NATURE

SATURDAY, FEBRUARY 7, 1931.

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3197, Vol. 127]

International Health.

THE report on the Health Organisation of the League of Nations adopted by the last Assembly noted the success which international co-operation can achieve in technical matters. Co-operation in health matters is indeed relatively easy: there are few, if any, vested interests comparable with those which hinder progress in the economic or political fields. Health administrators, in recognising the essential similarity of health problems in different countries and in different areas, and the value to all of the experience of particular administrations, have come to recognise also the responsibility of co-operation and of placing at the disposal of all the special information and experience which some have gained.

The success of international as well as of national health work is, however, so closely connected with economic, financial, and social conditions that to select only one of these factors for study and action would be to invite failure. Such considerations alone would suffice to connect the work of the Health Organisation with the main stream of international co-operation which is developing through the League of Nations.

At a recent session of the Health Committee, Dr. Madsen, Director of the Danish State Serum Institute, who has been chairman of the Committee since its foundation, submitted a memorandum reviewing the present position of the Health Organisation in the light of its ten years' work and suggesting the lines of future development. The very success of this form of international co-operation, and the fact that certain branches of the work are tending to assume a permanent character, make it highly desirable that the work of the Health Organisation should be directed along generally approved lines of policy.

The study and collection of information is a branch of activity of which the Singapore Epidemiological Intelligence Bureau and the compilation of public health statistics are outstanding examples, and represents a phase through which every branch of the League's health activities, including even the activities of its Epidemic Commission in Poland in 1920, has to pass.

Investigations lead in due course to the formation of general opinions and the elaboration of certain principles and recommendations for action. The work of the Permanent Standardisation Commission in establishing and maintaining uniform international standards and methods of testing for serological and biological products is an example of

this stage, which is tending to assume permanency because such work must be continuous in order to keep in touch with developments of scientific technique and thought. Similarly, the lengthy regional studies carried out by the Malaria Commission in Russia, south-eastern Europe, the Mediterranean countries, and in India, as well as in the Mississippi basin, have led to an agreed general programme of anti-malaria measures; while the plans for epidemiological study and administrative action which are now under discussion will require at least three years to complete. The Sleeping Sickness Commission has already made some progress in the study of a disease which has hitherto defied the independent national efforts of African administrations, but a considerable period of international study and co-operation will undoubtedly be required before sleeping sickness can be brought under adequate control in tropical Africa. The Leprosy Commission, after a preliminary world survey of leprosy conditions, has, however, only just commenced its real work; and even certain partial studies, such as those on scarlet fever and diphtheria, are yet incomplete.

Such scientific work and the continuous liaison work with health administrations, notably the system of interchanges or study tours for public health officers, are, of course, the main feature of the work of the Organisation. Their development must inevitably tend to stress the third stage of activity of the Organisation, the initiation of action upon the lines indicated by the data obtained.

Primarily, of course, action is a matter for the individual health administrations, but in recent months the Governments of Greece, Bolivia, Bulgaria, and China have all sought the technical advice and assistance of the League Health Organisation in elaborating plans or policies for health reconstruction work. One of the chief developments of the Health Committee's work will undoubtedly lie in its collaboration with Governments seeking technical advice, and in the elaboration of a suitable administrative and medical technique.

The advisory opinions given in this way represent essentially a declaration of the present state of knowledge and practice in particular fields of public health. They are based on the pooled knowledge and experience of leaders in public health and medical research, and are, as Dr. Madsen points out, needed in a number of fields of investigation at the present time. Notably this is true in regard to maternal and infant welfare. The infant mortality inquiry has led to the collection of a large amount of information, and a general report on the subject would be invaluable, not only to the South American States who extended the scope of inquiry at the Monte Video conference, but also to other countries anxious to organise national campaigns against infant and maternal mortality.

Here, as in the case of such social diseases as cancer, rheumatic fever, heart disease, against which sanitary administrations have been compelled to take action in the last two decades, an analysis of the reasons which have led different countries to adopt specific measures, the determination of the degree of agreement existing on such measures and of the points where diversity of practice suggests further investigation, would be of very material assistance. A series of reports of this type, properly prepared, would set out in detail the modern practice of preventive medicine and should furnish a basis for the study of the relations between public health services and health insurance.

Similarly, the survey of medical schools and education in which the Organisation is assisting in China is another field which cannot be omitted from the programme of the Committee, if its studies of public health conditions are to be complete, and this is notably true in regard to Colonial administration.

The growth and success of the International Health Organisation are of outstanding interest to all who are concerned with scientific progress. The Organisation represents a definite advance in international scientific co-operation. There seems to be no inherent obstacle to the development of international co-operation along similar lines by other scientific workers. There are, indeed, indications that this is a most hopeful line of advance by which scientific workers can assume their responsibilities of leadership. An international scientific organisation, as the experience of the Health Organisation demonstrates, is able to express a technical or scientific opinion which is too important to be disregarded and accordingly receives due consideration with the economic, financial, social, or political factors involved.

The lack of administrators qualified to evaluate scientific as well as other factors involved in social, political, and economic problems has been responsible for many of society's most acute problems to-day, and has not been without effect upon the course of the rationalisation movement in industry. It is at least possible that the development of international co-operation of the character represented by the League's Health Organisation may assist in the production of this much-needed type of administrator.

The Significance of the Seventeenth Century.

The Seventeenth Century. By G. N. Clark. Pp. xii + 372. (Oxford : Clarendon Press ; London : Oxford University Press, 1929.) 15*s.* net.

THOSE who remember the brilliant chapter by Prof. Whitehead on "The First Physical Synthesis", in "Science and Civilization" (Unity Series), will rejoice greatly in Mr. G. N. Clark's volume. Prof. Whitehead said that 1642, the year of the death of Galileo and the birth of Newton, was one of the crucial points in the history of mankind. It marked "the centre of that period of about 100 years during which the scientific intellect of Europe was framing the synthesis which has remained down to our own times the basis of science. . . . Our modern civilization is due to the fact that in the year when Galileo died, Newton was born. Think for a moment of the possible course of history supposing that the life's work of these two men were absent. . . ."

Now Mr. Clark, without labouring the point or even expressly announcing it—for he does not seem to have noticed the striking coincidence of the dates—yet manages to provide, in a masterly survey of the whole field, abundant and conclusive evidence of the truth of Whitehead's remark. On all sides of life in the Western world the seventeenth century saw the growth of the new spirit of inquiry, observation, synthesis, and, above all, measurement, which are the marks of science and of which Galileo and Newton were the greatest exemplars. The great personal interest of Mr. Clark's book lies in the fact that he comes to this conclusion without *parti pris*, as a professional historian trained rather on literary than scientific lines, but with an open mind and a supreme impartiality. His book surveys the century from all points of view under topics, and without the accustomed political framework. Politics and literature, of course, find their place, but only as two of twenty main subjects into which the matter is divided. One might have thought that this would render reading less easy, but it is not the case. The style and the selection and arrangement of the matter are so good that interest never flags.

The chapters on science, philosophy, and other more specially intellectual things, do not take the first place, but we are led up to them through an account of the population, industries, constitutions, armies, navies, and colonies of the nations of Europe. Then, near the end of the book, we reach the characteristic and most active force of the age, the scientific mind. There is no attempt to press the connexion unduly or over-simplify the problem, but we see the same awakened intellect which in the outlying departments of practical life was ordering the national States, regularising armies, arranging postal services, and measuring and counting political and social facts, engaged at the centre in the supreme philosophic task of putting together the facts of the universe. Undoubtedly, all these things are interconnected, and Mr. Clark often shows the same man engaged both in purely abstract and in practical work, as Newton in the Mint or Grotius as ambassador. What is so refreshing about his presentation is the attempt to give the whole in a manageable shape, allowing the salient points to appear above the details. Of these points, two are most obvious, science and organisation. We have spoken of the former ; the latter is equally pervasive.

The seventeenth century first made prominent in the West the tendency to knit society together, first nationally and then internationally, after the dispersive effects of feudalism and the religious wars of the sixteenth century. Collective thought and action are the pre-eminent human qualities, and, on a certain plane and with certain intellectual presumptions, the Catholic Church had been achieving unity for many generations. From the fourteenth century onwards, however, this work had been done more and more feebly and was at last completely interrupted. The independent national sovereign States then began to take it up in a more drastic and comprehensive way. Each State began to bring together, organise, and regulate the lives of its citizens with a thoroughness which an international Church had never been able to secure.

Mr. Clark exhibits for us the various spheres in which this activity was exercised by monarchs who, for this time and this purpose, needed to be practically absolute. Hence arise the new and increasing standing armies, the organisation of government posts, the regulation of industry, the control of religion and education. But, although the direction was largely governmental, it was by no means entirely so, and less in England and Holland than in other countries. Combined effort of a more spontaneous kind was also a feature of the times, which saw the rise of joint stock companies and the great trading companies for exploitation abroad, such as the East India Company and a host of others, mainly English, French, and Dutch. Though these and other activities were at that time and long after mainly national and aggressive towards other nations, we may trace the beginnings

of combination between nations in such spheres as diplomacy and international law; while, as Mr. Clark reminds us, the end of the century witnessed the first definite joint consciousness of the West as against Turkey and the East since the Crusades.

The eighteenth and nineteenth centuries were to see both these movements worked out to their logical conclusion. First England and France and then England and Germany were to fight to the point of exhaustion for colonies and maritime supremacy, while the forces of co-operation were gathering strength behind the scenes. Our own times have seen the tragic outcome of the first process and the final apotheosis of the second.

Mr. Clark has not written with any propaganda in his mind, and for that reason the moral shines out the more clearly from his pages. Readers of this review will turn with special pleasure to those parts of his book where he describes the beginnings of the apparatus which was ultimately to re-establish the broken contacts of the Middle Ages and make them stronger and more universal. They will remember with gratitude that it was a man of the seventeenth century, Huygens the Dutchman, at home both in Paris and London, who gave as his English motto, "The world is my country, to promote science my religion." F. S. MARVIN.

American Coal Mining.

Transactions of the American Institute of Mining and Metallurgical Engineers (Incorporated). Coal Division, 1930: containing Papers and Discussions presented at Meetings held in New York, February 1928, February 1929, and February 1930. Pp. 724. (New York: American Institute of Mining and Metallurgical Engineers, Incorporated, 1930.) 5 dollars net.

THE American Institute of Mining and Metallurgical Engineers is one of the most important learned societies in the United States, and its *Transactions* have for many years taken very high rank amongst the world's technical publications. Until quite recently, the *Transactions* took the form of one or two annual volumes, covering all branches of mining and allied technology, but recently a system has been introduced of collecting all papers dealing with one specific branch of the subject into one volume and publishing this by itself. The present volume is the first volume of this kind, dealing exclusively with coal mining, and is the outcome of the papers and discussions presented during the years 1928, 1929, and the early part of 1930.

It is quite natural that with the increase of complexity which characterises modern methods in nearly every subject, increased specialisation has become necessary; one outcome of such specialisation is the subdivision of the *Transactions* of the American Institute of Mining and Metallurgical Engineers into a number of separate divisions. This system has its drawbacks as well as its advantages. In the older volumes were to be found papers dealing with every branch of the whole wide subject, and an engineer interested in one section only, who turned over the volume to find papers on his special branch, could scarcely help seeing the others; he might even be induced to read them, and would probably find that every paper, however remote its subject might appear to be from the particular subject upon which he was engaged, would, nevertheless, throw some new light upon it and prove of some assistance to him. This advantage he now loses under the new method. His knowledge of the individual subject may, no doubt, become more profound than it was, but he necessarily loses that breadth of outlook which is one of the most valuable qualities that an engineer can cultivate.

Persistence in the method symbolised by the volume now before us would undoubtedly lead gradually to the separation of coal mining from metalliferous mining, a separation from which engineers in Great Britain have suffered for long, owing in their case to statutory requirements. The result has been that in Great Britain coal mining engineers were, generally speaking, ignorant of what was being done in metal mining, and vice versa, and appliances devised for use in one branch of the industry might remain for years unknown to the other, although it would be quite capable of finding useful application therein. A case in point is the use of tables of the Wilfley type, devised originally for the dressing of ores in a relatively fine state of division. Such tables have proved to be equally useful for the cleaning of small coal, but it was many years before British coal mining engineers learnt anything about the capabilities of such tables and attempted to apply them to coal mining needs.

The volume under notice gives a useful epitome of the coal mining problems to-day in the United States and of the methods adopted for solving them. There are, in all, some forty-four papers; ten deal with coal mining, covering such subjects as ventilation, subsidence, and misfires; there are four papers on coal cleaning, three papers on coking, some nineteen papers on the classification

of coal, and a number of miscellaneous papers, including several which deal more especially with the methods of coal analysis. It will be seen at once that the field covered is a wide one, and that the information contained in this volume is likely to be of great value to all coal miners, not only in the United States but also in Great Britain.

We in Great Britain have already learnt a great deal from our coal mining friends in the United States, especially in matters relating to the mechanisation of collieries and the replacement of manual labour by mechanical appliances. In the present serious condition of the British coal mining industry, it is quite evident that we shall necessarily have to progress much further along the same road, and British coal mining engineers will no doubt welcome the opportunity which this volume affords of learning how American coal miners are attacking problems which, after all, are more or less the same for both countries, although, having regard to the differences in natural conditions, they can never be quite identical. In Great Britain, where, as already pointed out, coal mining and metal mining are necessarily separated from each other by a legislative barrier, a volume devoted entirely to coal mining will, no doubt, be welcome and will prove a great advantage. Whether the artificial setting up of such a barrier in the United States, which this volume indicates, will be equally beneficial to American mining engineers may, for the reasons already stated, be open to doubt.

Quantum Mechanics.

(1) *An Outline of Wave Mechanics.* By N. F. Mott. Pp. vi + 156. (Cambridge: At the University Press, 1930.) 8*s*. 6*d*. net.

(2) *The Physical Principles of the Quantum Theory.* By Prof. Werner Heisenberg. Translated into English by Carl Eckart and Frank C. Hoyt. (The University of Chicago Science Series.) Pp. xii + 186. (Chicago: University of Chicago Press; London: Cambridge University Press, 1930.) 8*s*. 6*d*. net.

(3) *Quantum Chemistry: a Short Introduction in Four Non-Mathematical Lectures.* By Prof. Arthur Haas. Translated by L. W. Codd. Pp. ix + 77. (London: Constable and Co., Ltd., 1930.) 6*s*. net.

THE new theories of physics grouped under the title of 'quantum mechanics' are at present passing through a further stage in their development, in which the expositor is following close on the heels of the original investigator. It is all to the good to have these less technical and less involved accounts of the theories.

(1) Mr. Mott, who is lecturer in theoretical physics in the University of Manchester, has written a book which will be of great value to a student who has completed an honours course in physics and wishes to understand the principles of wave mechanics. Employing mathematical methods which should be familiar to such students, the author seeks to expound the general principles of the new quantum theory. Extensive use is made of analogies from different branches of physics, and the result is a book which may be recommended to the advanced student of experimental physics and to the research worker. It seems strange that the name of de Broglie is not mentioned on the first page along with the names of Heisenberg, Schrödinger, and Dirac, but the author makes amends on page 8 by calling the waves which represent certain of the properties of electrons de Broglie waves. The purely symbolic character of these waves is insisted on from the outset, the fundamental assumption of wave mechanics being that our knowledge of the position and velocity of any particle can be represented by a wave. "All that can be known about the electron in a hydrogen atom is summed up by the behaviour of a wave."

(2) As Prof. A. H. Compton remarks in a foreword to this English edition of Heisenberg's work: "The 'uncertainty principle' has become a household phrase throughout our universities, and it is especially fortunate to have this opportunity of learning its significance from one who is responsible for its formulation". In all experimental methods of making measurements of small scale phenomena there are limitations imposed by the interaction between the process of measurement and the measuring instrument, and it is the formulation of these limitations which constitutes the principle of indeterminacy. The book is by no means an easy one to read, but there is no doubt that it will take an important place as an authoritative statement of Heisenberg's views on this aspect of the quantum theory.

(3) In this book Prof. Haas gives a short account of modern quantum theory in the form of four lectures for chemists. In the first lecture he deals with the arithmetic of the periodic classification and describes the four quantum numbers required for the interpretation of line spectra. The second lecture is concerned with the quantum theory of valency and chemical forces. After an account

of London's theory of chemical combination, the difference between heteropolar and homopolar compounds is explained. A digression on the subject of wave mechanics is followed by the hypothesis of Heitler and London that homopolar compounds of elements are due to the coupling by means of resonance of two similar atoms. The third lecture is concerned with electron grouping and the periodic system, and is based on Pauli's principle. The last lecture is of special interest, for in it the author discusses quantum problems of molecular and nuclear structure. We find that the new mechanics gives an interpretation of radio-active disintegration as a chance phenomenon without any special hypothesis. This gives us a beginning of a quantum theory of the nucleus. This all too brief volume provides a convenient summary of recent theoretical work.

Inorganic Chemistry.

A Text-Book of Inorganic Chemistry: for University Students. By Prof. J. R. Partington. Third edition. Pp. viii + 1083. (London: Macmillan and Co., Ltd., 1930.) 15*s*.

THE third edition of this excellent text-book will be as welcome as were its predecessors. Compared with the first issue, which appeared in 1921, the biggest change made is the substitution of the original last chapter, which dealt with the radio-elements and atomic structure, by one of about three times its length, which is inserted earlier in the work, immediately after the elementary treatment of the Periodic Law. Commencing with cathode and positive rays, this new chapter (xxv. —The Structure of the Atom) introduces the conception of isotopes, proceeds to discuss in turn X-ray crystal analysis, atomic numbers, and radio-active phenomena; touches on the Rutherford-Bohr conception of the atom and the artificial disintegration of elements; deals with the octet theory of G. N. Lewis, different types of linkage, and quantum numbers; and concludes by a discussion of atomic structure, the periodic table, and valency, reference being made, *inter alia*, to the work of Grimm and of Fajans, and to wave mechanics.

The book as a whole remains essentially as before, and displays all those qualities of clear, concise, restrained and yet fresh treatment which have justly led to its wide popularity in recent years. The historical notes in the earlier chapters are particularly attractive, and the sponsorship of the author is a guarantee of their accuracy.

The detail has been brought up-to-date—thus, the oxides of bromine and of fluorine, chlorine fluoride, and chlorine hexoxide are mentioned. Brief reference is also made to such matters as the connexion between energy and mass, cosmic rays, ortho- and para-hydrogen, atomic hydrogen, active nitrogen, the adsorption theory of Langmuir, the shapes of molecules, the Debye-Hückel theory of strong electrolytes, and the quantum theory of specific heats.

Opinions will differ as to the desirability of the mention of, at all events, some of these topics, as of those in Chapter xxv., in what is designedly a relatively elementary book, even when admitting that a judicious use has been made of small type (which, incidentally, has helped to keep the size of the volume sensibly as in previous editions). With intelligent students *and* teachers, there should be no trouble; in other cases, there is an obvious danger that, when used as "a reference book for higher forms in schools", a type of instruction in chemistry may be fostered which university teachers are practically unanimous in deploring. There are few other points open to any criticism. The statement, however, on p. 198, that the photochemical union of hydrogen and chlorine "when once started, goes on spontaneously", is misleading if taken away from its immediately preceding context.

Our Bookshelf.

Forestry: a Study of its Origin, Application and Significance in the United States. By Prof. Arthur B. Recknagel and Prof. Samuel N. Spring. Pp. xii + 255 + xxxvii. (New York and London: Alfred A. Knopf, 1929.) 10*s*. 6*d*.

IN this book, the two authors, well-known members of the staff of Cornell University, set out to discuss the present-day economic problems of the forestry question in the United States. They state that they were encouraged to undertake the work by "the tremendous interest which many people have taken in the country's forestry problem, and by the need of orienting the public, particularly the younger generation in schools and colleges, in the important economic aspects of this problem". These words might equally well have been written for Great Britain, with the exception that instead of having the forestry problem restricted to one country, ours is scattered all over the world, the most important work being outside the small island of Great Britain.

The book under review is in no sense intended as a compendium of forestry information: nor is it a manual of methods. Its sub-title explains the aims of the authors. Some of the economic problems of present-day forestry are common to many parts of Europe, the biggest one being the question of the possible shortage of coniferous softwood supplies. The position of the United States, that great

exploiter of coniferous forests during the past half-century, is well known in this respect. Inter-State imports have been proceeding for some time past, and the United States will for some decades to come import forest produce on an increasing scale. From the British point of view, perhaps the first two chapters of this book will prove of greatest interest. The first, " How Forestry came into being ", gives us an excellent summary of the various stages the forests and forestry in the United States have passed through since their utilisation by the white man first commenced. In the second chapter we are shown how the early movement towards forest protection and conservation ran parallel with the immense economic development of the forest industries, the merging of these two great movements being discussed in subsequent chapters. The second half of the book deals with the introduction of principles and methods of forestry with the advent of the trained forester, with education and research, and the real status of forestry in the United States administration. The authors may be congratulated on the way they have handled their material and presented it to the public.

Beiträge zu einer einheitlichen Auffassung gewisser Chromosomenfragen: mit besonderer Berücksichtigung der Chromosomenverhältnisse in der Spermatogenese von Alydus calcaratus *L.* (*Hemiptera*). Von Enzio Reuter. (*Acta Zoologica Fennica*, 9.) Pp. viii + 487 + 8 Tafeln. (Helsingforsiae: Societas pro Fauna et Flora Fennica, 1930.)

THIS work is a careful cytological study of spermatogenesis in a Hemipteran insect, but it is much more; for it includes a discussion of literature in all the related fields of plant and animal cytology. After some sixty pages giving a critical account of spermatogenesis in this insect, the remainder of the volume is devoted to a discussion of such questions as the structure of chromosomes, hypotheses of chromosome phylogeny, chromosome persistence and composition, the 'resting' period between mitoses, chromosome splitting, the method and meaning of chromosome conjugation, the nature of genes, and other questions. The views and observations of others are freely cited, making the work a very useful one in comparative cytology.

The questions considered are much too numerous to discuss here, but it may be mentioned that in the spermatogonial nuclei of *Alydus* the chromosomes split in the prophase. The somatic number is 13, consisting of five pairs of ordinary autosomes of different sizes, one pair of micro-chromosomes, and the *X*, which, as usual, becomes compact at an early stage. The oogonial divisions show two *X*-chromosomes.

Some of the drawings of chromosomes are made from the living cell. There is no continuous spireme or bouquet stage, but the long chromosomes in meiosis pair laterally, beginning at one end, to form five gemini. Remaining attached at one end, they afterwards diverge until they are end-to-end and then split lengthwise. Before reaching their definite shape in diakinesis, they pass through characteristic extended (chromomere) and diffuse stages. But it is strongly emphasised that from the last spermatogonial telophase to diakinesis all the chromosomes maintain strict genetic continuity as separate and distinct individuals. The *X*-chromosome is seen *in living cells* to be composed of four segments.

All biologists wishing a critical summary of the present position on these cytological questions will find this work useful. The bibliography alone occupies more than a hundred pages. R. R. G.

Einführung in die Bodenkunde der Seen. Von Einar Naumann. (*Die Binnengewässer: Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten*, unter Mitwirkung von Einar Naumann und herausgegeben von August Thienemann, Band 9.) Pp. ix + 126 + 7 Tafeln. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1930.) 16 gold marks.

