A complement to the theory of adiabatic invariants according to T. Levi-Civita.—G. Lampariello: Propagation of waves in isotropic, but not necessarily homogeneous, elastic media.—G. Galanti: Algorithms of motorial calculus.—A. Consiglio: Power of a translatory-circulatory current in presence of a Joukowski obstacle. An earlier communication (1930) has given an evaluation of the resultant of the dynamic actions of an irrotational, permanent, translatory-circulatory current on a Joukowski pisciform obstacle. The power relative to such a current is now calculated.—B. Caldonazzo: Vortex in a field limited by a cardioid.

In general, the presence of salient cuspids on rigid walls bathed by a perfect liquid in plane motion contributes to the dynamic actions exerted on the walls themselves. The case here considered is the motion caused by a free, isolated vortex in the field limited by a cardioid, which exhibits a cuspid salient with respect to the field of motion.—G. Cecchini: The absolute magnitude of the Cepheids. Although difficult to treat, parallactic data obtained by direct observation are able to confirm, by way of laws valid for ordinary stars, the necessity of a systematic correction in the absolute magnitude of the Cepheids determined from the period-luminosity curve. The correction found for the zero point is in the sense and of the order established by various means by several investigators and indicates that the distance of every celestial object deduced on the basis of Shapley's curve should be reduced by the factor 0·6.—M. Tenani: Contribution to the knowledge of the tides of the Arctic Ocean. Consideration of the data, collected during the sojourn of the *Città di Milano* at Spitsbergen in June-July 1928, furnishes fresh confirmation of the view, expressed by Nansen and supported by others, that the Arctic Ocean is continuous. It is not in accord with Harris's hypothesis of the existence of a wide expanse of unknown land in the zone still unexplored.—G. A. Barbieri: Compounds of bivalent and of tervalent silver. Argentipyridine persulphate, in which the silver functions as a bivalent metal, forms mixed crystals with the analogous cadmiopyridine persulphate, and argentiphenanthroline persulphate with cadmiophenanthroline persulphate. When hydrolysed, both the so-called silver peroxidonitrate, Ag_7NO_{11}, obtained by electrolysis of concentrated nitric acid solution, and a nitric acid solution of the oxide AgO yield the oxide Ag_2O_3, for which the equivalent ratio between active oxygen and silver has the value 1·5:1.—L. Mascarelli and D. Gatti: Contribution to the knowledge of diphenyl and its derivatives (8). New 2:2′-disubstituted derivatives of diphenyl. The compounds described are the nitrochloro, nitrobromo, nitroiodo, nitrohydroxy, aminochloro, aminobromo, aminoiodo, chloroiodo, chlorobromo, and iodobromo derivatives. The scheme was as follows: $NO_2 . C_6H_4 . C_6H_4 . NO_2 \rightarrow NH_2 . C_6H_4 . C_6H_4 . NO_2 \rightarrow X . C_6H_4 . C_6H_4 . NO_2 \rightarrow X . C_6H_4 . C_6H_4 . NH_2 \rightarrow X . C_6H_4 . C_6H_4 . X$, where X represents a halogen atom.—G. Tallarico: Preservation and productivity of corn grain: Functional predetermination. In order to maintain the activity of the embryo of seed wheat during storage, the conditions must be such that the consumption of the reserve food material, to be utilised by the young plant, is reduced to a minimum and that the lethargic rest of the embryo is not disturbed. This is attained by limiting the respiratory activity to the minimum required to keep the seed in a living condition. The seed should, therefore, be dried and stored in a cool place, and accumulation of carbon dioxide in the mass should be permitted. Experiment shows: (1) that grain from the interior of an undisturbed heap gives higher yields of both grain and straw than that from the surface layers of the same heap, and (2) that grain left at rest furnishes higher yields than the same seed subjected to turning during storage.

SYDNEY.

