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CONTENTS.

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The Application of Scientific Agriculture.

THE title of the annual journal of the Agricultural Education Association, *Agricultural Progress* (London: Ernest Benn, Ltd. 5*s*.), is ambitious. As an expression of the aims of this useful Association, the designation of its journal is beyond reproach, especially as modified by the expression of modesty implied in the Virgilian couplet (*pater ipse colendi . . . Haud facilem esse viam voluit . . .*) which completes the title-page. But the words inevitably suggest reflections as to the extent to which agricultural education has, so far, been effective in leading to progress in a material sense.

Academically, no one ventures to question the achievements of agricultural science. In the last hundred years the additions to knowledge have been very great, but in the material consequences—the increased production of human food—doubts must arise. Rothamsted itself, by the lips of its director, has been heard modestly to suggest that many of its discoveries have gone to confirm the wisdom of the ages. Even the most progressive country in the world, we are told, feeds itself, in the main, by the exploitation of the fertility locked up in its 'virgin prairies' rather than on the fruits of new knowledge.

Measured in profits, there has been really only one 100 per cent addition to traditional practice in tillage of the soil in the last century, and that is the discovery of chemical fertilisers—that substances extraneous to the soil of definite composition can be used to increase its production. Following this epoch-making discovery there have been many others of supreme scientific importance—the new biological activity of the soil may be instanced—but not one of them has had a material outcome comparable with the first mentioned; for they have all been of the same order of magnitude as the seasonal fluctuations by which *pater ipse* has willed that the husbandman's way should be made difficult.

It is, however, only fair to admit that a particular tiller of the soil, fortified at all points with scientific knowledge and endowed with capital sufficient to tide over hard times, such as the present, has it in his power, by adopting *all* the minor advances which his knowledge suggests, to maintain his average level of profits. Thus he may add one 10 per cent by making use of the improved wheats and barleys with which the scientific plant-breeder has presented him; and another 10 per cent by feeding his animals according to scientific

principles, and so on. But even the members of the Agricultural Education Association must admit that such men are rare.

The obvious reply is, of course, that the educational standard of husbandmen in general is not high enough. But is not the difficulty really psychological? The adoption of the teachings of education in the everyday affairs of life is dependent on a will to progress, a desire for efficiency. As the late head of the Educational Department of the Ministry of Agriculture once pointed out (to American students of all people!), the pursuit of efficiency is philosophically not always desirable. A marsh starred with Grass of Parnassus is more productive of peace of mind than its efficient substitute a water-cress bed! Rural life is undoubtedly productive of a certain passivity—contentment with things as they are. It is perhaps irreverent to attempt the improvement of Nature's plants. A factory is always crying for improvement, but the lily does not suggest a painter!

Be that as it may, the fact remains that scientific agriculture has not furnished an incitement to the rural worker, unless, possibly, in one direction: the improvement of the animal has always attracted the British farmer, and that as a rule is the chief delight in farming. The animal has proved more plastic than the plant or soil, and it is somewhat unfortunate that the science of animal improvement has scarcely emerged from obscurity. Nevertheless, progress on the practical side is continuous. Such recent triumphs as the 300-egg hen and the 3000-gallon cow offer the husbandman greater rewards than even the largest gift of the chemist, fertilisers from the air, and irradiated foodstuffs.

Physico-Chemical Embryology.

Les bases physiologiques de la fécondation et de la parthénogénèse. Par Albert Dalcq. (*Les problèmes biologiques*, Tome 2.) Pp. viii + 274. (Paris: Les Presses universitaires de France, 1928.) 45 francs.

AMONG all the departments of biology, the study of the developing embryo has probably felt least that powerful tendency towards physico-chemical explanations which has transformed so completely other biological fields. It is possible that this impression may be partly mistaken and due to the fact that no one has yet brought together into a fruitful correlation all the isolated and scattered researches on the chemical phenomena taking place in ontogeny. However that may be, the subject of fertilisation and the earliest happenings in the egg-cell has, as is generally known, given rise to a great many investigations which have been carried on with physico-chemical methods and a full appreciation of the importance of the quantitative. Fertilisation, moreover, forms a convenient subject for a review, in that its boundaries are fairly clear-cut and that for practical purposes it can be discussed in separation from the complicated events which follow it.

It is now thirteen years since Prof. F. R. Lillie published his little book on fertilisation, and the amount of activity which biologists have devoted to fertilisation since that time has made a new survey of the subject very desirable indeed. Such a survey was all the more necessary in that Lillie's book was written to a certain extent in the service of a particular theory, that of 'fertilisins,' a theory which is not now held in the unmodified form of that time. This survey has now been brought to a successful completion by Dr. Albert Dalcq, of the University of Brussels. Although those intimately acquainted with this field of work will not agree with him in all his individual judgments, they will certainly admit the success of his review as a whole, and most biologists can scarcely fail to find it a necessity for their shelf of monographs. The book is divided into seven chapters, which work backwards chronologically; thus the first deals with the physiology of cleavage and segmentation, the second with the time elapsing between the fertilisation act and the first cleavage, and the third chapter with the fertilisation process itself. The exposition is expanded at this point to include chapters on the agents of fertilisation and parthenogenesis, and the cytology of the 'activation' mechanism. The sixth chapter, on the physiological consequences of fertilisation, is practically an extension of the first one, but the seventh and last continues the time sequence by dealing with the period between full maturation and fertilisation. The book concludes with an admirably written summary of the present position.

Speaking generally, we may be said to know far more about fertilisation from the outside, as it were, than from the inside, for although a very great number of influences have been brought to bear on the egg-cell and the spermatozoon, the part played by actual physico-chemical analysis of the material itself has been much smaller. Almost all the factors in the environment of fertilisation which can be varied have been varied, and their effects noted minutely. The weakest part of our knowledge of the subject lies in the direct assess-

ment of the physico-chemical changes going on inside the cell itself during these early hours of development. The strongest part of our knowledge is probably the straightforward cytology of the fertilisation process. All of these aspects are dealt with fully by Dalcq, who is particularly happy in his treatment of parthenogenetic agents, which he lists in convenient tables, and in his discussion of the various theories of cell-division.

A critical consideration of some of the details of his book, of course, brings to light various matters which could be improved in a second edition. No mention, for example, is made of the work of W. J. Crozier and his collaborators on the temperature characteristics of cell-division, although the time has surely now gone by when it can be regarded as useful to reproduce Loeb and Wasteneys' Q_{10} values without comment. Again, the discussion of the respiration of the egg-cell before and after fertilisation is confined unnecessarily to data on echinoderms, and such suggestive work as that of Parnas and Krasinska on one hand, and Bialascewicz and Bledovski on the other, is omitted. Thirdly, the investigations of various French workers, in which the 'energy of segmentation' was calculated from the energy required to stop it, are not treated in a very satisfactory manner. But it is unnecessary to catalogue such imperfections, which are inevitable in a book with any personal flavour at all, and will seem to biologists far more than compensated by the obvious value of the monograph as a whole. It may be noted in parenthesis that the proof-reading has not been too carefully done, so that the text and the bibliography are now and then at vexatious cross-purposes. There is no index.

The union of exact biochemical and biophysical work with the basis of cytological and morphological facts already known must inevitably lead to a new era in the study of the 'coming-into-being' of animals, and of this Dr. Dalcq's book on fertilisation provides a happy augury. J. N.

Timber Trees of Malay.

Malayan Forest Records. No. 3: *Commercial Timber Trees of the Malay Peninsula.* By F. W. Foxworthy. Pp. 195 + 140 plates. (Kuala Lumpur, F.M.S.: Forest Department, 1927.) 5 dollars; 12*s*.

THIS important and useful volume of the *Malayan Forest Records*, issued under the auspices of the Federated Malay States Government, has been prepared by Dr. F. W. Foxworthy, Forest Research Officer. The author states that the aims kept in view in its compilation are primarily those of the forest officer of the Malay States. A study of the volume has shown, however, that it is likely to have a wider range of utility, if alone for the very excellent series of photographs of the trees dealt with, with which the book is profusely illustrated. It is worth recording that, although the book is printed locally by a Singapore press, the plates are the work of Messrs. Lascelles and Co., Ltd., of London. Those who have had anything to do with the reproduction of good photographs to illustrate memoirs and so forth drawn up in many parts of the British Empire are well aware that it is very often difficult to obtain good results with the unavoidably inadequate local resources available. The action taken in this matter in the present volume is well worth following.

The timber trees of the Malay Peninsula are of many kinds and are very imperfectly known, says the author, and the need of a manual as an aid to the identification of the more important ones has been very much felt. He states that there are 2500 known species of trees in the Peninsula. "This is, perhaps, more than are recorded from all British India and Burma." This statement is not quite correct. In Gamble's "Manual of Indian Timbers" (2nd ed., 1922) the following is found: "In his introduction to the 'Flora of British India' Sir Joseph Hooker writes of the Indian region (including Ceylon) as 'perhaps the richest, and certainly the most varied, botanical area on the surface of the globe,' and true as this is of the flora in general, it is no less true for the woody species that constitute the forest vegetation." In a tabular statement appended to this remark, Gamble shows series, natural orders, number of genera, and number of species of the trees, shrubs and climbers of the Indian and Burma forests. The grand total comes to 4749, of which the trees number 2513, exclusive of introduced trees.

In discussing the lines on which his manual is drafted, Dr. Foxworthy states that such a manual should give, as simply as possible, the identification marks for each kind of tree and should also give a concise summary of what is known about each of the commercial trees. Work of this kind had been begun by the late Conservator of the States, A. M. Burn-Murdoch (who was previously in the Indian service). In 1911 and 1912 he published two parts of his "Trees and Timbers of the Malay Peninsula." The work came to an end by his death in 1915 and was discontinued. When the present author took up the work, it was

reorganised so as to condense the material within one handy volume. It was therefore restricted to "those trees which are considered as present-day commercial timber trees with others which, not falling within that category, are so conspicuous in appearance as to commend attention in the forest."

After detailing the lines upon which the field work was carried out, in which he had the assistance of forest officers and others, Dr. Foxworthy gives some general statements on the geography, climate, and soils of the Peninsula, and then deals with the location, extent, natural conditions, and composition of the forests. The area occupied by the commercial forests is estimated to be about 30,000 square miles, although considerable parts of this tract have not yet been fully examined. There are also considerable areas which have been destroyed by the practice of shifting cultivation and are now only covered with inferior growth. As has been said, the species of trees are very numerous and it is not unusual to find single acres of forest which carry more than 100 species of trees.

The forests are roughly classified as littoral, lowland, and mountain or hill forests. The littoral forests are subdivided into the beach forests and the mangrove swamps, the latter forming an important source of firewood. The hill or mountain forests divide themselves into three types. The highest mountains are clothed with a very dense low-growing forest cover containing many species of poor quality, small trees with thick leathery leaves; the forest is at present of little value. Below this comes the mid-mountain forest with better commercial prospects, though at present it is only exploited in the neighbourhood of hill stations. In the mountainous country, high ridges stand out sharply and bear a dense cover of large trees on their crests, amongst which *Shorea Curtisii* is often abundant. The hill forests are roughly taken to be those above 2000 feet elevation.

The third division is the lowland forests. This type starts where the beach forest ends and runs up to the hill type, although, as is usual in such forests, the dividing line is not a sharp one. Briefly, the lowland forests are subdivided into swamp forests, forest which has been subjected to shifting cultivation and is now covered with a poor growth, and high forest. It is calculated that the second type—the aftermath of shifting cultivation—will require 250 years under natural conditions before it again becomes a valuable forest of commercial species. The high forest is what Schimper ("Plant Geography," Chaps. ii. and iv.) terms 'rain forest.' It contains a large number of species and includes most of the present-day commercial timber trees of the Peninsula.

"Our forests," says the author, "are most closely related to those of the Netherlands Indies, Borneo and the Philippines. Detailed studies in the two latter regions have shown that the forests have from 60 per cent. to 90 per cent. of their volume produced by trees of one family, the *Dipterocarpaceæ*. The indications are, from such studies as have been made in the Malay Peninsula, that our forests have about 60 per cent. of their volume of timber in this group."

Dr. Foxworthy has drawn up a key, which is mainly intended for use in the forest by forest officers; it lays most emphasis on those features which are most apparent in the field, more especially the bark, which forms the basis of the key. He has not arranged his material in botanical sequence since he says the book has no pretence at being a botanical flora; for the same reason his descriptions of trees are in simple language. All will not perhaps subscribe to Dr. Foxworthy's arguments or arrangement of his work. It is probable, however, that he will find the average forest officer and others working in the forests in agreement with him; and for the rest, time alone will prove whether the key fulfils the practical objects it aims at. This being said, the author may be congratulated on the compilation of a piece of work which should prove of great utility to all who work amongst or wish to become acquainted with the commercial trees of this region.

Prehistoric Research in France.

(1) *La Grotte de l'Observatoire à Monaco.* Par Marcellin Boule et L. de Villeneuve. (Archives de l'Institut de Paléontologie humaine, Mémoire 1.) Pp. 114+27 planches. 150 francs.

(2) *Les Poissons, les Batraciens et les Reptiles dans l'Art quaternaire.* Par Henri Breuil et R. de Saint-Périer. (Archives de l'Institut de Paléontologie humaine, Mémoire 2.) Pp. 170. 80 francs. (Paris: Masson et Cie, 1927.)

(1) "LA Grotte de l'Observatoire à Monaco" is the first of a series of memoirs to be issued by the Institute of Human Palæontology at Paris, founded some years ago by Prince Albert I. of Monaco.

The late Prince will long be remembered by prehistorians for the active interest he took in all kinds of prehistoric research and for the magnificent series of publications he inaugurated. Not least among these latter were numerous volumes dealing with the results of excavation in

the caves near Mentone. The excavations were under the careful supervision of the Chanoine de Villeneuve, and it is largely due to his scientific precision and careful digging that so much valuable material was obtained.

After the work at Mentone was finished, attention was turned to another cave near Monaco, just below the Observatory and high up on the hillside overlooking the sea. For many years past excavation has been proceeding there, and the work in many ways has been one of peculiar difficulty. In the volume under review we have the results of these years of labour described for us by the Chanoine de Villeneuve and Prof. Marcellin Boule, who has undertaken the detailed study of the objects found, especially of the fauna.

The cave consists of a vestibule, descending rapidly at the back. A large number of archæological layers have been isolated, but these can be grouped into three series, separated by layers of stalagmite; at the bottom were found Lower Palæolithic, in the middle Mousterian, and at the top Aurignacian industries. An interesting find in one of the lower levels was a *coup de poing* made of limestone. This is the first one known in the Riviera district.

The fauna is as might be expected, but the presence of *Cuon alpinus* race *Europæa* is important, although it is not the first example to be found in the district, another having been discovered some years ago in a cave near Vence.

A chapter on the history of the excavations is first given. This is followed by an account of the individual layers and their contents, after which follows a careful description of the fauna and the tools found. The volume concludes with a large number of plates.

The only criticism that can be offered is that the description of the implements is perhaps rather inadequate, and the space allotted for the purpose insufficient. Especially is this the case when we consider the amount of space allowed for the description of the fauna. The plates are good, although perhaps not all quite up to the standard of what we have learned to expect from the Institute. All the same, the volume is a valuable addition to our knowledge of prehistoric times in the district, and Prof. Boule and his collaborator are indeed to be congratulated.

(2) The second of the memoirs published by the Institute deals with certain conventionalisations derived from naturalistic representations of fish, lizards, serpents, etc., that appear in Quaternary art. For many years past M. Breuil has been collecting material and forming series showing how the naturalistic representation of the animal becomes conventionalised. Starting with the original naturalistic representation, a number of diverging lines of development can be determined, there resulting finally totally different conventionalisations. These conventionalisations are of the nature of symbols, having apparently little connexion with the animal they represent; it is only by the finding of all the links in the chain that their meaning has been elucidated.

Collaboration with the Comte de Saint-Périer is indeed happy, and, as M. Breuil himself says, the descriptions are largely due to his colleague, to whom has been given his *dossier* of drawings and his general ideas on the subject. What that *dossier* of drawings is like the reviewer well knows. He spent much time in 1914 in wading through that enormous and precious mass of material.

An added interest is given to the work in that an attempt is made to correlate the various stages of conventionalisation with the actual age of the objects on which they are found. For this purpose the sixfold system of subdivision for the Magdalenian culture, long ago suggested by M. Breuil and now generally accepted in England, is adopted. The results are very interesting, as they show how the conventionalisation altered in the different industries belonging to these various subdivisions.

An important paragraph, which is not further elaborated, deals with the distribution of the industries of the various Magdalenian stages. It is interesting to note at what moments the Magdalenian culture spread its influence far and wide.

M. Breuil and the Comte de Saint-Périer are to be congratulated on their work and on the numerous well-chosen illustrations therein. It is to be hoped that the matter will not be allowed to remain where it is and that further volumes dealing with the conventionalisation of other animal forms, etc., will be issued within the next few years.

M. C. BURKITT.

The Minor Constituents of Coal-Tar.

The Higher Coal-Tar Hydrocarbons. By Dr. A. E. Everest. Pp. xiii + 334. (London: Longmans, Green and Co., Ltd., 1927.) 18*s*. net.

COAL-TAR products may be divided roughly into two groups, the major and minor constituents of tar, this division having relation to the percentage amounts in which these substances appear in the various fractions of tar distillation, but not necessarily to their intrinsic

importance. Among the major constituents are the well-known benzene, naphthalene, and carbolic acid. Of the minor constituents, the most valuable, and historically the most interesting, is anthracene, the yield of which from average high temperature tar is about 0·4 to 0·8 per cent. Until recently anthracene was the only starting-point in the manufacture of anthraquinone colours, although now this important quinone is synthesised industrially from benzene and phthalic anhydride, the latter being derived from naphthalene.

Dr. Everest's book is devoted to a group of higher coal-tar hydrocarbons which are constituents of the less volatile fractions of coal-tar distillation and, like anthracene itself, they form only a very small proportion of the total distillate from tar, but owing to the large scale on which this distillation is conducted, the quantities of these hydrocarbons available would be considerable if they became of value for technical purposes. The subject matter of this book is arranged in three main chapters, dealing respectively with the acenaphthene, fluorene, and phenanthene groups. A concluding chapter is devoted to several hydrocarbons not immediately related to the three foregoing main sections.

Acenaphthene itself is a hydrocarbon which has already been utilised in colour-making. For this purpose it is first oxidised to its quinone, acenaphthenequinone, which is then condensed with hydroxythionaphthene (thioindoxyl) or its derivatives. The resulting colours are vat dyes of the Ciba scarlet series. More recently another oxidation product of acenaphthene, namely, naphthalic acid, has come into prominence as a starting-point in the production of complex vat dyes of the perylene series. The hydrocarbon, perylene, in the volume under review, is considered as a derivative of phenanthrene. It is figuring more and more in modern chemical literature, and is the subject of many current patent specifications.

Dr. Everest's treatise arrives at an opportune time, when fresh interest is being aroused in coal-tar products owing to the circumstance that the attention of chemical investigators is now directed to a new variety of tar produced during the low-temperature carbonisation of coal. This tar also contains its two groups of major and minor constituents, and among the latter are hydrocarbons either identical with or closely related to the hydrocarbons discussed in the present volume, which contains references to coloured hydrocarbons of unknown constitution, such as crackene and chrysogene. Recent investigations have revealed the presence of similar coloured substances in the less volatile fractions of low-temperature tar.

Many interesting research problems are presented by the hydrocarbon, fluorene, and its derivatives. This hydrocarbon has the remarkable property of forming a potassium derivative with heated caustic potash and a sodium derivative with warm sodamide. The latter reaction renders possible the isolation of fluorene on a large scale. The most readily prepared diamine of fluorene possesses certain analogies with benzidine and other colour-producing diamines, but although the disazo dyes from 2 : 7-diaminofluorene are direct dyeing cotton colours, they offer no special advantages over the commercial dyes made from benzidine and dianisidine. The long chapter on phenanthrene contains a comprehensive survey of the large amount of research which has been carried out on this hydrocarbon. Phenanthrene is still the forlorn hope of the colour-maker, although it is of great scientific interest owing to its relationship to the opium alkaloids, morphine, codeine, and thebaine, all of which contain a phenanthrene nucleus.

The phenanthrene structure has also been revealed in several more complex hydrocarbons. Among these are retene, obtained from wood tar, or by the action of sulphur on resin oils; chrysene and pyrene derived from high-temperature tars; and picene, a product of the distillation of lignite tar. All these substances are adequately discussed, and throughout the book there are copious references to original literature. The utility of the work as a reference book is further increased by the inclusion of complete author and subject indexes. Within a handy compass, the book contains a considerable store of both scientific and industrial information, and is accordingly a useful addition to the technical literature of coal-tar products.

G. T. M.

Thermionics and Flames.

Handbuch der Radiologie. Herausgegeben von Prof. Dr. Erich Marx. Zweite Auflage. Vierter Band, Dritter Teil: *Glühelektroden*, von Prof. Owen W. Richardson, übersetzt und bearbeitet von Prof. Dr. A. Karolus; *Technische Anwendung der Glühelektroden*, von Prof. H. Rukop; *Flammenleitung*, von Prof. Erich Marx. Pp. xvi + 724. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1927.) 50 gold marks.

THE present rapid rate of progress in physics seems to make it inevitable that parts of a monograph should need revision even in the interval between

preparation of the manuscript and publication of the book, whilst the task of bringing out new editions is at once the more necessary and the more difficult. The three sections of this volume of the "Handbuch der Radiologie" present as many different attempts to cope with the problem. "Glühelektroden" is essentially Prof. O. W. Richardson's "Emission of Electricity from Hot Bodies," with some additional references, and an appendix by E. Rupp, where the main results obtained in this field between 1921 and 1926 have been summarised. The decision to leave it in this form appears wise, since although there is no immediate prospect of radical alterations in the experimental basis of the subject, Prof. Sommerfeld's very recent application of the Fermi statistics to free electrons has at least shown that its theoretical basis is in too fluid a state to justify more drastic alterations yet.

The second section, Prof. Rukop's account of the technical applications of thermionic phenomena, is, on the contrary, entirely new. In its main features it constitutes another appendix to the preceding part, and deals with the two branches of thermionics which were deliberately omitted from the latter, namely, the construction of valves of various types, and their use as units of conducting networks. It will be of special interest to English readers from the fact that most of the references are to German patent specifications and literature, whilst two pictures of the Königswusterhausen and Langenberg transmitting stations will lend life to two voices which most of us will have heard but few can have seen. The hundred odd figures are good, and go far to contribute to the success of the writer in compressing his subject into as many pages.

The electrical properties of flames have again been treated by Prof. Marx, and his plan has been to retain the bulk of the older historical and descriptive work, but to give some considerable space to more modern theory. Prof. Marx himself has been largely responsible for the application of the Saha theory of thermal ionisation, and his account of it is thus particularly valuable and authoritative. One wishes that the phenomena of glow discharges were equally amenable to analysis. It is to be regretted that no reference has been made to the important researches of the last few years on cold flames, since the presence or absence of ionisation in these, and their peculiar spectroscopic properties, suggest strongly that they represent isolated processes which occur as intermediate reactions at higher temperatures.