THE part of " Die Binnengewässer " before us deals exclusively with lake bottoms. It is a large and interesting subject and very thoroughly handled from all aspects. The study of fresh waters as undertaken at the present day is a comparatively recent branch of science, and there has arisen, with its growth, a number of new terms, mostly introduced by the Swedish school at the Limnological Laboratory, Aneboda, of which Dr. Naumann is director. This laboratory is a model for all such fresh-water research. Most of these terms have come to stay, although many of them have no English equivalent. Good definitions are given throughout the work. The chapters deal with the development and origin of the various bottoms, their layers and zoning, principles and methods of sampling, with descriptions of apparatus; the botany and zoology of the layers, including bacteria; and the organic and inorganic deposits. All these are carefully classified and described. *Bodenkunde* is the study of the origin, qualities, and changes of the bottoms. In it, geology, zoology, and botany are all involved, besides physics and chemistry. It is an extremely important part of the larger and wider study of fresh waters in general. This volume is indispensable to all those engaged in such researches, and is one of the most interesting of the series. It is illustrated by photographs, maps, and text figures which are good and well selected.

A Century of Wood Preserving. Edited by Sir Harold Boulton. Pp. x + 150 + 3 plates. (London: Philip Allan and Co., Ltd., 1930.) 8*s.* 6*d.* net.

AT the present time, when a renewed interest in the scientific study of wood preservation is being shown in Great Britain, it is well to recall that this country was a pioneer in this work, and the method of forcing antiseptics into timber by means of pressure in a cylinder was patented by Bethell so early as 1838. " A Century of Wood Preserving ", edited by Sir Harold Boulton, contains the substance

of a paper read in 1884, before the Institution of Civil Engineers, by his father, Mr. S. B. Boulton, who gave a complete and valuable survey of the progress made up to that date. An account of the discussion which followed is reprinted and makes interesting reading, reminding us that the theory of the action of preservatives which was attributed to the coagulation of albumen was not yet dead at that date.

Recent developments are briefly summarised by Mr. Hubert Fergusson, and in the numerous appendices are reprinted some of the original patents and early papers referring to the action of preservatives. The history of wood preservation has been one of trial and error, but advance must always be slow in work where results from practical experiments do not become available for many years. Accurate scientific investigations are now beginning to take the place of empirical conclusions which have long been accepted as facts. The experience of the past is apt to be forgotten, and the volume under review is of value in recalling to us the work achieved and the considerable knowledge of the subject that had been gained half a century ago. The name of Boulton has long been associated with the progress of wood preservation, and it augurs well for the success of the newly formed British Wood Preserving Association that its first president should bear the name of the editor of this book.

The British Journal Photographic Almanac and Photographers' Daily Companion, with which is incorporated The Year Book of Photography and Amateurs' Guide and The Photographic Annual, 1931. Edited by George E. Brown. Pp. 748 + 64 plates. (London: Henry Greenwood and Co., Ltd., 1931.) Paper, 2*s*. net; cloth, 3*s*. net.

BESIDES the usual epitome of progress, formulæ, tables, and miscellaneous information, this volume includes concise essays on the makers of photography, modern enlarging, and colour photography, with a note on bromoil. The "Makers of Photography" is by the editor, and is a history of the development of photography from the earliest times up to approximately 1890, though, as might be expected, the last twenty or so years of the period is very sketchily done. The value of this article lies in the history of the earlier periods, practically the first half of last century, as certain items which have only recently come to light are duly incorporated for, we believe, the first time. The other articles also are excellent summaries of the subjects with which they deal.

The advertisements, which are a very valuable section of the work, show what great advances have been made in the development of the apparatus for cinematography. Lenses are now provided for it up to the extraordinary aperture of *f*/1, and cameras costing from a few pounds up to £250 or more.

The "Gravure Pictures" are not of scientific value; but a considerable number appear to us to have been made from very much under-exposed negatives. However, that appears to be the fashion at present.

Photo-electric Cells and their Applications: a Discussion at a Joint Meeting of the Physical and Optical Societies, June 4 and 5, 1930. Editor: Dr. John S. Anderson. Pp. 236. (London: The Physical and Optical Societies, 1930.) 12*s*. 6*d*.

A descriptive account of the discussion on photo-electric cells arranged by the Physical and Optical Societies appeared in the issue of NATURE for June 21, 1930. This volume contains the original papers contributed by various authors, together with the general discussion which took place at the meetings at the Imperial College of Science and Technology. The subject affords an excellent illustration of the importance of research in pure science, as few of the original workers in the subject of photo-electricity could have anticipated the various technical applications which have arisen in connexion with their discoveries. Not only in photometry, but also in connexion with such diverse problems as talking films and photo-therapy, photo-electric cells have been employed, and the successful solution of the problem of television is probably to be found through their use. The relative merits of different types of cell provided material for much discussion, but as the sensitivity of a cell is largely a matter of definition, no general agreement was reached. It is probable that the rivalry between the alkali metal cell and the selenium cell will continue, as each type seems to possess advantages for special purposes. Although theoretical questions were not the main subject of the discussion, some interesting papers were contributed dealing with the theory of photo-electric action, notably Dr. N. R. Campbell's paper on selective photo-electric emission.

The American Annual of Photography, 1931. Vol. 45. Edited by Frank R. Fraprie. Pp. 292 + Ad. 64. (Boston, Mass.: The American Photographic Publishing Co.; London: Sands, Hunter and Co., Ltd., 1930.) Paper, 7*s*. 6*d*.; cloth, 10*s*. 6*d*.

OF the twenty-nine literary communications to this 'Annual', we note specially Dr. Wightman's discourse on "Light and Matter", in which he traces the history of the subject and describes the theories at present held, and Dr. Maximilian Toch's "Scientific Photography of Oil Paintings". Dr. Toch demonstrates by examples that experts cannot judge of the condition of a painting from a photograph of it, "because it depends entirely upon how the photograph was taken as to whether the picture appears good or not". He gives some of the results of his prolonged experience. Mr. Neblette, as in previous years, contributes a review of the progress in photography for the past year. The very large number of formulæ given are for the most part set forth in convenient tables, which save space and facilitate reference and comparison. As the illustrations claim to be pictorial, we hesitate to remark upon them; but the under-exposure in many cases, and in some a slaty fog that covers the whole and is particularly conspicuous by artificial light, do not commend themselves to us as good photography.

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.*]

A Method of Measuring Upper Atmospheric Ionisation.

THE experimental investigation of the electrical structure of the upper atmosphere by means of wireless waves as the exploring agency has shown that there exist two main ionised regions from which such waves may be reflected. The lower of these regions is the Kennelly-Heaviside layer, which reflects long waves in long-distance transmission. The upper region is found to be much richer in ionisation than the lower, so that if we project vertically upwards waves of gradually increasing frequency (and therefore gradually shorter wave-length) we find that, at a certain critical frequency, the lower region is just penetrated and reflection takes place from the upper region.

In experiments carried out during the last twelve months it has been found that the value of this critical frequency is surprisingly definite and therefore can be taken as a measure of the ionisation content of the lower region.

The relation between the critical frequency f and the value N of the maximum number of electrons per cubic centimetre can be derived as follows: Waves sent into a medium of gradually increasing ionisation are reflected at a region where the refractive index μ tends to zero. For a magneto-optical medium such as the upper atmosphere, I have shown (*Proc. International Union of Radio-Telegraphy*, vol. 1, part 1, 1928) that such conditions are reached for any direction relative to the earth's magnetic field H_0 when

$$\text{either} \qquad \mu^2 = 1 - \frac{\frac{Ne^2}{\pi m}}{f^2 + \frac{1}{3}\frac{Ne^2}{\pi m}} = 0,$$

$$\text{or} \qquad \mu^2 = 1 - \frac{\frac{Ne^2}{\pi m}}{f^2 \pm f f_H + \frac{1}{3}\frac{Ne^2}{\pi m}} = 0,$$

according to the polarisation of the waves. Here e and m are the electronic charge and mass, and f_H is equal to $\frac{H_0 e}{2\pi mc}$. The results of an experimental study of the polarisation of downcoming waves (*Proc. Roy. Soc.*, A, vol. 117, p. 576; 1928) lead us to adopt the second equation with the upper sign for ff_H. The relation between the maximum electronic content N and the critical frequency is therefore

$$N = \frac{3\pi m}{2e^2}(f^2 + f f_H).$$

In experiments carried out between the emitting station at the National Physical Laboratory, Teddington, and receiving stations at King's College, London, and the Radio Research Station, Datchet, a technique has been developed which permits one determination of the critical frequency in a period of an hour, and we have reason to believe that, with still more experience on the part of the observing personnel, this period can be reduced to half an hour.

A recent twenty-four hour run using this method has shown that for a mid-winter day over southern England the value of N reaches $2{\cdot}0 \times 10^5$ electrons per c.c. at noon, after which the value falls steadily and remains at the low value of 3×10^4 during the greater part of the night. About half an hour before sunrise a very sharp increase is noted, after which the ionisation increases more gradually until the maximum midday value is again reached. The noon value of ionisation is thus found to be more than six times the midnight value.

The diurnal variation curves bear a pronounced resemblance to theoretical curves deduced by Prof. S. Chapman (*Proc. Phys. Soc.*, vol. 43, part 1, p. 26, Jan. 1931) for a case of atmospheric ionisation by monochromatic radiation.

The experiments have been carried out as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.

Wheatstone Laboratory,
King's College,
London, W.C.2, Jan. 18.

The Meaning of Existence.

OTHERS perhaps besides myself may have regretted that the recent correspondence between Sir Oliver Lodge and Sir James Jeans should have closed just at the point at which questions were raised by it that go far beyond the actual issue between these distinguished physicists, and yet may have an important bearing upon it. Asked whether ether *exists*, Sir James sums up his attitude to the question in the words, "nothing in science seems to exist any more in the good old-fashioned sense—that is, without qualifications; and modern physics always answers the question 'To be or not to be?' by some hesitating compromise, ambiguity, or evasion" (NATURE, Dec. 6).

To those approaching the question from the side of metaphysics rather than of physics, this conclusion is likely to seem one of the most interesting outcomes of present-day discussions as to the status of physical reality. Physics seems here to have arrived by its own path at the position made familiar to philosophers in the last generation: in America by William James in the brilliant section of his "Principles of Psychology" which deals with "The Many Worlds"; in England by F. H. Bradley in the chapter in "Essays on Truth and Reality" entitled "On my Real World". These writers approach the subject from different sides: James characteristically being concerned with 'belief', Bradley with 'reality'; but one point which they have in common is precisely that of Sir James Jeans, namely, that before there can be any talk of existence you must define the world within which it is affirmed—what the logicians call 'the universe of discourse' within which your proposition falls. Is it, for example, the universe of ordinary sense perception, defined by Bradley as that which is "continuous with the felt, waking body", or is it one of those 'sub-universes', as James calls them, though 'super-universes', in some cases, would be a better word—the world, for instance, of history in which Julius Cæsar or of poetry in which Hamlet lives and moves and has his being?

It is, however, not merely a question of different worlds. Within the same world a like ambiguity breaks out. In the world "continuous with the felt, waking body"—the world, for example, of the pen I hold in my hand and the action that moves it—there is the difference between the appearance in time and space, the 'here' and the 'now' and the enduring system of atomic events in the pen, of habits and dispositions

in the movement. If existence means what is all here and now, it is difficult to see in what sense these latter, the essence of which is just not to be all here and now, can be said to exist. If, on the other hand, it means that which appears or expresses itself in what is here and now, it is difficult to see how we can assign more to the here and now than the shadowy form of the really existent. Finally (and this brings us back to what Sir James Jeans has probably in view) we have the difference between the particular and the universal, in the ordinary sense: the difference (to confine ourselves to the physical) between the pen and the law of its mass, where the same difficulty again meets us—the difficulty that has engaged philosophers from the time of Plato to the present day, and has led some of them to deny existence to that which appears to sense except as 'the moving image', or perceptible embodiment of an intelligible essence.

Whether these distinctions throw any light on the controversy as to the existence of ether it is not for a mere metaphysician to say. But it suggests at any rate that while those who maintain its existence may be making a mistake in thinking of it in terms of something that is continuous with the world of the felt, waking body, or as something that can be said to fill space, they yet may be right in insisting that the word stands for an element in that world which the resolution of it into mathematical symbols or 'pointer readings' fails to make intelligible. What is emerging more and more from the treatment of the world of sense perception from a philosophical point of view, is that, do what we can by our constructions, algebraic or other, to express it in conceptual terms, there remains, as a surd, an element of inexpugnable givenness, which must be taken not only as 'existent' but also as the source of the real existence of everything else belonging to that world.

Other questions of interest both to the physicist and the metaphysician are suggested by Sir James Jeans's reply—chief among them the sense in which he would admit the existence of what it has come to be fashionable to call 'values' of which truth, beauty, and goodness are stock examples. Do these, as some things he has elsewhere said seem to imply, occupy a world apart from existing things? Or are they, as Prof. Whitehead insists, a side of them apart from which no intelligible account can be given of them? But this is another story carrying us far beyond the particular point to which the discussion refers.

J. H. MUIRHEAD.

Dyke End,
Rotherfield, Sussex,
Jan. 11.

Meteorological Conditions during the Air Raid on London, Oct. 19-20, 1917.

IN NATURE of Nov. 29, 1930, p. 847, Col. E. Gold, discussing upper air conditions, states that the note under "Historic Natural Events", in NATURE of Oct. 18, 1930, p. 633, gives a misleading impression of the cause of the high winds at an altitude of 10,000-20,000 feet on Oct. 19–20, 1917. A true explanation of the air structure which led to the loss of four German airships is of some importance, though not bearing directly on the loss of the *R101*. In "Aids to Forecasting" (M.O. Geophysical Memoirs, No. 16) types IV. and VI. are listed for Oct. 19 and 20, 1917. The former shows '*lows*' north-west and north-east of the British Isles, and the latter an advancing '*low*' with characteristic pressure gradients. For Oct. 21 the type indicates a deep V. *low*.

Col. Gold is of opinion that although there was no pressure gradient at sea-level, there was a steep west to east gradient at great heights, due to a steep horizontal gradient of temperature also from west to east. Such a wind was a thermal wind only, and surface pressure "had nothing to do with the case". Trustworthy records are meagre, and the argument for the assumed steep horizontal temperature gradient and thermal wind rests mainly upon a record at Ipswich on the forenoon of Oct. 20, which shows an isothermal condition at 4400 metres. The case is discussed by Sir Napier Shaw in his "Manual of Meteorology", part iv., p. 112, and it may be that the record rightly tells of the remnant of a tongue of relatively warm air passing east. The important point, however, is that at the ground there was little or no wind, and with clear skies radiation had full play. There was no convection, and so a characteristic ground radiation fog formed. In other words, there was a temperature inversion in the lowest level, whatever happened above. London had no need of anti-aircraft guns that night. Its citizens slept in quiet, unaware that four of a fleet of eleven airships were overhead, laden with bombs. Nature provided a defence which cost nothing, was noiseless, and thoroughly effective.

The whole story of that great air raid will probably never be made public. Owing to failure of radio and loss of touch with Nauen, the ships went astray. From midnight to 7 A.M. of Oct. 20 they moved south-east instead of east, unaware apparently of drift, unless the course was in error. If there was a northerly wind at 4400 metres it had little or no strength at lower levels, and the airships probably flew low for several hours, seeking to penetrate the fog and locate themselves. What saved London was not the northerly wind at high levels but radiation fog at the surface. For forecasting purposes in connexion with aviation, the likelihood of fog at low levels would seem to be a matter of prime importance.

ALEXANDER MCADIE.

Blue Hill Observatory,
Readville, Mass., U.S.A.

I THINK Prof. McAdie's view of the vital importance of fog in aviation will command general assent, and I am not acquainted with anything contrary to his suggestion that fog prevented the German airships finding their objective on the occasion in question. This, however, does not explain why the airships drifted so far south and failed to return to their bases. The strong northerly winds at great heights, of which the ordinary weather maps of surface conditions gave no definite indication, do furnish a reasonable explanation of this fact.

I do not think the existence of these northerly winds admits of doubt: they were actually observed by pilot balloon in north-east France on the night of Oct. 19, 1917, at a height of 14,000 feet. Nor do I think there is any doubt about the existence of the steep horizontal gradient of temperature: with the distribution of surface pressure which existed at that time, there could not have been strong northerly winds at great heights without a steep horizontal gradient of temperature. The question on which there may be difference of opinion is, whether the northerly winds were the cause or the effect of the horizontal gradient of temperature (if one can speak of cause and effect in connexion with phenomena which must co-exist and which must develop together).

E. GOLD.

8 Hurst Close,
London, N.W.11.

Separation of Bitumen from Bituminous Sands.

THE separation of the bitumen from the Alberta bituminous sands by washing with hot water has been under study by the Research Council of Alberta for a number of years. It has been found that generally good separation can be effected by first thoroughly mixing the bituminous sand with about one-fifth of its weight of a solution of commercial silicate of soda of 2 per cent or less concentration, heating the mixture to a temperature of about 85° C., and then introducing the bituminous sand thus treated into a body of hot water also at a temperature of about 85° C. The bitumen collects on the surface of the water as a froth. Runs through our laboratory separation plant using recently mined bituminous sand of from 10 to 17 per cent bitumen content yield separated bitumen containing 5 per cent or less of mineral matter. However, in spite of careful control of ordinary factors, such as temperature, quantity and concentration of reagents, time of treatment, rate of feed, etc., it has not seemed possible to duplicate results closely. Two batches from the same supply of bituminous sand might give separated bitumens containing 1 and 4 per cent of mineral matter, although care had been taken to separate them under similar conditions.

Last summer we operated a 25-ton per day separation plant at the bituminous sand deposits in Northern Alberta. Bituminous sand from some parts of the quarry acted very badly in the plant and gave poor results. When such material was being run, it was noted that the plant water became distinctly acid. Samples of bituminous sand were collected from various points in the quarry. These were stirred up in from two to three times their volume of water and the acidity of the water noted. The *p*H values varied from 2·5 to 6·4.

At a location some fifty miles distant from our plant a private party was separating bituminous sand by hot water. The separation plant was very crude and no treating reagents at all were being used. Yet separation results were apparently good. Water in which bituminous sand from this location was stirred gave a *p*H value of 6·4.

Supplies of sand from our quarry that had given varying degrees of trouble were brought to our laboratory at Edmonton. It has been found that if, in the preliminary treatment of the bituminous sand, alkali is added until the *p*H value of water in which a test sample of the batch has been stirred becomes 6·4 or higher, the treated material then gives excellent separated bitumen on washing in hot water. A series of runs shows steady improvement in the cleanliness of the separated bitumen as the *p*H value of 6·4 is approached, but little change as this value is passed. Sodium hydroxide and silicate of soda, both singly and in combination, have been used so far.

A preliminary washing of a refractory bituminous sand in cold water has the result of greatly diminishing the quantity of alkali which must be added to bring the *p*H value to 6·4. It also has the advantage of removing clay from the bituminous sand, if clay is present. Clay apparently has a bad effect on separation, as well as causing trouble by fouling the plant water.

The acidity in the bituminous sand is probably due largely to ferrous and ferric salts carried into the bituminous beds by ground water passing through the clayey overburden. Salt incrustations appeared on some parts of the face of our quarry. Analysis showed that this salt accumulation was a mixture of ferrous, ferric, aluminium, calcium, magnesium, and sodium sulphates.

A careful study of the effect on separation of adjusting the acidity of the bituminous sand in the preliminary treatment and of related factors is being made. The detailed results of the study will be published in due course.

K. A. CLARK.

Research Council of Alberta,
University of Alberta,
Edmonton, Alberta, Canada,
Jan. 6.

Nutritive Value of Benniseed.

THE question of the nutritive value of benniseed (*Sesamum indicum*) was recently raised and analyses were carried out in this laboratory. This seed is grown along the Benue River and its tributaries by the various clans of the Munshi or Tiv people. A small amount of it is eaten and a little oil is extracted, but the bulk of the crop is exported, I gather, to Europe for the manufacture of 'salad oil' and the very fine grade machine oil called 'Sesame'. What happens to the 'cake' I do not know.

Analyses gave the following relevant percentages: Oil 52·6, protein 23·4, total ash 4·0, CaO 1·2, P_2O_5 1·39, from seed grown in the Yandev Area of the Benue Province. The Government Analyst, Mr. A. Hobson, has confirmed the calcium oxide percentage, but his phosphoric anhydride figure is 1·13 per cent.

All analyses of Nigerian soils so far carried out—not by this laboratory—show exceedingly poor figures for calcium and phosphorus, and so the percentages of these minerals in benniseed would be sufficiently astonishing on these grounds alone, but I can find no recorded analyses showing a higher calcium content for any food: cheese is 0·9, for example, and only New Zealand spinach and the leaves of the sweet potato seem to approximate to this exceedingly high figure; nor can I find any ash analysis of benniseed itself.

As previous work has shown,[1] the natives of Northern Nigeria suffer from gross deficiencies of calcium and protein in their dietary, and so the importance of benniseed cake is at once obvious. Indeed, measurements of the boys in the Dutch Reformed Church's Mission School at Mkar show clearly, within the limitations imposed by the numbers, that the benniseed-eating Munshi boy is shorter but heavier than the Hausa schoolboy.

There might be an even more important general point. It has become the fashion to discount soil analyses in some nutritional quarters, and to use instead the analyses of the crops that grow on the particular soil. Benniseed grown in the arid north of Katsina Emirate and from French territory contains 1·18 per cent of calcium oxide, and, therefore, it would appear that this plant exercises a strong selective absorptive power for calcium. There is no reason to believe that other plants will not show the same capacity. It might prove of value to soils poor in calcium and phosphorus to plant benniseed to concentrate these minerals, and then to plough in the flowering plant, or the dried plant after the crop has been reaped. I have just been informed that the Munshi women burn the seed-bearing heads, after removing the seeds, and use the ash in their soups. This is a strong hint to analyse the leaves and the stem.

Green manure is firmly established as a way to increase available nitrogen and to prepare humus in arid regions, and so it might be worth while to attempt concentrating minerals in deficient soils, such as Northern Nigeria, by the same method. Such work must have been attempted somewhere, but I am unable to find any reference to it in the limited

literature at my disposal. This letter may serve, I hope, to initiate such experiments, or to bring to our notice in Nigeria work already done.

W. E. McCULLOCH.

Dietetics Research Laboratory,
Katsina, Northern Nigeria, B.W.A.,
Dec. 18.

[1] "An Enquiry into the Dietaries of the Hausa and Town Fulani of Northern Nigeria, with some observations of the effects on the National Health, with recommendations arising therefrom." W. E. McCulloch, *West African Medical Journal*, **3**; 1929–30.

Determination of the Velocities of Projectiles by the Method of Light Interception.

MESSRS. Payman and Woodhead appear to have misunderstood the method described in our letter in NATURE of Dec. 27, p. 994. We made no claim to originality of application of the principle of light interception. Our method does not depend on shadow or ordinary photography, which has been used in ballistics since the time when Boys took his first shadow photographs in 1893, and differs from that used in other optical chronographs (see, for example, Cranz, "Experimentelle Ballistik", **3**, chap. ii., 1927), of which Kampé de Fériet's is one.

Fériet's method consists in taking a continuous photograph of the projectile itself, by ordinary daylight photography, on a plate moving at right angles to the direction of flight. The records show a band at an angle to the direction of motion of the plate. The velocity determination involves the measurement of this angle. There are no discreet interceptions as in our records.