Linnean Society of New South Wales, Sept. 30.—H. L. Jensen: Contributions to our knowledge of the Actinomycetales (2). The definition and subdivision of the genus *Actinomyces*, with a preliminary account of Australian soil Actinomycetes. These organisms can be divided into two main groups: (i) *Actinomyces*, which produce an aerial mycelium with spores. These are the common soil inhabitants. (ii) A new genus in which spores are not produced in the aerial mycelium, and there is a tendency to assume a bacterium-like appearance. These are more rare soil forms, but include many parasitic forms.—A. Jefferis Turner: Revision of Australian Lepidoptera.—Supplementary. Corrections and additions to families previously revised, and descriptions of four genera and thirty-nine species as new.—R. J. Tillyard: The wing-venation of the order Isoptera (1). Introduction and the family Mastotermitidæ. This paper deals with the wing-venation of the archaic Australian termite *Mastotermes darwiniensis* Frogg. The determination of the homologies of the veins by this method shows some interesting results, the most important being the delimitation of the anal lobe of the hindwing, which is now proved not to be homologous with the anal fan of the Orthoptera, but is rather comparable with the alula of the Diptera. An interesting discovery was made in the form of a hitherto unrecorded small wing-flap attached to the clavus of the forewing and folding beneath it; this closely resembles the structure called the alula in the coleopterous family Hydrophilidæ. It appears to be a reduced homologue of the anal lobe of the hindwing.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 17, No. 9, Sept. 15).—Emma L. Fisk: The chromosomes of *Lathyrus tuberosus*. The haploid number is seven, as in other species of *Lathyrus*. The chromosomes are unusually large and varied sizes and shapes.—Th. Dobzhansky and Jack Schultz: Evidence for multiple sex factors in the *X*-chromosome of *Drosophila melanogaster*.—John W. Gowen: Body pattern as related to mammary gland secretion. Analysing the data from about 6000 Jersey cows, it is shown that weight and a wedge-shaped form when viewed from in front are indicative of milk yield. Other dairyman's 'points' are without significance. All correlations of dimensions of an animal and milk yield are materially influenced by the cow's age, and for the purpose of this paper, the data were adjusted to the age of 8 years 3 months.—F. Zwicky: Why crystals exist. Ordinary cohesive forces with action radii of the order of atomic dimensions are responsible for condensed states of matter but are not characteristic for the crystalline state. The transition from liquid to crystal is sharp and can only be effected by the simultaneous co-operation of large numbers of atoms in a directional arrangement; this co-operation will not generally have the same symmetry character as the primary structure of the crystal. Hence crystals are supposed to have a primary structure, revealed by X-ray analysis, on which is superimposed a secondary structure; the former is characterised by structure insensitive properties, the latter by structure sensitive properties.—Paul S. Epstein: On the air resistance of projectiles. A theoretical discussion. Solutions are derived of Euler's equations of hydrodynamics for velocities greater than that of sound for the two-dimensional case of polygonal contours. At very high velocities the expressions are valid for contours with curved sides and for three-dimensional bodies.—T. L. Ho: High vacuum pressure control apparatus. A hot wire or ionisation gauge is attached to the vacuum system to be kept at constant pressure. This gauge is connected with a galvanometer which controls a vacuum tube amplifier; the latter in turn controls magnetically an iron float in a U-tube of mercury, so arranged that it opens or closes a connexion between the vacuum system and a vacuum reservoir attached to a pumping system.

Forthcoming Events.

Societies.

FRIDAY, JANUARY 8.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—Mrs. Murray Chapman: Through Lapland in Winter with Sledge and Reindeer (Christmas Lecture for Young People).

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—S. B. Freeman: Modern Types of Propelling Machinery for Mercantile Marine Use (Thomas Lowe Gray Lecture).

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. W. F. Whittard: An Expedition to East Greenland, 1929 (Lecture).

SATURDAY, JANUARY 9.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: The Universe of Light (Christmas Lectures) (6): Light from the Sun and the Stars.

TUESDAY, JANUARY 12.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—W. Deacon: The Romance of Perfumes (Lecture).

WEDNESDAY, JANUARY 13.