K. G. E.

Our Bookshelf.

Radio-Elements as Indicators: and other Selected Topics in Inorganic Chemistry. By Fritz Paneth. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vol. 2.) Pp. vii + 164. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 12*s.* 6*d.* net.

PROF. PANETH'S introductory lecture was partly of a historical character and partly critical of certain well-known claims of more recent years, being a discussion of "ancient and modern alchemy"; in it the author incidentally announced his inability to confirm Collie and Patterson's claim to the synthesis of helium and neon, but remarked that our cautious return to an earlier view of the feasibility of the transmutation of elements—"Alchymia scibilis est, non tamen adhuc scitur"—has greatly stimulated popular interest, unfortunately sometimes ignorant and credulous, in this branch of knowledge and speculation.

Nine following chapters are devoted to a consideration of the use of radio-elements as indicators, whereby, in view of the ease of detection of radioactivity and the known chemical identity of isotopic elements, it is possible to deduce or to follow the course of physical and chemical changes by an indirect process. Thus the method is applicable, for example, to a determination of the solubility of lead chromate, a known quantity of thorium-*B* being first added; to proof of electrolytic dissociation and of the interchange of ions; to a study of the phenomena of adsorption and colloid chemistry, and to technological, physical, and physiological problems. The discovery of the hydride of thorium-*C* was followed by the preparation of bismuth hydride from ordinary inactive bismuth, and lead hydride, first prepared by the radioactivity method, was later obtained from ordinary lead.

Four chapters which are devoted to the group of volatile hydrides are no less valuable than the preceding section. The remainder of the book, constituting a brief study of the natural system of the elements, does not invite particular comment. Name and subject indexes are provided.

A. A. E.

The Earth, the Sun, and the Moon. By Dr. George Forbes. Pp. 80. *The Stars.* By Dr. George Forbes. Pp. 79. (Benn's Sixpenny Library, No. 106 and No. 107.) (London: Ernest Benn, Ltd., 1927.) 6*d.* each.

THE above little books by Dr. George Forbes may be described jointly. They are designed to awaken the interest and enthusiasm of beginners, and deal with the heavenly bodies in large measure from a poetical and romantic view-point. But they embody many of the latest results, including a brief description of Brown's lunar tables, and a note on Einstein's explanation of the motion of the perihelion of Mercury; the author seems to view the latter with disfavour as upsetting Newton's

great law ; but it seems more correct to view it as a slight amplification of the law, which Newton himself would have been glad to make if the evidence for it had then been available.

A few points call for comment: in the first book, on p. 59, it should be explained that the lunation is 2·2 days longer than the moon's period of revolution round the earth ; the text suggests that they are identical. On p. 62, no extended regions of the moon approach the brilliance of snow as is stated in the text ; even Aristarchus, the brightest point on the disc, has a lower albedo than this. In the book on the stars, on p. 60, the sun's motion is only two-thirds of the earth's orbital speed, instead of being " a little quicker " ; on p. 68, it is an exaggeration to say that the pitch of a note from a locomotive whistle can be altered as much as an octave by the motion of a train. Even if the listener were in another train travelling in the reverse direction, the speed of each being 60 miles an hour, the change of pitch on passing would be less than this.

A. C. D. C.

Benedetto Croce: an Autobiography. Translated from the Italian by R. G. Collingwood. Pp. 116. (Oxford: Clarendon Press ; London: Oxford University Press, 1927.) 5*s*. net.

ALTHOUGH the translation of this autobiography has only recently appeared, the work itself was completed during the War, and in fact before Italy was involved. The writer had reached his fiftieth year, and the value of the book is increased by a suitable prefatory note by J. A. Smith, summing up the importance of the influence of Croce and Gentile during the last twenty years.

The author's object in his work, which was not originally intended for publication, consists neither in confession, nor recollection, nor memoir. He seeks in plain terms to sketch a criticism and therefore a history of the contribution which he has made to the common stock of work done. It is natural that outward events enter into the narrative, which thereby gains in human interest, and one is conscious of the contrast between the political atmosphere of Rome and the academic quiet of Naples. His criticism of Marxism resulted in a deeper interest in philosophy, and in 1902 appeared the " Theory and History of Æsthetic." In the years of activity that followed, Croce found by experience the falsity of that pedagogic theory which restricts education to the first part of life. He also came to possess that toleration which reveres the efforts of past thinkers and recognises that no man can achieve finality in the search for truth.

H. D. A.

Frequency Curves and Correlation. By W. Palin Elderton. Second edition. Pp. viii + 239. (London: Charles and Edwin Layton, 1927.) 15*s*. net.

THIS work deals with the data used by the actuary, for whom it is primarily intended. Nevertheless, the account here given of curve fitting by the method of moments should prove extremely valuable to the non-actuarial reader, who is, however, recommended to begin by reading Appendix VII. An admirable discussion of fitting curves of Pearson's types is fully illustrated with numerical examples and diagrams. A valuable feature is a table of the various types, giving their equations, and a criterion for their applicability. The equations are also given with the origin at the mean, thus allowing a uniform procedure.

The treatment of ' goodness of fit ' given in a later chapter could, with advantage, have been fuller. The matter of random sampling is treated in a somewhat summary fashion, the author advancing the opinion that a little thought and common sense are all that are required. The remainder of the book deals with various aspects of correlation. For the benefit of those who are more interested in this part of the subject an abridged course of reading is given in Appendix VIII. A table of the logarithmic gamma function is also given. No great mathematical attainments are demanded of the reader, and the book should continue to prove very useful.

Recent Advances in Ophthalmology. By Dr. W. Stewart Duke-Elder. (The Recent Advances Series.) Pp. xvi + 339 + 4 plates. (London: J. and A. Churchill, 1927.) 12*s*. 6*d*.

THE author of " Recent Advances in Ophthalmology " is careful to point out that this book is in no way to be considered a text-book. His object is to summarise the research work of recent years in association with the subject, to indicate the lines along which ophthalmology is at present developing, and to guide the student seeking what is of value in the accumulation of modern literature. This survey extends over a wide range, from physiological and embryological research to the neuro-psychological foundations of vision, and discusses methods of diagnosis and treatment and morbid processes. From the nature of the eye, it is inevitable that diagnostic methods should attract much attention ; of these, the most important is bio-microscopy by means of the slit-lamp, the value and limitations of which are fully considered.

The chapter on neurology includes the observations of neurologists and ophthalmic surgeons on the visual paths and centres and their associated tracts in the nervous system. There is also a brief but well-reasoned section on the psychological aspects of vision and perception. The book is well illustrated and indexed and numerous references are given. Dr. Duke-Elder is to be congratulated on the way he has carried out his task.

Interpreters of Nature. Essays by Sir George Newman. Pp. 296. (London: Faber and Gwyer, Ltd., 1927.) 12*s*. 6*d*. net.

THESE essays, whether relating to explorers in science, great practitioners, or interpreters of human desires (as, for example, Keats), were well worth publication in collected form. They supply excellent reading. Especially interesting are those on the disciples of Boerhaave in Edinburgh, and William Osler as a physician of two continents. A more extended index would have been useful and convenient.

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.*]

Pressure of Calcium in the Sun's Atmosphere.

IN a recent interesting investigation, A. Unsöld has estimated the total number of atoms of various kinds in the solar atmosphere which give rise to Fraunhofer lines of the observed width and depth (*Zeits. für Phys.*, **46**, 765; 1928). The theoretical curves he has calculated reproduce with remarkable fidelity the contours of such lines as those of sodium, calcium, strontium, and barium. They give, it is true, too small values for the residual intensities in the centres of the lines, but in the wings, where the theory seems unquestionably trustworthy, they agree exceedingly well with observation. With the aid of the Saha theory of ionisation, Unsöld has deduced the total number of atoms of a given species per square centimetre column above the 'photosphere.' The results as regards the relative abundances of atoms of different kinds are in agreement with Miss Payne's estimates of *relative* abundances in stellar atmospheres, but Unsöld's method leads to an *absolute* determination. For example, for calcium he finds $2{\cdot}3 \times 10^{19}$ atoms per cm.^{2}.

The question arises why this constant should have this particular value. Why should there be $2{\cdot}3 \times 10^{19}$ atoms of calcium per cm.^{2} present for absorption purposes in the solar atmosphere? As we penetrate the solar layers from outside, we shall go on encountering calcium atoms in various stages of ionisation, right into the far interior. How comes it that only the uppermost $2{\cdot}3 \times 10^{19}$ atoms per cm.^{2} render themselves apparent in the formation of absorption lines?

The answer must be that below the level corresponding to $2{\cdot}3 \times 10^{19}$ atoms per cm.^{2} complete opacity must have set in. Unsöld himself has calculated the *mean* pressure of these calcium atoms, assuming they extend through the complete chromospheric column of 14,000 km. thickness. He finds thus $1{\cdot}1 \times 10^{-8}$ atmos. But it appears to me, for reasons I have given elsewhere, that the greater part of this column of 14,000 km. is at a much lower pressure, in circumstances of what I have called 'chromospheric equilibrium,' the atoms being almost entirely supported by radiation pressure. This column thus includes only a minority of the calcium atoms, and the bulk of the atoms will accordingly be at a higher pressure, concentrated in a small thickness (some 100 km.) at the base of the column and comparatively unsupported by selective radiation pressure. It therefore seems to me more significant to calculate not the mean pressure but the pressure at the base of the column. For this purpose we may neglect radiation pressure and estimate the pressure by multiplying the value of solar gravity by the mass of calcium atoms per cm.^{2}. The result is a pressure of $4{\cdot}1 \times 10^{-5}$ atmos. This must accordingly be the pressure at which complete opacity sets in. A more refined calculation given in *Mon. Not. R.A.S.* (**88**, 200; 1928) gives 5×10^{-5} atmos.

I wish here to point out that this result is in very fair agreement with an estimate which I made in 1925 (*Mon. Not. R.A.S.*, **85**, 778) by an entirely different method. The method consisted in a crude modification of Kramers' theory of the absorption coefficient in the continuous spectrum formed by the ejection of photo-electrons. Assuming the sun was entirely composed of calcium atoms, I found that at the level from below which only one per cent of the continuous spectrum emerges, *i.e.* roughly at the level at which almost complete opacity is established, the total pressure (electrons plus ions) was $1{\cdot}1 \times 10^{-4}$ atmos. The corresponding pressure of calcium atoms (I assumed for simplicity complete first-stage ionisation down to this level) was accordingly $5{\cdot}5 \times 10^{-5}$ atmos. This is to be compared with the above values $4{\cdot}1 \times 10^{-5}$ atmos. and 5×10^{-5} atmos. derived by an entirely different path of reasoning direct from Unsöld's treatment of the observed line-widths of the *H* and *K* lines. The theory I was using is subject to criticism in details, but generally speaking the agreement of the two estimates strongly confirms the suggestion that photo-ejection of electrons is the dominant cause of the sun's continuous spectrum.

In the tentative picture of the sun's calcium atmosphere to which we are led by these and allied calculations, it appears that to a first approximation we may divide the chromospheric layer from the reversing layer and photospheric layers by a certain plane of

CALCIUM ON THE SUN.

Nature of Equilibrium.	Level.	Partial Pressure of Calcium (atmos.).	Ca^{++}.	Ca^{+}.	Ca.
			(Fractions).		
Chromospheric Equilibrium or Monochomatic Radioactive Equilibrium. (Strong selective radiation pressure.)	High Level Chromosphere	Small pressure gradient.	0	1·0	0
	(7000 km.)				
	Middle Chromosphere		0	×	×
	(7000 km.)		(Plane of demarcation)		
Local Thermodynamic Equilibrium. (Selective radiation pressure rapidly decreasing.) (Reversing Layer and Photospheric Layers.)	Base of Chromosphere	10^{-13}	1·0	10^{-2}	0
	(100 km.)				
	Level of maximum Ca^{+}	2×10^{-7}	10^{-3}	1·0	10^{-3}
	(30 km.)				
	Depth of complete opacity	5×10^{-5}	0	0·85	0·15
	Interior.		Ca rises to a maximum. Then Ca^{+}, Ca^{++}, Ca^{+++} . . . in turn.		

demarcation. Above this plane the rarity of collisions permits monochromatic radiative equilibrium with strong selective radiation pressure. Below the plane collisions give rise to a state of local thermodynamic equilibrium in which selective radiation pressure decreases inwards exponentially with the optical thickness. In the upper region only those atoms are present which are capable of support by selective pressure. In the lower region the dissociative equilibrium of the different kinds of ions is determined by Saha's theory. The pressure at the interface will be very low, and even Ca^+ atoms will be in a minority compared with Ca^{++} atoms. As we descend, the proportion of Ca^+ atoms increases and rises to a maximum, thereafter decreasing and giving place to Ca atoms. Ultimately, increasing temperature causes ionisation of Ca atoms, and we pass in turn through maxima of Ca, Ca^+, Ca^{++}, etc., as first pointed by Pannekoek some years ago.

The accompanying rough table gives the scheme of pressures and stages of ionisation. Actually, of course, the two layers separated by the plane of demarcation in the scheme must merge into one another continuously, and the scheme does not pretend to treat the transition accurately.

E. A. MILNE.

The University, Manchester.

The Spectrum of the Hydrogen Molecule.

THE very accurate table of wave-lengths in the secondary spectrum of hydrogen which has recently been published by Gale, Monk, and Lee (*Astrophys. Jour.*, vol. 47, p. 90; 1928), has made possible a great advance in our knowledge of the structure in this spectrum. The very extensive series of band systems described in *Proc. Roy. Soc.* (A, vol. 113, p. 368; 1926) is fully confirmed, and the combinations are found to be exact to the accuracy of the new data. This is true in all essential details for the bands which involve the electron transitions $3\rightarrow 2$ (α), $4\rightarrow 2$ (β), and $5\rightarrow 2$ (γ), but the weak bands involving the $6\rightarrow 2$ (δ) and higher transitions will require some reconsideration.

As a result of a re-examination of the series of band systems towards the violet end of the spectrum, described in *Proc. Roy. Soc.* (A, vol. 115, p. 528; 1927), we have been led to the discovery of a very large number of bands which have the same final states as these. The bands as there described consisted of 6 progressions with a maximum of 4 members in each. We now have about 40 such progressions, several of them extending to 9 members. Many of the leading lines are very strong, and have been measured with the interferometer as standard lines by Gale, Monk, and Lee. As a result of this and of the large number of systems, we are able to determine the relevant data with very great precision. For example, we believe the following to be the final vibrational differences ($1''\rightarrow 0''$, $2''\rightarrow 1''$, etc.) of the lowest rotational levels of these systems: 1312·55 (4), 1276·60 (2), 1242·382, 1209·062, 1176·33 (3), 1144·00, 1112·08, and 1081·29. All these numbers are believed to be sure to within half a unit of the last digit but one. Where the last digit is enclosed in brackets it is less sure than in the other examples. In the one case in which there is a double check involving only standard lines, that is to say, in which all 4 lines have been measured with the interferometer, we find the practically identical values $1242{\cdot}381_1$ and $1242{\cdot}383_5$ cm.$^{-1}$.

The vibrational differences of the B states got by Dieke and Hopfield from measurements of the ultra-violet absorption bands of H_2 are 1313, 1276, 1247, and 1209 in succession. In spite of the apparent discrepancy at the third interval, we think that these B states must be the same as our final states, because the identity is now confirmed by the value of the moment of inertia. For a number of the bands we have been able to identify the $Q(m)$ lines up to $m=6$. This enables us to obtain the quantity a in $B_n''=B_0''-an''$. From the vibrational data, using Kratzer's formulæ, we then deduce $2B_0''=uw_0=31{\cdot}1$. This is about 12 per cent higher than the value got by Birge (NATURE, Jan. 28, 1928) from the ultra-violet data, and the agreement is as good as the method warrants.

Owing to the very large number of these progressions it will take some time to arrange them. The distribution of intensity among the bands presents different and interesting features in the various progressions, and the initial states evidently exhibit considerable variety. These bands, which extend from the ultra-violet right through the visible into the infra-red, account, together with the α, β, γ bands, for about half the total strength in the secondary hydrogen spectrum.

Many of these bands have an alternation in the intensity of the successive lines with a 3 to 1 ratio, such as was found to be characteristic of the strong bands of the α, β, γ series. These results now rest not only on the data of McLennan, Grayson-Smith, and Collins, but in the case of ${}_1A_2Q(m)$ they are confirmed by the intensity measures of Ornstein, Kapuscinski, and Eymers, and in the case of some of the α-bands by the intensity measures of Goos.

O. W. RICHARDSON.
P. M. DAVIDSON.

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

Yield Variability in *Hevea brasiliensis*.

THE most perplexing problem of the rubber-planting industry is the variable yield capacity of different *Hevea* trees. The yields of individual trees range from half a pound to 12 lb. a year, and rare trees are known that have given regularly 30 lb. and more per annum. It is the presence of so many poor yielders (unrecognisable before the tapping age) that keeps down production. Crops per acre on the average estate seldom exceed 350 lb., and numerous tests have shown that most of this rubber is obtained from some 25 per cent of the trees.

Investigations into the causes underlying yield variations have been in progress at the different rubber research stations for many years, and it was thought at one time that the number of rings of latex tubes in the cortex—a factor which is correlated in some measure with yield—would, on closer study, prove to be the determining factor.

With the object of throwing some light on this problem, I commenced in 1922 a detailed study of a group of 250 *Hevea* trees. Anatomical investigations of the cortices of these trees have been made regularly every year, and some of the trees have been studied exhaustively from root tip to leaf tip. Since 1925, when tapping commenced, the yields of all the trees have been measured after each tapping, and attempts have been made to correlate yields with the anatomical characters noted.

The decisive results obtained will be embodied in a forthcoming publication. Meantime it can be stated here that my investigations conclusively show that the number of latex rings is at no stage sufficiently closely related to yield to justify one in regarding this as the chief determining factor. In the early life of the plant, the number of rings present is no guide to

the yield value of the tree, the correlation coefficient even so late as the fourth year being only about +0·37.

With regard to the disposition of the various rings in the cortex, there appears to be nothing in the arrangements in the successive years from the third to the eighth which is likely to augment materially the value of the ring number factor as a dependable criterion of yield.

The inadequacy of the factor mentioned led me to investigate other characters, and in 1923 I discovered the existence of a relation between the bore of the latex tubes and yield. The great technical difficulties in the way of accurate measurement of average latex tube bore made progress in the study of this character extremely slow, but by the middle of last year I had definite evidence that the bore of the latex tube was the missing factor in the causation of yield variations. High yielders had, I found, large bored tubes, and poor yielders small bored tubes. Of particular importance was the discovery that trees in which the latex tubes have bores below a certain value never become high yielders.

Thanks to improvements made in technique, which enable measurements to be carried out with greater speed and accuracy, I have lately obtained complete confirmation of the previously discovered relation between latex tube bore and yield. Careful duplicated measurements of the latex tubes in the large group of trees mentioned have brought to light a striking correlation. Notwithstanding the disturbing effect of differences in the number of rings in the trees compared, the correlation coefficient of tube diameter with latex yield works out at the high figure of +0·76 (P.E. ±0·018). When the aberrations introduced by the variable number of latex rings are discounted by considering only the yield per ring, the correlation coefficient rises to +0·83 (P.E. ±0·014). (It may be mentioned here, for comparison, that the correlation coefficient of ring number with yield is only from +0·3 to +0·5 according to age of trees.)

It is interesting to find that latex yield increases much more rapidly than the square of the tube diameter. This is no doubt to be attributed to the disproportionate reduction in the internal resistances to flow which a slight increase in the bores of tubes of the order of latex tubes would bring about.

Other anatomical features, such as the density and disposition of the individual latex rings (the latter especially) are occasionally responsible for yield variations. If the disturbing influences of these two factors are taken into account, it will, I think, be evident that we now have, on the anatomical side at any rate, a fairly adequate explanation of the causes of yield variations in *Hevea brasiliensis*.

The practical value of the ascertained correlation between tube bore and yield is that it places at our service a character (defined early in the life of the tree) that can be used to distinguish potentially poor from potentially good yielders, for my observations show that for a rough initial classification, the latex ring factor can be ignored.

As to whether latex tube bore is a hereditary and constant character, there seems little doubt. Numerous one-year-old *Hevea* plants of vegetative origin have been found by me to have latex tubes of the same average bore as those of the 15- to 20-year-old trees from which the plants have been derived. Further confirmatory evidence has been provided by a recent examination of several hundred six-months-old nursery plants. In these, not only is a similar range of differences in latex tube bore observable, but roughly the same proportion of large, medium, and small bored plants occurs as among adult trees. It has, indeed, been found possible to classify *Hevea* plants by the new factor even at this early age, and although such a test bristles with difficulties, I am convinced that the detection of the 50 per cent odd plants found in every nursery that have latex tubes of too small a calibre to enable them to become good yielders can be made a practicable business. The elimination of such plants alone would be the means of doubling the productivity of future planted rubber areas.

It may perhaps be of general interest to botanists to know that I have also found a noteworthy correlation between the average cortex cell diameter and latex yield. This is only traceable in certain tissues, particularly the phloem parenchyma. Here also an agreement in cell size between *Hevea* trees and their budded offspring has been observed. Unfortunately, average cell size is, for many reasons, difficult to measure with certainty, and as a diagnostic character of yield capacity in *Hevea* (for which it was investigated) has too many pitfalls to be depended upon. However, the observation may not be without value also to those concerned with other branches of economic botany in which the vegetative organs are the source of the crop.

HERBERT ASHPLANT.
Rubber Experimental Station,
Travancore, S. India.

Diffraction of Cathode Rays by Mica.

A DIFFRACTION pattern was obtained by passing a cathode ray beam through a thin sheet of mica, with an apparatus similar to that used by G. P. Thomson in his interesting experiment on the diffraction of cathode rays by thin films of celluloid and some metals (*Proc. Roy. Soc.*, Ser. A, vol. 117, p. 600; 1928).

FIG. 1.

The pattern shows in some respect a resemblance to the Laue pattern of X-rays, but the most conspicuous feature of the former is quite different from that of the latter. In Fig. 1 is reproduced one of the photograms obtained, in which the distance between the crystal and the plate was 12 cm., and the voltage applied to the tube was about 50 kilovolts. As will be seen from the photogram, three sets of parallel bands intersecting each other at an angle of 60° form a net of triangular mesh, of which the net points are arranged into an array of spots. Some of the spots are remarkably intensified and somewhat elongated.

The distance between the parallel bands decreases

as the applied voltage is increased. The distribution of the intensified spots is also changed with the applied voltage. When a magnetic field is applied in the path of the rays, the pattern as well as the central spot are shifted. From the magnetic deflexion it is found that the primary rays are more or less heterogeneous, while the transmitted rays seem to be fairly homogeneous. The formation of the net-like pattern may be accounted for as due to the diffraction of short waves by a two-dimensional lattice placed perpendicular to the incident beam, or, in other words, the diffraction of the ' de Broglie waves ' by a single layer of net plane parallel to the cleavage face with atoms arranged in a triangular lattice.