In our method the motion of the film of the camera (which is a simple drum-camera with a cylindrical lens at the shutter, not a 'photographic' camera in the ordinary sense) is parallel to the axis of flight. The projectile eclipses one or more beams of light which are brought to a fine focus (less than one millimetre) on the line of flight, and it is these eclipses or interceptions of the beams by the body of the projectile in flight which are recorded, not the reduced shadow images of the projectile. In Fériet's method there is no 'range' in the technical sense; in our method the 'range' is the accurately measured distance between the two foci of the interception beams on the line of flight. Fériet's camera gives the ratio—velocity of projectile to velocity of plate—whereas our camera simply gives a time interval between the eclipses by the body of the projectile of two fine beams of light placed a known distance apart. The difference is obvious when it is realised that a velocity determination can be made from Fériet's photographs alone, without other data, whereas from our photographs it is not possible to determine a velocity unless the 'range' is known.

Since the publication of our original letter in NATURE of Dec. 27, 1930, we have learned through the courtesy of the Director of Ballistics Research, Woolwich, that a method on the same principle as our own was developed by Thompson, Hickman and Riffolt and published in the *Proceedings* of the U.S. National Academy of Sciences (*Proc.*, **6**, 169, April 1920). These workers utilised a single narrow beam of light, whereas we utilise two finely focused beams: the illuminating and recording apparatus is different but the principle is the same.

JAMES TAYLOR.
ROBERT WARK.

Research Department (Nobel Section),
Imperial Chemical Industries,
Stevenston, Ayrshire.

Embryology and Evolution.

IN the issue of NATURE for Dec. 13, Mr. G. L. Purser gives us an analogy of the modern manufacture of motor cars as a contribution to the solution of the problem of embryonic evolution which is novel and interesting, but far from satisfactory.

The comparison of the function of the hypothetical gene to that of an intelligent workman is but adding to the mystery. Often the workman in the modern factory functions merely as the trigger-release of processes altogether beyond his ken, and subservient to the will and preconceptions of the motor car designer. The more excellent the machine, the less dependent it is upon the control of the workman-intermediary; but however excellent the machine, the sole origin of that excellence lies obscurely hidden in the phenomenon we term intelligence. Devoid of motive power, the most excellent of all machines stands immobile. It cannot move productively unless, again by some intelligence, a motive force is accurately applied, and the moment this force ceases to reach it, the machine stops.

Most of us before we reach the age of ten have learnt that anything which 'goes' is driven by a force external, yet although we live to be a hundred, what a host of us regard with sublime abhorrence the suggestion that the same thing is likely to be true in regard to living cells! We willingly accept the validity of 'kinetic', 'electrical', gravitational', or other forces, but we dogmatically affirm that a 'vital' force is but a bogy from the limbo of fantastic superstition; and so we evoke the genie, perhaps the gene, and by its spell try to account for all we see—with as much success as if we claimed that the revolving flywheel of our motor engine were the real source of its motive power.

Personally, I feel that incredulity of a 'vital' force is scarcely any longer compatible with true scientific observation. Anyone who has studied mitotic division of the cell and is conversant with electro-physical phenomena feels instinctively that he is observing the action of a force strikingly similar to that of the magnetic field. Irradiation with ultra-violet light is found to augment the process of ovulation in the domestic fowl, while the reproduction of fur-bearing animals in northern lands is strangely correlated with magnetic solar radiation.

Entelechy, like the word phlogiston, may be the signpost on the way to a new enlightenment, which will, I predict, ere long result in the acceptance of the view that the living cell is, after all, merely a machine primarily operated by some external force. Even so, let us remember that vitalism and spiritualism are not synonymous. MALCOLM E. MACGREGOR.

Wellcome Field Laboratory,
Wisley, Surrey.

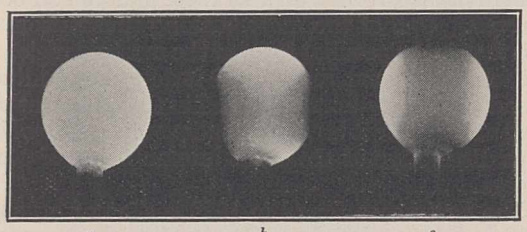
Use of Tungsten Arc Lamps for Photomicrography.

THE uniform intrinsic brilliancy and compactness of the tungsten arc lamp have led to its extensive application as an illuminant for photomicrography. It does not appear to be generally recognised, however, that the light which leaves the metal surface at angles approaching a tangent is so strongly plane polarised that it is difficult to obtain uniform illumination when crystals are being photomicrographed by plane polarised light.

The polarised light emitted at an acute angle to the incandescent metal surface has its vibration direction parallel to that surface. This effect may be shown by projecting an image of the incandescent tungsten sphere on to a white screen by means of a 2-inch objective, and then interposing a Nicol prism

in the beam of light, when the edges of the image parallel to the long diagonal of the Nicol are darker and those parallel to the short diagonal are brighter than the centre of the field. By placing a '1st order red' selenite between the light source and the Nicol prism, the edges of the image appear red or greenish-blue according to their orientation with respect to the prism.

The degree of lack of uniformity of illumination which can result when 'contrasty' photographic materials are used in photomicrography by polarised light, is shown in Fig. 1, *a*, *b*, *c*, which are photographs



a *b* *c*

FIG. 1.

of the tungsten sphere of a Pointolite lamp. Fig. 1*a* was the ordinary appearance in the absence of a Nicol prism, whereas Figs. 1*b* and 1*c* show the appearance when a polarising prism was interposed with its plane of vibration horizontal and vertical respectively.

This effect, which is not given by either a carbon arc lamp or the sun, could give rise to appreciable errors if a tungsten arc lamp were used for spectrophotometry without the interposition of ground glass to form a secondary source.

EDWIN E. JELLEY.

Research Laboratory, Kodak, Ltd.,
Wealdstone, Jan. 14.

A Relation between the Radial Velocities of Spiral Nebulæ and the Velocity of Dissolution of Matter.

I SHOULD like to make the following comments upon Dr. McCrea's remarks in NATURE of Dec. 6, 1930, upon my letter in NATURE of Nov. 8; my comments also apply to a certain extent to Dr. Wilhelm Anderson's letter in the issue of Dec. 6:

(1) As I have shown recently (*Anzeiger der Akad. d. Wiss. Wien*, 1930, No. 16), equation (1) can also be deduced without general relativity theory from the postulate that the total energy of the universe cannot be negative, or that the negative gravitational energy of the universe corresponds in magnitude with its proper energy. By mass in equation (1) Eddington's proper mass is to be understood.

(2) It is true that a negative velocity results, as Dr. McCrea insists; I have, however, indicated this myself in my letter, where I showed that v agrees well with the radial velocity of the spiral nebulæ only in *magnitude*, that is, without reference to sign.

(3) If, again, my equation (2) is to be interpreted from the point of view of Lemaître's theory, with introduction of a temporal variation of λ, then it must not be overlooked, on the other hand, that Lemaître's theory requires further assumptions to make it complete. Such would, perhaps, be necessary to bring the assumption that the velocity becomes greater by $c/2000$ for every million light years' distance in agreement with the other assumption that the initial radius of the universe, calculated to be 1200 million light years, is doubled every 1400 million years, that is, within a time shorter even than the age of many minerals—not to speak of astronomical estimates of the age of the sun. ARTHUR HAAS.

University of Vienna, Jan. 3.

Photographs of John Dalton.

I SHALL be glad if any readers of NATURE can assist me in tracing the present whereabouts (if still in existence) of three original photographs of Dr. John Dalton. These were taken in Manchester, at one sitting, somewhere about the year 1842, by the Daguerre process, then recently introduced into Great Britain, and so far as I know were the only photographs of the great chemist ever made. Their production has been wrongly attributed to John B. Dancer, the fact being that it was through Dancer's good offices that Dalton was induced to sit at the local Daguerre studio.

It is on record that one of the three copies passed to Dalton himself, another to Dancer, and a third to Mr. John Dale, manufacturing chemist. Dancer's passed at the time of the Jubilee exhibition in Manchester in 1887 to Mr. (afterwards Sir James) Dewar, the eminent chemist; I have also seen it stated that another (possibly Dale's) was in the possession of the late Mr. Thomas Kay, manufacturing chemist, of Stockport. There is no trace of such a photograph in the collection of Dalton's apparatus at the house of the Literary and Philosophical Society where he did so much of his work, nor in the more personal relics preserved at Dalton Hall.

Dancer's photograph was lent by him on various occasions to artists and engravers for copying, and became somewhat disfigured in consequence.

Perhaps this letter may meet the eye of someone who has actually seen one of the originals or can assist me in tracing them. HENRY GARNETT.

3 Lea Road, Heaton Moor,
Stockport, Jan. 19.

The Black-necked Grebe.

IN the note upon this bird (NATURE, Jan. 3, p. 35) its generic name is given as *Podiceps*, perpetuating an error in orthography for which, I think, Yarrell was originally responsible and has been followed by some later writers on ornithology. On the analogy of *biceps*, *calviceps*, etc., *Podiceps* can only be translated 'rump-headed'; whereas the right name of the genus is *Podicipes* (Linn.), meaning 'rump-footed', referring to the peculiar position of the legs and feet in birds of the family Podicipedidæ. HERBERT MAXWELL.

Monreith.

WERE all taxonomists as familiar with the classical languages as is Sir Herbert Maxwell, mistakes such as he points out would be rarer; but although they appear in Latin guise, generic and specific names need not be evolved from anything but the author's sense of propriety. The name is a label and need have no meaning in itself. The consequence of that, and of the accepted rule of nomenclature that the first legitimate christening holds the field, is that *Podiceps*, used by Latham in 1789 to designate our grebes, is now the accepted generic name.

THE WRITER OF THE NOTE.

Dimorphism of Long Chain Carbon Compounds.

FROM recent X-ray measurements (Malkin, NATURE, Jan. 24, p. 126) it is claimed that the ethyl esters of fatty acids may have two forms of chain. An account of an investigation of several binary systems of C_{16} and C_{18} compounds will shortly be published, in which it is shown that the ethyl esters are dimorphous, ethyl palmitate melting at 19·4° or 24·15°, and ethyl stearate at 30·9° or 33·4°. J. C. SMITH.

The Dyson Perrins Laboratory,
Oxford, Jan. 29.

The Significance of Peking Man.*

By Prof. G. ELLIOT SMITH, F.R.S.

THE brain-case found by Mr. W. C. Pei at Chou Kou Tien on Dec. 2, 1929, is the most significant and illuminating relic of primitive man ever recovered. Prof. H. Fairfield Osborn, writing in *Science* of Feb. 22, 1929, raises the possibility that Piltdown man may be so old as the Pliocene. He claims that the dark-coloured fragments of the skull of *Eoanthropus* are intermingled with similarly coloured fragments of proboscidian molars of unquestionably Upper Pliocene age, and that it is not certain that *Eoanthropus* belongs to the Lower Pleistocene. In the case of *Sinanthropus*, there is no such uncertainty as to the contemporary fauna, for the human remains were left on the floor of a cave and a vast number of the animals which roamed the region of Chou Kou Tien in these remote times left their bones in the same cave. As all these fossils belong to the same geological epoch, the Lower Pleistocene, there can be no doubt of the age of *Sinanthropus*.

The discovery, at Chou Kou Tien, of fossil teeth of Lower Pleistocene age which were identified as human, had made it evident that at the close of Tertiary or the beginning of Quaternary time man, or a very closely related anthropoid, actually did exist in eastern Asia. This knowledge is of fundamental importance to students of human palæontology. For in the same geological epoch *Pithecanthropus* was living in Java, *Eoanthropus* was roaming the region around Piltdown in England, and at Mauer, very shortly afterwards, the man of Heidelberg, *Palœanthropus*, represented the human family in Germany.

In November 1928 additional remains of human skulls—further teeth, portions of two lower jaws and fragments of brain-cases—were found. The peculiar features of the chin region of these jaws differed from those of all other known human specimens excepting only the Piltdown jaw, to which they present a general resemblance, without being generically identical. There is a similar ape-like obliquity in the slope of the symphysis and traces of the simian shelf in the lingual aspect of the jaw. Not only do these peculiarities emphasise the peculiar features of *Sinanthropus*, but they also afford welcome confirmation to the views of those who regard the Piltdown jaw as human.

The skull discovered by Mr. W. C. Pei was successfully freed from travertine after a labour of four months by Dr. Davidson Black, and then disarticulated and reconstructed. It is important not merely because it gives a much fuller idea of the exact form of the skull of an Early Pleistocene man (free from the doubts which arise in the case of a reconstructed specimen), but also because its peculiar features, revealing as they do many points which suggest an affinity with *Pithecanthropus*, associated in the same skull with others such as are known only in the case of the Piltdown skull, form a bond of union between the other two Early Pleistocene skulls, the characters of which hitherto have been supposed to be irreconcilable one with the other.

In addition to this, the skull of *Sinanthropus* reveals many features which are unknown in either of the other types and throws a great deal of light upon the characters of the common ancestor of the human family, from which all these genera had been derived. One of the most striking illustrations of this fact is the peculiar form of the mastoid region of the temporal bone, recalling as it does the condition found in the new-born child and in the adult anthropoid apes. For it lacks that salient character which is so distinctive of the adult human being of other genera.

The brain-case found in 1929 is that of a young adult corresponding in the state of its development with the condition found in modern human skulls at about eighteen years of age. When the skull was first examined, Prof. Davidson Black was impressed by the grace of its contours in comparison with the uncouth outlines of *Pithecanthropus*, and suggested the possibility that it might be female, with the reservation, of course, that the evidence at our disposal regarding this hitherto unknown type of being was altogether inadequate for any definite decision upon this matter.

The discovery of another brain-case was made in July 1930 by recovering from material brought in from the Chou Kou Tien cave (in October 1929) a series of fragments which articulated naturally one with the other to form the greater part of the calvaria. This discovery of a skull of another young adult of approximately the same age revealed a more lightly built skull with smaller eyebrow ridges, a less prominent forehead, and less obtrusive parietal eminences, which both Prof. Davidson Black and I consider to be probably of a different sex from the other skull.

One of the most remarkable points of contrast between the brain-case of *Pithecanthropus* and of *Eoanthropus* was the remarkable thickness of the latter, whereas the skull of *Pithecanthropus* was much thinner. In the case of the skull of *Sinanthropus* found on Dec. 2, 1929, the thickness of the bone (Fig. 1) approximates to that of the Piltdown skull. Not only does it resemble it in mere thickness, but also the architecture of the cranial vault (which in the case of the Piltdown skull has hitherto been regarded as quite distinctive) is almost exactly reproduced in the case of *Sinanthropus*. In all other known human skulls the cranial bones consist of two fairly thick tables united by a comparatively thin layer of diploic tissue consisting of fine trabeculæ. In the case of the thick cranial bones of both the Piltdown and the Peking skulls, the tables are relatively thinner, and the thicker layer of diploic bone consists of a very robust network of coarse trabeculæ. These similarities suggest that in the thickness and peculiar texture of the cranial bones of two Early Pleistocene skulls of different types

* From the Henderson Trust Lectures (No. 11), delivered in the University of Edinburgh on Jan. 30.

(separated geographically as their habitats were by the whole extent of the continental land mass

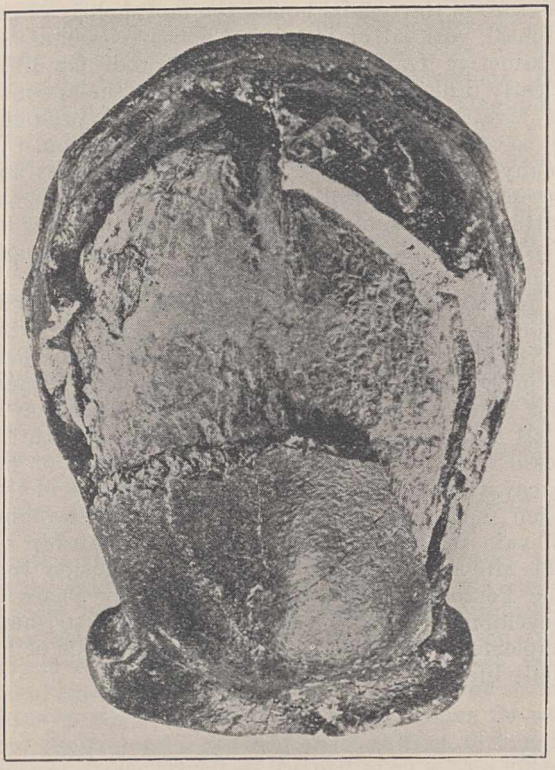


FIG. 1.—Photograph of the upper aspect of the Peking skull with part of the roof removed to display the exceptional thickness of the bones and the small size of the brain cavity, which is occupied by a mass of limestone (travertine). The thickness and texture of the skull reveal an unexpected similarity to the conditions found in the Piltdown skull.

between England and China) we are dealing with characters of primitive man for which no close analogy can be found in the apes. This condition in the Piltdown skull was regarded either as pathological or the result of some freakish mutation. But the presence of the same condition in *Sinanthropus* enhances its importance.

Why the skull of primitive man should attain such an enormous thickness is difficult to explain: but the evidence provides an interesting problem for morphologists to endeavour to solve. Did primitive man's skull increase in thickness because the increase in the capacity of the brain-case deprived an increasing area of the protection of the temporal muscles?

For the moment, when there is no clear indication as to the meaning of this peculiar morphological feature, it is of interest as emphatic evidence of the affinity between *Eoanthropus* and *Sinanthropus* and of the enhanced importance of the structural peculiarity itself. The contrast in thickness between the cranial vault in *Pithecanthropus* and *Eoanthropus* acquires a new interest in view of the fact that the three (adult) skulls of *Sinanthropus* (one of the fragments found in 1928 is thin because it is part of a child's skull) reveal a considerable range that is sufficient to bridge the gap which separates Piltdown man from the ape-man of Java.

The discovery of the two jaws in 1928, presenting as they did features hitherto known only in Piltdown man, raised the possibility that there had been discovered in China a type of human being more closely akin to the Pleistocene man of England than that of the ape-man of Java, who was geographically much nearer to the Peking man. When, however, in 1929 the skull was found (and the base was still embedded in the solid mass of travertine) the striking resemblances of the brain-case (Fig. 2) to that of *Pithecanthropus* suggested that, after all, the newly found genus was more nearly akin to his neighbour from Java. The skull revealed great projecting eyebrow ridges like those of *Pithecanthropus*, which provided a marked contrast to the condition found in Piltdown man, in which such ridges were lacking. The front part of the skull was also flattened and ill-filled, and had a prominent median crest such as that of *Pithecanthropus*. There was this difference in the frontal region of the bone, however, that the frontal eminences were definitely more obtrusive than those of *Pithecanthropus*. Turning to the consideration of the parietal bones, one finds a close resemblance to those of the Piltdown man. This resemblance depends both upon the fact that the bones tended to be raised up towards the middle line and are not so flat as those of *Pithecanthropus*, that there is a very definite parietal eminence such as is completely lacking in the Java skull, and that the postero-inferior corners of the parietal bones are everted in that peculiarly distinctive way found in the Piltdown skull. The occipital bone again presents a much closer resemblance to that of *Pithecanthropus*, and when we turn to consider the temporal bones we find a much more primitive condition of the mastoid and of the tympanic bones than that which is revealed in *Eoanthropus*. Unfortunately the temporal bone of *Pithecanthropus* has not yet been discovered, so that we cannot

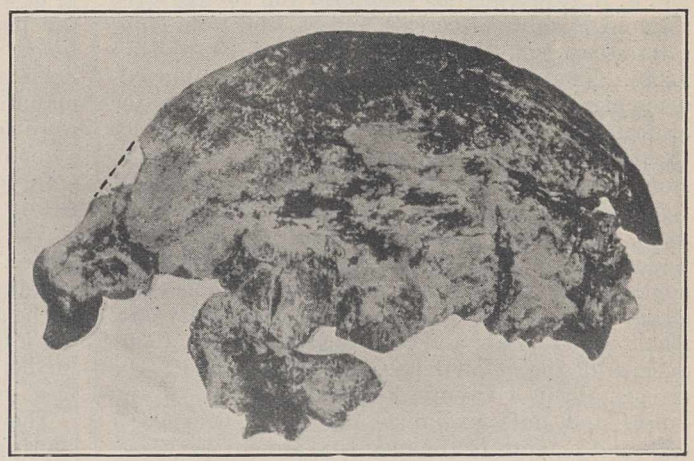


FIG. 2.—The left side of a skull of Peking man found in July 1930. It shows the root of the nose and part of the base of the skull which were not present in the specimen found in December 1929, and it reveals certain minor differences from the other skull which have been interpreted as due to a difference in sex.

institute comparisons between *Sinanthropus* and *Pithecanthropus* in this respect.

One of the most interesting features of the specimen found in 1929, a feature which Dr. Davidson Black inferred from the nature of the wear of the teeth long before the skull was found, is the fact that the condyloid fossa for articulation with the mandible presents a very close resemblance to the condition found in modern man, in size, depth, and direction. This fact is all the more remarkable because in other extinct members of the human family, in particular Rhodesian man and Neanderthal man, there are much more profound differences in the under-surface of the temporal bone. The attainment of the condition which became a permanent factor in *Homo sapiens* suggests that *Sinanthropus* is a primitive generalised type, and that modern man has retained many of these primitive characters.

Looking at the skull as a whole, one can say that its general form is intermediate between the conditions found in *Pithecanthropus* and *Eoanthropus*. It enables us to unite into a solid foundation the characters of the three most primitive members of the human family at present known. In giving coherence to this knowledge it also enables us to picture the nature of the common ancestor of all three, the as yet hypothetical Pliocene man.

The suggestion has been made that the Peking man's distinctive features are not sufficiently pronounced to exclude him from the genus *Pithecanthropus*. The whole configuration of the skull, the texture of the cranial bones, the morphology of the frontal, parietal, and occipital bones, as well as the distinctive features of the teeth and mandible, clearly differentiate Peking man from the ape-man of Java, and present a contrast which is so profound as to compel us to accord it generic distinction. In many respects it differs from *Pithecanthropus* and resembles *Eoanthropus*, but the contrast to the latter is even more obtrusive. It occupies an intermediate position between the two, but is more primitive and generalised than either.

It is a very significant phenomenon that at Chou Kou Tien, in spite of the most careful search in the caves during the last three years, no trace whatever of implements of any sort has been found. It must not be forgotten, however, that Dr. Andersson in 1921 found pieces of quartz in association with the fossil bones, and that in the later stages of the excavation Mr. Pei found further examples of this alien material. Those who have been searching in vain for evidence of human craftsmanship on this site are being forced to the conclusion that the Peking man was in such an early phase of development as not yet to have begun to shape implements of stone for the ordinary needs of his daily life.

Vitamin B.

Distribution and Physiology.

THE general distribution of vitamin B is now fairly well defined, but the adequacy of different food substances in this respect for different species and the distribution of the various factors in the B complex are still subjects for investigation. R. H. A. Plimmer, with W. H. Raymond, J. Lowndes, and J. L. Rosedale, has examined the comparative vitamin B value of cereals, pulses, and nuts (*Biochem. Jour.*, vol. 21, p. 1141, 1927 : vol. 23, p. 545 ; 1929). The preventive method was employed, using pigeons, and the criterion was maintenance for at least 26 weeks. All the vitamins required by the pigeon were therefore included in the estimation; symptoms of deficiency were paralysis and loss of weight. The diets used contained 5 per cent fish meal, white flour or white rice, and the substance under test in varying proportions. Dried yeast contained most vitamin : of the other foodstuffs, wheat germ was about half as good as the yeast, whole wheat, bran, and middlings contained about a tenth of the amount present in yeast, and other cereals about a twentieth. The majority of the pulses and nuts examined contained between a fifth and a tenth of the quantity present in yeast. More vitamin B is required for hatching and rearing young than for maintenance. Chickens require half as much again as pigeons, rats only about half ; the requirements of human beings may be intermediate between those of the pigeon and the rat.