ROYAL SOCIETY OF ARTS, at 3.—Prof. E. N. da Costa Andrade: The Vacuum, or the Importance of Nothing at All (Dr. Mann Juvenile Lectures) (2).

THURSDAY, JANUARY 14.

ROYAL GEOGRAPHICAL SOCIETY, at 4.—Revision of Bye-Laws.—At 5.—Geographical Film.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Discussion on Generalisations of Fourier's Integral.

INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at Chamber of Commerce, Birmingham), at 6.—N. G. Gedye: The Mechanical Handling of Coal at Ports (Vernon Harcourt Lecture).

FRIDAY, JANUARY 15.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry—South Wales Section) (at National Oil Refineries, Skewen), at 7.—Dr. A. E. Dunstan: Liquid Fuels To-day and To-morrow (Lecture).

Public Lectures.

FRIDAY, JANUARY 8.

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: Vulcanism (Swiney Lectures) (2).

MONDAY, JANUARY 11.

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: Vulcanism (contd.) (Swiney Lectures) (3).

WEDNESDAY, JANUARY 13.

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: Vulcanism and Landscape (Swiney Lectures) (4).

BELFAST MUSEUM AND ART GALLERY, at 8.—Prof. J. Kaye Charlesworth: Crystals.

THURSDAY, JANUARY 14.

SCIENCE MUSEUM, SOUTH KENSINGTON, at 4.30.—D. Brunt: Meteorology in History.

FRIDAY, JANUARY 15.

UNIVERSITY COLLEGE, at 5.—Dr. A. S. Parkes: The Physiology of Reproduction. (Succeeding Lectures on Jan. 15, 22, and 29, and Feb. 5, 12, and 19.)—G. P. Wells: Comparative Physiology. (Succeeding Lectures on Jan. 15, 22, 29, Feb. 5, 12, 19, 26, and March 4, 11, and 18.)

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: The Instability of the Earth (Swiney Lectures) (5).

Exhibition.

JANUARY 11 (CONTINUING FOR A MONTH).

ROYAL METEOROLOGICAL SOCIETY (at Science Museum, South Kensington).

Discussion.

JANUARY 12 AND 13.

FARADAY SOCIETY (in Biochemical Laboratory, Oxford).—General Discussion on The Adsorption of Gases.

Jan. 12, 2.30 to 6.—Prof. H. S. Taylor: General Introduction: The Adsorption of Gases.

Section I. Experimental Methods.—Prof. E. K. Rideal: Introductory Paper.

Prof. J. A. Becker: The Use of Thermionics in the Study of Adsorption of Vapours and Gases.

Dr. H. Cassel: The Thickness of Adsorbed Films on Mercury.

Dr. H. Dohse and Prof. H. Mark: On Mixture Isotherms at Active Points.

Dr. J. Chariton, Dr. A. Schalnikoff, and Prof. N. Semenoff: On the Behaviour of Adsorbed Atoms.

Dr. F. P. Burt: Sorption of Gases by Glass.

C. N. Hinshelwood: The Rôle of Surface Adsorption in Chain Reactions.

Prof. F. G. Tryhorn and W. F. Wyatt: Adsorption of Saturated Vapours by Porous Substances. Experimental Methods.

Jan. 13, 9.30 A.M. to 1 P.M.

Section II. Kinetics and Energetics.—Prof. H. Freundlich: Introductory Paper.

Prof. K. F. Bonhoeffer and Dr. A. Farkas: On Adsorption and Reflection Processes in the Interchange of Hydrogen and Metals.

Dr. W. Frankenburger: New Experiments in the Adsorption of Hydrogen, Nitrogen, and Ammonia on Metallic Tungsten and the Mechanism of Catalytic Ammonia Decomposition by this Metal.

Prof. A. F. Benton: Adsorption and Solution of Gases by Metals.

Prof. A. J. Allmand, W. J. Burrage, and R. Chaplin: Discontinuities in Adsorption Processes.

Dr. F. H. Constable: The Kinetics of Adsorption in Relation to Reaction Velocity.