This explanation seems to be justified, as the distance of the bands gives a right order of magnitude for the atomic distance. The appearance of the intense spots may be due to the effect of a three-dimensional lattice, and therefore they may correspond to the Laue spots. The elongation of the spots is perhaps due to the distortion of the specimen.

Further experiments are being made.

S. NISHIKAWA.
S. KIKUCHI.

Institute of Physical and
Chemical Research,
Tokyo, May 14.

New Type of Discharge in Neon Tubes.

THE new type of discharge described in NATURE of May 19, p. 794, is evidently the same as that which I have produced when using a neon lamp as a safety device (*Proc. Leeds Phil. Soc.*, **1**, 185; Nov. 1927). The method, although different, is similar in principle.

An ordinary ' Osglim ' lamp, with the safety resistance removed from the cap, was connected across the coils of an electromagnet excited by 110 volts. This

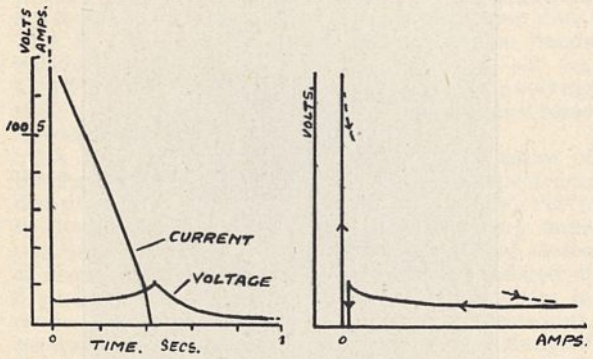

FIG. 1.

is not large enough to excite the neon lamp, but if the current is suddenly broken a high E.M.F. will, of course, result on account of the self-induction of the coils. The presence of the neon tube, however, limits the rise of voltage, since its resistance falls to a low value when excited in this manner.

The behaviour of the neon tube under these conditions, which, as indicated by the nature of the discharge, was quite different from that when in normal use, was investigated in some detail. The results of these investigations agree in general with those already described in NATURE (loc. cit.), and an account of them is to appear in the next issue of the *Proceedings* referred to, but one or two points of interest may be mentioned here.

The ' Osglim ' lamp used was of the ' letter ' type, as the bee-hive pattern did not stand up to the discharge so well. With the aid of a cathode ray oscillograph, curves giving the relation between current and voltage, current and time, and voltage and time, were obtained and photographed. Several exposures were of course necessary, but with suitable precautions it was possible to repeat any particular curve as often as desired.

The variations of voltage and current with time in a typical case are conveniently shown together in Fig. 1 (*a*); and (*b*) indicates the nature of the current–voltage curve. It may be seen that on breaking the current in the inductive circuit across which the tube is connected, the voltage rises with great rapidity (to 300-400 volts) and drops almost immediately to a low value (about 11 volts in this instance). At the same time the current rises to more than 6 amp., and, as Fig. 1 (*b*) shows, attains its maximum as the voltage reaches its low value. The resistance of the tube at this stage is between 1 and 2 ohms.

The extinction voltage (which varies somewhat as the conditions are altered) is also seen to be quite different from that usually found when the ordinary pink glow is seen. It was thought at first that the second rise in potential (Fig. 1 (*a*)) synchronised with a second increase in brightness which is usually observed, but the current is always zero before the second peak is reached. Sometimes as many as three or four flashes were seen, and there were other divergences from what may be regarded as the normal behaviour under these particular conditions, but it is not possible to discuss them here.

F. A. LONG.

Physics Laboratories,
The University,
Leeds, May 26.

The Corpus Luteum and the Cause of Birth.

RECENTLY, Dr. F. H. A. Marshall (*Biol. Rev.*, **2**, 129; 1927) has examined the question of the relation of the corpus luteum to the causation of parturition. He has not reached any definite conclusion on the matter, but suggests that the stimulus for parturition may result from an ovarian-pituitary mechanism. Certain investigations which I have been carrying on for some time into the fœtal membranes and placentation of the marsupial *Bettongia cuniculus* have brought in their train observations which appear to show that the ovary has no influence whatever in causing parturition.

Bettongia cuniculus is a small diprotodont marsupial of the family Macropodidæ. A couple of hundred females of this animal have come into my hands in the last few years. *Bettongia* is polyœstrous, its breeding season lasting over seven or eight months of the year. Only one uterus is pregnant at a time, pregnancy being entirely unilateral. There is never more than one produced at a birth, there being only one ovum extruded from the ovary of one side. I have found no exceptions to these rules.

In the early stages of pregnancy the two uteri undergo identical changes, so that by external examination of the uteri alone it is impossible to say which of them is the pregnant one. The sterile uterus is therefore in a condition which is to be regarded as one of ' pseudo-pregnancy.'

It is now well established that uterine development, whether of pregnancy or pseudo-pregnancy, is a result of the stimulating influence of the secretion of the corpus luteum, and Hartmann (*Am. Jour. Phys.*, **71**, 2, p. 436) has shown that the Marsupialia, as represented by the opossum, agree with the Monodelphia in this respect. In the case of *Bettongia*, the ' pseudo-pregnancy ' of the sterile uterus must be induced by the corpus luteum of the contralateral ovary, seeing that there is no similar body in the

ovary of its own side. This confirms, in the living normal marsupial, observations made by Hartmann (loc. cit. p. 441) on pregnant opossums from which the uterus of one side and the ovary of the other had been removed. This supports, too, Hartmann's contention that operative interference had nothing to do with his results. When the egg in the pregnant uterus has reached the stage where it possesses a well-formed primitive streak, involution of the sterile uterus begins to take place, while the other uterus undergoes the usual enlargement associated with normal development.

Seeing that a single corpus luteum, situated in one ovary, influences, up to this stage, the activities of both uteri, is it not reasonable to suppose that, at the time of involution of the sterile uterus, the secretory activity of the corpus luteum has begun to wane ? As such seems to be the case, it is obvious that parturition could scarcely be caused by the action of the corpus luteum.

The only other way of accounting for the regressive changes in the sterile uterus is to suggest that they may be due to some inhibitory influence, but it does not seem that any such influence could exist without involving both uteri. T. THOMSON FLYNN.

University of Tasmania,
May 4.

Personal and Impersonal Styles in Scientific Communications.

DELIBERATELY encouraged by some editors, though not, I am assured, by the Editor of NATURE, a prejudice is growing against the use of the first person in scientific writings. If it were part of a more general prejudice against the increasing egotism of scientists (manifested, for example, in squabbles over priority and the assignment of credit), it would be admirable, though probably futile. But it is not ; it is merely the stylistic fad of the moment, and is wholly contemptible. Truly, it is not well to be always saying 'I' ; but there is no virtue, moral or literary, in the mechanical substitution of the third person for the first. The literary vice is not the repetition of pronouns or of any pronoun in particular ; it is needless repetition in general ; pronouns are mentioned specifically only because it is particularly tempting to repeat them too often. It is very much worse to repeat a cumbrous and artificial phrase than to repeat a pronoun ; and when we find our pages, sedulously cleared of 'I's,' besprinkled with 'the present writer' and 'the author of the present paper,' it is surely time to protest against a Pharisaical misinterpretation of the Law.

Pedants are too often ingenious in excusing their sins ; and somebody will probably discover literary sanction even for this last abomination, perhaps in the introductions to the Waverley novels. I would therefore insist that, even if Scott's circumstances had been normal, even if he had said 'the present' when he meant 'this,' Scott and his like, for all their excellencies, would still not be fit models for those whose first duty is to be brief and direct. If we must imitate anyone, let it be the masters of our craft ; let us try to learn from Faraday, Rayleigh, Huxley, and many others how to say 'I' freely, naturally, with elegance and with dignity.

For there are real difficulties, peculiar to scientific writing, that it would be foolish to ignore. An analysis of about 200 of the worst flounderings in recent journals suggests that they arise in three ways. First, Prof. Smith wants to refer to his own earlier work, but does not like to say 'I found in 1924 . . .' Why should he not denote himself, as he would any other person, by his name, and say, 'Smith found . . .' Second, impersonal narrative becomes tedious ; we want to vary 'The next experiment was . . .' with 'Then I tried . . .' Why should we not ? The pronoun here is quite unobtrusive ; for no emphasis can fall on it, as reading aloud will show. Last, we want to make a personal statement, distinguishing our opinion from facts or from the opinions of others. Here a moral issue is raised. If we are not prepared to make a personal statement in personal form, are we justified in making it at all ? Can true modesty, or any other virtue, permit me to occupy valuable space in airing my views and yet forbid me to call them mine ? NORMAN R. CAMPBELL.

The Arc Spectrum of Chlorine.

REGULARITIES in the arc spectrum of Cl were first discovered by Turner (*Phys. Rev.*, **27**, 397 ; 1926), who found three pairs showing the difference 880 cm.$^{-1}$. A consistent extension of this work into the visible, and theoretical interpretation has, however, never been attempted, especially because the separation of the chlorine lines into arc and spark lines had not been possible. Thus the data given in Kayser's "Handbuch" contain lines of both types.

Recently Mr. K. Asagoe, of this laboratory, has been able to identify 23 arc lines in the region between 4700 A. and 4200 A. The method is similar to that used by Wood and Kimura (*Astrophys. Jour.*, **46**, 181 ; 1917) in separating the arc and spark lines of iodine. An examination of these Cl lines shows that they form the combination $4s\,^4{}^2P - 4p\,^4{}^2(S, P, D)$. The frequency differences between the five lower levels are 530·4 ; 338·7 ; 1399·1 ; 640·8 cm.$^{-1}$. Attention has already been directed to the first of these by de Bruin (*Amsterdam Proc.*, **30**, 19 ; 1927). But these are just the differences which one finds between Turner's lines in the far ultra-violet region. They must consequently be identified as $^2P(3p^6) - {}^4{}^2P(3p^5, 4s)$. In the following table the individual lines, their intensities and levels, are given :

1396·5	3	$^2P_1 - {}^4P_2$	1351·7	3	$^2P_2 - {}^2P_1$
1389·9	4	$^2P_2 - {}^4P_3$	1347·2	5	$^2P_2 - {}^2P_2$
1379·6	5	$^2P_2 - {}^4P_2$	1335·8	2	$^2P_2 - {}^2P_1$
1363·5	5	$^2P_1 - {}^2P_2$			

All the lines found by Turner are thus accounted for. Although the terms arising from the configurations $(3p^6)$ and $(3p^5, 4s)$ are still approximately 'normal,' that is, the corresponding vector coupling is of Russell-Saunders type, the higher term group arising from $(3p^5, 4p)$, which the visible lines have as initial state, has a decidedly different character ; this term group is—as one usually puts it— of 'higher rank.' The situation is quite similar to that in the arc spectrum of argon, where, according to the classification of Meissner (*Zeit f. Phys.*, **39**, 172 ; 1926), the four $4s$ levels arise from a Russell-Saunders coupling, whereas the ten $4p$ levels which are grouped quite irregularly, are apparently due to some intermediate coupling (Goudsmit-Uhlenbeck). There is consequently a certain ambiguity in assigning l-values to the $(3p^5, 4p)$ group. However, the weakness of intercombinations leads to a distinction between doublet and quartet levels.

Corresponding results in bromine and iodine have been obtained, but the work is still in progress.

My thanks are due to Prof. M. Kimura, through whose kindness my stay in Kyoto has been possible.

OTTO LAPORTE.

Physics Department,
Imperial University,
Kyoto, May 6.

The Influence of Gravitation on Electromagnetic Phenomena.[1]

By Prof. E. T. WHITTAKER, F.R.S.

IN the Bakerian Lecture of 1850, Faraday described a series of experiments which he had made in searching for a connexion between gravity and electricity. "The long and constant persuasion," he said, "that all the forces of Nature are mutually dependent, having one common origin, or rather being different manifestations of one fundamental power, has made me often think upon the possibility of establishing, by experiment, a connexion between gravity and electricity, and so introducing the former into the group, the chain of which, including also magnetism, chemical force, and heat, binds so many and such varied exhibitions of force together by common relations."

The results of Faraday's experiments were negative; but, he said, "they do not shake my strong feeling of the existence of a relation between gravity and electricity, though they give no proof that such a relation exists." The proof was, indeed, not obtained until seventy years afterwards, when the measurements of photographic plates taken at the eclipse of May 1919 showed a deflexion of the rays of light from stars when the rays pass close to the gravitating mass of the sun.

The general theory of relativity, by which this deflexion was predicted, asserts that the presence of matter or energy in any region of space affects the metric in that region; as we may say, it causes a 'curvature' or 'distortion' of space, which not only determines all the gravitational effects in the region, but also has a remarkable influence on any electromagnetic phenomena which may be taking place there. This is the true solution of Faraday's problem.

It is important to notice that gravity and electricity have been brought into connexion in essentially the same way as light and electricity were brought into connexion by the Maxwellian electromagnetic theory of light, namely, by postulating that the same 'ether' transmits both kinds of actions. It is true that we do not speak much of the ether nowadays, and certainly do not regard it as a quasi-material medium filling all space; but when we endow space itself (or, in non-statical problems, space-time) with properties such as curvature, we are making it play the part of an ether. The principle that one and the same ether ought to serve for all purposes was enunciated by Faraday himself: "It is not at all unlikely," he said, "that if there be an ether, it should have other uses than simply the conveyance of radiations."

In what follows I shall make the simplifying assumption that the gravitational field is 'statical,' that is, such as would be produced by gravitating masses which are permanently at rest relative to each other, so that the curvature of space at any point does not vary with the time. In the distorted space of this fixed gravitational field, I suppose an electromagnetic field (either statical, or varying with the time) to exist; strictly speaking, the electromagnetic field has itself a gravitational effect, that is, it changes the metric everywhere; but this effect is, in general, small, and we shall treat the ideal case in which it is ignored, so we shall suppose the metric to be simply that of the gravitational field originally postulated.

The problem before us, therefore, is to study the existence and propagation of electromagnetic fields in a medium whose properties (that is, the distortions of space) vary from point to point, and this naturally suggests a comparison with the Maxwellian theory of electromagnetic fields in a medium the specific inductive capacity and magnetic permeability of which vary from point to point. Do the effects of the distortion of space resemble in any way the effects of a variable dielectric constant and permeability?

The answer is in the affirmative, though the resemblance is not quite perfect. In a gravitational field there are eight partial differential equations which have exactly the same form as the usual Maxwell's equations, but in place of the three simple linear equations which connect the components of the electric displacement of the Maxwellian theory with the components of the electric force, and the three equations which connect the components of the magnetic induction with the components of the magnetic force, we now have six linear equations which express six of the twelve components in terms of all the six others.

Thus, from the mathematical point of view, the problem is similar to that of the Maxwellian electromagnetic field in a medium the dielectric constant and magnetic permeability of which have a kind of six-fold æolotropy. A prophetic adumbration of all this is to be found in a remarkable sentence written by FitzGerald so long ago as 1894: "Gravity is probably due to a change of structure of the ether, produced by the presence of matter."

To learn what happens we must solve these equations, and, as a first and simplest case, let us suppose that the electromagnetic disturbance is a ray of light. In this case it is not necessary to obtain the complete solution of the partial differential equations, since we can make use of the theorem that "a ray of light is a null geodesic of space-time." Let us, then, suppose that the gravitational field is due to a single gravitating mass, which we may call the 'sun,' and let us find the null geodesics of this field, which will be the paths of rays of light in the field of a single gravitating centre. We find that a ray of light which comes from infinity and does not pass too near the 'sun' is simply deflected through a small angle, in the same way as the light from stars was actually found to be deflected in the eclipse photographs. But if it is aimed almost directly at the mass (which, it must be remembered, we are supposing to be collected in a point-centre), much more interesting things may happen. Thus if a certain constant

[1] From a lecture delivered to the London Mathematical Society.

depending on the initial conditions has a particular value, we obtain light-rays which are spirally asymptotic to a certain circle surrounding the 'sun'; one type of ray represents light which, coming from infinity towards the mass, is 'captured' by it, and never gets away again, but circles round it for ever; another type of ray, on the other hand, represents luminous energy which is, and always has been, imprisoned in the immediate neighbourhood of the mass.

These phenomena cannot be observed in the case of our actual sun, because its mass is not sufficiently concentrated: the sun's bulk prevents the light rays from getting close enough to its centre; but it seems conceivable that, at the nucleus of an atom, we may have a concentration of mass into a space so small that the capture of light by an intense gravitational field may be realised.

To pursue this matter somewhat further, let us consider the field round a point-mass. If we draw round this mass a circle, the length of the perimeter of the circle may be denoted by $2\pi R$, a definition which determines the physical meaning of the quantity R. But the normal distance between two adjacent circles, of perimeters $2\pi R$ and $2\pi(R-\delta R)$, is *not* δR, but δR multiplied by a multiplier which increases indefinitely as R approaches a certain value a which depends on the sun's mass: that is to say, as we approach the circle of perimeter $2\pi a$ from outside, we find greater and greater difficulty in making any headway; we have to travel a very great distance in order to pass from one of these circles to another just inside it, the perimeter of which differs from it only very slightly, and we can never actually attain to the circle with perimeter $2\pi a$.

If, then, we consider a ray of light coming from infinity and travelling directly towards the point-mass, the velocity of the light will always be c; but when it begins to approach the circle of perimeter $2\pi a$, this velocity will only be sufficient to carry it onwards very slowly, if we measure its progress by the rate of diminution of perimeter of the circles it cuts through, and it can never, in any time however great, get nearer to the mass than the circle of perimeter $2\pi a$.

Thus, although the light is actually travelling for ever with its usual velocity, it remains permanently in the neighbourhood of the point-mass. The capture and imprisonment of radiation by the intense gravitational field surrounding a point-mass is a remarkable theoretical possibility, markedly different from anything in pre-relativity physics.

Let us now leave the consideration of light rays and pass on to other kinds of electromagnetic phenomena. The mathematical difficulties here are greater, since we now cannot avoid the partial differential equations; but they can be solved in many cases, provided that we take the simplest possible type of gravitational field, which may be arrived at in the following way. Consider the field due to a single gravitating centre, and, fixing our attention on the neighbourhood of a point O, suppose the gravitating centre to be removed to a very great distance from O, while its mass is increased, so that the attractive force at O (to use the language of the older physics) remains finite and equal to g; then we obtain what we may call a *quasi-uniform* gravitational field. In the neighbourhood of O it is essentially the 'uniform gravitational field' of the old physics.

Let us now consider the shape of the equipotential surfaces in a quasi-uniform gravitational field, due to a single electric charge at (say) the origin. We find that these equipotential surfaces are a family of coaxal spheres, having one limiting point at the origin. Thus the difference which a quasi-uniform gravitational field makes to the equipotential surfaces of a single electric charge is that, instead of being concentric spheres, they become coaxal spheres—they become more crowded together on one side of the charge, and less crowded on the other. The effect is exactly the same as if we supposed that, instead of having a gravitational distortion of space, we had the specific inductive capacity and magnetic permeability of the medium each varying as we move in the gravitational field, so that the medium is stratified at right angles to the direction of gravitation.

From these calculations we can deduce a physical result of some interest. Suppose we have an electric charge at rest at the origin, and suppose we have initially a quasi-uniform gravitational field in some particular direction, and that we then reverse this so as to have a quasi-uniform gravitational field in the opposite direction, and then reverse back to the original state of things, and so on. At each reversal the electric equipotential surfaces will change from being a family of coaxal spheres with their second limiting point in one direction, to a family of coaxal spheres having their second limiting point in the opposite direction. But this regular alternation of the electric field must set up radiation, just as the alternation of the electric field in a Hertzian oscillator does: and therefore an electron at rest in a varying gravitational field will, in general, emit radiation.

The knowledge that a motionless electron may radiate, while (as a natural consequence) an accelerated electron does not necessarily radiate, in a gravitational field, may prove useful in accounting for the behaviour of electrons in atoms.

Let us now pass on to the case when the gravitational field is that due to a single gravitating mass at a point, so that we have Schwarzschild's metric. The solution which represents the potential of a single electric charge, and therefore corresponds to the $1/R$ of the ordinary theory, has recently been discovered by Mr. Copson.[2]

The form of the equipotential surfaces is remarkable. Very near the electric charge they are, of course, practically spheres the centre of which is at the charge. But as we get farther from the charge and nearer to the gravitating mass, the equipotentials behave as if they were repelled by the mass, so that eventually they become concave to it (and therefore convex towards the charge!), the mass being in a cup-shaped depression in the

[2] *Proc. Roy. Soc.*, A, **118**, 184; 1928.

equipotential surface. Eventually we reach an equipotential which consists of two closed surfaces touching each other, one (the smaller one) enclosing the gravitating mass but not enclosing the charge, while the other (the larger one) encloses this smaller surface and also encloses the charge. Beyond this, again, we have a series of simple closed surfaces, each of which encloses all the earlier members of the family.[3]

The electric field is precisely the same as would be obtained, in the ordinary electrostatics, by supposing that the specific inductive capacity and magnetic permeability of the medium vary in a certain way with the distance from the gravitating mass.

Solutions of the fundamental equations have been found which represent more complex fields than those I have described; but they are perhaps not well suited for description in a lecture,[4] and I will therefore conclude with a remark about energy. In a *statical* gravitational field, electromagnetic energy is a scalar quantity, so we can calculate the 'total electromagnetic energy' contained in a specified region of three-dimensional space by integrating the amounts of energy contained in the sub-regions into which the region may be divided; and the conservation of electromagnetic energy holds. In *non-statical* gravitational fields these theorems are no longer true, since energy is not then a scalar quantity; the energy in one region is different in kind from the energy in another region, just as momenta in different directions are different in kind from each other.

[3] A figure is given in Mr. Copson's paper, loc. cit.

[4] Reference may be made to *Proc. Roy. Soc.*, A, **116**, 720; 1927.

Heirlooms of Industry in the Science Museum.[1]

By Col. Sir HENRY G. LYONS, F.R.S.

THE idea of a general museum of science is only seventy-five years old, and was due to the Prince Consort, who, after the Great Exhibition of 1851, urged the formation of an institution which would extend the influence of science and art on productive industry. From this proposal arose the Science and Art Department with, as an essential part of it, the South Kensington Museum, the dual activities of which are now represented by the Science Museum and by the Victoria and Albert Museum respectively.

For a long time previous to this, scientific instruments, pieces of apparatus, mechanical devices, and such like had been preserved in many places, but a museum designed to illustrate the influence of science on technical development did not exist; even the Museum of the Conservatoire national des Arts et Métiers in Paris, which dates from the end of the eighteenth century, was, and still is, primarily the teaching collection of the Conservatoire. Recently technical museums having similar aims have been established at Munich in 1903, and at Vienna in 1919; others illustrating special industries are to be found in many cities.