A. L. Bacharach and E. Allchorne (*ibid.*, vol. 22, p. 313 ; 1928) found that the vitamin B content of malted flour was the same as that of the original unmalted flour, but that the malt extract appeared to contain more : the experiments were carried out on rats and the effect is attributed to the improvement in appetite brought about by the extract.

The content of vitamin B in seeds has been shown to be markedly influenced by the manure applied to the plant, by M. J. Rowlands and B. Wilkinson (*ibid.*, vol. 24, p. 199 ; 1930). Two similar plots of grass and clover were manured with an artificial manure and pigs' dung respectively : the pigs were fed on barley meal, middlings, and a small amount of a mixture of meat meal, rye and wheat embryo, bone meal, and cod liver oil. The manured patch produced a heavier crop, containing more clover, but the growth on the dunged patch was bigger. By preventive and curative growth tests on rats, it was shown that the vitamin B content of the seeds from the manured patch was much less than that of those from the dunged patch. In further experiments vitamin B was extracted from pigs' dung by means of alcohol.

There is evidence that lower organisms can synthesise vitamin B or similar growth factors, and that this synthesis may occur also in the intestinal tract in higher animals. Thus, Reader has found that the meningococcus can synthesise a growth factor for a streptothrix, all the vitamin B_1 being previously removed from the medium; and G. L. Peskett (*ibid.*, vol. 21, p. 1102 ; 1927) has shown that yeast can synthesise vitamin B_1. Intra-

intestinal synthesis may be the explanation of 'refection' which has been described by L. S. Fridericia and H. Chick and M. H. Roscoe (see *Lancet*, vol. 1, p. 37 ; 1928). In this condition rats maintained on a vitamin B free diet containing uncooked rice starch passed bulky white fæces, and at the same time were cured of their symptoms and put on weight. The fæces contained abundant vitamin. The condition appeared to depend on the presence of uncooked starch in the diet and a virus in the intestine.

W. R. Aykroyd and M. H. Roscoe (*Biochem. Jour.*, vol. 23, p. 483 ; 1929) have investigated the distribution of vitamin B_2. Wheat and maize were poor sources: the germ and bran of wheat contained more than the endosperm, but maize germ contained less than wheat germ: dried peas also contained little. Dried yeast and ox liver and fresh milk were excellent sources, and egg-yolk and dried meat good. It was possible to cure rats suffering from the dermatitis of vitamin B_2 deficiency, as well as to stimulate their growth.

The physiological functions of the vitamin B complex are incompletely understood: in its absence the metabolic processes of the tissues are imperfectly performed, and investigations have thrown some light upon the details of the defects. Thus the vitamin is related to both protein and carbohydrate metabolism. G. A. Hartwell has found that young rats die, with engorgement of the kidneys, when the synthetic diet contains 20 per cent edestin and 5 per cent yeast extract, although older animals thrived on the diet even with a lower allowance of yeast (*Biochem. Jour.*, vol. 22, p. 1212 ; 1928). Increasing the amount of yeast extract permitted normal growth: the factor responsible was found to be thermostable. Caseinogen and egg-albumin required less yeast extract than edestin for normal metabolism.

H. W. Kinnersley and R. A. Peters have investigated the relation between the lactic acid content of the brain and the symptoms of head retraction in pigeons fed on a diet of polished rice (*ibid.*, vol. 23, p. 1126 ; 1929 : vol. 24, p. 711 ; 1930). Using a special technique, it could be demonstrated that birds showing opisthotonos had more lactic acid in their brains than normal birds, and that this increase was most marked in the parts below the mid-brain and occurred here first at a time when symptoms were threatening. The increase was not observed after cure by a dose of vitamin B_1 concentrate. The symptoms appear to be due to this accumulation of lactic acid, and the fact that it is localised indicates that vitamin B_1 is intimately concerned in the intermediary metabolism of carbohydrates, apparently with the oxidative removal of lactic acid. In this connexion it might be remarked that H. Yaoi found that muscle from polyneuritic pigeons reduced methylene blue more feebly than normal muscle, but that there was no difference in the glutathione contents (*Proc. Imp. Acad. Tokyo*, vol. 4, p. 233 ; 1928). Peters in his Harben Lectures has adduced some evidence that vitamin B_3 may be concerned with the mobilisation of water, and that in its absence together with that of vitamin B_1 œdema accompanies the polyneuritis in its terminal stages.

C. W. Carter and A. N. Drury have examined the nature of the slowing of the heart beat in rice-fed pigeons (*Jour. Physiol.*, vol. 68, *Proc.*, p. i., 1929) : it appears to be due to an overaction of the vagal centres producing a heart block. The condition is cured by whole wheat, so that the factor responsible may be that described by Williams and Waterman.

G. F. Marrian, L. C. Baker, J. C. Drummond, and H. Woollard (*Biochem. Jour.*, vol. 21, p. 1336 ; 1927) noticed changes in the adrenal glands of pigeons starved or fed on rice only, and Marrian has investigated these alterations in more detail (*ibid.*, vol. 22, p. 836 ; 1928). Hypertrophy was found in inanition, even though vitamin B_1 was given, and in vitamin B deficiency, whether accompanied or not by inanition : œdema accounted for half the hypertrophy in inanition. The adrenaline content was increased in the latter condition, but was relatively low in vitamin B deficiency. It appeared that the hypertrophy in inanition affected chiefly the medulla, and in vitamin B deficiency, the cortex of the gland.

It is now well known that vitamin B deficiency is associated with loss of appetite. B. Sure has made a detailed study of the anorexia in the rat and found that it is promptly cured by the administration of a vitamin B concentrate (*Jour. Nutrition*, vol. 1, p. 49 ; 1928). The loss of appetite may be associated with the failure of the gut to empty itself, and a decrease in the digestive secretions. J. L. Rosedale and C. J. Oliveiro (*Biochem. Jour.*, vol. 22, p. 1362 ; 1928) found that in pigeons suffering from beri-beri the pancreas failed to form the enzymes required to digest protein and fat.

It might be expected that animals suffering from vitamin B deficiency would show derangements of the sexual function. H. M. Evans, however, found that in male rats, provided vitamin E was supplied, fertility was unaffected and sex interest was decreased only a few days before death (*Jour. Nutrition*, vol. 1, p. 1 ; 1928). In the female rat the œstrous cycle stopped abruptly after about four weeks on the deficient diet ; loss of weight followed immediately (A. S. Parkes, *Quart. Jour. Exp. Physiol.*, vol. 18, p. 397 ; 1928). Injections of œstrin produced the signs of œstrus during the anœstrus, but without stimulating the ovaries, which had become much atrophied.

W. Nakahara and E. Sanekawa have found that chicken sarcoma and rat sarcoma and carcinoma do not apparently require vitamin B_1, and contain little of it (*Proc. Imp. Acad. Tokyo*, vol. 5, p. 55 ; 1929 : vol. 6, p. 116 ; 1930 : *Scient. Pap. Instit. Physic. and Chem. Res.*, vol. 10, p. 211 ; 1929). In the first set of experiments, chickens were fed on polished rice and a salt mixture ; the livers from healthy birds, and those carrying growths of the Rous sarcoma, were found to contain equal amounts of vitamin B by test on rats, indicating that the tumour did not deplete the birds' store of vitamin. In the second set, the rat tumours were fed to pigeons and rats maintained on vitamin B free diets : only minimal amounts of the vitamin were found to be present.

Obituary.

MR. H. W. MONCKTON.

MR. HORACE WOOLLASTON MONCKTON, who died on Jan. 14, was the son of Col. the Hon. H. M. Monckton, a younger son of the fifth Viscount Galway, his mother being a daughter of Sir Thomas Woollaston White, Bart. He was born in 1857 and was educated at Wellington College. His father built a house there, on land belonging to the College, and here Monckton and his sister continued to live for the rest of his life. He also had chambers in the Temple, where he lived when not at Wellington. He was called to the Bar in early life and had some practice on the Midland Circuit and at the Parliamentary Bar, and was all his life an enthusiastic member of the Inner Temple. Visits to the Yorkshire coast and the gault exposures at Folkestone attracted him to geology when still a boy, and in 1882 he was elected a fellow of the Geological Society and he joined the Geologists' Association in the same year. Later he became interested in botany, and was elected a fellow of the Linnean Society in 1892.

Monckton's residence at Wellington College naturally gave him an interest in the Tertiary and Gravel Beds of the surrounding districts. He was associated with the late Sir W. H. Herries in the discovery in 1880 of an abundant fauna in the Upper Bagshot Beds, when the railway cutting through the Fox Hills at Tunnel Hill was quite fresh. The Upper Bagshot of the London basin had hitherto been supposed to be practically unfossiliferous. A series of papers followed dealing with the relative ages and positions of the various exposures of Bagshot Beds, both in relation to the London clay and to the corresponding beds in the Hampshire basin. In this discussion the Rev. A. Irving, Sir Henry Lyons, and others took part. The Upper Bagshot of the London basin was practically proved, by its fossil contents, to be the equivalent of the Lower Barton series of Hampshire, in a joint paper published in the *Quarterly Journal* of the Geological Society in 1888 by Mr. Starkie Gardner, Monckton, and the late Henry Keeping. Monckton also wrote many papers on the various gravel beds, extending his researches to Essex and throughout the south-east of England. He acted as joint-editor with Mr. R. S. Herries of the jubilee volume of the Geologists' Association, and contributed the articles on the Dorset coast and (jointly with Mr. Osborne White) on Hampshire and the Bagshot district. He was an indefatigable leader of excursions of the Geologists' Association and various field clubs. Monckton's activities were not confined to England. He went annually to Norway for a number of years, and studied especially the glacial phenomena there. He organised an excursion of the Geologists' Association to that country, and devoted one of his presidential addresses to the Association to the district round Bergen.

Though so long officially connected with the Linnean Society, he did not publish much of botanical interest. He made considerable collections of plants, however, and was specially interested in mosses. In the few contributions he made on this subject, his idea was to link up botany and geology by making lists of plants growing on particular geological soils.

No account of Monckton would be adequate which did not mention the great amount of work that he did in the management of the societies to which he belonged. He was vice-president and treasurer of the Linnean Society from 1905 until the time of his death. He was at one time treasurer, and several times vice-president, of the Geological Society, and served on its Council for some twenty-five years in all. Of the Geologists' Association, he was at various times president, secretary for excursions, and editor of *Proceedings*. He also on several occasions acted as recorder of Section C (Geology) of the British Association. Sound business instinct combined with legal knowledge made his opinion much sought after, and his advice was generally followed by his colleagues.

Besides geology and botany, Monckton was interested in archæology and was an excellent photographer. He made his own slides, and was always ready to give a lantern lecture to the Wellington College boys or others. He wrote the volume on Berkshire for the Cambridge County Geographies, and the article on geology in the Victoria County History. He was also a fellow of the Royal Numismatic Society and made a carefully selected collection of English silver coins. He was a man who will be much missed by many friends, and especially by the sister whom he leaves to mourn his loss.

PROF. A. LEITCH.

THE death on Jan. 26 of Prof. Archibald Leitch, director of the Research Institute of the Cancer Hospital, following in less than a year the loss of Dr. H. J. B. Fry of the same laboratory (see NATURE, May 31, 1930), leaves a woeful lacuna in the ranks of cancer research. Born in 1878, Leitch was educated at Rothesay Academy and the University of Glasgow, where he had a distinguished record in arts and medicine, graduating in 1902. He soon devoted himself to pathology, acting as assistant in the Cancer Research Laboratory of the Middlesex Hospital. From London he passed to Dundee as director of the Caird Research Laboratory, a post he occupied until his return to London as pathologist to the Cancer Hospital, becoming director of the Research Institute a few years before the War. During the War, Leitch was in charge of a Mobile Laboratory, retiring with the rank of Major, R.A.M.C. (T.F.).

Leitch's most productive period fell in the succeeding years, when renewed interest in carcinogenetic studies followed the pioneer investigations of Fibiger, for whom his admiration was intense, and Yamagiwa. His best-known contributions to knowledge in this domain dealt with the carcinogenic action of lubricating oils and the causation of mule-spinners' cancer, and he served on the

Home Office Committee appointed to inquire into this disease.

Of greater theoretical importance was Leitch's demonstration of the carcinogenic action of arsenious acid, and the fact that this factor was not responsible for the carcinogenic action of tar. He also showed that in the production of tar cancer in mice, the essential damage was completed before the appearance of proliferative changes in the skin, although a relatively long latent period might elapse before definite tumour development supervened. This important observation has revolutionised our earlier attitude to the problems of compensation in occupational cancer.

Leitch's numerous publications are characterised by a careful and polished diction, enlivened from time to time by striking and appropriate phrases, which betrayed his literary and classical learning and training. He was an able and attractive speaker, and many of his addresses on formal and informal occasions were enlivened by a wealth of appropriate anecdote. He leaves a widow and four children, to whom will be extended the sympathy of his co-workers at home and abroad.

J. A. MURRAY.

MR. R. G. LUNNON.

ROBERT G. LUNNON, who died on Jan. 25 at the age of forty years, was widely known both for his scientific and for his humanitarian work. He was educated at Tottenham County School and University College, London, where he held the Neil Arnott Scholarship of the University of London, and after graduating was appointed to a lectureship in the department of applied mathematics. During the War he served in France with the Red Cross and later was engaged in relief work for refugees in Holland.

In 1919, Mr. Lunnon was appointed lecturer in physics at Armstrong College, Newcastle, where he remained to the time of his death. His work there gave full scope to his many abilities. In addition to his departmental duties, which he discharged with conspicuous success, he undertook a great deal of work on behalf of the students, and had acted since 1926 as senior tutor in the Faculty of Science. His colleagues were also greatly indebted to him for his work in connexion with the Association of University Teachers, both as secretary and representative on the council. He attended the meetings of the British Association regularly, and served on the committee of Section A.

Mr. Lunnon's published papers relate to a variety of topics, the best known being a series on the motion of spheres in fluid media, which gave evidence of mathematical and experimental ability of a high order. Although extremely active in academic and scientific work, he yet found time for a great deal of social service in various forms. These are too numerous to detail; but the cause of international goodwill was perhaps the one nearest his heart, and he laboured to promote it with all the enthusiasm and energy that was in him. His students, his colleagues, and his many friends will always remember him with gratitude as one who had great gifts and used them to the full—but always on behalf of others.

WE regret to announce the following deaths:

Sir Andrew Balfour, K.C.M.G., director of the London School of Hygiene and Tropical Medicine, on Jan. 30, aged fifty-seven years.

Dr. W. E. Johnson, Sidgwick lecturer in moral philosophy in the University of Cambridge, and author of a work on "Logic", three volumes of which out of the four contemplated have been published, on Jan. 14, aged seventy-two years.

Prof. Orazio Marucchi, professor of archæology at the University of Rome and director of the Vatican Egyptian Museum, on Jan. 21, aged seventy-seven years.

Dr. R. B. Moore, formerly chief chemist of the U.S. Bureau of Mines and recently professor of chemistry in Purdue University, who was known for his work on radioactivity, applied chemistry and metallurgy, aged sixty years.

Dr. J. Perrin Smith, emeritus professor of palæontology at Stanford University, with which he had been connected since 1892, on Jan. 1, aged sixty-six years.

News and Views.

THE causes of the present agricultural depression in Great Britain are reviewed by Mr. C. S. Orwin, director of the Institute for Research in Agricultural Economics at Oxford, in an article in the *Political Quarterly*, vol. 2, No. 1, entitled "The Agricultural Problem". Although the assertion that in previous years wages have been based entirely on the price of wheat is probably an over-statement, it is evident that at the present time wages are fixed with reference to a standard of living regardless of the condition of the industry, and the fact that the necessity for paying a statutory wage continues, while the guarantee for prices has been withdrawn, constitutes one of the farmer's chief complaints. From a comparison of the costs of production of such commodities as wheat, mutton, and milk for the years 1914, 1925, and 1930, it appears that for the two earlier years the corresponding figures were almost identical, and even in 1930 the cost of production has only risen appreciably in the case of wheat. The problem is, therefore, mainly one for the arable farmer; but the obvious course of abandoning corn-growing in favour of the more profitable industries is no solution for the eastern districts, where climatic conditions are unsuitable for dairying or market gardening; and further, the transformation of these areas into sheep farms could only be done at a great sacrifice of employment and production.

THE solution of the present agricultural problem, Mr. Orwin thinks, lies in a readjustment of the principles underlying arable farming. In the first place, he questions the advisability of continuing mixed farming, which includes the production of both corn

and meat. Times have changed since man was entirely dependent on farmyard manure for the growth of his crops. The labour involved in its production and the cost of internal farm transport he regards as unnecessary, whereas an interdependent system of live stock and corn farming might prove quite economical. In another aspect also, a break with tradition is recommended. Farm and fields were originally laid out in sizes convenient for horse labour, but with the development of the tractor and other forms of mechanical power, some readjustment of areas is needed for efficient working. The argument that such an industrialisation of agriculture will only aggravate the unemployment problem is ruled out, as much poor grass land could be profitably used for corn-growing if only the cost of production could be reduced. A warning is added of the danger of over-production if farmers rely solely on those branches of the industry which tend to be profitable at the moment, and emphasis is laid on the necessity for fundamental reorganisation if the solution of the present problem is to be permanent.

THE trustees of the London Museum have made a new departure in museum work by instituting a studentship for the encouragement of research in some subject germane to the interests of the museum. They have been enabled to take this step through the generosity of Viscount Esher, who has placed at the disposal of the trustees the sum of £300 per annum as a memorial to his father, the late Lord Esher, one of the founders of the museum. The studentship will be awarded "for the purpose of promoting research into some aspect of the history or archæology of London, whether by documentary research, by excavation, by museum work, or by a combination of these methods". The award will be made by the trustees on the recommendation of an advisory committee, on which representatives of the Society of Antiquaries, the British Academy, and the universities of Oxford, Cambridge, and London will serve, and the tenure will be normally for a period of two years. The researches of the student will be incorporated in a thesis, which may, in due course, be published at the direction of the trustees. It is hoped that, in the course of years, a very substantial amount of useful and original material bearing directly or indirectly upon the arts, crafts, and history of the metropolis will be collected. The scheme may be regarded as an interesting experiment in the development of that extra-mural work which is now regarded as appropriate to our national museums. Entries for this studentship are invited on or before Mar. 14.

TOWARDS the end of last month several earthquakes were recorded at Kew Observatory. On Jan. 27, at 8 h. 20 m. 59 s. P.M., the first vibrations of a great earthquake reached Kew, from a centre in about lat. 26° N., long. 98° E., or near the south-west border of China. Of this earthquake no direct news has yet come or is likely to come. A few hours later, at 5 h. 59 m. 37 s. A.M. on Jan. 28, there was another, though of much less importance, with an origin about 1260 miles from Kew: no doubt the same as that reported in the *Times* for Jan. 29 as having caused much damage and some loss of life at Koritza in Albania, one of the most active earthquake centres in that country. At 9 h. 43 m. 6 s. P.M. on the same day an earthquake of moderate intensity was recorded with its epicentre in about lat. 7° N., long. 142° E., or in the western Pacific to the north of New Guinea. The U.S. Coast and Geodetic Survey (according to a *Daily Science News Bulletin* issued by Science Service, Washington, D.C.), with the aid of fourteen seismograms, has estimated the position of the Mexican earthquake of Jan. 14 to be in lat. 16° N., long. 96° W., or close to the coast of the Gulf of Tehuantepec, and also to the origin of another destructive earthquake on Mar. 22, 1928. An earthquake of great intensity occurred in North Island, New Zealand, on Feb. 3. The first shock was noted at 8.51 A.M., and shocks continued for two hours. The epicentre appears to have been submarine and in the vicinity of Napier, which has a population of 19,000, and the main portion of the city has collapsed. A heavy death-roll is estimated in Napier and for many miles around. A sea wave followed the earthquake.

IN his presidential address to the Royal Microscopical Society delivered on Jan. 21, Prof. R. Ruggles Gates reviewed certain aspects of the history of the Society showing its importance in the development of biology, and cited some of the eminent scientific men who had taken part in its work. Prof. Gates then discussed adaptations in cell structure. He cited various cases of complicated structures in the Protozoa, and referred to the widespread occurrence of cilia in many animal and plant cells. The mechanism of mitosis or nuclear division was treated as an adaptive mechanism which originated very early in evolution and made possible the multicellular structure of higher organisms, at the same time serving to perpetuate many of the differences arising through variation. The capillitium in Mycetozoa and puff-balls, the elators of Liverworts and of *Equisetum*, were discussed as examples of evolutionary adaptation, arriving at the same goal by different paths. The development of the spiral markings in wood cells was explained; and the long, coiled suspensors of Conifer embryos were treated as a study in adaptation and over-specialisation through competition between the young embryos and the principle of developmental selection. The frequency of parallel mutations in the evolutionary development of many cell structures was emphasised, and it was shown that the principles of adaptation in cell structures are the same as in the development of adaptations in the organism as a whole.

FOR his lecture on the beginnings of tropical medicine, before the London School of Hygiene and Tropical Medicine on Feb. 3, Dr. P. Manson-Bahr chose the life and work of Patrick Manson as the chief topic. Patrick Manson, to whom the London School of Hygiene and Tropical Medicine owes its inception and its very existence, was one of the most original and outstanding medical personalities of the last century. Not only did he himself make many original and lasting discoveries in the field of medicine, but also he

laid the foundations of the science of tropical medicine. Born on Oct. 3, 1844, he graduated at the University of Aberdeen in 1865, and then proceeded to Formosa and worked there as well as in Amoy, China, for ten years before seriously interesting himself in the scientific side of medicine. It was in 1875 that he first saw the microscopic embryo filaria in the blood of the local Chinese, and it was in the elucidation of the life history of this parasite that he first achieved everlasting fame. He was the first to recognise that this small worm was to be found in countless numbers in the blood at night time, and recognised that its peculiar habits and structure were adapted to a second life in the body of a mosquito. This insect he proved to be an essential intermediary in its transference from one human being to another and in its growth into an adult worm, which was afterwards found to inhabit the lymphatic tissue and to attain the length of nearly two inches. In 1892 he commenced to study malaria seriously, and deduced the probable life history of this parasite from what he had already ascertained to be the case in the filaria. In 1894 he formulated his mosquito-malaria hypothesis and became associated with Ronald Ross. It was the outcome of this ideal collaboration which resulted in the verification of the complete cycle of the malaria parasite in the Anopheles mosquito in 1898. In 1897 Manson became medical adviser to the Colonial Office, and became intimately associated with Joseph Chamberlain in schemes for the betterment of health conditions in the Colonies. The first outcome of this collaboration was the foundation of the London School of Tropical Medicine in 1899.