A. R. Ubbelohde: The Occlusion of Hydrogen by Palladium.

A. C. G. Egerton and A. R. Ubbelohde: The Occlusion of Hydrogen by Palladium, Part II.

A. R. Ubbelohde: The Influence of Nuclear Spin on the Sorption of Hydrogen on Charcoal.

Dr. E. B. Maxted and N. J. Hassid: The Kinetics of the Adsorption of Hydrogen on Platinum and Nickel.

Prof. W. E. Garner: The Heats of Adsorption and the Kinetics of Adsorption.

F. E. T. Kingman: The Adsorption of Hydrogen on Charcoal.

Prof. H. S. Taylor and A. Sherman: Activated Adsorption and the Para-Hydrogen Conversion.

H. W. Thompson: The Explosive Combination of Hydrogen and Oxygen. The Function of Water in Gaseous Reactions.

2.30 to 4.30.

Section III. Theories of Adsorption.—Prof. M. Polanyi: Introductory Paper.

Prof. M. Volmer: The Migration of Adsorbed Molecules on Surfaces of Solids.

Dr. R. H. Fowler: Theories of Adsorption of Gases. Quantum Mechanics of the Reversible Electrolytic Cell and of Electrolysis.

Prof. E. Hückel: Theory of Heat Evolved in Capillary Condensation.

Prof. A. Magnus: The Electrical Theory of Gaseous Adsorption.

Dr. J. K. Roberts: The Interchange of Energy in Collisions between Gas Atoms and Solid Surfaces.

A. F. H. Ward: The Suggested Existence of Activated Adsorption.

Prof. J. W. McBain: Persorption and Mono-molecular Sieves.

Dr. Schuster: Hydrogenation of Adsorbed Ethylenic Hydrocarbons.

C. Evans: Deviations from the "Ideal" Translation Motion of Adsorbed Molecules.

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London School of Hygiene and Tropical Medicine (University of London). Seventh Annual Report to the Court of Governors 1930–31. Pp. 17. Report by the Dean on the Work of the School for the Year ended July 31, 1931. Pp. 54. (London.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. (Ae. 522—T. 3132): Motion of H.M.A. *R.101* under certain assumed Conditions. By D. H. Williams and A. R. Collar. Pp. 17+28 plates. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twenty-fourth Annual Report, 1930–31, presented by the Council to the Court of Governors on the 23rd October 1931. Pp. 42. (Cardiff.)

Hastings and St. Leonards Natural History Society. Report and Balance Sheet for the Session 1930–31. Pp. 15. (St. Leonards.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 51: A Soil Survey of the Swamps of the Lower Murray River. By J. K. Taylor and H. G. Poole. Pp. 42+6 maps. Bulletin No. 52: The Soils of Australia in relation to Vegetation and Climate. By Prof. J. A. Prescott. Pp. 71+12 plates. (Melbourne: H. J. Green.)

Catalogue of Indian Insects. Part 20: Alucitidae (Pterophoridae). By T. Bainbridge Fletcher. Pp. iv+61. (Calcutta: Government of India Central Publication Branch.) 1.6 rupees; 2*s*. 3*d*.

Tide Tables for the Atlantic Coast of Canada for the Year 1932: including the River and Gulf of St. Lawrence, the Atlantic Coast, the Bay of Fundy, Northumberland and Cabot Straits, and Information on Currents; in addition, Tide Tables for New York and Boston, U.S.A. (Thirty-sixth Year of Issue.) Pp. 92. (Ottawa: F. A. Acland.)

Forest Bulletin No. 73: The Herbarium of the Forest Research Institute. By R. N. Parker. Pp. iii+10. 5 annas; 6*d*. Forest Bulletin No. 74: Summary of Results of Treated Experimental Sleepers laid in the various Railway Systems of India, brought up to date. By F. J. Popham. Pp. ii+30. 8 annas; 10*d*. (Calcutta: Government of India Central Publication Branch.)

The Indian Forest Records. Entomology Series, Vol. 16, Part 4: Immature Stages of Indian Coleoptera (9). By J. C. M. Gardner. Pp. ii+21+5 plates. (Calcutta: Government of India Central Publication Branch.) 1.2 rupees; 3*s*.