While no one will dispute the utility of technical museums, it must be admitted that they fall far short of art museums in the attractiveness of the objects which they contain, and this fundamental difference affects every stage of museum arrangement. For the objects in a technical museum to be interesting, something of their history and their purpose, the part which they have played in the age-long development of the branch of industry to which they belong, must be known to the visitor, and to this end carefully edited labels are essential; important objects may be so displayed that the internal working parts can be seen, and their purpose understood; coloured diagrams and specially arranged illumination may be employed; models, etc., may be shown in motion; others may be so arranged that they can be set in motion by the visitor; all this being done with the object of supplying essential information in a form intelligible to the general visitor, with additional technical description for the specialist.

The dominating principle in such a museum must be to illustrate development. Everything, whether it be an industry, or a group of related objects, or a type of tool, is shown so as to emphasise the successive stages of development which have been traversed from early crude forms which sufficed in the days of hand labour through various grades of slow improvement to the rapid advances of modern times so effectively aided by steam and electricity. In some branches of human activity it is instructive to show a few examples from the times of the earliest civilisation, and from the handiwork of primitive races who exist to-day. In this way the story of time measurement, of various hand tools, and of land and water transport for example, can be illustrated far more effectively and attractively than if the exhibits were restricted to those dating from the last few centuries.

To take the case of an industry, aeronautics furnishes a convenient example of rapid development, for air transport has grown from its first experimental stages to an important branch of world communication within the lifetime of many of us. The series exhibited in the Science Museum begins with the first power-driven model aeroplane which John Stringfellow constructed in 1848, and which achieved a free flight of forty yards. Later on experiments in 'gliding flight' were of great importance in providing information on many points in aerodynamics, and Otto Lilienthal was its greatest exponent. One of his gliding machines of 1896 is exhibited. During the next seven years Prof. Samuel P. Langley, of the Smithsonian Institution at Washington, designed and constructed a man-carrying tandem monoplane, of which a model is on exhibition, but it failed to make a successful flight when tried in 1903.

Inspired by the experiments of Lilienthal in

[1] Synopsis of a discourse delivered at the Royal Institution on Friday, April 20.

gliding flight, the brothers Wilbur and Orville Wright, of Dayton, Ohio, carried out a large number of gliding flights during several years after Lilienthal's death, and the success which they achieved encouraged them to construct their first power-driven aeroplane, with which they made their first successful flights on Dec. 17, 1903, the longest being one of fifty-nine seconds, when the distance covered was 852 feet. The aeroplane with which they made their flight is now on exhibition in the Museum, having been lent by Mr. Orville Wright. Another important example is Mr. A. V. Roe's light tractor triplane, which was built and flown by him in 1909, and is remarkable for low power of the engine, a 9 h.p. twin-cylinder J.A.P. engine. Another interesting type is the Antoinette model, of French design, which was flown across the English Channel by H. Latham in July 1909. Mr. S. Cody's machine, which he used in the military manœuvres of 1912, is also preserved in the Museum as an instructive type of pre-War aeroplane. This series is fittingly concluded by the Vickers-Vimy Rolls-Royce aeroplane on which Sir John Alcock and Sir Arthur Whitten Brown made the first direct trans-Atlantic flight in June 1919. The extraordinarily rapid development of this form of transport is strikingly demonstrated by the fortunate juxtaposition in the gallery of the Museum of the Wright Brothers' aeroplane, which flew 284 yards in 59 seconds in December 1903, and the Vickers-Vimy aeroplane, which covered 1890 miles in 15 hours 57 minutes in June 1919, only 15½ years later.

Road transport also provides a series in which the transition from early types to modern practice is strikingly shown—that of the bicycle. Starting from the hobby-horse of 1818, the first practical form of two-wheeled machine was the early bicycle invented by Kirkpatrick MacMillan, a blacksmith, of Dumfriesshire, in which he anticipated the rear-driving safety bicycle of forty years later. Michaux's bicycle of 1865, one of the so-called 'boneshakers,' the Starley Spiderwheel Bicycle, and Lawson's bicyclette of 1879, bring us to the safety bicycles of to-day.

Just as in an industry, so with each tool or machine, the successive stages by which the early form has advanced through others of increased efficiency, or of greater convenience, bear witness to the inventiveness of successive generations, and, wherever possible, this is illustrated. Miners' lamps are represented by a long series, including every type of importance from Sir Humphry Davy's to the latest pattern of the modern lamp. In the same way a most instructive series of radio-valves, beginning with original valves of Prof. Fleming, and continuing through many modern types, illustrates the rapid advances made in a modern instrument of great economic importance.

In machine tools, the primitive form of lathe, in which the work is rotated by means of the forward and backward movement of a bow held in the right hand, was long in use and still exists in some countries, but it was replaced later by the spring beam, or pole drive, and this type is still used by the chair-makers of High Wycombe. About 1800, Henry Maudslay combined the slide rest and the use of a lead screw with change wheels for the production of screw threads, and the first workshop tool in which Maudslay embodied his invention is preserved in the Museum. A further advance is shown by Roberts's back-geared slide lathe of 1817, after which examples of the most modern types of workshop lathe complete the story.

The early history of the hammer is illustrated among the hand tools, where there is one of the diorite hammer stones which were used to hammer out the shafts of granite for the obelisks of ancient Egypt; but when greater power was needed mechanical devices were adopted. A lift hammer of 1556 is shown by a model, and lift and tilt hammers were still in use at the beginning of the nineteenth century; two hammers which were erected in Portsmouth Dockyard in 1804 by Simon Goodrich are shown by a model. In 1839, James Nasmyth invented his steam hammer, which is represented by a working model; and other models show the various improvements which were introduced at later dates. The great power presses of to-day are too large and heavy to be shown, but illuminated photographic transparencies are utilised to show the form and character of those used in modern practice.

The early forms of any machine or tool are now of the greatest interest to us as we compare them with later developments, but only in few cases have they been preserved. The first design is modified and improved; its importance is thereby diminished; and it is not until much later that its historical value is realised. By that time it has usually disappeared. Fortunately, a considerable number of such early types have been acquired from time to time for the nation, among which are:

Arkwright's original 'drawing frame' of 1780, in which the drawing of cotton is effected by successive pairs of rollers revolving at increased rates of speed.

Two of James Watt's double acting rotative beam engines of 1788 and 1797, of which the latter is shown in motion. Among locomotives, the original *Puffing Billy* of 1813 and the *Rocket* of 1829 are the most important of four which are shown.

In marine engineering, among many notable landmarks, are the engine of Bell's *Comet*; also the T.S. *Turbinia*, and the turbine engines with which she steamed thirty-five knots at Spithead in 1897.

The collection of ship models contains a number of early and important contemporary models which furnish details of hull construction and of rigging which are not otherwise obtainable; they include a model of Christopher Columbus's ship, the *Santa Maria*, which was presented by the Spanish Government; the *Prince*, which was built at Chatham by W. Pett in 1669; also a contemporary model of a 64-gun man-o'-war of 1805, which has supplied much information for the recent re-rigging of the *Victory* at Portsmouth. Another very instructive model is that of a yacht

of 1660, built in the style of the Dutch vessels of that period.

The wholesale disappearance of the earliest forms of technical instruments, to which reference has already been made, has often deprived us of all but a single specimen of its type. An accurate copy is then the only way of representing it in a collection, and in recent years a number of reproductions of this kind have been acquired by the Museum. They include an astronomical instrument of Egypt (the 'merkhet') which was used for setting out lines, and for determining the time by observing the passage of selected stars over the meridian, and a shadow clock of the same country, both dating from about the eighth or tenth century B.C.; the 'groma,' as used by the Roman land surveyors, and also one of their 10-foot rods; two telescopes made by Galileo, which are now preserved at Florence; Newton's reflecting telescope, made by himself, and now in the possession of the Royal Society; and a copy of a fourteenth century rain-gauge from Korea.

It only occasionally happens that the life-work of one of the great inventors of the past can be suitably shown in a museum, but in the case of James Watt, the attic workshop in which he worked during the last twenty years of his life has been reproduced, and in it are placed all the machines, tools, and other contents of the original room at Heathfield, near Birmingham.

Obituary.

PROF. OTTO NORDENSKJÖLD.

DR. OTTO NORDENSKJÖLD, professor of geography in the University of Göteborg, died on June 2, at the age of fifty-eight, as the result of a street accident sustained two days before. A nephew of the great Swedish explorer and scholar, Baron A. E. Nordenskiöld, his attention was turned to natural science at an early age, and as a student at the University of Upsala he specialised in geology. He was appointed lecturer on mineralogy at Upsala after taking his degree in 1894.

The spirit of Linnæus broods over his old university, and the young Otto Nordenskjöld felt the old urge which for nearly two hundred years has sent out Swedish naturalists as pioneer-explorers to all parts of the earth. In 1895 he organised his first expedition, when he led a party of Swedish men of science for a summer's work in Tierra del Fuego in order to compare the geological formations, the fauna and flora of that southern archipelago, with those of north-western Europe. The glacial deposits attracted his attention in particular, and after the return of his companions he proceeded to the little-known lake-district of southern Patagonia, where the Cordillera of the Andes is interpenetrated by the fjords of the Pacific and where a narrow zone of sharp transition separates the wooded slopes exposed to the wet west winds from the dry gravel plateaux of the pampas. The region, then unexplored and uninhabited, was of special interest at the time, because of the dispute between Chile and the Argentine Republic as to the delimitation of the boundary set out in the treaty as "the highest summits of the Cordillera forming the watershed," and Nordenskjöld's demonstration that the watershed showed no relation to the Cordillera foreshadowed the compromise which Sir Thomas Holdich's subsequent arbitration commission happily settled. In the summer of 1898, Nordenskjöld conducted a small scientific expedition to the Klondyke region of Canada, then at the height of the gold rush.

On returning from this expedition Nordenskjöld found the interest of European geographers concentrated on Antarctic research, to which his own attention had first been directed at the Sixth International Geographical Congress in 1895. The *Belgica* expedition had just returned from its experience of the first Antarctic night, the *Southern Cross* expedition under Borchgrevink was wintering for the first time on the Antarctic continent, and preparations for two great national expeditions, working on a common plan in different regions, were going forward rapidly in Great Britain and Germany. Nordenskjöld determined that Sweden should take its part in Antarctic research; he set himself to the tremendous task of raising funds by private and public appeals to the small circle of scientifically minded Swedes. In order to gain personal experience of polar conditions he went to East Greenland as a member of Amdrup's expedition of 1900. He succeeded in fitting out an expedition in time to take part in the simultaneous series of observations. He was fortunate in securing Capt. C. A. Larsen, a Norwegian who had already had experience in the Weddell Sea, to command his ship the *Antarctic*, and in enlisting a very able body of scientific assistants. Early in the Antarctic summer of 1901–2 he reached his base at the farthest accessible point in the Weddell Sea on the east coast of Graham Land, while the *Gauss* under Prof. E. von Drygalski (now the sole survivor of the Antarctic leaders who started their work with the present century) and the *Discovery* under Capt. Scott took up their stations at two far-distant points on the circumference of the continent. A year later the *Scotia* under Dr. W. S. Bruce completed the first of the great combined international efforts to study the physical conditions of Antarctica.

Nordenskjöld alone of the four decided to send his ship back after landing, in the expectation that she should return the following year to take him off. He passed the winter of 1902 at Snow Hill in 64° 27′ S., carrying on meteorological and magnetic observations, and on the approach of summer making large geological and zoological collections. He found the conditions adverse to any extended sledge journeys from his base, though he discovered King Oscar Land, and followed its coast to 66° S. On returning he eagerly awaited the return of the ship which never came. A second winter had to be spent in the hut, but the observations were

continued steadily until in the summer of 1903–4 an Argentine vessel appeared to bring him back to civilisation. The *Antarctic* had found the ice conditions of the previous year so bad that a party was landed to attempt to reach Snow Hill by sledging over the coastal ice, while the vessel returned northward in the hope of getting in towards the land farther east. The Weddell Sea proved inexorable and the ship was crushed and sank. Larsen and his crew wintered in a hut, Gunnar Andersson and his land-party in another, and by the most dramatic coincidence in the history of exploration, both parties arrived at Snow Hill just in time to return as a united expedi- with Capt. Irizar in the *Uruguay*.

On his return to Europe, Nordenskjöld was appointed professor of geography in the University of Göteborg, where he continued to occupy himself in preparing the full report of the results of his expedition, the publication of which was facilitated by a grant from the Swedish government. The Antarctic gives no rest to a man who has once come within the field of its attraction, and Nordenskjöld, like Scott and Shackleton, set his heart on a second and greater effort to get at the baffling problems of south polar geography, glaciology, and geology. By 1913 he had worked out, in conjunction with Admiral Palander, a scheme for an Anglo-Swedish expedition, and obtained promises of support from his own government and from influential authorities in Great Britain. The outbreak of war in 1914 put an end to the preparations, and he never saw the Antarctic again. In 1909 he had visited West Greenland, and since the War he made frequent visits to Spitsbergen and Iceland, continuing his earlier studies in Arctic geology. In 1920 he revisited Patagonia with a party of Swedish geologists, following the discovery of remarkable fossil reptiles.

During his tenure of the professorship at Göteborg, Nordenskjöld had always inspired his students with the spirit of research and maintained the high traditions of Swedish explorers and students of Nature. He was modest and unobtrusive in his manner, but insistent and persevering in the promotion of exploration and research. As a leader he was less a commander than a trusted comrade and a constant friend. An enthusiast in the search for knowledge, he was indifferent to the spectacular publicity which gratifies small-minded ambition. He always maintained the happiest relations with the geographers and polar explorers of other countries, and he will be greatly missed by many friends in all parts of the world, whose sympathy goes out to his widow and children. HUGH ROBERT MILL.

DR. J. A. THOMSON.

DR. JAMES ALLAN THOMSON, who passed away on May 6, was at the time of his death director of the Dominion Museum in Wellington, New Zealand, and also president of the New Zealand Institute. Notwithstanding ill-health, he had a very distinguished career. He was the first New Zealand Rhodes Scholar, and went to St. John's College, Oxford, in 1906, where he was awarded the Burdett-Coutts Scholarship, and later he was appointed to a lectureship in geology at St. John's.

Leaving Oxford in 1908, Thomson worked on the geology of the Western Australian goldfields, and published several papers relating to them. He was chosen senior geologist for the second Scott Expedition in 1910, and went to Sydney to work with Sir Edgeworth David with the view of preparing himself for his work. Unfortunately, at this point in his career, the first signs of the disease to which he ultimately succumbed began to show, and, greatly to his own disappointment, and that of others, he was not allowed to go with the expedition.

Returning to New Zealand, Thomson joined the Geological Survey as palæontologist, a position which he held until 1914, when he was appointed to succeed the late Mr. A. A. Hamilton as director of the Dominion Museum, and in spite of failing health he continued to occupy this position until the end. Though repeatedly forced to lay aside his work and battle with disease, his scientific activities never ceased for long and his interest in scientific matters was never dulled. He published many papers on geological subjects, and during the last six years of his life he was busily occupied on a monograph on the brachiopods, a work which he lived just long enough to finish and to see in print.

For his geological work, Thomson was awarded the Hutton Medal of the New Zealand Institute, and last January was elected president of the Institute; he was also one of its original fellows. His death removes a scientific worker of the highest ideals and a man of exceptionally attractive personality; in the face of much physical weakness he maintained an unconquerable cheerfulness. He died of tuberculosis at the early age of forty-seven years. C. C. F.

PROF. JOHANNES GADAMER, Director of the Pharmaceutical-Chemical Institute in the University of Marburg, died on April 15 at the age of sixty-one years. A native of Waldenburg, in Silesia, he was appointed professor of pharmaceutical chemistry at the University of Breslau in 1902, and in 1919 he succeeded the late Prof. Ernst Schmidt at Marburg. Gadamer worked upon many alkaloids and glucosides. He also edited the *Archiv der Pharmazie* and published a "Lehrbuch der chemischen Toxikologie." After the death of Prof. E. Schmidt, Gadamer undertook the completion of his book, "Ausführliches Lehrbuch der pharmazeutischen Chemie."

PROF. G. SCHULTZ, Director of the Chemical Technical Laboratory in the Technische Hochschule at Munich, died at the end of April, aged seventy-six years. A native of Finkenstein, in West Prussia, Schultz spent several years in the Berlin laboratories of the aniline dye factories, becoming later factory director at Basel. In 1896 he was appointed to the chair of chemical technology in Munich. He was the author of well-known standard works, including "Die Chemie des Steinkohlenteers" and "Farbstofftabellen."

News and Views.

APART from the 'news value' of the woman passenger, the latest Atlantic flight is mainly of technical interest. The *Friendship* is a Fokker F VII float monoplane with high-set, deep-section wing, driven by three Wright-Whirlwind engines of 150 kw. each. Taking the empty machine as 3·3 tonnes, crew, etc., as 300 kgm., fuel and oil as 3 tonnes, the total starting weight would be about 6·6 tonnes. The route chosen was a small circle from Newfoundland to Valentia, but in the prevailing fog the seaplane alighted 600 km. farther on, near Llanelly, on the south coast of Wales. A geographical distance of 3300 km. was covered in 21 hours at an air speed of 130 km. per hour, with a following wind of 30 km. per hour according to estimates. Navigation was almost entirely by compass and dead reckoning, and the accuracy with which the course was maintained indicates a fortunate absence of serious changes in the magnitude of the cross wind. The flight may be compared with the distance of 5200 km. from New York to Paris covered, solo, by Lindbergh in an aeroplane of one-third the size and power. The performance, measured in ton-miles in proportion to the total weight, is heavily in favour of the smaller aircraft.

RENEWED efforts to reach General Nobile and his companions have met with success. On June 20, Major Maddelena, in an Italian aeroplane, flew over General Nobile's camp on the pack-ice to the north of North East Land. He found it impossible to land, but dropped supplies of food, clothing, guns, and ammunition. General Nobile's party totals seven, including Prof. Behounek. On June 23, a Swedish machine succeeded in landing by General Nobile's camp. General Nobile himself was picked up and brought to Whale Island, and thence to his base ship the *Citta di Milano* on the following day. Swedish aeroplanes have been searching the coast for Prof. Malmgren and his two companions, who left the main camp and travelled westward to find help. Several steamers are at hand waiting in the hope of the ice opening, as is not improbable shortly, and Soviet ice-breakers are in Spitsbergen waters. These should be useful if loose pack or young ice bars the way, but it is unlikely that they could force a way through the heavy ice off North East Land. At the time of writing there is no news of the remainder of the *Italia's* crew who drifted away with the wrecked airship. Capt. R. Amundsen with Com. Guilbaud left Tromsö on June 18 in a French aeroplane to take part in the search. His plans were uncertain, and lack of news of his movements need not be taken to imply disaster. His aeroplane had a cruising radius of nearly 3000 miles, while the distance from Tromsö to General Nobile's camp is about 1000 miles. Norwegian and French warships have been sent north to help in the search.

PHYSICAL chemists of all shades of opinion will wish to associate themselves with the two hundred and more colleagues and students of Prof. Sydney Young, who, on June 15, offered, in an address, their congratulations on the occasion, a few months ago, of his seventieth birthday, their high appreciation of his services to the progress of physical chemistry, their regret on learning of his resignation from the chair of chemistry at Trinity College, Dublin, and their cordial good wishes for long and happy—in fact, active—leisure years. Prof. Sydney Young, whose name is associated in the minds of all chemists with investigations of fundamental importance on vapour pressures, boiling points, and specific volumes of liquids and mixtures of liquids, on the efficiency of apparatus for distillation, and on the quantitative aspect of fractional distillation, is a Lancashire man, his birthplace being Farnworth, near Widnes. In 1882 he was appointed lecturer and demonstrator at University College, Bristol, and occupied the chair of chemistry there from 1887 until 1903, when he became professor of chemistry at Trinity College, Dublin. Prof. Young was elected a fellow of the Royal Society in 1893; he was a member of the council of the Chemical Society from 1894 until 1898, and a vice-president from 1917 until 1920; from 1920 until 1925 he was a member of the Advisory Council of the Department of Scientific and Industrial Research, whilst he occupied the presidential chair of the Royal Irish Academy from 1921 until 1926. Two important books bear his name on the title-page: "Stoichiometry" (Sir William Ramsay's series of text-books of physical chemistry, 1907 and 1918) and "Fractional Distillation" (1903), revised and extended in scope, with the assistance of experts in various branches of manufacture, in 1922, under the title "Distillation Principles and Processes." Among Prof. Young's numerous original papers are some devoted to a study of the composition of petroleum.

SINCE the anthropoid ancestry of man became a subject of scientific discussion and table-talk, the interest aroused in the great apes, the nearest living relatives of humanity, has had an unfortunate repercussion upon the very creatures which a fellow-feeling should have spared and guarded. Only a few years ago a general outcry arose against the inordinate slaughter of gorillas in Africa, where large numbers were killed, sometimes for scientific purposes, more often in the name of sport! Now another of the great apes, the orang-utan, more restricted in distribution than its African relative, is threatened with rapid extermination in Sumatra, one of its two strongholds. The natives have discovered an easy method of catching orangs alive, and since there is a steady demand for living specimens for zoological gardens, they find the labour lucrative, and large numbers have been exported during recent months. In ordinary cases the market would become sated and decreasing demand would check the supply at its source, but there is a heavy mortality amongst captured orangs, so that one cannot look to economic laws to check the disastrous trade. In view of recent events, it would seem that nothing but drastic restriction of the capture and

export of the orang can prevent its speedy extinction, and much support will be given to the Society for the Preservation of the Fauna of the Empire in its efforts to induce the Dutch Government to impose the necessary restrictions at the earliest possible moment.

THE annual report of the executive committee of the British Science Guild, presented at the annual meeting on June 21, comments on a variety of important problems associated with applied science. Attention is directed to some anomalies in Patent law, in particular the insecurity of British as compared with German and American patents. This insecurity arises largely through the fact that invalid patents are freely granted in Great Britain. There are also 'paper' patents—obtained merely with the view of extracting undeserved royalties from manufacturers who shrink from patent litigation, the cost of which is frequently enormous. Another subject that receives attention in the report is the position of science teaching in the public elementary schools. At present the selection of subjects is left to the local education authorities. Instruction in elementary science may be inadequate or even omitted entirely. A letter has been circulated amongst leading local authorities asking for the names of elementary schools in which adequate teaching of elementary science is being carried on. This inquiry should elicit some useful information regarding the nature of courses and the methods of instruction followed. The position of the technical expert in the public service and in industry is now being studied by a special committee appointed by the Guild. Since the War, administrative and clerical branches of the public services have been reorganised and a material improvement in the prospects of officers in these classes has been effected. There has been no similar reorganisation of the technical and scientific branches; new measures are necessary to afford such professional officers a status corresponding to modern conditions.