DR. G. A. REISNER, director of the joint expedition of the Boston Fine Arts Museum and Harvard University in Egypt, has recently given an account at Cairo of his excavations in Giza Cemetery and the Pyramid area, and summarised the evidence bearing on the development of Egyptian ideas on the life after death and the cult of the dead in the Old Kingdom. A report of two lectures, delivered on Jan. 16 and 20, is given by the Cairo correspondent of the *Times* in the issue of Jan. 31. The Egyptian tomb consisted of two parts, the burial chamber and the offering place, the former being originally a square pit excavated in the gravel, which developed finally into a stone mastaba or pyramid. The construction of the pyramids in the great cemetery of Giza, founded by Cheops, the second king of the fourth dynasty, employed tens of thousands of men on unproductive labour, and by the end of that dynasty the population was supporting a large body of priests to feed the dead of centuries. The funerary priest was a civil functionary who, as a result of contact with an individual, became the servant of his *ka*. By a contract, the functionary and his heirs in perpetuity became owners of land, in return for maintenance of offerings in the funerary chapel of the dead. The pyramid cities housing these functionaries, who enjoyed immunity from taxation and forced labour, were crowded with inhabitants. In tracing the development of other features of the cult—the slab stelæ, the wall paintings, the festivals of the dead, and so forth—Dr. Reisner sketched a remarkable picture of the Cemetery of Giza as a city of living spirits whose daily needs were supplied by the living servants they had engaged while themselves still living.

THE Electricity Commissioners held an exhaustive public inquiry on the application of the Fulham Borough Council for permission to extend its Townmead Road generating station. Judging by the rapid and increasing demand for electric power in the south-east England area, there could be no question about the usefulness of this station ; but there was considerable opposition on the ground that it would seriously affect the amenities of the neighbourhood. It was suggested that the required power could be obtained by building a new power station on the lower reaches of the Thames. If this were done, a transmission system at least 18·5 miles long would have to be provided. Numerous high tension cables would therefore need to be provided, and a survey showed that it would be very difficult, if not impossible, to find room for these cables, owing to the existing congestion under the streets. The alternative method of laying cables along the bed of the Thames was not considered practicable. The loss in transmission due to heating the cables would be about £150,000 a year, and there would in addition be very heavy capital charges. To make extensions by building a number of small stations would about double the cost. The Commissioners came to the conclusion that any nuisance arising from the emission of grit and sulphurous fumes could be obviated by the installation of modern devices. By observing also the conditions laid down by the Port of London Authority, the effluent from this plant can be rendered harmless. Assuming that the Fulham Borough Council take the best known precautions for the due consumption of smoke and for preventing so far as reasonably practicable the evolution of oxides of sulphur, the Commissioners gave their consent to the proposed extensions on Jan. 27.

IT seems highly probable that in a few years' time much of our electric lighting will be done by incandescent gases in luminous tubes and not by incandescent filaments. This kind of lighting is generally referred to as neon lighting, but argon, helium, krypton, and other gases are used. Although Lord Rayleigh and Sir William Ramsay were the first to separate these gases from the atmosphere, yet the commercial development of them for lighting purposes is mainly due to Georges Claude in France. There are now about a hundred companies in various parts of the world exploiting his patents and all bound together by an agreement to interchange technical information and research results. All the countries concerned have a common interest in advancing the science of tubular lighting. In the December *Journal* of the Junior Institution of Engineers an abstract is given of a lecture by H. Marryat describing many of the recent advances that have been made. In the Paris factory the great difficulties in the way of introducing a minute quantity of an absolutely pure gas into an

absolutely clean tube were finally overcome by the introduction into the factory of the methods of the precise scientific worker. Neon tubes are familiar in London from being used for advertisement lighting. The original voltage used was 32,000, but it has now been reduced to 1000, and tubes have been made in the laboratory that will work at 200. At present their most important use is for the lighting of aerodromes and air routes. The light from Croydon beacon can be seen by airmen when flying over France. Luminous signals are employed to indicate to the pilot the velocity of the wind and its direction at ground level, so that he may alight against the wind at the correct speed. For domestic lighting, however, we have to await the commercial development of the white tubular light, which laboratory experiments have shown to be a very desirable one.

IN the *Westinghouse International Journal* for January there is an interesting account of a device for controlling traffic which is being adopted in several towns in the United States and is a modification of the 'Stop and Go' light system. In many main streets the traffic is always heavier than on a little-used intersecting street; hence the traffic may be held up in the main street although there are no vehicles using the side street. In order to obviate this drawback, a device is used in connexion with the 'Stop and Go' light whereby the latter only shines red down the main street when a motor vehicle approaches the intersection from the side street. The device is based on the principle of the photo-electric cell, and is mounted on a pedestal three feet above the curbstone in the side street, near the crossing. When a vehicle approaches from the side street it necessarily has to stop, and in this position it intercepts a beam of light which falls on a device called the 'electric eye'. The interruption of this light beam automatically changes the visible signal facing the side street from red to green and the signal in the main street from green to red for an interval long enough to enable the motorist to cross the main street. This device enables the traffic speed to be greatly increased, and is working well in everyday use.

DR. J. ROBINSON, formerly chief of the Radio Research Department of the Royal Air Force, has invented a system of multiplex telegraphy. A demonstration of it was given on Jan. 20, at the offices of the *Daily Mirror*, using a line to Bristol and back, a distance of about 240 miles. The line was specially lent by the Postmaster-General for the development of the method, and both sending and receiving instruments were in the same room. The main advantage claimed for the method is that by its use more than twice as many messages as are now possible can be sent simultaneously over one wire. In England only six channel frequencies are employed; but in America twelve are sometimes used. The stenode radiostat system uses a separate audible frequency for each of the messages sent. The transmission is carried out by modulating each audible frequency at a speed which is determined by the speed of sending. It is claimed that with this type of receiver the broad spacing of the frequencies made necessary in practice to avoid overlapping has been considerably reduced. The selectivity of the instrument is due to the successful use of tuning-forks as electrical filters. At the demonstration, the channel frequencies were placed apart by only a hundred cycles a second. At this spacing, communication of 80 words a minute was carried out.

DR. F. S. SINNATT, deputy director of fuel research, in a public lecture delivered on Feb. 2 at the Sir John Cass Technical Institute, E.C.3, gave an account of the work being carried out by the Coal Survey, which is one item in the programme of work of the Fuel Research Division of the Department of Scientific and Industrial Research. The Survey is undertaking a systematic investigation of the coal seams of Great Britain, and in order to carry out the work committees have been appointed in all the major coalfields of the country and laboratories have been established at convenient centres. The work is now in progress in Scotland, Northumberland and Durham, West Yorkshire, South Yorkshire, North Staffordshire, Nottinghamshire and Derbyshire, and South Wales, while a laboratory is being equipped to serve the coalfields of Warwickshire, Cannock Chase, and South Staffordshire. Upon the technical side the investigations are carried out by obtaining a solid pillar of coal representing the whole thickness of the seam, and transporting this to the laboratory, where it may be investigated in detail. Certain parts of the analyses are carried out rapidly so as to prevent changes due to oxidation, etc., and the seam is then examined for its physical characteristics and, if necessary, divided into a number of layers, depending upon the character of the seam. Samples of the various coals are obtained and submitted in the first instance to proximate analysis, together with the estimation of sulphur and the determination of the calorific value. The broad properties of the seam are then reviewed, and after consultation with the staff of the colliery the number of layers which will be examined in greater detail is decided upon. The seam as a whole and the various layers are then examined exhaustively. It is the object of the survey to trace the variations of the seams throughout the coalfield, and to correlate with this change in properties the possible effect they will have upon the way in which the seam is utilised commercially.

SIR J. J. THOMSON will receive the Dalton Medal of the Manchester Literary and Philosophical Society when he delivers the Dalton Lecture before the Society on Mar. 17, 1931.

THE Second Pedler Lecture of the Chemical Society, entitled "Studies on Biological Oxidation", will be delivered by Prof. H. Wieland, of Munich, on Friday, Mar. 6, at 5.30 P.M., in the meeting hall of the Institution of Mechanical Engineers. Admission is free, without ticket.

THE second course of Scott Lectures at the University of Cambridge will be delivered by Dr. Irving Langmuir, of the Research Laboratories of the General

Electric Company, Schenectady, N.Y., in the Cavendish Laboratory, at 4.45 P.M., on Feb. 9, 11, 13, 16, and 18. The subject for this course is "Fundamental Phenomena in Electrical Discharges in Gases". The lectures are open without fee to all members of the University.

THE University of St. Andrews has sent its congratulations to Dr. W. W. Keen, of Philadelphia, one of its honorary graduates, on his attainment, on Jan. 19, of the age of ninety-four years. It is twenty-three years since Dr. Keen resigned the professorship of surgery at Jefferson Medical College. The honorary degree of LL.D. was conferred upon him by the University of St. Andrews in 1911, during the celebration of the five-hundredth anniversary of the foundation of the University. Dr. Keen's longevity and cheerful hardihood are matched by those of emeritus Prof. W. C. M'Intosh, also of St. Andrews, who is ninety-two years of age and is still busy with scientific work.

THE following committee has been set up jointly by the First Commissioner of Works and the President of the Board of Education, to consider the recommendation of the recent Royal Commission on National Museums and Galleries that a national folk museum should be established, if possible, in London, and also to advise as to the practicability and cost of establishing such a museum: Sir Lionel Earle (chairman), Mr. E. R. D. Maclagan, Mr. E. S. Makower, Sir Henry Miers, Prof. J. L. Myres, Mr. C. R. Peers, Sir Henry Richards, and Dr. R. E. Mortimer Wheeler. The secretary is Mr. E. F. Muir, Ancient Monuments Branch, Office of Works, London, S.W.1.

AT the annual general meeting of the Royal Microscopical Society, held on Jan. 21 at B.M.A. House, Tavistock Square W.C.1, the following officers and new members of council were elected: *President*—Prof. R. Ruggles Gates; *Treasurer*—Mr. Cyril F. Hill; *Secretaries*—Mr. J. E. Barnard, Dr. Clarence Tierney; *New Members of Council*—Mr. C. Beck, Mr. G. R. Bullock-Webster, Prof. R. T. Hewlett; *Librarian*—Dr. Clarence Tierney; *Curator of Instruments*—Mr. W. E. Watson Baker; *Curator of Slides*—Mr. E. J. Sheppard.

THE provisional figures of the vital statistics for England and Wales for 1930 have been issued by the General Register Office. The rates per 1000 population were: for births, 16·3, the same as for 1929, which was the lowest recorded; and for deaths, 11·5. The death rate is 1·9 below that for 1929, and is the lowest recorded, being 0·1 below the rates for 1923 and 1926, the previous lowest. The infant mortality rate (deaths under one year per 1000 live births) was 60, and was also the lowest on record, being 5 per 1000 below that for 1928, the previous lowest, and 14 per 1000 below that for 1929.

MESSRS. Flatters and Garnett, Ltd., of Manchester, have issued a new catalogue of lantern slides illustrative of the various branches of science. There is a very wide range of types amongst this collection, from plain and coloured photographs of geological interest to macroscopic pictures of plants and microscopic photographs and diagrams of Protophyta and Protozoa. The list in all branches, and especially that of botany, has been greatly enlarged. This is due chiefly to Mr. Flatters, who is especially interested in the study of plants from the anatomical and histological point of view. Messrs. Flatters and Garnett, Ltd., take full advantage of the fact that their establishment is close to the University of Manchester. Members attend the public lectures, meetings, and exhibitions which are held in the University, and their assistants are sent to the evening course in biology. Thus much valuable information with regard to the production of lantern slides, the type required, the arrangement of lists, and so forth, is obtained. The lantern slides produced by Messrs. Flatters and Garnett, Ltd., are invaluable assets to the public lecturer, the university lecturer, and the school teacher.

MESSRS. W. Heffer and Sons, Ltd., Cambridge, will publish shortly "The Scientific Detective and the Expert Witness", by Dr. C. Ainsworth Mitchell, which work aims at giving a more or less popular description of the methods by which those with specialised training have been able to assist in solving problems constantly arising in criminal investigation.

THE Museum of Comparative Zoology at Harvard University announces that the first volume of a check list of the birds of the world by James Lee Peters is now in press and will be issued shortly. The classification followed for the higher groups is that proposed by Dr. Wetmore, with the sequence of genera and species according to the author's own ideas where no authoritative treatment has been published. The first volume will contain about three hundred genera and one thousand seven hundred species and subspecies. It is expected that at least ten volumes will be required to complete the work. The second volume is in active preparation and preliminary work on others is under way. The new check list is not a Museum publication and will not be distributed to the Museum's exchange list, but will be sold by the Harvard University Press.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A professor of anatomy in the Madras Medical College and a professor of anatomy and physiology in Vizagapatam Medical College—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Feb. 10). A principal of the Acton Technical College—The Secretary (F), 10 Great George Street, Westminster, S.W.1 (Feb. 14). A museum assistant in the Leicester Museum and Art Gallery—The Director, Museum and Art Gallery, Leicester (Feb. 16). Inspectors under the Ministry of Agriculture and Fisheries, for the purposes of the Diseases of Animals Acts, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Feb. 16). A temporary assistant mycologist under the Department of Agriculture for Scotland, for work in connexion with bracken disease—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (Feb. 16). A principal of

the Kingston-upon-Thames Technical College—The Secretary, Education Department, County Hall, Kingston-upon-Thames (Feb. 21). Inspectors under the Board of Education, for technical and evening schools—The Secretary, Board of Education, Whitehall, S.W.1 (Feb. 21). A senior lecturer in physics in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W.C.2 (Feb. 24). A University reader in mathematics at Westfield College — The Academic Registrar, University of London, South Kensington, S.W.7 (Feb. 27). A lecturer in physics at Armstrong College — The Registrar, Armstrong College, Newcastle-upon-Tyne (Mar. 5). Assistant examiners in the Patent Office — The Secretary, Civil Service Commission, Burlington Gardens, S.W.1 (June 4). A temporary science master at Merchant Taylors' School, for chemistry (or possibly physics) during May, June, and July—The Headmaster, Merchant Taylors' School, Charterhouse Square, E.C.1. A Grade "E" technical assistant in the Signals Experimental Establishment — The Superintendent, Signals Experimental Establishment, Woolwich Common, S.E.18. An advisory veterinary officer at Reading University, for the Southern Province—The Registrar, The University, Reading.

Our Astronomical Column.

Registration of Solar Prominences.—In a recent issue (No. 88) of the *Bulletin* of the Kodaikanal Observatory —a biannual publication containing current observations of solar prominences and disc phenomena recorded spectroscopically at Kodaikanal—the Director, Dr. T. Royds, directs attention to the publication of additional data of prominences photographed in hydrogen light (Hα). There are two spectroheliographs in daily use at this observatory, one of which is used for obtaining composite photographs showing the disc markings and the prominences at the sun's limbs in calcium light (K), whilst the other instrument is employed for registering the disc markings in hydrogen (Hα) light. Owing to the increased speed of panchromatic plates, it has been found possible to include in the daily programme since Jan. 1, 1929, the registration of the prominences in hydrogen light. Dr. Royds finds that the mean daily areas of Hα prominences in 1929 are considerably less, about 54 per cent, than those of the calcium prominences. This, he points out, is not necessarily to be interpreted as evidence that the hydrogen prominences are less extensive or less high than calcium prominences, for there are numerous examples where individual prominences are identical in shape, height, and area in the Hα and the K photographs. There is, however, considerable evidence that in the fainter and more scattered parts of K prominences the Hα counterpart is relatively much fainter when compared with the brighter parts of the prominence. This is not a photographic effect caused by the under-exposure of the Hα plate, for whilst the main part of a prominence may be stronger in the Hα photograph than in the calcium, the reverse is often true in the fainter parts of the same prominence. The exact relations between the relative intensities in different parts of Hα and K prominences require further study, and it is very satisfactory that data for this purpose will be accumulated at Kodaikanal.

Rotation Period of Uranus.—The two most trustworthy determinations of this period were those made by Profs. Lowell and Slipher at Flagstaff in 1911 and that of Mr. L. Campbell in 1917; the former was spectroscopic, the latter by light-variation. The results were practically identical, $10^h\ 50^m$ and $10^h\ 49^m$ respectively. But there was considered to be room for a further investigation, since the indicated probable error of the spectroscopic method was 17 minutes, and the light-variation was not confirmed by several other observers. It may, however, have been produced by a temporary marking. *Pub. Ast. Soc. Pac.* for December contains an account of a new spectroscopic determination made by Messrs. Moore and Menzel. They used a higher dispersion than Lowell and Slipher, also the equator of Uranus is more nearly central on the disc. Their weighted mean is $10^h\ 50^m$ with a probable error of 10^m; but in spite of the close accord with the previous results, they do not consider that the period is certainly known within several minutes; Mr. Moore's results, taken alone, give $11^h\ 18^m$ and those of Mr. Menzel $10^h\ 26^m$. The uncertainty arises from the small size of the disc of Uranus. It will be remembered that in their Neptune investigation they estimated the uncertainty as a full hour.

The *Gaz. Astron.* for January announces that M. V. Tshernov has been making photometric observations of Uranus during the autumn of 1930. He finds for the period of rotation $10^h\ 47^m\ 34^s$. Before opposition the range of magnitude was from 5·97 to 6·16; after opposition, from 5·78 to 6·10.

The Radial Velocities of the Spiral Nebulæ.—Prof. C. D. Perrine notes in *Astr. Nach.*, No. 5754, that radial velocities of recession approaching 10,000 km./sec. have been deduced at Mount Wilson for some of the faint distant spirals. He makes the suggestion that the annual aberration of these objects should be compared with that of neighbouring stars; according to former ideas, since these bodies are receding with a velocity one-thirtieth of that of light, the velocity of their light-waves relatively to the observer would be less than that of the stars in the same proportion. Hence the constant of aberration for them should be greater than for the stars by 0·7″; a quantity easily measurable on good photographs.

According to Einstein's theory the apparent velocity of the light is constant for all objects. But just as observations of the Einstein shift of stars near the sun are still made during total eclipses, it would seem to be worth while to make this experiment in order to test the theory further. Photographs should be taken as nearly as possible at the times when the objects are at the two ends of the major axis of the aberration ellipse.

Minor Planets.—*Kleine Planeten* for 1931 (published by the Berlin Rechen-Institut) indicates that there are now 1152 numbered planets, five of those discovered in 1930 having been already numbered. Many planets that were long missing have been picked up, and there are now only five planets in the first 400 that have been lost since the year of their discovery. Many new names have been given; the seventh Trojan planet, discovered in 1929, has been named Odysseus. The names Probitas, Perseverantia, and Hilaritas have been given to three planets discovered by the late Dr. Palisa of Vienna, being regarded as expressing qualities of his character. A group of planets are named after flowers: Begonia, Camellia, Petunia, Primula. Planet 1134 is named Kepler.

Research Items.

A Hand-Axe from East Anglia.—Mr. J. Reid Moir, in *Man* for January, figures and describes a hand-axe found last November in the Upper Chalky Boulder Clay at Ipswich. It was dug out of solid clay at a depth of 2½ ft. It was in two pieces, which lay about 15 in. apart. The fracture was ancient and had been caused by thermal action along the line of a weakness in the flint, without doubt at the time of the deposition of the boulder clay. The specimen is typical of the implements found in the Upper Chalky Boulder Clay. In colour it is greyish-black, and shows no sign of patination or abrasion. There are a few ancient striations. The flaking is all of one period. Greatest length $4\frac{3}{16}$ in., greatest breadth $2\frac{15}{16}$ in., greatest thickness $1\frac{1}{16}$ in., and weight approximately 8½ oz. There is now a large body of evidence to show that the Upper Chalky Boulder Clay of East Anglia, representing the third glacial period of this part of the country, was laid down at the close of the Early Mousterian epoch. The flint implements found in the boulder clay have all been derived from other and older deposits torn up by the glacier in its advance. In certain parts of East Anglia sites have been discovered where these deposits have escaped destruction and they have been shown to contain artefacts such as occur in the boulder clay which overlies them. These pre-Upper Chalky Boulder Clay deposits are usually in the form of brick-earth such as have been excavated and studied at Ipswich, Hoxne, and High Lodge. In each of these cases the Upper Chalky Boulder Clay overlies the brick-earth, and in the latter deposit at Hoxne and High Lodge have been found hand-axes of precisely the same type and workmanship as that now described. One found by Mr. Reid Moir at Hoxne in an Early Mousterian floor at the base of the brick-earth under the glacial bed laid down by the Upper Chalky Boulder Clay glaciation is almost a duplicate of this specimen. It may now be said that the Early Mousterian period in East Anglia was succeeded by the third glaciation in that area, and that *in situ* in the Upper Chalky Boulder Clay, which was then laid down, derived flint implements of the Early Mousterian epoch have been unearthed.

Treatment of Trypanosomiasis.—Dr. Louise Pearce has written a critical review entitled "The Treatment of Human Trypanosomiasis with Tryparsamide" (Monograph No. 23 of the Rockefeller Institute for Medical Research). Tryparsamide is the name given to the sodium salt of *N*-phenylglycineamide-*p*-arsonic acid, a compound developed at the Rockefeller Institute for Medical Research during the course of chemotherapeutic investigations on certain protozoan infections. It has the advantage of being very soluble in water and may be administered intravenously, intramuscularly, or subcutaneously with satisfactory effects. The dose is usually 2 gm., and the amount required for the treatment varies from 15 gm. to 25 gm. for early cases up to perhaps 100 gm. for advanced cases. The only untoward effect noticed has been visual disturbances in some 5 per cent of the cases, which is more or less permanent in 1·8 per cent of the cases. The present analysis deals with the results obtained in 1197 cases of sleeping sickness with *Trypanosoma gambiense* infections, of which 96 were considered to be early cases and 1101 late ones. Of the early cases, some 96 per cent appear to have been cured by the drug. Of the 1101 advanced cases, 646 (58·7 per cent) appear to be cured, 272 (24·7 per cent) were improved, and 183 (16·6 per cent) were failures. The results obtained with tryparsamide appear to be vastly superior to those observed with any other drug. Several other papers which have appeared since this analysis was written are also reviewed, and a bibliography is appended.

Fresh-water Mussels Raised in the Laboratory.—The *Daily Science News Bulletin*, Science Service, Washington, D.C., of Nov. 21, announces that Dr. M. M. Ellis has discovered a method of speeding up the development of fresh-water mussels. In its natural environment the mussel spends the first four to six weeks of its life as a parasite on a fish. Dr. Ellis has found a nutrient medium to take the place of the fish, in which the mussel is able to develop. After spending a certain time in the medium, the mussels, important economically for the making of pearl buttons, may be planted out in the rivers which have been depleted by pollution. The raising of these molluscs will be undertaken at the University of Missouri in the new laboratory space just provided by the University for the use of the U.S. Bureau of Fisheries.

Biology of the River Wharfe.—E. Percival and H. Whitehead have already done good work in connexion with Yorkshire streams and rivers. Their recent paper, "Biological Survey of the River Wharfe: Introduction and Report on the Invertebrate Fauna" (*Journal of Ecology*, vol. 18, No. 2, Aug. 1930), records investigations arising out of meetings of the research committee of the Yorkshire Naturalists' Union, in which the River Wharfe, being practically unpolluted, was decided on as a subject requiring detailed examination. Three stations, representing the three main physiographic regions through which the river flows, were worked monthly over a period of one and a half years, and in addition subsidiary collections and observations were made at other stations. A net with a mesh of 0·5 mm. was chiefly used, allowing a number of small creatures to escape. Therefore some groups, such as the Protozoa, Nematoda, and Rotifera, have been omitted. Insects are the most important and are dealt with fully. The station at Ulleskelf, where the river becomes affected by tides, is markedly different from the others. The great majority of the species from all the stations require water well charged with oxygen. The environmental conditions and dominant invertebrates are given for each station, and notes on the different groups show details of distribution, habitat, and breeding seasons. There seems to be little seasonal variation in the faunas except those related to breeding and life cycles. Most of the insects produce eggs from March to October. General conclusions of a preliminary nature are that the various types of stream bed can be approximately classified according to their structure and fauna: and that the variation in number of organisms is due in part, at any rate, to the nature of the life cycle, to the effect of temperature, and to the amount of rainfall both during the previous breeding season and at other times, and the amount of flooding, of erosion, and general disturbance of the river bed.