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Transactions of the Rochdale Literary and Scientific Society. Vol. 17, 1929–31. Pp. 96+xxii+4 plates. (Rochdale.)

Records of the Geological Survey of India. Vol. 65, Part 2. Pp. 189-314+plates 3-15. 2.12 rupees; 5*s*. Vol. 65, Part 3. Pp. 315+443+plates 16-18. 2.12 rupees; 5*s*. (Calcutta: Government of India Central Publication Branch.)

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Astronomische Abhandlungen: Ergänzungshefte zu den Astronomischen Nachrichten. Band 8, Nr. 4: Spezieller Kanon der Sonnenfinsternisse für Vorderasien und Ägypten für die Zeit von 900 v. Chr. bis 4200 v. Chr. Unter Mitwirkung von R. Hiller, Bearbeitet von P. V. Neugebauer. Pp. D32+17 Tafeln. (Kiel: Druck von C. Schaidt.) 6 gold marks.

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Scientific Papers of the Institute of Physical and Chemical Research. No. 330: The Determination of Phosphoric Acid and Molybdenum as Ammonium Phosphomolybdate. By Sansei Kitajima. Pp. 285-330. 60 sen. Nos. 331-332: Hyperfine Structure of Mercury, 2, by Kiyoshi Murakawa; Systematics and Statistics of Nuclei, by Kiyoshi Murakawa. Pp. 9. 15 sen. Nos. 333-338: Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck, 9: Versuche mit dem Co-Cu-MgO-Katalysator, von Kenji Fujimura: Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck, 10: Versuche über die Einflüsse einiger Stoffe auf die katalytische Wirkung des Co-Cu-MgO-Katalysators, von Kenji Fujimura; Untersuchungen über Lignite, von Ryohei Oda; Über die pyrogenetische Zersetzung von Paraffinöl und einigen anderen Kohlenwasserstoffen bei Gegenwart von verscheidenen Katalysatoren sowie unter Wasserstoffhochdruck, von Ryohei Oda; Distribution of Chemical and Thermal Effects in Spark Gap, by Hikotarô Takô; Studies on the Coagulation of von Weimarn's Au_F Sols, 3, by Eiichi Iwase. Pp. 11-87. 90 sen. (Tôkyô: Iwanami Shoten.)

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Contributions from the Department of Geology of Stanford University. Vol. 1, No. 2: Eocene Foraminifera from Martinez, California. By Joseph A. Cushman and Julian D. Barksdale. Pp. 53-73+plates 11-12. 50 cents. Contributions from the Dudley Herbarium of Stanford University. Vol. 2: The Trees and Shrubs of Western Oregon. By Gilbert Thereon Benson. Pp. 170. 3 dollars. Stanford University Publications: University Series. Biological Sciences, Vol. 6, No. 3: The Primary Groups of Oviparous Cyprinodont Fishes. By George Sprague Myers. Pp. 241-254. 50 cents. Biological Sciences, Vol. 7, No. 1: The Arachnid Order Chelonethidae. By Dr. Joseph Conrad Chamberlin. Pp. 284. 2 dollars. Mathematics and Astronomy, Vol. 2, No. 1: Terrestrial Electricity. By Prof. Fernando Sanford. Pp. 208. 2.50 dollars. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press.)

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Spectrograph of Great Intensity. (Lispec 31.) Pp. 4. (Delft: P. J. Kipp and Zonen.)

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Outfits for Absorption Spectrophotometry: a Guide to the Choice of Suitable Spectrophotometric Apparatus for (*a*) the Ultra-Violet Region, (*b*) the Visible Region. Pp. 38. (London: Adam Hilger, Ltd.)

Surgical Diathermy. Pp. 28. (London: Watson and Sons (Electro-Medical), Ltd.)

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Geophysical Prospecting by Electrical Methods. (List No. 62.) Pp. 12. (London: H. Tinsley and Co.)

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