THE report also presents a series of six memoranda of considerable interest, illustrating recent developments in the application of science—mainly in the fields of agriculture and food products. In connexion with animal nutrition, great importance attaches to recent investigations of the part played by vitamins. The discovery that ergosterol, when submitted to ultra-violet irradiation, acquires very powerful anti-rachitic properties, is an example. Attention is also being paid by the National Institute of Industrial Psychology to the problem of eliminating needless human effort and waste of time in agricultural processes. In such matters as the destruction of injurious fungi and insect pests and the elimination of animal diseases distinct advances have recently been made. Consideration of these problems leads to a reference to the recent Imperial Conference on Agricultural Research. At this conference several useful proposals were made, including the establishment of three new bureaux devoted respectively to soil science, animal nutrition and animal health, and the formation of 'correspondence centres' to act as clearing houses for information. Other notes deal with the Empire Timber Exhibition (held in London last year), the formation of Imperial Chemical Industries, Ltd., and "Scientific Method in Conference Procedure."

THE results of archæological investigation in Egypt during the past winter seem to be in a fair way to establish beyond question the early dating of the prehistoric cultures of the Fayum and at Badari, for which Sir Flinders Petrie has urged a Solutrean origin and a dating directly related to the occurrence of that period in the European area. The excavations which Miss Caton-Thompson has carried out under the auspices of the Royal Anthropological Institute in the Fayum were mainly directed towards finding material to date the culture as it is found in that area. Although the much-desired cemetery which might produce dateable relics did not come to light, one site afforded evidence which, while without prejudging its Badarian affinities, may be regarded as directly determining the relation of the Fayum culture to predynastic. A preliminary report of Miss Caton-Thompson's expedition is being published in the July issue of *Man*. Miss Caton-Thompson's report also clears up a situation of some ambiguity which has arisen from accounts of the discovery of an alabaster factory which did not make it clear that two different sites were involved. An exhibition of such material as has been allowed to leave Egypt will be held at the Royal Anthropological Institute on July 9-21; admission free to non-fellows on presentation of a visiting card.

WHILE Miss Caton-Thompson was excavating in the Fayum, Mr. Guy Brunton was engaged on a similar problem at Badari, continuing under the auspices of the British Museum the work begun by the British School in Egypt. Here the evidence was complicated by the occurrence of copper beads from settlements and cemeteries apparently of an earlier date than any previously known. These had produced objects similar to those from the Fayum, pottery ware, some finer in ware and finish than any other known, a delicately worked flint dagger, and the oldest known stone vase. During the past season, on which Mr. Brunton has reported in the *Times* of May 26, further support of the view that the Badarians were older than the predynastic peoples has come to light in the discovery of the undisturbed graves of the latter superimposed on those of the Badarians. A second phase of Badarian culture has also been discovered with pottery of different forms and eye-paint palettes of alabaster instead of the usual slate.

A PAPER on talking and synchronised motion pictures, by W. H. Bristol, the president of a company well known for its recording instruments for industrial applications, is published in the *Journal of the Franklin Institute* for February. The de Forrest and Case-Fox systems, where the sound is photographed on the edge of the film, have already been successfully used in picture theatres for short sketches and news films. Complete talking motion picture dramas, however,

have not yet been presented to the public. It seems probable that very shortly the author's method will enable this to be done commercially. Many so-called educational films are used primarily for indirect advertising, but there are some truly educational films the value of which will be considerably enhanced by synchronised sound. In the Bristol system the turntable for the phonograph and the projector for the film are kept exactly in step by two synchronous electric motors operated by alternating current. Each of them is capable of transmitting about a quarter of a horse power. The sound-reproducing system consists of three parts, the electrical 'pick-up,' an amplifier, and a loud speaker. The quality of the reproduction depends on each of these three elements. The electrical device converts the mechanical undulations of the phonograph recorder into corresponding electrical oscillations. A long horn and a special amplifier are used for theatres. When taking a picture it is of the greatest importance that no extraneous noises be recorded. Hence the camera is placed in a booth, the only sounds reaching it being those which are intended to be recorded. In perfecting the 'talking motion picture' two main difficulties had to be overcome. The first was to get a simultaneous record of the sound and motion, and the second was the loss resulting when a film was broken and a piece of it lost. In the latter event both the sound and photographic records were spoilt.

THE government of Greenland has recently presented to the Department of Zoology of the British Museum (Natural History) a white whale or Beluga from Greenland, with the heads and flippers of three other individuals. This extremely valuable material was collected specially for the Museum by the Danish administration, preserved in salt, shipped to Copenhagen, and thence to London. On arrival in the Museum the whale was found to be in perfect condition. A plaster cast of the entire animal, a male measuring 12 feet 6 inches in length and weighing about 1 ton, has been made, and this will in due course be exhibited. Dissections of the whale are in progress, and the skeleton when cleaned will form an important addition to the collection. The Beluga is hunted in the Greenland seas for the sake of its blubber and for its remarkably tough hide, which is used in the manufacture of boot-laces. The Department has also received the skin and skull of a Swedish wolf in exchange from the Stockholm Museum; this animal is now nearly extinct in Sweden. Mr. D. Holderness, engineer to the Harbour Board, Auckland, New Zealand, has presented seven specimens of the Giant Ship Worm (*Kuphus arenarius*) from the Solomon Islands. They were obtained for the Museum by Capt. Burgess of the Mission steamer *Southern Cross*, after several years of search and inquiry among the natives, and are the first specimens of the soft parts of the animal that have been seen by any naturalist since the time of Rumphius, more than two centuries ago. The Mineral Collection of the Museum has recently acquired a set of minerals from the pegmatite quarries at Newry, Maine, U.S.A., which are now being worked for pollucite; this mineral contains 34 per cent of cæsium oxide and is the richest known source of this alkali metal, which now finds an application in the construction of thermionic valves.

AN offer of considerable interest to anthropologists and statisticians is made by the Eugenics Research Association, which announces a competition with prizes of £200 and £40 for the best two essays by American authors on "A comparison of both the crude birth-rate per 1000 females 15 to 45 years of age and the 'vital index' (or 100 births/deaths ratio) of the Nordic and non-Nordic peoples in the Americas." Data are to be considered in different periods from 1850 to the present time or last available census. Nordic peoples are considered to be those whose ancestors came mainly from Nordic countries. Such countries are defined as including the Scandinavian countries south of lat. 63° N., the Netherlands, England, Scotland, North Ireland, and certain German States, non-Nordic being regarded as the rest of Europe, Asia, and Africa north of the Zambesi. Essays must reach the Association at Cold Spring Harbor by Feb. 1, 1929. Prizes of the same amount are offered to European authors for essays on the same subject and under similar conditions.

THE Right Hon. Viscount Astor will deliver the inaugural address to the congress at Plymouth of the Royal Sanitary Institute on Monday, July 16. The popular lecture by Prof. W. E. Dixon on "Poisoning in Daily Life" will be delivered on July 20. The subjects for discussion cover a wide field, and include the tuberculosis problem, immunity in scarlet fever and measles, puerperal fever research and fœtal deaths and injuries, juvenile rheumatism, ultra-violet therapy treatment, health conditions in factories and industrial rheumatism, smoke abatement, refrigeration, contamination of foods exposed for sale, milk, refuse and sewage disposal, and water supply. More than eight hundred delegates have been appointed to take part in the congress by government departments in the British Empire and foreign countries. Visits to institutions dealing with child welfare work, and municipal undertakings of professional interest to medical men, engineers, and others, are being arranged, as well as excursions of more general interest. The Health Exhibition, which is an important part of the congress, will include exhibits on water softeners, refrigerators, electric appliances, soaps and disinfectants, sanitary appliances, etc., and will be opened by the Mayor of Plymouth on July 16.

A PRELIMINARY announcement has been issued giving information about the Fuel Conference, 1928, organised as a sectional meeting of the World Power Conference. It has the support of forty-five countries, many government departments, universities, societies, important industrial corporations in Great Britain, and will be held at the Imperial Institute, London, on Sept. 24–Oct. 6. Application for membership should be addressed to the Secretaries, Fuel Conference, 1928, World Power Conference, 36 Kingsway, London, W.C.2, the fee for membership being 30*s*., or 20*s*. for members of participating institutions and

associations. The Conference will be divided into Sections A-X, covering every aspect of the fuel industries, and advance copies of the papers to be presented are to be available to members of the sections in which they are interested. Reduced fares will be available on the railways under conditions to be announced later. Messrs. T. Cook and Sons, Ltd., have been appointed official travel agents and will assist members in obtaining hotel accommodation, Arrangements are being made for official receptions, entertainments, and excursions.

THE radio photogram service which has been conducted by the Marconi Company since May 1926 for the transmission of photographs, drawings, signatures, and facsimiles of all kinds by radio between London and New York, has now been extended so that photograms received in New York by radio may be transmitted to other important commercial centres in the United States of America. A photogram sent from London by radio addressed to these cities is transferred in New York to the telephone-wire picture service of the American Telegraph and Telephone Company. The cities included in the radio-and-wire photogram service are Boston, Cleveland, Atlanta, Chicago, St. Louis, Los Angeles, and San Francisco. The service between London and New York has been widely used since its inception for the transmission across the Atlantic of news pictures, facsimile signatures, and even Christmas cards.

IT is announced in *Science* that the Willard Gibbs gold medal, given annually by the Chicago section of the American Chemical Society, has been awarded to Prof. William D. Harkins, of the University of Chicago. The medal is awarded for work in either pure or applied chemistry of wide importance.

AN earthquake of moderate intensity was recorded at Kew Observatory on June 21 at 16 hr. 37 min. 58 sec. G.M.T. The epicentral distance is estimated to be 4600 miles, and the shock probably occurred near Alaska. A smaller disturbance was recorded earlier at 10 hr. 59 min. 54 sec. G.M.T., the epicentre being nearly 10,000 miles away.

THE Institution of Naval Architects has acquired the freehold of two houses in Adam Street, thus securing for the Institution a permanent home in the same neighbourhood as before. On and after July 1 the address of the Institution will be 2 Adam Street, Adelphi Terrace, London, W.C.2.

'COMMEMORATION DAY' was held at Livingstone College, Leyton, on June 15. Dr. Carmichael Low was in the chair and gave an address on the advances that have been made in tropical medicine during the last forty years. The Principal reported that 1020 students had passed through the College, and appealed for £400 to close the financial year without deficit on the year's working.

REFERRING to Sir Herbert Maxwell's letter in NATURE of June 9, Miss E. Armitage, Dadnor, Ross, Herefordshire, writes recording two similar events of death due to voraciousness. In a pond in her garden, a dead perch was found with a smaller perch fixed firmly in its mouth, while on another occasion, and on the bank of the pond, a dead kingfisher was discovered with a perch fixed in its mouth.

THE fourteenth lecture in the series arranged by the Institute of Physics on "Physics in Industry" will be given, with the co-operation of the seventh International Congress of Photography, by Dr. C. E. Kenneth Mees, Director of the Research Laboratory, Eastman Kodak Co., Rochester, N.Y., at 8 P.M. on July 12. Dr. Mees will take as his subject "Physics in Photography," and his lecture will be delivered at the Institution of Electrical Engineers.

THE annual report of the School of Tropical Medicine, Institute of Hygiene, and Carmichael Hospital for Tropical Diseases, Calcutta, for 1927, has recently been issued. A memorable event during the year was the unveiling, by Lord Lytton, Governor of Bengal, of a "Gate of Remembrance," which commemorates the great discovery of the mosquito transmission of malaria by Surgeon-Major Ronald Ross, I.M.S., in 1898, in the presence of Sir Ronald Ross himself, who made a suitable reply. Teaching and research occupy the time of the staff of the school, and much valuable research work has emanated from it. The Director makes the interesting statement that "all our research workers agree that light teaching duties are useful rather than otherwise, as they compel the worker to keep in touch with the broader aspects of his subjects and to cultivate the art of lucid exposition."

THE following books are announced for early publication by the Cambridge University Press: "Great Britain: Essays in Regional Geography," by twenty-six authors, with an introduction by Sir John Russell and edited by A. G. Ogilvie; "The Symmetrical Optical System," Dr. G. C. Steward ("Tracts in Mathematics and Mathematical Physics").

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in physics at the Borough Road Training College, Isleworth—The Principal, Borough Road Training College, Isleworth (July 7). The headship of the geography department in the University of Leeds—The Registrar, The University, Leeds (July 8). Two junior assistants at the Fuel Research Station, East Greenwich, S.E.10—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (July 9). A public analyst for the Administrative Counties of Cambridge, Huntingdon, and Isle of Ely, and for the Municipal Boroughs of Cambridge and King's Lynn—The Clerk to the Cambridgeshire County Council, The County Hall, Cambridge (July 11). A demonstrator in the physics laboratory of the Royal Naval Engineering College, Keyham (Plymouth)—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (July 12). A full-time lecturer in the mathematics and physics department of the Polytechnic, Regent Street—The Director of Education, The Polytechnic, 309 Regent Street, W.1 (July 13). A whole-time research student in

the department of helminthology in the London School of Hygiene and Tropical Medicine—The Secretary, London School of Hygiene and Tropical Medicine, 25 Gordon Street, W.C.1 (July 14). An assistant on the higher technical staff of the science division in the Science Museum—The Director and Secretary, Science Museum, South Kensington, S.W.7 (July 16). An assistant lecturer and demonstrator in engineering in the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (July 16). An assistant inspector under the Ministry of Agriculture and Fisheries in connexion with agricultural and horticultural education and research—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (July 16). A reader in biology, a lecturer in physics, and a lecturer in chemistry in the University of Hong Kong—C.A. [N], The Secretary, Board of Education, Whitehall, S.W.1. Scottish candidates should apply to [N], The Secretary, Scottish Education Department, Whitehall, S.W.1 (July 30). Temporary assistant chemists in the Government Laboratory—The Government Chemist, Clement's Inn Passage, W.C.2 (Aug. 4). A professor of mathematics in the University of Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (Sept. 3). A full-time graduate assistant with works' experience to teach engineering subjects up to Higher National Certificate mechanical engineering standard at the Darlington Technical College—The Chief Education Officer, Education Office, Darlington. A full-time lecturer in mining subjects at the Mansfield Technical College—The Principal, Technical College, Mansfield. A lecturer in geography, botany, and zoology at the Bedford Training College—The Principal, Training College, 14 The Crescent, Bedford. A senior lecturer in the chemistry department of Battersea Polytechnic—The Principal, Battersea Polytechnic, Battersea, S.W.11. A head of the physics department of Huddersfield Technical College—The Director of Education, Education Offices, Peel Street, Huddersfield. A lecturer in the physics department of Woolwich Polytechnic—The Principal, Woolwich Polytechnic, Woolwich, S.E.18. An experienced graduate agriculturist, to initiate scientific pedigree breeding in selected indigenous breeds in Nigeria—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1.

Our Astronomical Column.

CONJUNCTION OF MARS AND JUPITER.—Mars and Jupiter are now 'morning stars,' rising nearly half an hour after midnight and approaching each other to a very interesting and close conjunction on July 3 at about 9^h P.M. They are situated among the south-westerly stars of Aries and both are moving eastwards, but the greater speed of Mars enables this object to overtake Jupiter on the evening of July 3 about three hours before they come above the horizon on July 4 at about $0^h\ 22^m$ A.M. Mars will be 0·3° south at the time of conjunction, and when both planets become visible, Mars will be a little to the south-east of Jupiter and very much fainter. Its ruddy light will contrast strongly with the pale yellow tint of Jupiter. Mars will appear faint, being only of 0·8 mag., while Jupiter will be of 1·8 mag., but neither planet will be near maximum brilliancy, being at considerable distances from the earth. Diameter of Mars, 6·6″, Jupiter, 34·8″. Maximum diameters:

Mars, opposition Dec. 21, diameter, 16″·0.
Jupiter, opposition Oct. 29, diameter, 46·3″ (Polar).

THE FIXING OF EASTER.—The passage of the measure for a fixed Easter through the House of Commons advances the solution of this matter by an important stage. It was wisely decided that the measure should not come into operation until the assent of the leading religious bodies had been obtained; but the indication of the desire of the representatives of the British nation is likely to bring this assent nearer. The Bill adopts the same rule for finding Easter that was adopted by the League of Nations Committee; namely, the first Sunday after the second Saturday in April.

VARIATION IN THE EARTH'S ROTATION.—It seems only a short time since this idea was put forward with hesitation as a possible explanation of the mysterious fluctuations that are found unmistakably in the motion of the moon, and to a smaller extent in the more rapidly moving planets. Prof. de Sitter, the president of the International Astronomical Union, has included proposals on this subject in the agenda for the coming meeting of the Union at Leyden. He divides the action into two parts, and gives formulæ for each in terms of the time and its square. The first part is taken to be discontinuous, and subject to abrupt changes at irregular intervals, varying from twelve to ninety years; the other is tidal friction; he suspects that the coefficient of T^2 is not constant, giving 1742 and 1869 as the dates of changes of rate. These dates do not coincide with any in the former list. He proposes that corrections based on his formulæ should be applied to astronomical time as now observed, thus reducing it to 'Newtonian' or uniform time. It will probably be difficult to secure unanimity in this matter, but it promises to give rise to an interesting discussion.

ASTRONOMICAL DISCOVERY.—Mr. W. F. Denning contributes a paper with this title to the *Nineteenth Century and After* for June. He gives an interesting review of many of the advances in astronomical knowledge that have been accomplished in recent years; but as he has himself been a successful cometary discoverer, it is natural to dwell more particularly on this section of his article. He notes that the record perihelion distance of a comet, which had been held for two centuries by the comet of 1729, has been broken twice in succession by the discovery of comet Schajn-Comas Sola in 1925, and again by the discovery of comet Schwassmann-Wachmann in 1927. The latter has an orbit that lies entirely between those of Jupiter and Saturn, and that deviates so slightly from a circle that it may be possible to follow it round the whole course of its orbit. Allusion is also made to other additions to Jupiter's comet family, the latest being Reinmuth's comet discovered last January.

Mr. Denning notes that 115 comets were detected between 1900 and 1925, of which 70 were new comets. The rate of discovery of the latter is therefore three per annum, very close to the figure derived from the statistics of the nineteenth century. It may be noted (though not included in Mr. Denning's paper) that we have to deplore the death of the most active and successful comet hunter of recent years—Mr. William Reid—which occurred in Capetown on June 8.

Research Items.

CONCEPTIONS OF GOD IN WEST AFRICA.—In No. 2 of *Africa*, the journal of the International Institute of African Languages and Cultures, Prof. D. Westerman analyses the religious beliefs of West Africa. Three groups of beings are conceived as more or less imbued with personality and worthy of veneration: (1) individual tutelary spirits, (2) local deities, (3) the God of Heaven. The individual tutelary spirit enters a man at birth and determines his character and destiny, and protects, advises, and helps him. As the *okra* or spirit had been married in the spirit world before entering upon its human tenement, among the Ewe it is necessary that at marriage the spirit wife should be propitiated by placing in a small hut dedicated to her a small part of each present destined for the earthly betrothed or wife. Local deities are the chief object of worship. Most are the incorporation of natural objects or phenomena, mountains, rocks, springs, thunder, rarely animals. There are also gods of war, peace, of the year, harvest, etc. Idols are often set up in their honour at which they can be worshipped. As a rule a priest is set apart for each deity. He is often selected by the deity, *i.e.* a state of ecstasy is induced in him. The local deity receives its power from the God of Heaven, by whom the administration of a definite sphere of living beings is delegated to him. The God of Heaven is also connected with a natural body, namely, the visible heavens; but he is unique in that he is above everything and is everywhere. Everything owes its existence to him. He is the creator and the preserver of all that is in the world. His characteristic qualities are power, justice, and goodness; but his remoteness, his universality, and his goodness have made the conceptions of him vague and shadowy.

MAGIC AND TABOO IN BENGAL.—In the *Indian Antiquary* for June, Dr. Biren Bonnerjea notes examples of magic and taboo in Bengal as positive and negative elements in an identical attitude of mind towards physical and spiritual phenomena. The use of a clay image is prevalent both as a love charm, when the heart is pierced with a thorn-tipped arrow, and a means of injuring an enemy, when a knife or pin is stuck into the heart. Night blindness is cured by the internal use of a firefly, which is eaten inside a banana. A still-born child is buried inside the house instead of cremated, in order that the mother may bear another child. Examples of contagious magic are the concealment of the name by the use of nicknames, while a woman is known as the daughter, wife, or mother of such and such a person. The placenta is taken away in an earthenware pot in order that no animal may devour it; nor should it be destroyed before the *annanprâśan* ceremony, 'the taking of the rice,' which is the naming ceremony, otherwise the child will die. A charm to stop rain is for a child to burn a candle of cloth. Much virtue is attributed to abuse as a protective or propitiatory rite. Hence in the month of Bhâdra (July–August) practical jokes are played with the object of provoking abuse, as a protection against ill luck; and with the same object those who have inadvertently looked at the moon in this month, throw stones and brickbats into their neighbours' houses. Among the taboos, excessive praise must be avoided. The names of scavengers and water carriers are taboo, and euphemisms are employed, nor must the names of snakes, robbers, tigers, and so on, be used after nightfall. Food taboos include not merely beef to all Hindus, but also many vegetables such as onions, garlic, palms, and lentils.

A TRANSATLANTIC FLIGHT.—Records of the passage of birds across the Atlantic from east to west are much less frequent than those of the contrary journey, and the experience of human aviators also suggests that, in general, weather conditions do not favour the Europe to America crossing. The more to be wondered at is the extraordinary migration of lapwings—by no means strong fliers—recorded by H. F. Witherby (*British Birds*, vol. 22, 1928, p. 6). On Dec. 20 and 21, 1927, flocks of lapwings, one of which was estimated to number 500 individuals and another 1000, arrived in Newfoundland. The lapwing is not an American bird, but the source of the migration was definitely indicated by the presence on one of the birds of a *British Birds* ring, which showed that it was a native of Cumberland. It is certain, therefore, that large numbers of lapwings crossed the Atlantic from Britain to Newfoundland—a distance of about 2200 miles—in a single flight. The author shows that the weather conditions were extremely favourable for such a journey. A spell of frosty weather in Britain made it imperative for the birds to seek new feeding grounds; they moved westwards and became involved in a wind blowing almost due west at a velocity of about fifty-five miles an hour. This, added to the lapwing's normal speed of some forty-five miles an hour, would permit of the total journey being accomplished in about twenty-two hours. Lapwings have been recorded from America only on eight previous occasions, and these were generally solitary birds.