Genetics of Field Mice.—Dr. F. B. Summer has contributed a further account of his well-known investigations on the geographical sub-species of the field mouse, *Peromyscus* (*Jour. Genetics*, vol. 23, No. 2). It is unfortunate that these important researches, which he has carried on at the present Oceanographical Laboratory in Southern California for more than fifteen years, are now to be discontinued, for they represent the most extensive study yet made of the natural sub-species in any mammal. We have

received from Dr. Summer a request to point out two errata which occur on p. 307 of the present paper. In line ten, "$(4/5)'$" should read "$(4/5)^3$"; and in the nineteenth line, "$(5/6)^2$" should read "$(5/6^4)$". The present paper contains a mass of data, statistically treated, resulting from crosses between the three sub-species, *leucocephalus*, *albifrons*, and *polionotus*, and also from a fortunate cross between two species of *Peromyscus*. The results are too numerous to summarise here, but the paper is a searching inquiry into the conception of multiple genetic factors as applied to sub-specific crosses. Differences in depth and extent of pigmentation, the tail stripe, and other features are believed each to depend upon several multiple factors, but it is concluded that the formulæ of Castle and Wright for determining the number of such factors is not applicable. The tables of measurements of tail, foot, ear, etc., in the hybrids have also been analysed. Wide phenotypic variability and other conditions offer great difficulties, and it cannot be said that the multiple factor hypothesis as here applied is a great success, in spite of the great care and attenton to detail which has entered into the analysis. The author is inclined to favour the view that the genetic changes between sub-species have resulted in some direct way from the action of the environment, the colour mutations being selectively controlled by their value in concealment.

Mitogenetic Rays.—A monograph upon this subject was reviewed in NATURE of July 13, 1929. It will be remembered that Gurvitsch and his school suggest that a special type of short-wave length radiation promotes cell division; they thought to detect this radiation by pointing one growing root-tip at another at close range, when the number of cell divisions in the second root was said to be greater, as the result of 'irradiation' from the tip of the first root, on the side 'exposed' to the pointing tip. Around this conception a lively controversy has raged, and so long as the only tests applicable to mitogenetic radiation are the number of cells in a tissue in a state of division, or the number of buds produced in a growing yeast culture, conclusive critical evidence in support of the new radiation remains difficult to produce. Of considerable importance, therefore, is a paper by Stempell (*Biol. Zentralblatt*, **49**, Heft 10; 1929) in which he attributes to the radiant energy from such growing organs the power of destroying the Liesegang rings which are formed with beautiful regularity when a drop of silver salt is placed on the centre of a thin layer of gelatin containing ammonium bichromate. These experiments of Stempell have been repeated and confirmed by B. P. Tokin (*Biol. Zentralblatt*, **50**, Heft 11; 1930), but at the same time this worker makes it clear that this interesting result is due to the volatile substances, probably ethereal oils, which are given off from the crushed tissue of the onion, which has been the source of the 'mitogenetic' radiation in these experiments. Tokin's work seems to make it quite clear that this new experimental field has failed to produce any evidence for the existence of 'mitogenetic rays'.

Mica-Peridotites of India.—In his memoir on "The Jharia Coal Field" (*Geol. Surv. India*, vol. 56; 1930) C. S. Fox gives a valuable account of the remarkable peridotite intrusions associated with the faults and coal seams of the region. The coalfields of the Damuda valley represent a series of areas of Gondwana sediments set in a pavement of Archæan gneisses on which they lie and into which they have been faulted. The synclinal structures of the so-called basins result from tectonic movements. The peridotites are generally much altered. Many are characterised by an abundance of mica, but the most remarkable feature is the richness in apatite, as first disclosed by Sir Thomas Holland in 1894. The high phosphorus content in the coals of many of the Gondwana fields can be traced with tolerable certainty to the peridotite intrusions. A number of new analyses are presented and attention is directed to these because of their petrological and geochemical significance and because they might easily be overlooked in a memoir dealing mainly with coal. The peridotite magma appears to have been squeezed up through fault planes in the gneissic floor, but once it entered sedimentary rocks the bedding planes offered numerous channels for escape, mainly above or below coal seams, where the bedding planes appear to have been more easily separable than elsewhere in the series.

Comparative Study of Soil Profiles.—An exceptionally thorough investigation of soil profiles in Holland and Java has been made by A. Te Wechel, L. Möser, and C. Van Aggelen (*Mitt. Geol. Inst. Landbouwhoogeschool in Wageningen, Holland*, No. 16, 1930). The profile on Senonian limestone in Holland is compared with the profiles on loess in Holland and on Tertiary limestone in Java. The end-products of soil formation are closely similar from the two contrasted types of parent rock in Holland, whereas they are widely different from the two similar rocks studied in Holland and Java (see table). The importance of climatic control is thus clearly demonstrated. The microscopic

Constituents.	Holland.		Java.
	Loess Soil.	Limestone Soils.	
$CaCO_3$ . .	2·21	1·75	2·02
SiO_2 . . .	73·55	73·38	37·87
Al_2O_3 . . .	8·04	7·59	24·08
Fe_2O_3 . . .	2·89	2·63	8·95
Clay . . .	41·40	40·50	37·80
Humus . .	5·14	4·42	4·31

(petrological), physical, and chemical character of the parent rocks and of four or five horizons in the profiles of each of the three examples investigated have been very fully determined. The memoir is well illustrated and constitutes one of the most illuminating studies of weathering and soil genesis yet issued.

The Constant of Gravitation.—A redetermination of the constant of gravitation (G), by P. R. Heyl, is described in the December number of the *Bureau of Standards Journal of Research*. The apparatus used was much the same as in the dynamical method of Braun, with, however, a considerable increase in the magnitude of the large attracting masses, and with the incorporation of the refinements possible to anyone working in a large institution. The attracting masses on the moving system were small spheres of gold, platinum, and optical glass, in each case of about 50 gm., but with the large stationary masses a radical change in shape was made, cylinders being substituted for the spherical form which had been previously almost universally employed: the mass of each was about 66 kgm. The reduction of the experimental data is thus enormously complicated, but it has been found that series which remained manageable could still be calculated fairly readily to express the forces due to the cylindrical masses; full details of these, which are probably of value in other connexions, are given. Other points in the experimental arrangements are the use of tungsten filament wires for the suspensions in place of quartz, with very satisfactory results, and the magnetic shielding

of the small paramagnetic and diamagnetic spheres which was found to be called for. The value finally adopted for the constant is $6{\cdot}670 \times 10^{-8}$ cm.^{3} gm.$^{-1}$ sec.$^{-2}$, with a precision of 0·005, as measured by the average departure from the mean. This result is in very good agreement with Boys' and Braun's value of $6{\cdot}66 \pm 0{\cdot}01$, in the same units. There is a curious outstanding discrepancy in the apparent dependence of the value on the material of the small masses, but it is considered that this is not due to the nature of the material.

Properties of Molecular Hydrogen.—In a paper in the January issue of the *Proceedings of the Royal Society*, on the chemical constant of hydrogen vapour and the entropy of crystalline hydrogen, T. E. Stern has extended some earlier calculations made by R. H. Fowler, essentially by introduction of the Einstein-Bose statistics in place of classical statistics. His results are important chiefly from the fact that they increase somewhat the accuracy of results predicted by Mr. Fowler, excellent agreement being obtained with Eucken's empirical values for the chemical constant. In addition, however, Mr. Stern has made some interesting remarks upon the nature of molecular motion in crystals. His analysis, like that of Mr. Fowler, assumes that the molecules of hydrogen rotate in the crystalline solid much as they do in the gas, and, as he points out, the reasonable nature of the predicted results furnishes good evidence for the validity of the assumption. It is not certain, all the same, that the moment of inertia remains unaffected by passage to the condensed phase, and an experiment is suggested by means of which any such change could be detected. There is possibly already evidence for a small diminution of the moment of inertia in formation of the liquid when liquid hydrogen is formed from the vapour from Prof. McLennan's investigation of the Raman effect. Rotation of molecules in crystals would appear not to be a universal phenomenon, as Mr. Stern refers to a theoretical investigation by Pauling as showing that in some crystals molecules cannot rotate at all, whilst in others they move in an irregular fashion which corresponds to wave-functions intermediate between those for pure rotation and for pure oscillation.

Constitution of Coal.—Two of the methods for studying the constitution of coal are the use of solvents for fractional extraction and the examination of the products of oxidation. At a meeting of the Royal Society of Arts on Nov. 26, Prof. W. A. Bone summarised the results of his experience with these two methods (*Jour. Roy. Soc. Arts*, **79**, 77). By means of benzene under pressure, material can be extracted from coals which is divisible into four fractions. Prof. Bone has adduced from this evidence that the solid fraction is really the material which imparts to a coal the property of forming a coke. By controlled oxidation of the extracted residue he has not only confirmed the view that the main product is a mixture of benzene carboxylic acids, but also accounted quantitatively for the material of the reaction. The same sort of product was obtained from coal in all stages of formation and in the carbonisation products, indicating that the benzenoid structure is present throughout. He advanced the view that coal is of the nature of a 'bakelite'.

Energy Distribution in an Oil Circuit-Breaker.—One of the most difficult problems which electrical engineers have to solve is to devise switches capable of breaking circuits in which large currents at high voltages are circulating. If the switch is incorrectly designed, the limit of rupturing capacity is low, and if used for large currents a short circuit results and the switch is destroyed. Automatic oil switches are now in general use, as they have been found both efficient and trustworthy. An arc drawn out between the separating contacts underneath the oil is rapidly cooled and compressed by the surrounding oil. The special feature of the switch seems to depend on the squeezing effect of the oil on the arc. In a paper read to the Institution of Electrical Engineers on Jan. 8 by C. E. R. Bruce, an elaborate study is made of the distribution of energy in an oil circuit-breaker. The paper is the latest of the reports on the subject made by the British Electrical and Allied Industries Research Association. It deals in considerable detail with the energy dissipated by large oil circuit-breakers at a pressure of 5500 volts. Rough but satisfactory measurements have been made of the various ways in which the energy liberated is dissipated. The energy dissipated at the contact surfaces and radiated from the arc was measured experimentally. That required to heat, vaporise, and break up the oil was calculated. The rest of the energy used for raising the arc to the gas temperature and in dissociating the hydrogen present could then be found and the temperature of the arc calculated. The temperature found in this way was about 3500° K. (3227° C.). This value is nearly double the value (1750° C.) which has previously been used. Tests were made with both open and closed tanks and with copper and aluminium electrodes. Interesting theoretical calculations are also given.

Electric Incubators.—In his recent address to the Scottish centre of the Institution of Electrical Engineers, E. Seddon gave an example of how electrical power is enabling the struggling industry of poultry farming to compete with imported products. It is a good illustration of the gradual mechanisation of farming. The Buttercup Dairy Co. has an electrical poultry farm near Edinburgh stocked with 200,000 laying hens. There have been installed nine incubators, each capable of holding 16,000 eggs. The eggs are placed end-downwards in special trays and packed tightly to prevent movement. The trays are then placed in the incubators at an angle of 45°. The eggs require to be turned during the process of incubation; by an ingenious device the trays are turned about a horizontal axis until they are perpendicular to their former position. The motion is reversed every six hours. Each incubator has an electric heater taking 2400 watts, which maintains the temperature between the limits of 99·5° and 100° F. The heat is controlled thermostatically and if the temperature varies by so much as 1° a bell rings. On the eighteenth day the trays of eggs are tested by being placed over high candle-power lamps. The unfertile eggs are quickly removed and the trays placed in the hatching compartments. The chicks hatch regularly on the twenty-first day. The average number of infertile eggs is 21 per cent, and 9 per cent contain dead germs. The chicks pass from the incubator rooms in cardboard boxes to the brooding rooms. The essential requirements are a constant supply of fresh air, protection from draughts, uniform temperature, and a moist atmosphere. Air drawn in by electric fans is steam-warmed and then drawn upwards through the cages containing the chicks to the exhaust fan in the roof. A complete change of air is effected every five minutes. All windows are of blue glass and the electric lamps are tinted blue. It is found that the chickens thrive under these conditions. Special lighting is arranged in the laying sheds to ensure egg-laying in the winter months. Electrically-driven conveyors convey the food to the bins, the consumption being about 150 tons of meal per week.

Cleveland Meeting of the American Association for the Advancement of Science.

THE American Association for the Advancement of Science and its affiliated societies held their annual meeting at Cleveland, Ohio, during the week of Monday, Dec. 29, 1930, to Saturday, Jan. 3, 1931. The attendance shown by the registration records was 2635. The sessions were held in the lecture rooms of Western Reserve University and the Case School of Applied Science; the large gymnasium of the University was used as a registration hall and for the exhibits.

The meeting was held under the presidency of Dr. Thomas Hunt Morgan, of the California Institute of Technology. The retiring president, Dr. Robert Andrews Millikan, of the same institution, delivered the principal address on Monday evening, on atomic disintegration and synthesis; this address appears in NATURE of Jan. 31, p. 167.

At its meeting on Thursday, the Council, the governing body of the Association, elected as president for 1931 Prof. Frans Boaz, of Columbia University, long a leading figure in American anthropology. The resignation of Prof. Burton E. Livingston, of the Johns Hopkins University, who has been permanent secretary of the Association for the past ten years, was accepted, and Prof. Charles F. Roos, of Cornell University, was elected to fill the vacancy. Prof. Roos had been secretary of Section K (Social and Economic Sciences) since 1928. Prof. Livingston was elected general secretary in succession to Prof. Frank R. Lillie, of the University of Chicago.

Sectional vice-presidents for 1931 were elected as follows: A (Mathematics), Dr. Earl R. Hedrick, University of California at Los Angeles; B (Physics), Prof. Bergen Davis, Columbia University; C (Chemistry), Dr. Charles A. Browne, U.S. Bureau of Standards; D (Astronomy), Dr. J. H. Moore, Lick Observatory; E (Geology and Geography), Prof. Douglas Johnson, Columbia University; F (Zoology), Prof. R. W. Hegner, the Johns Hopkins University; G (Botany), Prof. Elmer D. Merrill, New York Botanical Garden; H (Anthropology), Prof. W. K. Gregory, American Museum of Natural History; I (Psychology), Prof. H. S. Langfeld, Princeton University; K (Social and Economic Sciences), Prof. G. C. Evans, Rice Institute; L (Historical and Philological Sciences), Prof. W. B. Munro, California Institute of Technology; M (Engineering), Prof. Dexter S. Kimball, Cornell University; N (Medical Sciences), Prof. H. T. Karsner, Western Reserve University; O (Agriculture), Dr. C. W. Williams, Ohio State Agricultural Experiment Station; Q (Education), Prof. Ernest Horn, University of Iowa.

Plans were made for future meetings of the Association. The present year will see the inauguration of the new plan for holding a meeting during the summer months, in addition to the winter meeting. The first of the summer meetings will be held in Pasadena, California, in June. The 1931 winter meeting will be held in New Orleans, Louisiana. The summer meeting for 1932 will be held in New Haven, Connecticut, and the winter meeting probably in Atlantic City, New Jersey. The summer meeting for 1933 will be held in Chicago. The 1932 winter meeting should have been planned for Chicago, according to the policy of holding quadrennial meetings of the Association in Chicago, Washington, and New York in rotation; but the plan was modified to permit the Association to meet in Chicago while the forthcoming World's Fair there is in progress.

The Association's prize of one thousand dollars for an outstanding paper presented at its winter meeting, given each year by an anonymous benefactor, was awarded for a paper entitled "Experiments with High-voltage Tubes", presented by Dr. M. A. Tuve, Dr. L. R. Hafstad, and Odd Dahl, of the Carnegie Institution of Washington, Department of Terrestrial Magnetism. Using a Tesla coil with a tuned spark in the primary, they have built up voltages of five million and above. They have also constructed vacuum tubes of pyrex upon which a voltage of two million can be impressed without rupturing them. Operating these tubes at a working voltage of 1·4 millions, they have obtained beta particles with a velocity within 1 per cent of the speed of light, and gamma rays of a corresponding intensity. Since it is possible to achieve theoretically unlimited voltages by building up a large enough series of Faraday cages, sufficiently well insulated, Dr. Tuve and his associates intend to carry their researches with high-velocity discharges just as far as the limits of available materials will let them.

Another paper of outstanding interest and of great potential practical significance, though it was not entered for the consideration of the prize committee, was that of Dr. W. W. Swingle, of Princeton University, and J. J. Pfiffner, of Coldspring Harbor, N.Y., on "The Hormone of the Suprarenal Cortex". The authors have used a cortical extract successfully in reviving animals prostrate and apparently at the point of death from adrenalectomy. It has also been employed successfully in the clinical treatment of Addison's disease, hitherto regarded as incurable. A number of other papers were presented on endocrine physiology, especially on the effects of various hormones on the physiology of reproduction.

Dr. Harlow Shapley, director of the Harvard College Observatory, announced that the compilation of the latest results of the sky-mapping campaign of his observatory indicates an irregular distribution of galaxies in space. The Harvard College Observatory now has photographs of about one-tenth of the sky, showing all objects within the limits of photographic visibility. These show hitherto unknown galaxies to the number of about eighteen thousand. This irregular distribution of galactic matter in space, Dr. Shapley said, favours the concept of a non-static universe put forth by Le Maitre, Tolman, and others, as against the Einsteinian idea of a static universe, which demands a uniform distribution of galaxies.

The planet Pluto, the discovery of which in 1930 was the outstanding astronomical event of more than a generation, was sought and found but left unrecognised eleven years ago. Dr. Seth B. Nicholson, of the Mt. Wilson Observatory, California, made this known for the first time in a paper read before the Section of Astronomy. In 1919 workers at this observatory conducted a search in the region where the trans-Neptunian planet had been predicted by Lowell. The image of the planet appears on a number of their plates, but at the time it went unnoticed among the host of low-magnitude star images. After the discovery of Pluto by Clyde Tombaugh at the Lowell Observatory, Arizona, the old plates were checked over and the planet images found.

A suggestion as to the possible mode of formation of petroleum in the earth was offered by Dr. S. C. Lind, director of the School of Chemistry of the University of Minnesota. Dr. Lind and his associates have succeeded in synthesising carbon compounds of a complexity approaching that of the constituents of petroleum by subjecting simple compounds like methane to pressure, high temperature, alpha particle bombardment, and electrical discharges. He suggested that pressures and energy discharges developed in the process of crustal movements, acting

on simpler hydrocarbons, might readily have built up the larger molecules of petroleum. He would not at the present time, however, undertake to say whence came the simpler hydrocarbons, the raw materials in this geokinetic manufactory.

A lipoid extract from tuberculosis bacilli was reported to act as a true antigen against the organisms that produced it, by Prof. R. J. Anderson, of Yale University. Prof. Anderson has also discovered a new fatty acid in the bacillus, which seems to be the active agent in the formation of the tubercles that are the name-symptom of the disease. The new compound has been named phtiotic acid.

A modification of the now classic Chamberlain-Moulton hypothesis of planetary formation was put forward by Prof. Kirtley Mather, of Harvard University. Prof. Mather accepts the idea that the nucleus of a planet is provided by the tidal extrusion of a ' bolt ' of stellar stuff, caused by the near approach of two stars. He believes that this initial bolt contains the larger part of the mass of the new planet, possibly nine-tenths of it, including nearly all of the heavy metals, especially iron and nickel. Planetesimal accretions account for only the outer tenth of the total final spheroid.

Of the numerous symposia, perhaps the most popularly attractive was that on the future of man, conducted by the American Society of Naturalists on the afternoon of New Year's Day. This was participated in by Dr. A. V. Kidder, of the Carnegie Institution of Washington, who presented the subject from the archæologist's point of view ; Prof. William F. Ogburn, of the University of Chicago, who considered it from the sociological angle ; and Prof. E. M. East, of Harvard University, who spoke as a geneticist. Prof. Kidder opened the discussion in the rôle of a Cassandra, giving warning that if we are to build on the analogies furnished by past cultures, our own civilisation is in for a terrific crash unless by concerted action we head it off. But beneath the shadow of this Spenglerian doom, the succeeding two speakers indulged in a fine bout of Wellsian prophecy. They envisioned a world population of about three and one-half hundreds of millions of people, speaking one general language, composed of blendings of all the races, though nationalisms, and probably wars, will continue. Africa and the two Americas will be predominantly white ; the native races will be largely extinguished, and their remnants absorbed into the dominating population. The Malayan peoples will about hold their own, but will not increase their territorial holdings ; the Mongolian race will expand greatly. Birth-control knowledge will be universal ; parenthood, restricted by social pressure and indirect rather than direct legislation, will be honoured, and babies at a premium. The stream of scientific discovery and invention will continue in ever-increasing tempo, changing the social order faster than the social order can adjust itself to the changes, thereby keeping social sanctions and moral codes in a constant state of flux. With oil all gone, coal supplies dwindling, and such natural sources as water and wind power insufficient, the world will be hard put to it for sources of power, for the ' cracking of the atom ' is a vain dream. Many factories will go to the land for both raw stuffs and labour, instead of sending to the land for materials to be worked up in town. Thus the entire population will be urbanised.

Among the scientific exhibits, the one that attracted most attention was that of Dr. George W. Crile, a surgeon of Cleveland, who with his associates has re-combined lipoid, protein, and mineral salt fractions of animal tissue, obtaining microscopic bits of colloid stuff which he calls ' autosynthetic cells '. Although they are not alive, they display many of the physico-chemical phenomena of living cells, such as an electrical gradient from the centre outwards, absorption of food material (protein), increase in size, division into new units, absorption of oxygen and elimination of carbon dioxide, and deterioration and ' death ' in the presence of toxins.

Of more immediate practical importance is the new X-ray technique employed by Dr. Thomas O. Menees, of the Blodgett Memorial Hospital, Grand Rapids, Michigan, to learn the sex of a fœtus so much as three months before birth. The method consists in the injection into the fœtal circulation of a small quantity of strontium iodide. This is non-toxic, and opaque to X-rays, thus permitting the photography of fleshy parts as well as bone. The effect fades after three hours and entirely disappears in a day. It is expected that the new technique will be of value in doubtful cases where a Cæsarian section seems to be indicated.

The United States Bureau of Standards exhibited specimens of rubber vulcanised by a new method, employing trinitrobenzene instead of sulphur. This rubber has the virtue of being non-corrosive to metals that cannot stand contact with sulphur-vulcanised rubber, making possible such things as rubber-plated steel and copper. Another exhibit of the Bureau of Standards was a set of ' fourth-dimensional ' models constructed by Dr. Paul R. Heyl. These bear the same relation to figures in the fourth dimension that the two-dimensional pictures in books and on blackboards bear to figures in three dimensions.

Dr. Dmitry Borodin, who is working at the Boyce Thompson Institute, Yonkers, N.Y., presented a demonstration of his method for measuring the effects of mitogenetic radiation. He cultivates yeast in hanging drop colonies, and measures with the planimeter the comparative areas of colonies exposed to the radiations and of control colonies.