SOME TROPICAL CRUSTACEA.—In the *Bulletin of the Bingham Oceanographic Collection*, vol. 1, Art. 2, Mr. Lee Boone describes several rare and new Crustacea ("Scientific Results of the First Oceanographic Expedition of the *Pawnee*, 1925." Crustacea from Tropical East American Seas. 1927). This expedition was founded for the purpose of oceanographical research, undertaken and directed by Mr. Harry Payne Bingham in his yacht *Pawnee I.*, for exploration in the West Indian Caribbean regions, fishes being the chief object, but incidentally the crustaceans have proved of remarkable value. The range of depth explored was from littoral regions to nearly 500 fathoms, and it is the deep-sea forms which are of peculiar interest. In order to realise the richness of the crustacean fauna, one has only to glance at the records of the contents of two dredge hauls made consecutively north of Glover Reef, in which twenty species of deep-sea Crustacea were captured, nine of which (seven decapods and two isopods) are new, and two rediscovered forms, a brachyuran and a macruran, not seen since the type specimens were captured by the *Blake*; besides other rare finds. Perhaps the most interesting of all is a new isopod named *Arcturus pawneeanus*, which was found intertwined in the branches of a comatulid, living as a semi-parasitic commensal. Its six posterior legs are hooked for clinging and are entwined round one of the radials, whilst three anterior pairs of legs are feathery and floating, thus bearing a striking resemblance to the host so that it is difficult to distinguish between them, the segmentation also closely resembling the pattern of the radial. An anamouran *Uroptychus rugosus* Milne Edwards, previously taken by the *Blake*, occurred symbiotically on the same crinoid, intertwined in its arms, the legs resembling the cirrhi, the chelipeds resembling the radials, and the carapace being very like the central disc. Here again the commensal is difficult to distinguish from its host.

Yet another 'guest' inhabits the crinoid, a small stalked barnacle named by Boone *Scalpellum rodstromi*.

EFFECT OF POTASSIUM ON INVERTEBRATE MUSCLE.—In an article entitled "The Action of Potassium on Muscle-Preparations from Invertebrates (*Brit. Jour. Exp. Biology*, vol. 5, No. 3; 1928), Mr. George P. Wells makes an important contribution to the comparative study of various invertebrate muscles (*Aplysia*, *Helix*, *Maia*). Hitherto many contradictions have appeared in the action of potassium not only in different species but even in the same tissue from the same species in the hands of different workers. By studying very wide ranges of potassium concentration, the author has been successful in showing that these discrepancies originate chiefly in the great dependence of the action of potassium upon its concentration. There is, in fact, a remarkable similarity of behaviour in the invertebrate muscle studied and in vertebrate muscle. In all cases examined it was found that muscle is normally relaxed at a certain definite potassium concentration (which has a different absolute value in different species). At this concentration removal or addition of potassium causes contraction, the degree depending upon the concentration. Rubidium, cæsium, and also ammonium are shown to possess closely similar action to potassium; lithium has a different action. It is pointed out that the similarity of action of potassium and ammonium contradicts Zwaardemaker's hypothesis that the former acts by virtue of its radioactivity. A very plausible hypothesis of the action of potassium and its allies is put forward based on that of Mines. The very different physiological effects of potassium, rubidium, cæsium, and ammonium on one hand, and of lithium and sodium on the other, bear a very suggestive resemblance to the relative abilities of these ions to penetrate the highly impermeable membranes studied by Michaelis: the potassium group may well act by producing changes of potential difference across certain membranes in the cell which the sodium group is unable to effect.

ENCYSTMENT OF *PARAMECIUM*.—L. R. Cleveland (*Science*, vol. 66, p. 221; 1927) points out that *Paramecium* has not been definitely shown to encyst in Nature or in laboratory cultures, and that some investigators have doubted its ability to encyst. He therefore records his observations, though they are incomplete. Two or three cubic centimetres of a rich culture of *Paramecium* (species not determined) were injected into the recta of frogs, with the result that encystment of the *Paramecia* occurred in about two per cent of the frogs, namely, in three frogs. In one frog, examined five and a half hours after injection, only encysted *Paramecia* were present. Some of these were placed in depression slides and frequently observed, and on the fourth day fission was observed to be beginning, and on the fifth day two *Paramecia* were seen in the cyst and some of them excysted, especially when abundant tap-water was added to the preparations. A high percentage of the *Paramecia* were killed and disintegrated within one or two hours after injection into the frog's rectum. All attempts to bring about encystment in removed recta, or in rectal contents, failed.

LETHAL FACTORS IN A GRASS.—In a genetic study of the grass, *Lolium perenne*, Mr. T. J. Jenkin (*Jour. of Genetics*, vol. 19, No. 3) finds that many of the plants are highly self-sterile and that several types of chlorophyll-deficient seedlings occur, including complete albinos, variegated and various grades of green, as well as extreme dwarfs and a full green type which dies back for no apparent reason about the time the second leaf appears. Of these lethal types, yellow-tipped albino was the most studied. Selfing a vigorous green plant gave rise to normal green, non-surviving green, and this albino type. The latter may survive for several months, but they never become full green or strong plants. When the parent plant was crossed with unrelated green plants, lethals did not appear in F_1, but when the F_1 was back-crossed to the original parent, the offspring indicated that the latter was heterozygous for two lethal factors. Another plant was highly self-fertile, and produced green, variegated, and albino seedlings. Of these, 1770 were green. They were of two types, surviving and dying at the second-leaf stage, in the ratio 3 : 1. The non-surviving green was indistinguishable from that type derived from the other plant. But when these two plants were crossed they gave for the most part in F_2 and F_3 9 : 7 ratios. Hence the factor producing the non-surviving green type occupied a different position in the germplasm of the two species.

THE MORPHOLOGY OF BUD-SCALES.—The somewhat conventional treatment which the morphology of bud-scales receives in many botanical text-books gives an air of finality to the subject which it does not seem to possess. In a recent paper (*Biological Reviews*, vol. 3, No. 2), A. S. Foster makes a re-examination of the whole problem based on a very comprehensive survey of the most important literature on the subject. Morphological interpretations of the scales from the viewpoint of formal and idealistic morphology are considered, and their effects on recent theories indicated. The major emphasis, however, is placed upon the more dynamic aspects of the problem, and the nature of the bud-scale is examined in the light of developmental, experimental, anatomical, and causal investigations. The author thinks that Goebel's well-known interpretation of bud-scales as arrested growths of foliage leaf primordia fails to account satisfactorily for unsegmented bud-scales, and entirely leaves out of consideration the multipotent nature of foliar *Anlagen*. More recent work, especially on the anatomy of cataphylls, suggests that structurally they are divergent foliar organs, which in many instances develop unlike the foliage leaves from the beginning, and any attempt to recover the formal elements of the foliage leaf in every bud-scale is considered futile. Attention is then directed to the fact that in spite of the numerous morphological and phylogenetic interpretations of cataphylls, some of which rest almost entirely on theoretical considerations, almost no information is available as to the mode of internal development in scales, and the physiological factors which in part determine their divergent growth. It is suggested that further experimental and developmental research will show the important relation of the nutrition and metabolism of the developing bud to the periodic alternation of scale leaves and foliage leaves; and then the problem of bud-scale morphology will properly become an important phase of the wider question of organ differentiation at the growing point. Foster's paper, to which is appended a bibliography of 196 references, is a mine of detailed information regarding the subject of bud-scales.

THE ROCKS OF AFRICA.—The attention of geologists and explorers is directed to the "Catalogue of the Rock Collections in the Mineral Department of the British Museum (Natural History)," by W. Campbell Smith, of which Part I., dealing with Africa, has just appeared (British Museum, 1928. Price 2*s*.). Other parts, dealing in turn with each of

the continental and oceanic areas, will be issued in alphabetical order. The very carefully documented rock-specimens in the Mineral Department (numbering more than 50,000) form a most valuable reference collection for research and comparison, and it is of the greatest importance for the progress of petrology that workers in this branch of science should realise the wealth of material that is here available for their use. Moreover, the catalogue shows what regions of the world are at present poorly represented, and so encourage collectors of every description to fill up the gaps with contributions that will be especially welcome. The present part begins with an interesting historical introduction, and the rocks of Africa follow. Mr. Campbell Smith is to be congratulated on a compilation of the utmost value. Not only do the notes on each group of specimens indicate where, when, and by whom it was collected, but copious references to literature in which any of them have been described are added, together with a record of such analyses as have been made. Indexes follow of persons (donors, collectors, and authors); of localities; and of rock-names and geological formations. As it is issued, the growing catalogue will undoubtedly become for petrologists, and indeed for geologists in general, one of their most valued and stimulating books of reference.

THERMOGRAPHS AND HYGROGRAPHS.—We have received a copy of a recent catalogue issued by Messrs. Pastorelli and Rapkin, 46 Hatton Garden, London, E.C.1, showing Edney thermographs, hygrographs, and hair hygrometers. For amateur meteorologists, instrument No. 10, which records pressure, temperature, and humidity of the atmosphere on a single chart, will appeal on the grounds of economy and convenience. The price is sixteen guineas, which is far less than the combined prices of separate self-recording instruments for the three quantities measured. Fewer charts are required, and a smaller screen will house the single instrument. There is the added advantage that errors in the time scale due to swelling or contraction of the paper, or to gaining or losing of the clock, do not prevent simultaneity of occurrence of changes of the three quantities from being detected—an important point in studying 'fronts.' For official use these advantages may be counterbalanced to some extent by the drawback that in tabulating hourly values, time may be lost because three workers cannot use the same chart at the same time. No. 18 is a 'distance' recording hygrograph costing £24, designed for use in timber-drying kilns, etc. Such instruments — in which mercury in steel bulbs is used for the thermometers, with flexible steel capillary tubing connexions to a Bourdon tube and recording mechanism, enable the latter to be placed conveniently far from the kiln.

RESEARCH ON GLASS.—Vol. 10 of *Experimental Researches and Reports* has recently been published by the Department of Glass Technology of the University of Sheffield. It consists of a collection of papers published in other journals during 1927, giving an account of the work carried out in the Department. Some of this work is concerned with the properties of special glasses, but much of it is more technical in character. A useful contribution is entitled "Notes on Some Methods used in the Analysis of Glasses."

A MICRO-CALORIMETER.—In the *Journal of the American Chemical Society* for April, S. Lipsett, F. Johnson, and O. Maass describe a calorimeter which can be employed for the determination of heats of solution using only 4 c.c. of solvent and has an approximate heat content of 1 calorie. This calorimeter was made from a platinum crucible, and is arranged so that it can be rotated about a horizontal axis. The solute is placed in an inner vessel and is brought into contact with the surrounding solvent by rotation of the calorimeter, which is jacketed and submerged in a water bath. The temperature is measured with a platinum resistance thermometer. A series of determinations of the heat of solution of sodium chloride at constant concentration gave results differing by less than 0·26 per cent from a mean value.

APPARATUS FOR ARTIFICIAL SUNLIGHT.—Messrs. Watson and Sons (Electro-Medical), Ltd., of Sunic House, Kingsway, have published, under the title "Artificial Sunlight Apparatus," a catalogue of ultra-violet apparatus which includes some standard instruments of other leading makers in addition to their own. The instruments are classified under their different types, *i.e.* mercury arc, carbon arc, etc., and the list, though not large, is quite representative. The introduction to the publication deals briefly with the history of actinotherapy and with the physics of the absorption of radiation by matter. This latter section appears of somewhat doubtful value, for there is still a big gap between the knowledge of the reaction of the atom to radiation and the observed data of the biological effects on living tissue. The characteristics, advantages, and disadvantages of each type of lamp are dealt with in considerable detail, and summarised again at the beginning of the section dealing with that type. Such points as the cost of running, repairs, and the necessity for the use of goggles are treated very fully, and it is exactly this practical information which is required by the doctor who is compelled to select his apparatus from a catalogue. It should be noted that the cored carbons are here included under the section devoted to carbon arcs, though in many cases the radiation produced by the former is nearer to that of the typical metallic arc in quality.

DIESEL-ELECTRIC LOCOMOTIVES. — High-speed Diesel engines which run on crude residual oil are highly efficient from the commercial point of view and can now be made with a total weight of about 20 pounds per horse-power. In conjunction with a suitable direct current generator and two motors, they can be used advantageously in a locomotive for ordinary railway traction. In the *English Electric Journal* for April there is an interesting account of a Diesel-electric locomotive which has been made for the London, Midland and Scottish Railway. It will be used on the Manchester-Bury line. The power equipment consists of a 500-h.p. Beardmore engine coupled to a 340-kilowatt 600-volt generator. The generator supplies power to two traction motors, each of 280 h.p., mounted on one of the motor coach bogies. The engine has four running speeds, an 'idling' speed of 350 revolutions per minute, intermediate speeds of 600 and 750 r.p.m., and a full load speed of 900 r.p.m. The control is purely electric, the master controller being provided with 'dead-man's' handles. A battery of accumulators is provided for starting the engine. Self-propelled vehicles of this type do not affect the question of electrifying a railway system. If complete electrification of a system is commercially justifiable, it would probably be better and cheaper than using Diesel-electric units. But the latter units should prove very useful in those districts where the traffic density is not great enough to justify electrification. It provides a motive power considerably cheaper than that of steam-propelled vehicles.

Elections to the Royal Society.

AT the weekly meeting of the Royal Society on Thursday, June 21, Lord Melchett of Landford (formerly Sir Alfred Mond) and Sir William S. McCormick were elected into the Society under the statutory provision whereby two persons may be recommended at stated intervals who either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society. Lord Melchett, chairman of Imperial Chemical Industries, Ltd., was born at Farnworth, Lancashire, in 1868; he has brought a ripe experience and much earnest thought and judgment to the national and Imperial aspects of science and industry. His powers and his interests are in keeping with the family traditions. His father, Sir Ludwig Mond, was a chemist and inventor of high standing, and, moreover, a munificent benefactor to the Royal Society. Sir William McCormick, who was born at Dumfries in 1859, is administrative chairman of the Advisory Council on Scientific and Industrial Research, as well as chairman of the University Grants Committee.

The following were elected foreign members of the Society:

PROF. ALBERT T. J. BRACHET, rector of the University of Brussels, who holds the chair of anatomy and embryology in the Faculty of Medicine in that University. He is already a *correspondant* of the Paris Academy of Sciences.

PROF. DAVID HILBERT (born in 1862 at Königsberg) occupies the chair of mathematics in the University of Göttingen. He was educated there, and at Heidelberg, Leipzig, and Paris. Prof. Hilbert is the author of numerous memoirs and treatises in pure mathematics, published in continental journals.

DR. PAUL LANGEVIN is professor of experimental physics at the École Normale Supérieure, Paris. He is the enunciator of a theory of diamagnetism and paramagnetism, familiarly referred to under his name. He is already a foreign member of the Reale Accademia Nazionale dei Lincei, Rome.

DR. RICHARD PFEIFFER (who was born in 1858) is professor of hygiene and bacteriology in the University of Breslau; formerly he occupied a similar chair in the University of Königsberg. He is distinguished for his researches on the bacilli of cholera, typhus, and influenza, and on outstanding problems of protective inoculation.

PROF. LUDWIG PRANDTL (born in 1875 at Freising) holds the chair of applied physics, mechanics, and thermodynamics in the University of Göttingen. He received his technical training at various institutions in Munich, and filled important posts in that city. Before transferring (1907) to Göttingen, he was professor at the Technical High School, Hanover. He is a distinguished pioneer in the study of aerodynamics.

PROF. RICHARD WILLSTÄTTER, of Munich, who was awarded the Nobel prize for chemistry in 1915, was born at Carlsruhe (Baden) in 1872. Entering the University of Munich, he studied under Adolf von Baeyer, and ultimately succeeded the master in the chair of chemistry. He is the author (with A. Stoll) of the classic treatise, "Untersuchungen über Chlorophyll: Methoden und Ergebnisse" (Berlin, 1913). We may recall that on July 2, 1927, Prof. Willstätter was included in the Scientific Worthies series of NATURE.

Herring Investigations at Plymouth.

MR. E. FORD has published a report on his herring investigations in the *Journal of the Marine Biological Association* (vol. 15, No. 1, Feb. 1928, pp. 267-319). The report is in four parts, dealing in turn with the methods used in the treatment of the data, the average number of vertebræ in the herrings of the English Channel and the south-east of Ireland, the Plymouth winter fishery of 1924–25 to 1926–27, and the growth of young herrings in the area under discussion.

The first part is important, for in it the author gives a concise account of his methods of age estimation and growth calculation from the scales of the herring. In making comparisons between two lots of fish by means of growth calculation, difficulty is often experienced by the fact that very often one cannot be certain whether or not the calculated lengths, l_1, say, are bimodal. It was found that a fish with a small l_1 had a larger second-year growth than a fish with a large l_1, a fish with a small l_2 grew more than one with a large l_2, and so on, and equations have been deduced from which the length of a fish in any given year can be calculated from its length in the previous year.

The usual method of examining herrings for their 'racial' characteristics is to ascertain the statistical difference between the means of variable characters of samples of fish from different areas, but often these differences are so great even on one ground that the definition of a 'race' is impossible. If this mixture occurs on spawning grounds—and there is no doubt that it does—what is the chance of racial characters being passed on to the next generation? Mr. Ford defines the present limits of 'race' investigation, and confines himself to the study of morphological characters of temporary populations, which, along with the study of age and growth from the scales, should at least help in the solution of the problem of migration.

In the Plymouth winter fishery the 1920 year-class constituted a large proportion of the samples for three seasons, but it is not to be assumed that the same fish returned to the spawning grounds each year, because this was a widely spread rich year-class, and the return of fish to a ground cannot be proved without detailed examination of growth and other characters each year. There are large variations in the length of fish of the same age in this area, and the author names the following as causes for this: (*a*) Some fish were spawned earlier than others; (*b*) some had experienced better conditions for growth than others.

Added to these, however, is the effect of the mesh of commercial drift nets on the length of herrings in the samples. There is a difference in growth between the fish of the western end and those of the eastern end of the English Channel, the larger growth taking place in the more open waters of the west.

Observations on the growth of the young (whitebait) herrings taken in the rivers flowing into Plymouth Sound, show that there is a considerable variation in the length of the fish, but there seems to be a general agreement between the mean length of these herrings and the calculated length l_1 of the adult herrings of the Plymouth winter fishery.

Herring investigations in general present many obstacles to the observer, and in this paper the author has clearly defined the probabilities and difficulties of the work, while the concise accounts of his method of treatment of the data will no doubt be of great assistance to others engaged in marine biology.

Annual Congress of the South-Eastern Union of Scientific Societies.

THE thirty-third congress of the South-Eastern Union of Scientific Societies took place at Rochester on June 6–9, with Sir Martin Conway, M.P., in the presidential chair. The congress was well attended, and delegates were sent from most of the seventy-four societies comprised in the Union.

Sir Martin Conway's address was on "Mountain Exploration." The Matterhorn, Sir Martin said, was once thought to be the abode of evil spirits, and even now we find little chapels at the base of mountains, the object being to dam back the evil spirits from descending into the valleys. In the Andes of Bolivia the mountains were held to be the abode of gods. Indeed, almost all over the world the mountains were held to be the abode of either devils or gods. In the Chinese mind there is a great love for the mountains, and many poems have been dedicated to them; this affection is exceptional amongst the peoples of the world.

Sir Martin said that, geologically, mountains are quite modern, some of the youngest being found in the Himalayas, and the hundreds of peaks there have not yet been worn down as in the case of other ranges, as, for example, the Scottish mountains, where denudation has gone on for a much longer period. Mountains are continually being broken down by the forces of Nature, and at periods in geological history fresh mountains have been reared up from the crust, making up for the denudation of other ranges. In Great Britain, as in other countries, it was only during the course of the last century that people began to see beauty in great heights, and poetry and art have done much since to beget a love for mountain climbing.

Respecting the breaking down of mountains, Sir Martin said he has seen as many as eighteen avalanches in one hour in the Himalayas. In the same range there are great glaciers and great precipitation of snow. The South American Andes are in the main poorly supplied with snow, and the glaciers are as a rule eaten up by evaporation before they reach a low level. On the other hand, in Spitsbergen, although the highest of the mountains is but 7000 feet high, they are the grandest of all, as they are clothed with snow to their base.

In Dr. William Martin's address to the archæologists, he emphasised the necessity of organised work on proper lines, and showed how such work can be prevented from being but desultory and unscientific. He showed what powers exist under the Ancient Monuments Act to prevent destruction of objects of interest, and emphasised the fact that such powers are very limited, and that but little can be done where there is a determined effort to do away with monuments that are in the way of modern so-called improvement. In speaking of the archæological remains in the Medway Valley, Mr. A. E. Hurse stated that he considers that the ancient highway, sometimes known as the Pilgrims' Way, which may have really dated from neolithic times, crossed the Medway somewhere near Snodland. Another ancient highway, sometimes called the Old Road, is remarkable as being in the line of many megalithic remains, such as the circles at Addington, its dolmens, and Kits Coty House. The fact that neither road was much utilised to serve as parish boundaries seems to show that they were to a great extent lost before Saxon and Norman times, when boundaries began to be defined.

Mr. G. E. Hutchings in his paper on the vegetation of the district showed that the area comprises wide chalk areas and salt marshes, and forms an admirable one for the study of plant ecology; little work has yet been done in this direction. Papers of a botanical nature were read by Mr. C. E. Salmon, on fruits and seeds of allied plants, and by the Rev. L. Denton Sayers, on gall-formation in plants.

In the geological section Mr. H. B. Milner gave an illustrated paper on "Geology from the Air," and by the aid of numerous aerial photographs showed how the aeroplane can be utilised for geological study. During flights that he has made in Iraq and Palestine he has taken photographs which give an added interest to the geology of these districts. In thickly wooded country air pictures are particularly valuable, as they can form the basis of maps which can afterwards be more closely filled in by ordinary field work. 'Cut-offs' or ox-bow lakes can thus be identified which may be overlooked by ordinary means in such a country. The meanders of the Jordan were vividly portrayed in one of the pictures shown. English coast-line scenery takes on a new aspect from the air, whilst inaccessible regions in all mountainous parts of the earth can be studied in air pictures. Aerial geology is in its infancy, and much may be expected from it.

Dr. S. W. Wooldridge gave a characteristic paper on the geomorphology of the North Downs, and Mr. G. Dines a paper on the Bapchild palæolithic site. Prof. E. W. MacBride read a paper on the conditions of progressive evolution.

A public lecture was given by Mr. Aymer Vallance on old timber houses, introducing many pictures to illustrate the evolution of the half-timbered houses from what is considered the neolithic plan of drawing branches of trees so as to form an arched roof, to the curved 'ships' timbers' which in early houses supported the roof. Then followed the upright timbers to support a second floor, and finally the curved timbers were used only for walls of that floor, seen outside such a house as part of the half-timbering. The houses at first had a long room or hall where the household met for meals, and many of these were later cut up so as to form a number of rooms, or even separate cottages. When rooms were added on the upper floor the heads of the family would retire to one of these, which came to be known as the 'solar,' a name that gave rise to some discussion. It was suggested that the name arose from the room being in a position exposed to the sun, but it may have been the room where the family could be alone or *solus*.

In the Regional Survey Section, Mr. C. C. Fagg gave a history of the movement, in the development of which he has for many years taken an active part.

Many excursions were made during the congress, some of a strictly scientific nature, those devoted to archæology being well attended. Not the least interesting was that to Gads Hill Place, which was thrown open by the kindness of the occupiers, who showed the visitors many items of interest to lovers of Dickens. A reception by the Mayor in the Guildhall was followed by a lecture by Dr. Mortimer Wheeler on Roman Rochester. The remains of the old Roman walls, the Cathedral and the Castle, the House for Six Poor Travellers, and other places in the town, were visited under local guides during a comprehensive perambulation. At the delegates' meeting the honorary secretary announced that the congress for 1929 would be held at Brighton, under the presidency of Sir Arthur Keith.