Though not shown in the exhibits, a new type of phonograph was mentioned in one of the discussions of the physics section. This uses, instead of records, motion-picture film with twelve sound tracks on it. The machine can use a five-hundred foot film, and can play a two-and-one-half-hour grand opera at one ' loading ', The quality of the sound reproduction is said to compare favourably with high-grade radio reception from a near-by station. Commercial production of the new film phonograph, however, is not planned for the near future. FRANK THONE.

Botany in South Africa.

ON Nov. 10, Dr. Arthur W. Hill, who has since had the honour of K.C.M.G. conferred upon him, landed in Cape Town, on the invitation of the Government of the Union of South Africa, for the purpose of making personal contact with botanical affairs in the country. After spending some ten days in Cape Town, Sir Arthur Hill proceeded by the " Garden Route " to the forests of George and Knysna, proceeding from there to Port Elizabeth, Grahamstown, and East London, and then travelling to Bloemfontein and Fauresmith. At the latter place Sir Arthur saw the work which is being carried out at the recently established Karroo Pasture Station. He described this station as the most remarkable which he had seen in the course of his travels throughout the world. Here the semi-desert shrubs which form the vegetation covering the great Karroo areas were being investigated as regards their palatability, carrying capacity,

and food value. From Fauresmith Sir Arthur Hill proceeded eastwards over the Drakensberg Range via Van Reenen's Pass and Ladysmith to Pietermaritzburg, from which place he travelled to Durban. From Durban he went to Pretoria and, after spending ten days there, travelled north to the Woodbush Mountains, and this completed his tour in the Union.

Before Sir Arthur left Pretoria, the Union Government gave a reception in his honour at the botanical laboratories attached to the Division of Plant Industry. At this reception Col. G. N. Williams, Secretary for Agriculture, welcomed him on behalf of the Union Government. In doing so, he spoke of the long and close association which Kew had had with the South African Departments of Agriculture, and also mentioned the many botanical expeditions with which Sir Arthur had been connected in different parts of the world.

Mr. C. E. Legat, Chief Conservator of Forests, welcomed Sir Arthur on behalf of the Forest Department. He mentioned the assistance which the Department of Forests had received from Kew, and stressed the fact that South Africa had to depend upon the introduction of exotic trees because the native timbers took between 150 and 200 years to mature.

Dr. I. B. Pole Evans, Chief of the Division of Plant Industry and Director of the Botanical Survey of South Africa, welcomed Sir Arthur on behalf of the botanists of South Africa. He described the great benefits which Kew had rendered to South Africa, and referred to the publication of the "Flora Capensis" and the assistance which the South African Governments had given in the matter. He referred to the close association between the Botanical Survey of South Africa and Kew, whereby the Survey had maintained at Kew for some years past a South African botanist to assist with critical determinations, etc. Dr. Pole Evans mentioned the botanical areas, institutions, and problems which Sir Arthur had seen, and expressed the hope that he would realise that botanical science had made considerable strides in the country during the past twenty-five years, and that South Africa must in the future endeavour to help herself much more than she had in the past.

Sir Arthur, in returning thanks to the Government for its invitation, referred to the great importance and educational value of botanic gardens. He stated that he would like to see three great botanical gardens flourishing in the Union. There were the Kirstenbosch Gardens, but in addition he would like to see one in Natal and one in Pretoria. He spoke of the excellent work which was being done at Fauresmith and at Pretoria on the pasture plants of the country, and also stressed the importance of the work that was being done by the Botanical Survey. Regarding forestry matters, Sir Arthur expressed high appreciation of the work for the preservation of native forests in the Knysna area. In concluding, he hoped that means would be found for subsidising post-graduate research work in botany, since he thought South Africa would derive considerable benefit from work of this nature.

General Smuts moved a vote of thanks to Sir Arthur Hill, the British Government, and the Union Government, and pointed out that Sir Arthur was the first of Kew's great directors to undertake a tour of the Dominions—and in this connexion General Smuts paid a great tribute to the foresight of the Empire Marketing Board in making this possible. He referred to the valuable gift which Sir Arthur had made, through Kew, to the National Herbarium at Pretoria by donating type specimens of many of the older collections, and pointed out that the National Herbarium at Pretoria would now be able to do a very large part of the work which Kew originally did. He expressed the view that the time would probably come when South Africa might well become one of the great pasture countries of the world, and for this reason every effort should be made to develop the country's natural resources. This might in time become a question for the whole of Africa, and they would see not only one institution, not only one country such as the Union, but all the African Governments collaborating and trying to solve common problems. Science would have to be applied more and more to the economic situation. General Smuts referred to the great spaces in South Africa and the difficulties which isolated workers had to contend with, and he felt that Sir Arthur's visit would be a great inspiration to these people.

After the speeches of welcome, Dr. A. C. Leemann spoke on "Plant Immunity and the Aims of Modern Plant Pathology". He gave his audience the benefit of his researches in his own entirely new line of work in the realm of plant immunity, in which, by reinforcing soil conditions, he has found it possible to effect a marked change in the immunity of plants to certain fungus diseases. Dr. Leemann supplemented his remarks by giving a demonstration of plants which had been inoculated under these conditions.

Guests were then given the opportunity of inspecting a very interesting and instructive series of exhibits illustrating the work of the Division of Plant Industry. These included amongst others :—(1) Photographs of much of the vegetation of those parts of the country which Sir Arthur Hill had not been able to visit. (2) A collection of old type specimens presented to the National Herbarium by Kew and Berlin. (3) A collection of living pasture grasses recently collected on a tour from Pretoria to Lake Tanganyika. (4) A trap specially designed by Mr. H. Harris, as a result of his work in Zululand, for catching tsetse flies. The success already achieved by the use of this trap opens up considerable possibilities with regard to tsetse fly control (NATURE, Nov. 22, p. 817).

This visit of Sir Arthur Hill to the Union of South Africa is of outstanding significance, and much of botanical interest should accrue from it, for there is probably no part of the British Empire which has contributed more towards the pure and economic branches of botanical science, and it is scarcely possible to encounter a flora which could excel that of South Africa in beauty and scientific interest.

Scotland's Testimony to the March of Evolution.

THIS subject formed the main part of Prof. James Ritchie's inaugural address (reprinted in part in the *Scottish Naturalist*, Nov.-Dec. 1930) on his induction to the Regius chair of natural history in the University of Aberdeen.

Prof. Ritchie reminded his audience that bears were once common in the Caledonian forest, and that he, with his collaborators, had found in caves near Inchnadamph, in Sutherland, bones of bears, remains of wolves, lynxes, Arctic foxes, and lemmings, and more than nine hundred antlers of reindeer. All these animals, and more besides, have disappeared from Scotland; they have been swamped in the struggle for existence. Red deer, once common throughout Scotland, are now restricted to the Highlands; wild cats, pine martens, and polecats are dying out; and the white-tailed eagle, the kite, and the osprey have disappeared. On the other hand, many species of wild ducks are now nesting where they never bred before; and the fulmar petrel, for centuries confined

to St. Kilda and its islands, has in a generation colonised the north coast and the east coast to Flamborough Head. These and other changes in the balance of life illustrate the accommodation of living things to changing conditions and hence successful colonisation; and, on the other hand, the failure to accommodate and consequent elimination.

In his second line of evidence, Prof. Ritchie referred to examples of the plasticity of living forms. "Put broadly, Creationism emphasises the immobility of living forms, Evolution emphasises their plasticity." He pointed out that in a relatively short time Scotland has impressed its mark upon domestic animals: among horses it has bred the Clydesdale, among cattle Aberdeen-Angus, Ayrshires, Galloways and Kyloes, among dogs Skye terriers and others, among sheep Cheviots and Highland blackfaces—surely sufficient evidence of the plasticity of living forms that evolution demands. Granted that this plasticity can be made apparent by man's efforts, what evidence is there that it plays a part in natural processes? Prof. Ritchie believes that Scotland demonstrates better than almost any other country the evolution of life in progress. The former fauna was entirely obliterated in the ice age, and the new fauna flocked into the country from Europe. But all the animals are not exactly as they were; changes have been taking place, revealed by the intense examination of modern zoologists. The red grouse of Scotland is clearly different from the willow grouse of the Continent; it is a different species. Of the one hundred and fifty-nine different species of birds which breed in Scotland, thirty-two show characters which distinguish them from their closest relatives on the Continent. Others —and thirty-one of these are named—are distinct geographical races which, although differing from their continental relatives, are not different enough to be regarded as distinct species. Of the fifty-six different species and races of mammals which breed in Scotland, thirty are different from the most closely related continental forms; and of these, specialists have regarded eight as distinct species and twenty-two as geographical races.

Prof. Ritchie illustrated his argument by particular reference to the St. Kilda house-mouse and the St. Kilda field-mouse, both regarded as distinct species, and remarked that it is reasonable to suppose that these are the direct descendants, slightly modified, of the original migrants from the common fauna of Europe.

"In the fauna of St. Kilda and in the thirty-two distinctive birds and thirty distinctive mammals of Scotland we are looking upon the modelling from old species of new species and of geographical races, which we regard as the incipient stages of new species.

"In the changes taking place in the balance of life, in the plasticity of animal form, and in the formation of new races and species, not in the distant past of geologists, but in recent times, we are looking in Scotland upon evolution in its course."

The Mechanics of Mountains.*

THE earth's upper crust in the continents appears from seismology to consist of three layers, an upper one of granitic constitution, about 10 km. thick; an intermediate one about 20 km. thick, the properties of which fit tachylyte; and a lower one probably of dunite, extending half-way to the centre of the earth. Above the granitic layer is the sedimentary layer, with an average thickness of probably about 2 km., but considerably thicker in special regions. The outflow or inflow involved in maintaining isostatic compensation is in the lower layer, but at a smaller depth than 50 km.

The mechanical properties of the outer crust indicate that the crustal shortening in a major epoch of mountain formation should be of the order of 40 km. The actual height and extent of the great ranges correspond to a shortening of about 60 km. This estimate is arrived at by considering what elevation would be produced if the light upper layers were compressed by a given fraction of their original length and enough outflow in the dense lower layer took place to restore isostasy.

This estimate is much less than the horizontal movement observed in the field, and the only possible explanation is that the horizontal movement is a surface phenomenon almost confined to the sedimentary layer, and caused by the crustal shortening, but not equivalent to it.

Prolonged deposition of sediments leads to an obstruction of the normal outflow of heat from the earth, and hence to an increase of temperature and a reduction of strength through a depth of the order of 100 km., thereby localising the yield when the stresses due to contraction of the interior become too great for the strength of the outer crust to withstand. The immediate result of a local failure would be a local elevation so high that the heated sediments would proceed, as a secondary effect, to flow out horizontally under gravity and give a series of flat folds closely resembling the observed nappes. Explanations of 'back-folding' and of the gneissic core of a great mountain system appear to follow naturally.

Emphasis is laid on the importance of recognising the intermediate layer in discussions of the mechanics of geological processes. Isostatic readjustment can take place by horizontal outflow in this layer as in the lower layer, though much more slowly, and this process may play an important part in the formation of geosynclines and the levelling of old mountain systems.

* Substance of a lecture by Dr. H. Jeffreys, F.R.S., on "The Mechanics of Mountains", at the Geological Society of London, on Dec. 31, 1930.

Sinkage of Logs.

THE sinkage of logs during the river journey to the pulp-wood mills is a matter of considerable importance owing to the loss thereby incurred. The question has formed the subject of research by Prof. G. W. Scarth, Botanical Department, McGill University, and Mr. E. C. Jahn, associate professor of chemistry, School of Forestry, University of Idaho, the work being assisted by funds contributed by the Canadian Pulp and Paper Association. A paper on "Sinkage Studies—I." has now been published (*Can. Jour. Research*, vol. 2, June 1930). Experiments were made with logs of jack pine, spruce, poplar, balsam, and birch.

The distribution of water in floating logs (in a lake) was found to be similar to that in living trees. It was noted that the sapwood of these species became wet all round whilst the heartwood was relatively dry, becoming wetter in the order of the species given above; the heartwood in birch became as wet as the sapwood. The rate of radial penetration of water into logs of these species increased in the order, birch, jack pine, spruce, balsam, poplar; the penetration

taking place very slowly, even into the sapwood. Narrow outer rays and density of the wood diminish the rate of penetration. The advantage of a large proportion of relatively dry heartwood depends more on the initial buoyancy it confers than on the greater resistance to penetration it may possess. In air-dry logs penetration of free water is also very slow; saturation of the cell walls precedes it at a greater rate. The gas in floating logs is surrounded by water and can only escape in solution. There appears to be evidence that more gas may be liberated by fermentation of storage material in the parenchyma cells.

The problem as to whether escape of gas or penetration of water is the leading factor in determining the rate of sinkage of cut logs has been studied by Mr. R. D. Gibbs, of the Department of Botany, McGill University, and published under the title "Sinkage Studies—II." (*Can. Jour. Research*, June 1930). The species investigated were balsam, jack pine, birch, and poplar. In freshly cut softwoods, possibly excepting balsam, the water content is fairly uniform, very high in the sapwood but low in the heartwood. In birch the water content was higher in the centre than near the outside, whilst the reverse was the case in poplar. In jack pine the heartwood contained about 12 per cent water, the sapwood 52 per cent. Generally the heartwood contains more gas than the sapwood, and consequently the greater the proportion of heartwood in a log the better its floating properties. In the jack pine the heartwood contains 60 per cent of gas and the outer layers of wood about 23 per cent. Wood and density values vary considerably. Consequently, even by allowing for the variation of density across a log, the errors in measurement are scarcely reduced. In order to reduce error, standardised lots of logs should be examined, and seasonal and other measurements should be restricted to these lots.

The results of this investigation, when it has been carried further, are likely to have a wider application than to Canada alone, and they must therefore be regarded as of high value.

University and Educational Intelligence.

CAMBRIDGE.—It has been announced by the vice-chancellor that the treasurer has received a cheque for 5000 dollars "as a grant toward Dr. Eric K. Rideal's new department of colloids". No condition is attached to this gift, except that the donors do not wish their names to be published.

Mr. G. U. Yule, of St. John's College, has been appointed reader in statistics. Miss M. M. O'Reilly, of Girton College, has been appointed assistant curator of the Museum of Archæology and Ethnology.

The vice-chancellor has given notice that the Montague Burton professorship of industrial relations has been established, and that a meeting of the electors will be held on Feb. 27. Candidates are requested to communicate with the vice-chancellor on or before Feb. 14.

Sir Walter Thomas Layton has been elected to an honorary fellowship at Gonville and Caius College.

EDINBURGH.—The University Court at its meeting on Monday, Jan. 26, received, with much regret, intimation from Prof. A. Robinson, professor of anatomy, of his intention to retire at the end of the current academical year. Dr. C. H. O'Donoghue was appointed director of studies to students taking combined degrees in medicine and science. Leave of absence for the summer term of 1931 was granted to Prof. G. Barger, in order to enable him to deliver a course of lectures in the University of Heidelberg. It was announced that the Right Hon. Winston Churchill would deliver the Rectorial Address on Thursday, Mar. 5. Mr. M. Davidson was appointed lecturer in the Department of Engineering, to give a course of lectures and laboratory work in the subject of heat engines for second-year students. The Court received, with gratification, intimation of the gift to the University Department of Geology, by Mrs. Currie, of the valuable collection of minerals formed by the late Dr. J. Currie.

OXFORD.—On Jan. 27 a decree was passed by Congregation authorising a grant towards the expenses of a projected Oxford University Expedition to Baffin Island in the summer of 1931. This expedition will have similar objects to those of the recent expedition to Spitsbergen. Another decree authorised the Curators of the University Chest to receive sums not exceeding £500 per annum for the purposes of a scheme of research in economic ornithology; the scheme to be carried out by the Department of Zoology and Comparative Anatomy.

NOTICE is given by the Royal Society that applications for the government grant for scientific investigations must be made on special forms, returnable to the Clerk to the Government Grant Committee, Royal Society, Burlington House, London, W.1, by, at the latest, Mar. 31.

IN 1926 a Commission was set up which inquired into and advised on the system of technical education in relation to the requirements of trade and industry in the Irish Free State. It stressed the necessity for a sound organisation of continuation schools and classes, the object of which was to link the work of the primary school at age fourteen years with that of the technical school at age sixteen years, when young people normally enter employment. The Vocational Education Act imposes upon newly appointed vocational education committees the duty of establishing and maintaining such continuation schools and classes. A memorandum has been issued by the Department of Education with the view of assisting the committees in their task ("Vocational Continuation Schools and Classes in the Irish Free State": Messrs. Eason and Son, Booksellers, Lower O'Connell Street, Dublin). Since out of approximately 120,000 young persons between fourteen and sixteen in the Free State, 45,000 are in primary and secondary schools, the task of the committees is to provide suitable education for the remaining 75,000. Although the memorandum is confined to the subject of continuation schools and classes, it specifically stresses the fact that it conveys no suggestion of diminished activity in technical education. On the contrary, the anticipation is that provision of organised continuation classes will lead to an increased demand for technical education. The memorandum is divided into two parts, the first of which recapitulates the relevant sections of the Vocational Education Act with which the committees must deal. It indicates that obligatory attendance will not become operative until the necessary order is made: careful and complete organisation is, however, the necessary preliminary to the making of that order. In developing their schemes the committees are to secure information on the occupations open to young people in their area, the conditions of entry into these occupations, the forms of skill and knowledge helpful to beginners, and the attitude of employers, employees, and parents to vocational education. By this means definite and reliable advice will always be available. Suggestions for organisation of rural education, the use of existing technical schools, and the gradual provision of new buildings are given. The second part of the memorandum deals with the details of organisation and curricula.

Birthdays and Research Centres.

Feb. 8, 1868.—Lord ROTHSCHILD, F.R.S., Trustee of the British Museum.

I have studied the morphology and systematics of birds and butterflies and moths for forty-five years, and have endeavoured to make a world-wide collection of these, as complete as possible, to serve as material for higher studies in structure, evolution, and geographical variation, for which larger series of each species and race are necessary than the usual museums can find space for.

I am, at the present moment, much occupied in the study of certain melanic mutants of birds and insects, and it would be of great interest in the investigation of evolution if a careful study could be made of these melanic forms, in order to ascertain why melanic forms are almost invariably dominant, while white or blue forms are recessive. Miss Edna M. Turner is at present at Cambridge studying the question whether *physiological* and *chemical* differences are inheritable, and as melanic forms are due to an excess of *melanin* in the organism suspected, her line of investigation will be the one to demonstrate incidentally the reason for dominance or the opposite.

Feb. 11, 1862.—Dr. F. S. MACAULAY, F.R.S., formerly mathematical master at St. Paul's School, London.

A solution is desired of the following problem:—Let f represent any polynomial in n variables, $x_1, x_2, \ldots x_n$ with coefficients belonging to a corpus K, and ϕ any polynomial in $x_1, x_2, \ldots x_r$ only, with coefficients in K. Let M be a module of polynomials f with a given basis $(f_1, f_2, \ldots f_k)$, that is, let M be the whole aggregate of polynomials $a_1f_1 + a_2f_2 + \ldots + a_kf_k$ where $f_1, f_2, \ldots, f_k$ are given, and $a_1, a_2, \ldots, a_k$ are arbitrary, polynomials of the type f. It is required to find (that is, to devise processes for finding) a basis $(f_1', f_2', \ldots f_{k'}')$ of the module M' which is the aggregate of *all* polynomials f' such that $\phi f' = 0(M)$, where f' is an f and ϕ' a ϕ (n, r, k are given, but not k').

A step towards the solution is to find at least one particular ϕ such that $\phi f' = 0(M)$ for every $f' = 0(M')$. Then M' can be more simply described as the aggregate of all polynomials f' such that $\phi f' = 0(M)$, where ϕ is known. One value for ϕ is $\phi_1' \phi_2' \ldots \phi_{k'}'$, where $\phi_i' f_i' = 0(M)$; but this only shows that a ϕ exists satisfying the conditions.

Feb. 14, 1896.—Prof. E. A. MILNE, F.R.S., Rouse Ball professor of mathematics in the University of Oxford.

My chief investigation now in progress is on the structure of the stars, their interiors and atmospheres.

Observational astrophysics is rapidly increasing in scope, accuracy, and richness of method; but theoretical astrophysics scarcely as yet bears the same relation to observational astrophysics that theoretical physics bears to experimental physics. Theoretical astrophysics is largely an array of disconnected investigations of special points. It needs to acquire classical theorems and a recognised logical development. The beginnings of this are indeed to be found in the solutions of the classical problems associated with the names of Schuster, Schwarzschild, and Emden. But at present it is as if theoretical physicists were devoting themselves to working out the consequences of each separate experiment instead of synthesising a theory of general principles. Rather than investigating the detailed stellar situations disclosed by special observations, the worker in theoretical astrophysics might well devote himself to the more abstract aspects of idealised problems. A sharp distinction needs to be drawn between the manufacture of theories about the stars and the investigation of idealised models. The former need the touch of inspired imagination. The latter can be tackled by all, have a permanent value independent of current theories, and afford a sound background and corrective to speculation. Astrophysics might then emerge as a science as exact as geometry.

Societies and Academies.

LONDON.

Mineralogical Society, Jan. 13.—F. C. Phillips: On a soda-margarite from the Postmasburg district, South Africa. A fuller description is given of material first described by A. L. Hall. The mineral occurs in mica-like crystals associated with the Postmasburg manganese ores. The physical properties described resemble in general those of a mica, but analyses show 50 per cent of alumina and 10 per cent of alkalis, with little lime. It is best described as soda-margarite; in composition it resembles the 'ephesite' of J. L. Smith.—F. A. Bannister: On the distinction of analcime from leucite in rocks by X-ray methods. Powder-photographs of phenocrysts in blairmorite from the Lupata Gorge, Zambezi River, Portuguese East Africa, are identical with those for analcime and not for leucite. The icositetrahedral outlines of the analcime phenocrysts found in the rock strongly suggest their primary origin. The X-ray photographs indicate that the phenocrysts are not single crystals, but consist of aggregates of particles in sub-parallel position.—F. A. Bannister: On a chemical, optical, and X-ray study of nepheline and kaliophilite (with chemical analyses by M. H. Hey): correlated data have enabled the author to prove the approximate constancy of the number of oxygen atoms in the unit cells of several nepheline and elæolite specimens. Thence the numbers of atoms of each kind per unit cell have been counted. The cell volumes and optical properties have also been related to the chemical composition. An approximate structure is suggested which, together with the chemical work, explains the variable composition of nepheline. Kaliophilite is shown to possess a much larger cell than that of nepheline, and its Lauegram exhibits higher symmetry. 'Pseudonepheline' (rich in potassium) has a slightly greater cell volume than normal nepheline, but its Lauegram is almost identical and its axial ratio the same.—H. V. Warren: On an occurrence of grunerite at Pierrefitte, Hautes-Pyrénées, France. A grunerite-schist, consisting almost entirely of fibrous grunerite, occurs at the Pierrefitte mine, where needles of the same mineral also occur in the galena and blende of the ore-bodies. The grunerite is associated with a carbonaceous schist and with magnetite, and encloses specks of carbon. Analyses of grunerite from schist and ore by E. G. Radley are given.