University and Educational Intelligence.

BIRMINGHAM.—Considerable increases in the contributions of various authorities in the Midland district to the University of Birmingham have been announced recently. The County Council of Staffordshire has increased its grant from £1000 to £1250 per annum; Worcestershire C.C. from £750 to £1000; Warwickshire C.C. from £500 to £1000 (on the condition that two scholarships are provided); Smethwick from £250 to £350; Dudley from £100 to £200; West Bromwich £260 to £520; Shropshire C.C. £150 to £250. New grants have been made by Walsall (£250) and the City of Worcester (£250). The City of Birmingham has now decided to increase its contribution from £15,000 per annum to the proceeds of a penny rate (equivalent at the present time to about £26,000 per annum).

The degree Congregation which is to be held on June 30 is to be marked by the conferment of honorary degrees on distinguished members of the legal profession to signalise the inauguration of the Faculty of Law in the University.

CAMBRIDGE.—The George Henry Lewes studentship of the annual value of about £250 is being offered for research work. Candidates should send a statement of their qualifications, the subject of their proposed research, and the name of one referee, to Prof. Barcroft, Physiology School, Cambridge, by July 10.

LONDON.—Sir Gregory Foster, Provost of University College, has been elected Vice-Chancellor for 1928–29 in succession to Sir William Beveridge.

Prof. E. N. da Costa Andrade has been appointed as from Aug. 1 to the Quain chair of physics tenable at University College. Prof. Andrade was educated at St. Dunstan's College, University College, the University of Heidelberg, where he obtained the Ph.D. Degree in 1911 (*summa cum laude*), the Cavendish Laboratory (1911–12), and the University of Manchester (1913–14). Since 1920 he has been professor of physics at the Royal Military College, Woolwich. His published work includes: "The Structure of the Atom" (3rd edition, 1927); "Airs"; "The Atom"; "Engines"; and various papers on physical and mathematical subjects in *Proc. Roy. Soc.*, *Phil. Mag.*, *Annalen der Physik*, and other technical journals.

The following doctorates have been conferred: D.Sc. in Anatomy on Miss I. C. Mann (St. Mary's Hospital Medical School), for a thesis entitled "The Development of the Human Eye." D.Sc. in chemistry on Prof. E. C. Williams, until recently Ramsay professor of chemical engineering, for a thesis entitled "(1) The Use of Highly Porous Bodies in the Recovery of Benzole from Coal or Coke Oven Gas. (2) The Purification of Benzole by means other than Sulphuric Acid Washing." D.Sc. in Physiology on Dr. C. H. Best (University College and the National Institute for Medical Research), for a thesis entitled "The Effect of Insulin on the Dextrose Consumption of Perfused Skeletal Muscle." D.Sc. in mathematics on Mr. Charles Fox (University College), for a thesis entitled "I. Null Series and Integrals; II. Generalisation of the Fourier-Bessel Integral Transform."

The degree of M.Sc. in the principles, history, and method of science for internal and for external students will in future be termed the "M.Sc. Degree in History, Methods, and Principles of Science."

A University post-graduate travelling studentship has been awarded to Mr. H. I. Andrews. Mr. Andrews (Imperial College—City and Guilds (Engineering) College) proposes to undertake research work in locomotive engineering upon the locomotive test plant at the University of Illinois. A University post-graduate studentship in engineering has been awarded to Mr. D. M. Robinson (King's College), who was awarded in 1927 the Siemens' Prize in electrical engineering and a £50 research scholarship from the Institute of Electrical Engineers.

NEWCASTLE-UPON-TYNE.—The special committee appointed by the Council of Armstrong College has unanimously agreed to recommend the appointment of Sir Westcott Stile Abell as professor of naval architecture in succession to Dr. J. J. Welch, who retires on Sept. 30. Sir Westcott Abell was professor of naval architecture in the University of Liverpool from 1910 until 1914, and since then he has been Chief Ship Surveyor of Lloyd's Register of Shipping. Sir Westcott was president in 1924–25 of the Institution of Marine Engineers.

Mr. H. P. Mulholland, of Queens' College, Cambridge, has been appointed lecturer in mathematics as from Oct. 1.

OXFORD.—On June 18 the Halley Lecture was delivered by Dr. Harlow Shapley, Director of the Harvard College Observatory, on "A Search for the Centre of the Milky Way." Dr. Shapley, who illustrated his discourse by an ample supply of excellent lantern slides, succeeded in arousing and sustaining the interest of a large and appreciative audience. The lecture fell into three main divisions, namely, the search for the direction and distance of the centre; its surroundings; and the veil of cosmic material behind which it is hidden. Photographic views show that of equal areas of the heavens, one might contain 600 times as many stars as another. The stellar material may be either organised or nebular. Our galaxy has been shown to be a 'bun-shaped' system rotating round a centre. It is possible to see through the galaxy, and so to become aware of the existence of other 'supergalactic' systems. The dark obscuring veil is due to the presence of an enormous amount of meteoritic material. The dark structures observable in certain nebular regions are due not to gas, but to vast quantities of cosmic dust.

DR. JAMES DAVIDSON, chief assistant entomologist at Rothamsted Experimental Station, Harpenden, Herts, has been appointed head of the Department of Entomology at the Waite Agricultural Research Institute, University of Adelaide.

THE governing body of the Chelsea Polytechnic, London, S.W.3, has appointed Mr. F. J. Harlow, Principal of the Wigan and District Mining and Technical College, to be Principal of the Polytechnic in succession to Mr. Sidney Skinner, who retires on Aug. 31 next. Mr. Harlow will take up his duties at Chelsea on Sept. 1 next.

THE London School of Hygiene and Tropical Medicine has made arrangements for courses of lectures and practical demonstrations for the guidance of employees of business firms and other bodies who are about to proceed to tropical and sub-tropical countries or are home on leave. In addition to providing guidance for life in the tropics and personal hygiene, they will also include a short account of some of the more common diseases, with advice in regard to measures of protection against such diseases, and some guidance in simple methods of self-treatment. The first course of nine lectures is being given by Col. G. E. F. Stammers, on July 16–26, from 11.30 A.M. to 1 P.M. each day. A synopsis of the lectures can be obtained from the Secretary, London School of Hygiene and Tropical Medicine, 23 Endsleigh Gardens, Euston Road, W.C.1.

Calendar of Customs and Festivals.

MIDSUMMER PROCESSIONS AND FAIRS.—At about midsummer and the beginning of July, processions take place in many localities, sometimes as an observance of a forgotten local cult. More frequently, especially in connexion with fairs, they mark the close or beginning of an annual or semi-annual period. Such was the ceremony observed at Alnwick when, before the proclamation of the fair, representatives of the townships owing service to the Duke of Northumberland attended at Alnwick Castle. In London, up to Tudor times, the setting of the watch for the coming year was accompanied by processions on Midsummer Eve and St. Peter's night in which the Lord Mayor and Sheriffs took part, attended by cresset bearers, the city giants, minstrels, etc. A similar procession took place at Chester, where the pageant included a dragon, hobby horses, and other beasts of medieval fancy. At Burford a dragon was paraded around the town annually in memory, it was alleged, of a battle of Saxon times. The procession, which in the Isle of Man paid the rent of Mannan-beg-mac-y-heir, the eponymous deity of Manx mythology, by carrying green grass to the top of Barule, was rather in the nature of a first-fruit ceremony, of which similar traces remain in England in the dedication of cuttings of hay or rushes to the use of the church at midsummer.

June 30.

ST. PAUL THE APOSTLE.—Traditional accounts of the martyrdom of St. Paul preserve some particulars which are of interest, especially in connexion with the preternatural origin of springs. On decapitation, the head of the martyr gave three leaps, and at each of these there sprang up a fountain where the head fell, "which fountains remain to this day and are reverenced with singular devotion by all Christian Catholics."

July.

BOUPHONIA.—'The Slaying of the Bull' in Athens took place at the end of June or beginning of July. Barley and wheat were laid on the altar of Zeus Polieus. Oxen were then driven round the altar, and the one which ate the corn was sacrificed after being wetted with water brought by maidens. The ox was felled with an axe and its throat cut with a knife, both men who performed these operations throwing away the weapon and flying immediately. The beast was then skinned. All present partook of its flesh, and the skin was stuffed and yoked to a plough.

A trial for the murder of the ox followed. After each one officiating in the sacrifice had been accused and passed on the blame to the next grade of operators, the murder was finally brought home to the axe and the knife, which were condemned to be cast into the sea. The sacrifice was a crime demanding the extreme penalty. Frazer suggests that the victim, by partaking of the corn, showed himself to be the corn spirit, an aspect of Dionysus personified in the bull. The wetting of the bull is a rain charm analogous to customs of the harvest in many countries.

July 2.

ST. OTTO. A.D. 1139.—In the course of his missionary journeys among the Slavs, St. Otto necessarily came into antagonism with pagan beliefs. At Stettin a sacred oak, at the foot of which was a spring, was allowed to remain standing at the entreaty of the people on the condition that they ceased to perform their superstitious practices there; but an attempt to cut down a sacred nut tree nearly led to the death of the saint at the hands of the owner in whose field it stood. A peculiar form of divination in war at Stettin is recorded. Nine arrows were laid on the ground and a sacred black horse was led up and down among them by its attendant priest. If the arrows remained undisturbed by the horse's hoofs the result of the war would be favourable.

July 2-4.

PROCESSUS AND MARTINIAN.—If it rains on July 2 heavy showers will follow and the corn be spoiled. Rain on the day of the translation of St. Martin (July 4) will be followed by rain for forty days.

July 3.

A solemn celebration in the church of St. Leu and St. Gilles, Paris, commemorated the miracle of the bleeding of a statue of the Virgin in *la rue aux Ours* when it was struck with a knife by a drunken soldier in the year 1513. The image was transported to Rome; but the memory of the event was perpetuated by an annual ceremony performed by the inhabitants of the street, who used to throw a figure of the soldier, fashioned in faggots, into the fire. An elaboration of the ceremony was checked by the magistrates in 1744, whereupon it took the form of a three days' parade of Paris before the destruction of the figure, which was now made of osier, clothed and armed with a knife.

July 6.

OLD MIDSUMMER DAY.—This day was still reserved as the proper occasion for midsummer observances in remote localities in Britain so late as the early part of the nineteenth century.

At Puxton, Somersetshire, on the Saturday before Midsummer day O.S., used to take place the division of certain common lands for the ensuing twelve months. The rights were confined to certain estates and their tenants. They were summoned to the church for the ceremony of measuring the chain by the ringing of the bell. This chain was eighteen yards long, *i.e.* four yards short of the common chain. The party then repaired to the common. Twenty-four apples had been previously prepared with marks, each distinct and each having a distinctive name. As each acre was measured an apple was taken from the bag and a mark to correspond cut in the turf with a special knife kept for the purpose. A certain number of acres, called the 'outlet' or 'out-drift,' were set aside for expenses and let by an inch of candle, burnt in silence except for the bids.

July 7.

ST. THOMAS À BECKET'S DAY.—In Cornwall a festival called 'Bodmin Riding' was kept up on the Sunday and Monday after St. Thomas à Becket's day. A company on horseback with musicians, and a puncheon of ale brewed for the purpose in the preceding October, rode around the town, the crier saluting each house and wishing the inhabitants 'a prosperous morning, long life, and a prosperous riding.' The riding tune was then played and the householder invited to drink the riding ale. On the next day a procession went to the Priory, where they received two garlands on staves and then proceeded to Town End, where the games, lasting two days, were formally opened. A mock trial was also held, presided over by a lord of misrule. Pretended offences, such as peculiarity or irregularity in dress, were punished by a "summons to Halgraver," a place of which the name "signifieth goat's moor . . . a little without the town and very full of quagmires."

Societies and Academies.

LONDON.

Royal Society, June 21.—**C. V. Boys**: Solid dipleidoscope prisms. Bloxam's hollow prism, known as Dent's dipleidoscope, is described. The instrument affords the best practical means of comparing the intensity of illumination of two images, and can be used to check the accuracy of Fresnel's equations for the intensity of light reflected from and traversing refracting surfaces. The solid dipleidoscope prism might be used with advantage to increase the precision of good astronomical instruments.

G. I. Taylor: The forces on a body placed in a curved or converging stream of fluid. The particular case of straight converging flow is of special interest in aeronautics; the resistance is $-(1+a)\ V\partial p/\partial x$, where V is the volume, $\partial p/\partial x$ the gradient of pressure in the fluid, and the 'virtual mass' of the body for accelerated motion in the direction of the stream is a times the mass of fluid displaced. The equations are applied to find the couples exerted on bodies of various shapes. The couple about the direction of the stream-lines is the most interesting, because in a uniform stream of perfect fluid this couple is zero, and even in a real fluid it is zero for all bodies which possess a plane of symmetry containing the direction of the stream. When the stream is curved or converging the asymmetry of the stream reacts with certain elements of asymmetry in the body, causing it to take up certain definite positions. Thus an elongated body with a curved centre line rotates in a curved stream until the plane of the centre line coincides with the plane of curvature of the stream-lines, but the direction of curvature of the body is opposite to that of the stream-lines.

G. I. Taylor: The energy of a body moving in an infinite fluid, with an application to airships. The energy in the fluid surrounding a body which moves without rotation in an infinite fluid depends only on the terms of the first degree in the spherical harmonic series for the velocity potential. Conversely, these terms are completely determined when the expression is known which represents the energy of the flow in terms of the components of velocity of the body. As an application of these results a simple formula is developed giving the virtual addition to mass associated with a body moving with a uniform acceleration through a fluid in terms of the equivalent distribution of sources and sinks which give rise to the same external flow.

S. S. Cook: Erosion by water-hammer. The pressure generated at the first moment of impingement of a column of water against a fixed surface is independent both of the length and of the sectional area of the column, and therefore it may be inferred that the same pressure will arise from the impact of a drop of water, being in this case, however, confined to the point of impingement. In the case of vacuous cavities collapsing in an incompressible fluid, the work done by the surrounding fluid closing in is converted into velocity energy, concentrated, when collapse is nearly complete, at the reduced surface of the cavity; and, if further collapse is prevented by the interposition of a fixed surface, high water-hammer pressure will be produced. The erosion of steam turbine blades is attributed to the impact of drops of water struck by the rotating blades, and it may be aggravated by irregularity of shape of the drops, causing a cavity to be entrapped at the surface of impact.

Sir Robert Robertson and J. J. Fox: Studies in the infra-red region of the spectrum. Part I.—Description of prism spectrometer and apparatus. A description is given of the prism spectrometer and apparatus used to explore the infra-red absorption spectrum of ammonia, phosphine, and arsine. Attention had to be paid to the necessity for keeping the source of energy constant, for calibrating mechanism for reading wave-lengths, for shielding the thermopile from variations of air pressure, for keeping close watch on the temperature of the prism, especially when made of rock-salt, on account of the high temperature coefficient of its index of refraction; for accurate alinement of observation tubes, and for obtaining a galvanometer of great sensitiveness and freedom from external perturbations.

Sir Robert Robertson, J. J. Fox, and E. S. Hiscocks: Studies in the infra-red region of the spectrum. Part 2.—Calibration of prism spectrometer; general procedure; preparation of pure ammonia, phosphine, and arsine. The 'wave-length drum' was first calibrated in terms of angle of rotation of the prism table. Large-scale dispersion curves were constructed from Paschen's determinations of refractive indices of the three dispersing media, rock-salt, quartz, fluorite. For the region of the spectrum $0{\cdot}5\mu$ to $16{\cdot}5\mu$, a curve showing the correction, in μ, to be applied to any place on the drum graduation was drawn, and for regions $0{\cdot}5\mu$ to $3{\cdot}5\mu$ and $0{\cdot}5\mu$ to $9{\cdot}5\mu$ curves were drawn connecting drum graduation and wave-length for quartz and fluorite prisms respectively. The gases were purified by fractional distillation.

Sir Robert Robertson and J. J. Fox: Studies in the infra-red region of the spectrum. Part 3.—Infra-red absorption spectra of ammonia, phosphine, and arsine. Tables and graphs are given of oscillation and rotation-oscillation bands, together with a general description of the bands observed. With the prism instrument used partial resolution was obtained beyond $2{\cdot}2\ \mu$ with quartz, $4\ \mu$ with fluorite, and $5\ \mu$ with rock-salt, and fine structure obtained beyond 3μ with quartz, 6μ with fluorite, and $8\ \mu$ with rock-salt.

Sir Robert Robertson and J. J. Fox: Studies in the infra-red region of the spectrum. Part 4.—Discussion of absorption bands of ammonia, phosphine, and arsine. In certain sequences of bands the members preserve a constant ratio of wave-numbers to one another: 0·68 for PH_3/NH_3 and 0·91 for AsH_3/PH_3. Several harmonic sequences of oscillation bands are found in each gas, but a main sequence is common to all three gases, and a sequence common to ammonia and arsine alone. From the bands resolved, the fine structure has been evaluated, and wave-number differences obtained indicating rotation bands. Oscillation frequencies become slower in the order ammonia, phosphine, arsine, and wave-number differences in rotation bands show that the molecules rotate more slowly in the same order. Support for Hund's view that ammonia has a tetrahedral structure is adduced from bands observed for the three gases.

J. Hollingworth: The polarisation of radio waves. With the recently constructed apparatus the radio waves received can be split up into their physical components, which can thus be studied separately. In particular the form and extent of the abnormal polarisation of the wave returned from the upper layer can be defined quantitatively. Owing to the annual variations involved, observations must be continued for some time.

A. C. Menzies: The spark spectrum of copper. Instantaneous photographs of the copper spectrum in the Schumann region are obtained by fusing copper wires in a small chamber attached to a vacuum

grating spectrograph. The method allows of the use of small capacity pumps, since a low pressure is only required preliminarily. Owing to the high velocity of light the evolution of gases in the fuse is too slow to cause appreciable absorption before the light has reached the plate. Also the lines are very sharp, since 'wandering' of the source is reduced. The spectrograms are not rich in lines, but this is not a disadvantage when one is seeking the lines due to low-level terms. The lowest term of the copper spark spectrum $1\ ^1S_0$ has been identified with the term-value $-21929{\cdot}4$, and is in accordance with the Heisenberg-Hund scheme.

W. H. Taylor and **W. W. Jackson**: The structure of cyanite, Al_2SiO_5. A qualitative investigation has been made. Data were obtained from X-ray rotation photographs taken under conditions such that an estimate of the density of the photographic image yields reliable information concerning the relative strengths of reflection by different crystal planes. The fundamental assumptions are that the oxygen atoms are arranged in cubic close packing, with the silicon and aluminium atoms distributed among the interstices so that they lie at the centres of groups of four and six oxygen atoms respectively. The main features of the structure are described,. Explanations are suggested of the highly perfect cleavage parallel to the *a*-face, and also of the striking difference in hardness exhibited in different directions on this face.

F. H. Constable: A new interference method of measuring the surface area of film catalysts. (1) The theory. The meaning to be assigned to the surface area of a catalyst is discussed. The area will necessarily vary with the means of measurement adopted. In view of the urgent need for a standard method of measuring the area of film catalysts, and the uncertainty attached to adsorption methods, a chemical method has been adopted. The surface is covered with a very thin film of a compound the specific volume of which is considerably greater than that of the metal. The thickness of the film is known from the colour, and the mass of the film is determined independently, hence the area is known. (2) Nickel: a method of preparation of the film, an apparatus for activation and study of the surface area. Metallic films made by the oleic acid method, applying the finely powdered oxide to china clay rods, failed to conduct electricity, so that it was necessary to introduce a new method. Graphite-coated china clay rods were used as the foundation for an electrolytic deposit. The small masses of nickel used could be measured by the quantity of electricity passed. The method of the paper above was used in a special apparatus of quartz. The maximum increase in area on activation was about five times, while reduction at 563° produced a surface only 1·3 times the support area.

S. J. Davies and **C. M. White**: An experimental study of the flow of water in pipes of rectangular section. A built-up pipe was used which permitted variation in the controlling dimension of the section without change of the boundary surfaces. In all, 400 tests have been made on pipes, varying in section from 2·54 cm. broad by 0·0154 cm. deep to 2·54 cm. broad by 0·0681 cm. deep. A range of $\rho vd/\mu$ from 60 to 4600 has been investigated. Employing progressively shorter 'entrant lengths' gives evidence of a third or 'lower' critical point, in the neighbourhood of $\rho vd/\mu = 140$, below which eddies are not transmitted along a pipe. For turbulent flow the values of the resistance coefficient are the same as those obtained from tests of smooth circular pipes, provided that the comparison be made on the basis of the hydraulic mean depth. The latter is thus the controlling dimension in channels with a width-breadth ratio as great as 100 to 1, and hydraulic mean depth as small as 0·01 cm. (equivalent to a round pipe 0·04 cm. in diameter). Roughness, constituted by irregularities some 2 per cent of the distance between the surfaces, has no measurable effect upon the resistance to viscous flow or the turbulent resistance.

J. M. Walter and **S. Barrat**: The existence of volatile intermetallic compounds. The band spectra of the alkali metals and of their alloys with each other. The power of forming volatile binary compounds with each other is general among the alkali metals. Probably 1-5 per cent of the vapours of mixed alkali metals at their boiling point are in the form of these diatomic molecules. Each compound possesses a characteristic band spectrum. Many of the spectra show, in addition, a narrow region of continuous absorption, which, it is suggested, corresponds to the continuous absorption of the halogen molecules. The vapour density of potassium, redetermined by the Victor Meyer method, indicates that the proportion of the diatomic molecules cannot exceed 5 per cent in the vapour at 935° C.

G. Temple: The theory of Rayleigh's principle as applied to continuous systems. This paper deals primarily with continuous one-dimensional oscillating systems, such as a metal bar. If we consider the system to be vibrating in its gravest mode, we may use Picard's method to construct a sequence of functions which form successive approximations to the amplitude. Rayleigh's principle can be applied to each member of the sequence to yield an approximation to the fundamental frequency. The approximations thus obtained steadily decrease to the true value. An upper limit to the difference between the true fundamental frequency and any approximation belonging to the sequence is obtained. Rayleigh's principle is extended to the calculation of the frequency of the first overtone.

R. Schlapp: The Stark effect of the fine-structure of hydrogen. The influence of an electric field on the fine-structure of the energy levels of the hydrogen atom in the Stark effect is investigated by means of the wave-equations of Darwin and Dirac. In weak fields each level splits up into several, the electric separations being, in general, proportional to the field-strength. In the highest fine-structure level of any state, however, the separations are proportional to the square of the field. On Kramers' theory the separation due to a weak field is always proportional to the square of the field. In strong fields each of the Stark levels of the Schwarzschild-Epstein theory is found to have a modified fine-structure. The case of $H\alpha$ is worked out in detail.

Dudley M. Newitt: Gaseous combustion at high pressures (Part 10). The co-volume corrections, maximum temperatures, and dissociations of steam and carbon dioxide in explosions. After applying all necessary corrections, it is shown that in explosions of a theoretical hydrogen–air mixture the mean maximum temperature actually attained rises from about 2585° to between 2660° and 2715° (absolute) as the initial pressure is increased from 3 to 175 atmospheres, the degree of steam dissociation steadily diminishing from 2·2 to about 1 per cent. In a theoretical carbon monoxide–air mixture the mean maximum temperature actually attained gradually rises from 2385° up to between 2700° and 2760° (absolute) as the initial pressure is increased from 3 to 175 atmospheres, the degree of dissociation of carbon dioxide at the maximum temperature remaining fairly constant at 5 per cent throughout. In

the explosion of a $2CO + O_2 + 4CO$ mixture where carbon dioxide dissociation at the maximum temperature is entirely suppressed, the mean maximum temperature gradually rises from 2710° up to between 3020° and 3100° (absolute), as the initial pressure is increased from 3 to 150 atmospheres.

Lord Rayleigh: Observations on the band spectra of mercury. A mercury band spectrum is described which is excited by fluorescence, with the continuous hydrogen spectrum as a source. This spectrum is remarkable as showing in emission the band 2540 near the resonance line 2537 without the resonance line itself. It is observed also that the continuous spectrum on the short wave side of the bands 2345, 2338, etc., extends as far as 2150 and thus much beyond the position of the forbidden line $1\ ^1S_0—1\ ^3P_2$, 2270, which was found under other conditions to limit this continuous spectrum. The series of bands 2345, 2338, etc., examined in emission with large resolving power, is free from the complications of a finer underlying structure which appear in absorption. The structure in the band 2482 to 2476, described by earlier writers as continuous, is enigmatic in terms of the quantum theory. The band does not appear in absorption.

L. P. Davies: The photo-electric properties of some metals in the soft X-ray region. A photo-electric detector is fitted with iron, cobalt, copper, and nickel photo-electric plates in turn, and these four metals also form the anti-cathode. The ratios of the soft X-ray efficiencies are not affected by changing the photo-electric plate, but their absolute values are. Approximately, iron and nickel are 10 per cent more efficient than cobalt and copper as soft X-ray emitters, and 20 per cent more efficient than cobalt and copper as photo-electric detectors.

C. F. Powell: Condensation phenomena at different temperatures. An apparatus is described whereby the supersaturation required to produce condensation on ions and on associated molecules in the presence of dust-free air, over a range of temperature from −25° to 50° C., has been measured. The effect of the air is of importance not only by determining the amount of water vapour condensed per unit volume for a given degree of supersaturation, but also by preventing the evaporation of water from the walls of the expansion chamber. Apart from the experimental difficulties to be met in working at higher temperatures, atmospheric temperature gives the best conditions for the cloud method of investigating atomic phenomena.

(To be continued.)

Physical Society, May 25.—**W. H. Eccles and Miss W. A. Leyshon**: Some new methods of linking mechanical and electrical vibrations. Methods whereby the frequency of an electric oscillatory circuit can be brought under the control of a tuning-fork are described. The electrical circuit may include a crystal contact, piezo-electric resonator, neon lamp, or pointolite lamp. The latitude of working conditions is narrow, but the difference in natural frequency between the fork and the controlled circuit may be very considerable.

DUBLIN.

Royal Dublin Society, May 22.—**S. Leonard**: The waste land of North County, Wicklow. A survey has been made to ascertain what areas of no agricultural value are suitable for afforestation. Owing to the need of shelter from the prevailing south-westerly winds, suitable areas are confined to the northern and eastern slopes of the hills. They amount to about 11 per cent of the waste land, or 6 per cent of the total surveyed.—**H. Ryan and J. J. Lennon**: The action of alcoholic hydrochloric acid on methyl-diphenyltetrahydropyrone. It has been shown previously that γ-benzylidine-methylethylketone reacts with benzaldehyde to form isomethyldiphenylcyclopentenone. The latter body was converted by acid into methyldiphenycyclopentenone, and this in turn reacted with benzaldehyde forming benzylidine-methyldiphenylcyclopentenone. The same ultimate product can be got from α-benzylidine-methylethylketone, which in the presence of alkali is converted by benzaldehyde into methyldiphenyltetrahydropyrone. From the latter, by means of concentrated hydrochloric acid in absolute alcohol, the same methyl-diphenylcyclopentenone was obtained as that previously got from γ-benzylidine-methylethylketone. In this way the α- and γ-benzylidine-methylethylketones by interaction with two molecular amounts of benzaldehyde formed the same ultimate condensation.—**H. Ryan and M. T. Casey**: The action of aromatic amines on nitric esters. The reactions between primary aromatic amines and nitric esters appear to be indirectly hydrolytic; for example, aniline and butyl nitrate gave aniline nitrate and butyl-aniline. In the case of secondary and tertiary amines the action of nitric esters seems to be chiefly one of oxidation. A slight degree of nitration also occurs. The reactions between dimethyl-aniline and the nitric esters of the polyhydric alcohols were found to be much more rapid than in the case of monohydric alcohols. The relative rates of decomposition of various nitric esters in the presence of dimethyl-aniline were measured by the intensity of coloration produced after a given interval.—**H. Ryan, J. Keane, and J. Dunne**: The estimation of diphenylamine and diphenylnitrosamine in the presence of their derivatives. Another method has been suggested by Ryan and Dunne which consists in extracting the powder with alcohol and reducing the extractive in alcoholic solution with stannous chloride and hydrochloric acid. The alcohol is removed from the mixture, which is then distilled in a current of steam. The diphenyl-amine is extracted with chloroform and estimated volumetrically with bromide water. A modification to this method is recommended by Ryan and Keane by the use of a chloroform instead of an aqueous solution of bromine, in which case the degree of bromination is less dependent on light conditions. —**N. Cullinane, J. Algar, and H. Ryan**: A synthesis of lotoflavin (5-7-2′-4′-tetrahydroxyflavone) and of 7-2′-4′-6′-tetrahydroxyflavone. Phloracetophenone-4-6-dimethylether interacted with methyl 2-4-dimethoxybenzoate forming 2-hydroxy-4-6-2-′4′-tetramethoxybenzoylacetophenone. The latter body on warming with hydriodic acid gave 5-7-2′-4′-tetramethoxyflavone, from which by further action of hydriodic acid 5-7-2′-4′-tetrahydroxyflavone was obtained. This flavone is similar in properties to, and probably identical with, lotoflavin obtained from *Lotus arabicus* by Dunstan and Henry in 1901. By a similar method the isomeric 7-2′-4′-6′-tetramethoxy and tetrahydroxy flavones were obtained from phloracetophenonetrimethylether.—**B. O'Donoghue, J. J. Drumm, and H. Ryan**: The commercial utilisation of Java citronella oil. In an attempt to determine whether it would be possible to produce high-class perfumes from the crude Java citronella oil which is imported for use in household soaps, it was found that citronellal can be readily separated from the crude Java oil by means of sodium bisulphite, and from the residual oil the geranial can be obtained with the aid of its double compound with calcium chloride. No economical process for separating citronellol was devised, but this

perfume can be readily got by electrolytic reduction of the citronellal separated from the oil.

PARIS.

Academy of Sciences, May 30.—A. Lacroix: A new region of intrusive nepheline rocks in Madagascar.—Belzecki: The equilibrium of elasticity of a rectangular prism.—Albert Portevin: The influence of various factors on the internal tensions in wire drawing.—Paul Piou and A. P. Bérard: The velocity of absorption of sulphur dioxide by magnesium hydroxide.

ROME.

Royal National Academy of the Lincei, Feb. 19.—U. Cisotti: The conception of constant tensors in Euclidean varieties.—G. A. Crocco: The weight of the aeronautic structure. The design of aeronautic structures is dominated by the criterion of minimum weight, and it becomes necessary to carry out a preliminary approximate calculation without defining exactly the design or developing all the calculations demanded by the science of construction. With the principal factors governing the weight of a structure as starting point, an approximate relationship is deduced which is valid for any structure statically defined, and is to be considered later in its application to aeronautic structures.—A. Lo Surdo: Characteristics of triodes with saturating grid tensions.—F. Zambonini and A. Ferrari: Investigations on lead phosphate and chlorophosphate (pyromorphite). The results of X-ray analysis by the rotating crystal method demonstrate the almost fundamental identity in crystalline structure of lead orthophosphate and pyromorphite, in contradiction to the formula proposed for the apatites by Abegg and Bodländer and by Werner, who regarded these minerals as halides of a complex cation. The mean value of the lattice constant, calculated from the position of the lines due to the radiation $K\alpha_{Fe}$ is 9·65 A. for lead orthophosphate and 9·91 A. for pyromorphite; the Debye method gives 9·67 A. and 10·135 A. respectively. From the mean values the densities are calculated to be 7·03 and 7·06, which are in good agreement with the experimental values.—S. Minetti: The necessary and sufficient conditions for an entire function to be of a certain genus and a certain order (3).—A. Masotti: The equivalence of tensors.—L. Berwald: A normal invariant form of the second variation.—A. J. M'Connel: The parallel transport of a vector along a finite circuit: Case of a Riemannian space (2). Results previously obtained are applied to the case of a Riemannian space.—G. Ascoli: Laplace's equation of hyperbolic space.—Gina Burani: Quadrics of Riemannian space of three dimensions. Slebodzinski has recently defined, as quadric of a Riemannian space $\surd_3$, a surface Q the lines of which are asymptotic to the geodetics of Q and consequently of $\surd_3$. It is now shown that, for quadrics so defined, Bonnet's theorem, according to which the quadrics (of S_3) are characterised by the property that along each line of curvature the principal relative radius of curvature is proportional to the cube of the other, is, in general, not valid.—G. Palozzi: The projective invariants of contact between oblique curves.—G. Scorza-Dragoni: The quasi-continuity of compound functions. If $f(y)$ is a continuous function in y, and $y(x)$ is a quasi-continuous function in x, the compound function $f(y(x))$ is also quasi-continuous, but if $y(x)$ satisfies a certain condition, the hypothesis of the continuity of $f(y)$ in this theorem may be replaced by that of its quasi-continuity.—E. Bortolotti: Local co-ordinates in the projective-differential geometry of a surface: the unit elements.—P. Nalli: Integral equation of the third species and applications to differential equations (2).—C. Cannata: Contribution to the ballistic theory of variable stars (2). Consideration of the essential features of the ballistic theory of variable stars for elliptic orbits shows that only two cases present themselves, dt/dT either remaining positive for any value of E or changing its sign; constantly negative values are excluded. These results are applied to various examples of each of the two cases.—E. Fermi: Statistical deduction of certain properties of the atom. Application to the theory of the periodic system of the elements (2). It has been shown that mean results concerning the distribution of the electrons about the nucleus of a heavy atom may be obtained by assuming that the electrons form round the nucleus a kind of gaseous atmosphere, to the calculation of which statistical considerations may be applied. Given the pronounced density of this electron atmosphere, it will be in a condition of complete degeneration at ordinary temperatures. Application of the statistical method to the theory of the periodic system of the elements renders it possible to predict exactly the atomic numbers at which the various anomalies of the periodic system commence.—G. Gentile: Rutherford's theory of the satellites. Calculation by means of classical electrodynamics gives results which throw doubt on the stability of the nuclear systems described by Rutherford in his paper on the structure of the radioactive atom and origin of α-rays, since values are obtained for the mean life which are incompatible with experimental results.—G. R. Levi and A. Celeri: Pyrophoric lead. This substance has the same face-centred, cubic crystalline structure as ordinary lead and is composed of granules sufficiently large to give sharp, thin lines in photograms obtained by the Debye method. Pyrophoric lead, sometimes slightly contaminated by the oxide, may be prepared by heating the citrate, tartrate, or formate. When slowly oxidised, it yields the oxide directly, but its more or less profound oxidation is a function of the time and of the dimensions of the metallic granules and does not stop at any definite compound.

SYDNEY.

Linnean Society of New South Wales, Mar. 28 (Annual General Meeting).—Late Prof. L. Harrison: Host and parasite. For many groups of parasites, host and parasite have come down the ages together. Parasites in general live under conditions which afford little stimulus to evolutionary change, and so tend to differentiate at a slower rate than their hosts, suffering what has elsewhere been called a retarded evolution. The relation between host and parasite may serve several useful purposes: a phylogenetic relationship may be established, or a supposed relationship may be refuted; suggestion of convergent resemblance may be refuted; support may be forthcoming for the common origin of groups now occurring on separated land masses, and thus for the existence of former land connexions. Little use appears to have been made of the host–parasite relation until comparatively recent years, but the degree of unanimity reached by workers on different groups of parasites indicates that the host–parasite relation is a general principle and is capable of wide application. It is concluded that there is a general specificity underlying obligate host–parasite relations, however much this may be obscured, in some groups, by the interposition of other factors.—Charles G. Oke: Notes on Australian Coleoptera, with descriptions of new species, Part 1. Notes on species belonging to the families Staphylinidæ, Pselaphidæ, Buprestidæ, Ptinidæ, Cerambycidæ, and Chrysomelidæ. Five genera and forty-four

species are described as new, fifteen species being noted as inquilines living with ants and one with termites.—W. F. Blakely: The Loranthaceæ of Australia, Part 7. This part deals with *Korthalsella*, *Notothixos*, and *Viscum*. Three species of *Korthalsella* are segregated from *Viscum*, and in the latter genus, two species are offered as new.—W. D. Francis: The growth rings in the wood of Australian Araucarian conifers. The degree of distinction and regularity in the growth rings which characterises the wood of many European and North American trees is not shown by the wood of the subtropical Australian Araucarian conifers.

Official Publications Received.

BRITISH.

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1927. Pp. 30+2 plates. (Jamaica: Government Printing Office, Kingston.)

South Western Naturalists' Union. Annual Report and Proceedings to December 31st, 1927. Pp. 44. (Bristol.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1126 (M. 52): The Distribution of Stress and Strain in the Wöhler Rotating Cantilever Fatigue Test. By Dr. W. Mason and Dr. N. P. Inglis. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 201.) Pp. 40+8 plates. 1*s.* 6*d.* net. No. 1129 (E. 28): Heat Transfer in Internal Combustion Engines. By Dr. H. Moss. (I.C.E. 618.) Pp. 30+6 plates. 1*s.* 3*d.* net. (London: H.M. Stationery Office.)

Medical Research Council. Eighth Annual Report of the Industrial Fatigue Research Board to 31st December 1927. Pp. 36. (London: H.M. Stationery Office.) 9*d.* net.

Royal Commission on Agriculture in India. Report. Pp. 100+755. (Calcutta: Government of India Central Publication Branch.)

Nature and Archaeology Circle, Littlehampton. Reports of Proceedings, 1926–1927. Pp. 30. (Littlehampton.)

Geophysical Surveying: showing the Practical Value of Geophysics in Mining, and in Prospecting for Minerals (including Petroleum) without Boring. Pp. 28. (London: The British Geophysical Survey, Ltd.) Free.

The Ross Institute and Hospital for Tropical Diseases (Incorporated), Putney Heath, London, S.W.15. Annual Report and Accounts for 1927. Pp. 48. (London.)

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 3, No. 33: The Blood Vascular System of the Spiny Dogfish, *Squalus acanthias* Linné, and *Squalus sucklii* Gill. By Dr. Charles H. O'Donoghue and Eileen (Bulman) Abbott. Pp. 823-890. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 8*s.* 6*d.*

Committee on Education and Industry in Scotland. Second Report. Pp. 40. (London: H.M. Stationery Office.) 9*d.* net.

Report of the Committee on Education and Industry (England and Wales). Second Part. Pp. 79. (London: H.M. Stationery Office.) 9*d.* net.

Wessex: an Annual Record of the Movement for a University of Wessex based on University College, Southampton. No. 1, 1928. Pp. 111. (Southampton: University College.)

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1927. Pp. 44. (Entebbe.) 3*s.*

The Carnegie United Kingdom Trust. Fourteenth Annual Report (for the Year ending December 31st, 1927) submitted by the Executive Committee to the Trustees on Friday, March 9th, 1928. Pp. ii+114. (Dunfermline.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 378, June. Pp. 569-668+xxxii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Proceedings of the Royal Society of Edinburgh, Session 1927–1928. Vol. 48, Part 1, No. 9: Generalised Derivatives and Integrals. By W. L. Ferrar. Pp. 92-105. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1*s.* 3*d.*

H.M. Treasury: Committee on Civil Research. Report of the Research Co-ordination Sub-Committee. Pp. 76. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

Aeronautics. Technical Report of the Aeronautical Research Committee for the year 1926–27 (with Appendices). Pp. viii+878+361 plates. (London: H.M. Stationery Office.) 35*s.* net.

British Science Guild. The Annual Report of the Executive Committee, 1927–8, presented at the General Meeting of Members, held at the Royal Society of Arts, London, 21st June 1928. Pp. 28. (London.) 1*s.*

FOREIGN.

Field Museum of Natural History. Botanical Series, Vol. 6, No. 2: Citrus Products, Part 2. By James B. McNair. (Publication 245.) Pp. ix+213-392+plates 7-22. Zoological Series, Vol. 14, No. 4: Contents to Vol. 14, Nos. 1-3. (Publication 246.) Pp. vii+233-235. Zoological Series, Vol. 12, No. 14: A new Crocodile from New Guinea. By Karl P. Schmidt. (Publication 247.) Pp. ii+177-181+plates 13-14. (Chicago.)

Field Museum of Natural History. Botany Leaflet 13: Sugar and Sugar-Making. By James B. McNair. Pp. 34. 50 cents. Anthropology Leaflet 22: Insect-Musicians and Cricket Champions of China. By Berthold Laufer. Pp. 27+12 plates. 50 cents. Anthropology Leaflet 25: The Civilization of the Mayas. By J. Eric Thompson. Pp. 110+14 plates. 75 cents. Geology Leaflet 8: Agate—Physical Properties and Origin, by Oliver C. Farrington; Archaeology and Folk-lore, by Berthold Laufer. Pp. 36+14 plates. 50 cents. (Chicago.)

Bulletin of the National Research Council. No. 62: Algebraic Numbers, II. Report of the Committee on Algebraic Numbers. Pp. 111. (Washington, D.C.: National Academy of Sciences.) 1.50 dollars.

Smithsonian Miscellaneous Collections. Vol. 80, No. 10: Drawings by John Webber of Natives of the Northwest Coast of America, 1778. By David I. Bushnell, Jr. (Publication 2961.) Pp. 12+12 plates. (Washington, D.C.: Smithsonian Institution.)

Smithsonian Institution: Freer Gallery of Art. List of Paintings, Pastels, Drawings, Prints and Copper Plates by and attributed to American and European Artists, together with a List of Original Whistleriana in the Freer Gallery of Art. (Publication 2963.) Pp. 51. (Washington, D.C.: Smithsonian Institution.)

Cornell University Agricultural Experiment Station. Memoir 101: A List of the Insects of New York, with a List of the Spiders and certain other allied Groups. Mortimer Demarest Leonard, Editor-in-Chief. Pp. 1121. Memoir 109: Studies of the Life History of *Ustilago avenae* (Pers.) Jensen and of *Ustilago levis* (Kell. and Swing.) Magn. By George Raymond Gage. Pp. 35. Bulletin 459: The Demand Side of the New York Milk Market. By H. A. Ross. Pp. 86. (Ithaca, N.Y.)

Department of the Interior: U.S. Geological Survey. Bulletin 797-A: Mineral Industry of Alaska in 1926, and Administrative Report. By Philip S. Smith. (Mineral Resources of Alaska, 1926-A.) Pp. ii+66+xii. Professional Paper 152: Geography, Geology and Mineral Resources of Part of Southeastern Idaho. By George Rogers Mansfield. With Descriptions of Carboniferous and Triassic Fossils, by G. H. Girty. Pp. xiii+453+70 plates. 2.40 dollars. (Washington, D.C.: Government Printing Office.)

Spisy Vydávané Přírodovědeckou Fakultou Masarykovy University. (Publications de la Faculté des Sciences de l'Université Masaryk.) Čís. 90: Některé pokusy o geometrických pravděpodobnostech (Quelques expériences sur les probabilités géométriques). Napsal Jos. Bata. Pp. 22. Čís. 91: Propriétés projectives du contact, I. Par Édouard Čech. Pp. 36. Čís. 92: Výklad vzniku krátkých elektromagnetických vln v elektronových lampách, 2 část (An Explanation of the Origin of Short Electromagnetic Waves in Valves, Part 2). Napsal Dr. Josef Sahánek. Pp. 24. Čís. 93: Sur les transformations itérées des variables aléatoires. Par B. Hostinský. Pp. 24. Čís. 94: Klimatická proměnlivost atmosférických srážek a její vztah k Brücknerově theorii (Les variations climatériques des précipitations atmosphériques et leurs rapports à la théorie de Brückner). Napsal Fr. Říkovský. Pp. 60. Čís. 95: Měření termomagnetického longitudinálního efektu potenciálového (De l'effet thermomagnétique longitudinal). Napsal Josef Zahradníček. Pp. 19. (Brno: A. Píša.)

Diary of Societies.

SATURDAY, JUNE 30.

GENETICAL SOCIETY (at the John Innes Horticultural Institution, Merton, S.W.19), at 1.—Annual Meeting.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Leicester). At 2.—Dr. H. Stanley Banks: On the Treatment of Toxic Diphtheria by Large Intravenous Doses of Antitoxin.

At 2.30.—C. H. Bond: On the Effect of Certain Radiated Sterols on the Cellular Constituents of the Blood.

At 3.15.—Dr. G. Brittain Gill: On Calcium Deficiency and its Treatment.

At 5.—Discussion.

MONDAY, JULY 2.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Presentation of Prizes:—Keith Prize—Joint Award—to Prof. T. J. Jehu and R. M. Craig. Neill Prize to Prof. A. Robinson.—Prof. J. R. Wilton: The Lattice Points of a Circle. (*To be read by title.*)—Prof. H. W. Turnbull and J. Williamson: The Invariant Theory of the Quaternary Quadratic Complex. II. The Complete System. (*To be read by title.*)

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

TUESDAY, JULY 3.

ROYAL SOCIETY OF MEDICINE, at 4.—Annual General Meeting.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Dr. E. H. Hunt: The Rock-hewn Temples of Ajanta and Ellora.

FRIDAY, JULY 6.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—F. Gossling: The Geology of the Country around Reigate.—H. A. Hayward: The Geology of the Lower Greensand around Dorking, Surrey.

PUBLIC LECTURE.

THURSDAY, JULY 12.

INSTITUTE OF PHYSICS (in Rooms of the Institution of Electrical Engineers), at 8.—Dr. C. E. Kenneth Mees: Physics in Photography.

CONGRESSES.

JULY 5, 6 AND 7.

OXFORD OPHTHALMOLOGICAL CONGRESS (at Keble College).

July 5.

Prof. Leonard Hill, W. S. Duke-Elder and others: Symposium on The Ultra-violet Ray.

July 6.

Prof. Arthur Thomson: Observations on the Eyes of Birds (Doyne Memorial Lecture).