Geological Society, Jan. 14.—E. S. Cobbold: Additional fossils from the Cambrian rocks of Comley (Shropshire). Species referred with reserve to *Micmacca* Matthew in 1910 are now confidently placed under that genus, or under *Strenuella*, and the relationships between *Protolenus*, *Strenuella*, and *Micmacca* are noted. The very plentiful *Ptychoparia attleborensis* Shaler and Foerste is placed under Walcott's genus of the Eodiscidæ, *Pagetia*, on the strength of an enrolled specimen of the complete dorsal shield. Some six or eight specimens of *Weymouthia nobilis* Ford throw considerable light on this species. A new genus is proposed for an undescribed Lower Cambrian

trilobite, which seems intermediate between *Dorypyge* and *Centropleura*.

Linnean Society, Jan. 22.—C. G. Trapnell: Vegetation in Godthaab Fjord, West Greenland. The Oxford University Greenland Expedition, 1928, worked principally at Isersintilik, in Godthaab Fjord, lat. 64° 40′ N. The problem of the classification of this heath is considered with reference to the climatic series of vegetation types found, and to competition.—B. P. Pal: Burmese Charophyta. An investigation into the systematics, distribution, ecology, and economic importance of Burmese Charophytes. Burma has a large number of species belonging to the genera *Chara* and *Nitella*. The importance of Charophyta as destructive agents of Culicid larvæ was negatived by experiments on *C. gymnopitys* and two species of *Nitella*. An apparent larvicidal effect in one case was discovered to be due to the presence of larvæ-eating insects.

BRUSSELS.

Royal Academy of Belgium, July 5.—Th. De Donder: The invariantive theory of the calculus of variations (9).—H. Buttgenbach: Mineralogical notes. Crystals of gold, of sphene, and of garnet.—Oct. Dony: The reduction of zinc oxide by carbon monoxide in a gas cycle, and on the mechanism of this reduction. Carbon monoxide, formed by circulating carbon dioxide over graphite at about 1000° C., rapidly reduces zinc oxide at about 1040° C. to metallic zinc. The admixture of solid carbon with the zinc oxide is unnecessary.—Victor Willem: The architecture of bees.—L. Godeaux: An algebraic variety representing couples of inverse points of space, and on surfaces of the fourth order having four uniplanar double points.—Jean Genard: A new resonance series of sulphur vapour.—R. H. J. Germay: The rôle of an exponential in the development in series of solutions of generalised Lagrangian equations. The application to the Gauss equation.—G. Gilta: The crystalline form of some alkylarsinic acids and alkaline alkylarsinates.—A. Heyting: Intuitionist logic.—R. Deladrière: Generalisation of the fundamental identities of the Einstein gravific.

Aug. 2.—Victor Willem: The respiratory operations in *Xenopus*.—Th. De Donder: Invariantive theory of the calculus of variations (10).—Lucien Godeaux: The groups of three W congruences having a common focal surface.—E. De Wildemann: Aerial roots.—J. Melon: Two minerals from the Belgian Congo: a non-pyroelectric tourmaline with special facies and a colourless chrysoberyl without twinning.—Marcel Winants: New applications of the theory of integral equations.—Miron Nicolesco: Functions conjugated on a surface, as defined by Beltrami.—R. Bouillenne: Contribution to the study of the phenomenon of osmosis in plant cells. A new apparatus for the measurement of the velocities of penetration of saline solutions in plant protoplasm.—R. Bouillenne: Studies on the permeability of cells of *Tradescantia virginica* and of *Allium Cepa*. Applications of the apparatus described in the preceding communication.—R. and M. Bouillenne: Sexuality and cellular oxidations in *Mercurialis annua*.—M. and R. Bouillenne: Experimental researches on the toxic agent of the pollen of Ambrosia. An investigation into the chemical constitution of pollen poisons. A bibliography relating to hay fever is appended.—Constant Lurquin: The functional relations for the mean elements of probability.

ROME.

Royal National Academy of the Lincei: Communications received during the vacation, 1930.—G. Andreoli: Pseudo-integrals and pseudo-derivatives.—Maria Pastori: Partial derivation of tensors in relation to their intrinsic and partially intrinsic representation.—Vladimiro Bernstein: Ultra-convergence (*Ueberkonvergenz*) of certain Dirichlet series.—Radu Badesco: Singularities of the solutions of a class of integral equations.—M. Manarini: Asymptotic lines on a surface. Application of Levi-Civita's conception of parallelism leads to the establishment of a necessary and sufficient condition for a line traced on a surface to be asymptotic.—M. Pierucci: The orbit of the ultra-Neptunian planet (2). With the new data for Lowell's planet obtained by Crommelin in July last, the three values for $\sqrt{ab}$ as yet found are 40·40 and 39·12 (Crommelin) and 39·90 (Banachiewicz). The mean of these values, 39·81, differs from the value calculated according to the author's rule by 0·46 per cent, and the mean difference between the calculated and observed equivalent radii is reduced to 4·31 per cent.—L. Caldo: Julian reform of the calendar.—G. Boaga: Formulæ for the topographic corrections in Eötvössian remainders.—A. Belluigi: Physical characteristics of the Modenese Apennine marginal plain.—M. Lombardini: The motion of the mass of air in the atmosphere.—C. Dei: Determination of the vapour pressure of ice at low temperatures. The method of measurement employed is based on the values of the explosive potential in a discharge tube corresponding with different known values of the density of the water vapour filling the tube. The results thus obtained for the vapour pressure of ice, in mm. of mercury, are: at −22·3°, 0·58 ± 0·023; at −55°, 0·0166 ± 0·0008; and at −66°, 0·0037 ± 0·0002. These values agree satisfactorily with those given by other authors.—B. Del Nunzio: A thermal analogue of the Barkhausen effect.—D. Graffi: The theory of the propagation of heat by natural convection.—G. Bozza: The mode of action of certain gas blowers (2).—A. Nasini and G. Natta: The crystalline structure of the inert gases; krypton (2). X-ray examination of solid krypton by the powder method in a special chamber reveals a face-centred cubic structure. The unit cell, which contains four atoms, has a side of 5·78 A., and the volume 193×10^{-24} c.c.; the density is 2·83.—G. A. Barbieri: Colour reactions of the molybdo-octocyanides.—C. Sandonnini and S. Bezzi: Catalytic decomposition of cetyl alcohol. At 340°-350° and in presence of oxides of aluminium, zinc, chromium, or iron, cetyl alcohol behaves similarly to primary alcohols with fewer carbon atoms. Dehydration of the alcohol by means of alumina furnishes a simple method of preparing hexadecylene in good yield.—G. R. Levi and D. Ghiron: Oxidation and reduction cells of alkali chlorites (2).—A. Ostrogovich and V. Galea: γ-Triazines: Synthesis of two aralkylaminothioltriazines. Benzylaminothioltriazine, prepared by the method used for obtaining the corresponding alkyl derivatives, melts and decomposes at 270°-271°, while styrylaminothioltriazine, obtained by the method used for the aryl compounds, melts and decomposes at 284°-285°.—C. Richard: A peculiar asymmetry of *Physeterides* and its relation to cranial asymmetry.—G. Mezzadroli and E. Vareton: Action of ultra-short electromagnetic waves, $\lambda = 2$-3 metres, on silkworms. The action of an exposure of thirty minutes daily to these waves manifests itself in an acceleration of the life cycle. After 20 days of the treatment, commencing when the worms are 15 days old, the increases in weight and length are respectively 112 and 37 per cent. The irradiated worms begin spinning some days earlier and give an appreciably greater yield than the untreated controls.—G. Brunelli: Colonisation of artificial lakes.—Giulio Cotronei and Celso Guareschi: Zoological constitution and transplanting: Experiments on *Anura* and

Urodeles (5).—Aldo Spirito: Experiments on the grafting of more extensive embryonic parts between *Anura* and *Urodeles*.—C. Jucci: Cocoon colour and blood-pigment migration to the silk in the F_1 of reciprocal crosses between the Chinese gold, native yellow, and Japanese white races of silkworms.—M. Mitolo: Reflex excitability as a function of *p*H.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 10, Oct. 15).—**Paul S. Epstein**: Reflection of waves in an inhomogeneous absorbing medium. A mathematical discussion. It is concluded that for an angle of incidence larger or slightly smaller than the angle of total reflection, a non-conducting medium gives total or considerable reflection; a slightly conducting medium behaves similarly. With increase of conductivity, reflection decreases rapidly and the coefficient of reflection becomes very small with large conductivity. Hence reflection is insignificant except when conductivity is small and the conditions approach total reflection; thus in radiotelegraphy, if rays are reflected, their paths can be computed neglecting conductivity, as if the medium were transparent.—**G. E. Coghill**: The structural basis of the integration of behaviour. Observations of the developing salamander indicate that the law or pattern of development consists in the expansion of a total pattern of action within which partial patterns arise by individuation through restriction of the field of motor action and the field of adequate stimulation. This has been demonstrated for unconditioned reflexes and seems to apply to the formation of conditioned reflexes and instincts. The structural basis of the law appears in the growth of the nervous system.—**C. Judson Herrick**: Localisation of function in the nervous system. The first neuromuscular reactions in the salamander are executed by localised chains of neurons discharging into the total body musculature. Innervation of limbs, etc., is an outgrowth from this integrated system. Local reflexes are established, but the neurons in the brain conveying them are linked up in a dense network of fine nerve fibres (the 'neuropil'). This diffuse and relatively equipotential neuropil provides the basis for behaviour generally; it is nearly homogeneous, but not quite, since every part receives a preponderance of fibres from specific sensory fields.—**Wilder D. Bancroft** and **George Bancroft**: Glycogen metabolism. A reversible equilibrium, maintained by enzymes, between glycogen or glucose and lactic acid, is postulated. Apparent displacement of equilibrium is due to changes in adsorption of glycogen by protein.—**Paul S. Epstein**: Note on the nature of cosmic rays. Rossi has suggested that if the cosmic rays are fast electrons, they have an energy a little less than 10^9 volts. It is shown mathematically that electrons of 10^9 volts energy coming from outside would be much deflected by the earth's magnetic field and can strike the earth only in two limited zones around its magnetic poles. Practically all countries where cosmic rays have been observed are outside these zones.—**H. T. Engstrom**: Periodicity in sequences defined by linear recurrence relations.

Official Publications Received.

BRITISH.

Proceedings of the Seventeenth Indian Science Congress, Allahabad, 1930. (Third Circuit.) Pp. xl+539. (Calcutta: Asiatic Society of Bengal.) 15 rupees.

Department of Agriculture, Trinidad and Tobago. Vol. 1, Part 3: Flora of Trinidad and Tobago. Olocales, Celastrales, Sapindales. By R. O. Williams. Pp. 165-196. (Trinidad: Government Printing Office.) 1s. 3d.

The Medical and Scientific Archives of the Adelaide Hospital. No. 9 (for the Year 1929). Pp. 126. (Adelaide: Harrison Weir.)

CATALOGUES.

The Nickel Bulletin. Vol. 4, No. 1, January. Pp. 32. (London: The Mond Nickel Co., Ltd.)

Arctic and Antarctic: Alaska, Greenland, N. Russia, Siberia and Kamtchatka, Scandinavia and Whaling. (Short List B.5.) Pp. 18. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, FEBRUARY 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Sir St. Clair Thomson, F. C. Ormerod, and others: Discussion on Tuberculosis of the Ear.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—The Escape of Radiation from the Atmosphere. Chairman, Sir Gilbert Walker. Opener, Dr. G. C. Simpson, followed by Sir Napier Shaw, Dr. F. J. W. Whipple, and Prof. E. A. Milne.

EMPIRE SOCIETY, at 4.30.—J. A. Richey: The Indian Educational System.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.30.—Discussion on Frontal Sinusitis and its Treatment.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—H. E. Beckett: The Radiation-Reflecting Powers of Rough Surfaces.—E. B. Moss: A Ballistic Recorder for Small Electric Currents.—F. J. Scrase: The Instrumental Phase-Difference of Seismograph Records.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. N. Gresley: High-pressure Locomotives.

COKE OVEN MANAGERS' ASSOCIATION (Midland Section) (at Grand Hotel, Sheffield), at 6.30.—A. Grounds: Some Aspects of Coal Treatment.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Midland Hotel, Manchester), at 6.30.—C. J. H. Trutch: The Diesel Engine and the Railways.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Section of Institution of the Rubber Industry) (at Engineers' Club, Manchester), at 7.—A. Fraser: Plant Used in the Manufacture of Synthetic Resins.—Dr. E. E. Walker and E. A. Bevan: The Effect of Certain Factors upon the Electrical Properties of Moulding Powder and Synthetic Resins.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—R. Davis, G. W. Bowdler, and W. G. Standring: The Measurement of High Voltages, with special reference to the Measurement of Peak Voltages.—Dr. L. E. Ryall: The Construction and Operation of a Simple Neon-Tube High-Tension Crest Voltmeter.—S. Whitehead and A. P. Castellain: Sphere-Gap Calibration.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.—Prof. W. Cramp: The Birth of Electrical Engineering (Faraday Lecture).

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Members' Evening.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—J. W. White: Aerial Wire Ropeways.

INSTITUTE OF FUEL (Bristol Centre) (at Bristol University), at 7.30.—M. H. Lewis: Recent Developments in Economy of Fuel for Small Boilers.

GEOLOGISTS' ASSOCIATION (in Botany Theatre, University College) (Annual General Meeting), at 7.30.—Prof. W. W. Watts: Bournes (Presidential Address).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—A. D. Wright: Spinal Analgesia, with special reference to Operations above the Diaphragm.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—J. M. Keynes: The Internal Mechanics of the Trade Slump.

INSTITUTE OF BREWING (North of England Section) (Annual General Meeting) (at Midland Hotel, Manchester).

SATURDAY, FEBRUARY 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. E. Cammaerts: Flemish Art (3): Rubens.

MONDAY, FEBRUARY 9.

ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH, at 5.—Dr. D. K. Henderson: Social Psychiatry (Morison Lectures) (1).

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R. W. L. Phillips and others: Discussion on Maintenance Service to Consumers in Rural Areas.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—P. J. Ryle: Two Transmission Line Problems: Suspension Insulators for Industrial Areas in Great Britain; Conductor Vibration.

INSTITUTE OF METALS (Scottish Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—D. R. Tullis: Gas Refinement of Metals and Alloys.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Mrs. Patrick Ness: To Lake Chad and the Sahara.

TUESDAY, FEBRUARY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Recent Experimental Physics (1): The Raman Effect.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Symposium on Salt Domes.

INSTITUTION OF CIVIL ENGINEERS, at 6.

INSTITUTE OF MARINE ENGINEERS, at 6.—H. E. Yarrow and S. Hunter, Jr.: Water-tube and/or Scotch Boilers.

ROYAL SANITARY INSTITUTE (at 90 Buckingham Palace Road), at 6.—Lt.-Col. W. Butler and others: Discussion on Recent Methods of Sewage Treatment.

INSTITUTE OF METALS (Swansea Section) (at Y.M.C.A., Swansea), at 6.15.—J. Frith: Application of Copper to the Building Trade.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.45.—J. H. S. Dickenson: The Manufacture of Heavy Steel Forgings for the Chemical Industry.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Loughborough College), at 6.45.—S. G. Brown: Loud-Speakers since their Conception, with Gramophone Pick-ups and Wireless Recording Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Section) (at Hotel Metropole, Leeds), at 7.—Informal Discussion on Earthing and the Safety of the Public, with special reference to Domestic Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at College of Technology, Manchester), at 7.—Prof. W. Cramp: The Birth of Electrical Engineering (Faraday Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—O. Howarth: The Metering of Three-Phase Supplies.

INSTITUTE OF FUEL (at 17 Albert Square, Manchester), at 7.—Dr. G. V. Slottman: Fuel Control in the Iron and Steel Industries.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—C. M. Oates: Panel Heating.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Colour Photography.

INSTITUTION OF AUTOMOBILE ENGINEERS (at King's Head Hotel, Coventry), at 7.30.—S. W. Nixon: The Compression-Ignition Automobile Engine.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—G. Wahl: Electric Welding in the Construction of Sea-going Vessels.

INSTITUTE OF METALS (North-East Coast Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—A. Wragg: Stress in Metals.

QUEKETT MICROSCOPICAL CLUB (Annual General Meeting) (at Medical Society of London), at 7.30.—Presidential Address.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—H. J. Hogbin: The Spirits of the Dead at Ongtong, Java.

WEDNESDAY, FEBRUARY 11.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Hotel Russell, Russell Square), at 2.30.—W. G. Case and W. E. Dennison: Boilers and Metals.

ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH, at 5.—Dr. D. K. Henderson: Social Psychiatry (Morison Lectures) (2).

GEOLOGICAL SOCIETY OF LONDON, at 5.30.

TELEVISION SOCIETY (at University College), at 7.—E. L. Gardiner: The Stenode Radiostat and its Application to Television.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—N. L. Hudson: The Use of Liquid Fuel in the Textile Trade.

ROYAL SOCIETY OF ARTS, at 8.—F. G. Wood: New Motives for Textile Designs.

THURSDAY, FEBRUARY 12.

ROYAL SOCIETY, at 4.30.—Prof. L. T. Hogben and D. Slome: The Pigmentary Effector System, VI.—H. Muir Evans: Brains of Cyprinoids and Habits of Feeding.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. Dingle: The Nature and Scope of Physical Science (4).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Capt. N. Macmillan: Air Navigation.

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.—J. Doonan: The Manufacture and Uses of Monel Metal (Film Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7.—Informal Meeting.

BURNLEY TEXTILE SOCIETY (at Mechanics' Institute, Burnley), at 7.15—R. Eastman: Efficient Lighting.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry) (at Cardiff Technical College), at 7.30.—F. J. Dippy: The Geochemistry of Coal.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—J. M. Paterson: Commercial Aspects of Electrical Engineering.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.

INSTITUTE OF METALS (London Section, jointly with Electroplaters' and Depositors' Technical Society) (at 83 Pall Mall), at 7.30.—Dr. H. J. T. Ellingham: Electrolytic Processes in Metallurgy.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—A. Richardson: The Modern Manufacture of Machine-cut Gears.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—Declaration of the name of the winner of the Operative Welders Prize and the awarding of the Prize and Gold Medal.—The Prize Winner: Welding Practices and Methods based on my own Experiences.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 8.15.—Extraordinary General Meeting.

ROYAL SOCIETY OF MEDICINE (Neurology and Psychiatry Sections), at 8.30.—Special Discussion on Mental Symptoms associated with Brain Tumours.

FRIDAY, FEBRUARY 13.

ROYAL ASTRONOMICAL SOCIETY (Annual General Meeting), at 5.—Presidential Addresses by Dr. A. C. D. Crommelin on the award of the Gold Medal to Prof. W. de Sitter, and the Jackson-Gwilt Medal and Gift to C. W. Tombaugh.

BIOCHEMICAL SOCIETY (at Lister Institute), at 5.—W. T. J. Morgan: A Specific Precipitating Polysaccharide from *B. dysenteriæ* (Shiga).—L. F. Hewitt: Oxidation-Reduction Potentials o Pneumococcus Cultures.—B. C. Guha: Investigations on Vitamin B_2.—E. Boyland and O. Meyerhof: Glycogen Synthesis in Muscle Poisoned with Mono-iodoacetic Acid.—Gladys Bird and P. Haas: The Cell Wall Constituents of Laminaria. Mannuronic Acid.—M. G. Macfarlane: The Influence of Potassium Mono-iodoacetate on Fermentation by Yeast Preparations.—R. Robison and E. J. King: Hexosemonophosphoric Esters.—W. Robson and J. Lamb: The Erlenmeyer Synthesis of Amino-acids.

ROYAL COLLEGE OF PHYSICIANS OF EDINBURGH, at 5.—Dr. D. K. Henderson: Social Psychiatry (Morison Lectures) (3).

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College), at 5.30.—R. Ellis Roberts: Reality in Life and Literature.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. C. S. Wigley: Ship Wave Resistance—an Examination and Comparison of the Speeds of Maximum and Minimum Resistance in Practice and in Theory.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Institution of Civil Engineers), at 6.30.—D. MacDonald: Silver, and its Application to Chemical Plant.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON) (at 36 George Street, Manchester), at 7.—D. W. Sanford: The Development of the Piston Valve to improve Steam Distribution.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section, jointly with Microscopical Society of Wales) (at Cardiff Technical College), at 7.30.—C. A. Seyler: The Microstructure of Coal.

BLACKBURN TEXTILE SOCIETY (at Blackburn Technical College), at 7.30.—S. N. Duguid: Smoke Abatement and Fuel Economy.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. C. Reid: Monolith Foundations.

INSTITUTE OF METALS (Sheffield Section) (at Sheffield University), at 7.30.—N. C. Marples: The Applications of High-Nickel Nickel-Copper Alloys and Pure Nickel in Industry.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. F. Ll. Hopwood: Ultrasonics: Some Properties of Inaudible Sound.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section, jointly with other Chemical Societies) (at Glasgow).

SATURDAY, FEBRUARY 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—J. Stephens: On the Reading and Speaking of Verse (1): On Speaking Verse.

PUBLIC LECTURES.

SATURDAY, FEBRUARY 7.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Prof. E. J. Salisbury: Some Rarer British Plants and their Distribution.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. F. A. Bather: The Cuttle-Fish and its Ancestors.

MONDAY, FEBRUARY 9.

UNIVERSITY OF CAMBRIDGE (Cavendish Laboratory), at 4.45.—Dr. Irving Langmuir: Fundamental Phenomena in Electrical Discharges in Gases (Scott Lectures). (Succeeding Lectures on Feb. 11, 13, 16, and 18.)

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Col. L. W. Harrison: Venereal Disease: Gonorrhœa.

UNIVERSITY OF LEEDS, at 5.15.—H. B. Butler: Some International Aspects of the Economic Depression.

TUESDAY, FEBRUARY 10.

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5.30.—Dr. F. G. Gregory: Growth Problems in Plants. (Succeeding Lectures on Feb. 17 and 24.)

UNIVERSITY COLLEGE, LONDON, at 8.15.—Miss E. Jeffries Davis: Replannings of London, *c.* 1520–1920.

WEDNESDAY, FEBRUARY 11.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Col. L. W. Harrison: Venereal Disease: Syphilis.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street, W.1), at 5.30.—C. O. Blagden: Peoples of British Malaya.

KING'S COLLEGE, LONDON, at 5.30.—Prof. E. Prestage: The Great Age of Discovery (4): Vasco de Gama and the Way to the Indies.

UNIVERSITY COLLEGE, LONDON, at 5.30.—I. C. Grondähl: Norwegian Life and Character. (Succeeding Lectures on Feb. 18 and 25.)

BELFAST MUSEUM AND ART GALLERY, at 8.—Prof. J. K. Charlesworth: Big Animals of the Past.

THURSDAY, FEBRUARY 12.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Mrs. Brajlal Nehru: The Position of Women in India.

KING'S COLLEGE, LONDON, at 5.30.—S. P. Turin: Workers' Family Budgets in Russia and Great Britain before and after the Great War.

SATURDAY, FEBRUARY 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Major G. M. Coombs: Fiji and the Fijians.

CONFERENCE.

WEDNESDAY, FEBRUARY 11.

CONFERENCE ON THE MAKING OF NEW GRASSLAND: EXPERIENCES OF PRACTICAL FARMERS (at the Rothamsted Experimental Station), at 11.30 A.M.—Chairman: Earl de la Warr. Speakers: Prof. F. L Engledow, J. Cruickshank, W. M. Findlay, J. Keith, A. R. McDougal, W. S. Mansfield, J. Alston, C. H. Gardner, A. MacArthur.