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## The World Economic Conference

THE World Economic and Monetary Conference now meeting in London is undoubtedly the most comprehensive and authoritative congress of its kind which has ever been convened. Sixty-six governments, ten of which are not members of the League of Nations, have sent representatives. Never before has there been such a meeting of heads of governments, ministers of foreign affairs and ministers of finance, with their technical advisers and experts.

The Conference is the sequel to the work done last year at Lausanne, when an immediate financial collapse was averted by means of a temporary agreement on War debts. The Council of the League of Nations then agreed to the recommendation of the Lausanne Conference that it should convene a wider conference to tackle the whole problem of the world crisis. A Preparatory Commission of experts was appointed to report on an agenda for the business of the World Economic Conference and the report of this Commission has been made the basis of the deliberations of the present Conference.

The magnitude and difficulty of the problems discussed in this report and now confronting the Conference are only matched by the urgency of the crisis and the desperate need of the world for harmonious international action designed to secure the alleviation of its economic malaise. The number of workers now without employment has been estimated by the International Labour Office to be at least thirty millions, but even this figure gives but a very inadequate conception of the universal distress, as it takes no account of dependants or of the distress afflicting the agricultural populations of the world.

Since October, 1929, the level of wholesale prices has fallen by about one-third, thus seriously reducing the purchasing power of countries engaged in primary production and imposing a serious check to trade in practically all countries. World stocks of agricultural products and other raw materials continue to accumulate without prospect of a sale for the surplus ; industrial production has been drastically curtailed and has declined by something like a third ; national incomes have fallen seriously, in some cases by so much as 40-50 per cent. The total world trade in the third quarter of 1932 was only about one half the volume of that in the corresponding quarter of 1929, while its value was only about

one-third. Only about a dozen countries have retained free and uncontrolled gold currencies, with the result that fluctuating exchanges and competition between nations in currency depreciation have further served seriously to disorganise international trade, which has also been nearly strangled by high tariffs, exchange restrictions, quotas and even prohibitions, not to mention disturbances in the normal channels of trade imposed by subsidies or other methods designed to promote national economic policies. As Mr. MacDonald stated in his opening address, "no one who has surveyed the facts and watched their progress can doubt for a moment that the experiences of the last few years have proved that a purely national economic policy in this modern world is one which by impoverishing other nations impoverishes those who pursue it".

The programme of reconstruction suggested by the Preparatory Commission did not include the problem of inter-governmental debts, because this lay outside its terms of reference, but it stated that, "until there is such a settlement, or the definite prospect of such a settlement, these debts will remain an insuperable barrier to economic and financial reconstruction". During the first week of the Conference, the general conviction unquestionably appeared to be that any solutions proposed by the Conference, if they are to be effective, must be accompanied by the settlement of War debts. Mr. MacDonald, Signor Jung, General Smuts and others have been emphatic on this question. Though it lies outside the scope of the Conference, this question of debt settlement is nevertheless inseparably linked with its work of world reconstruction. The first step towards its final settlement has now fortunately been provided by the statesman-like action of President Roosevelt, who in the face of all his domestic difficulties, accepted the British Government's proposal of a payment of ten million dollars in silver in recognition of British liability, pending a final adjustment of the matter. The merit of this arrangement is that it is neither default, which would be disastrous, nor payment in full, which would have left the old problem with us and might have jeopardised the success of the Conference.

In the field of monetary and credit policy, the Preparatory Commission recommended that the objective should be the restoration of an effective international monetary standard, together with a policy of easy money designed to promote a

healthy expansion of business. In its opinion, the abolition of exchange control is an essential condition of world recovery. To obtain this, it is necessary to secure balanced budgets and to restore the confidence of the foreign lending markets to prevent sudden withdrawals of short-term debts.

The Commission considered that there must be greater freedom of international trade and recalled that one of the most significant features of the present crisis is the fall which has occurred in the value and physical volume of world trade. Governments should set themselves to re-establish the normal interchange of commodities and every effort should be made to secure a general agreement for the progressive relaxation and the complete abrogation at the earliest possible date of such restrictions as prohibitions or quotas imposed on trade as a result of the crisis. In addition, it is necessary to reduce excessive tariffs. The Commission rightly concluded that any action in the direction of a return to freedom of trade has an intimate bearing on the stabilisation of currencies, as it is impossible to maintain the international monetary system except on the basis of an international economic system. In this respect the great creditor nations have a special responsibility.

The methods proposed by the experts for the restoration of world currencies are that countries on the gold standard should pursue a liberal credit policy, while those not on gold should smooth out short-term exchange fluctuations and avoid competition in exchange depreciation. When the gold standard is restored, the gold reserve requirements of central banks should be lowered while some countries should avoid demands upon the world's gold supply by adopting an improved system of the gold exchange standard. In assisting the smooth working of the gold standard, the Commission assigned an important part to the Bank of International Settlements. The general tenor of the experts' recommendations is an early and general return to an improved gold standard under such conditions as will provide safeguards against future disastrous fluctuations in the value of the monetary metal and secure a rise in world prices.

In all the opening speeches at the Conference, it was generally agreed that the problems to be solved are to stabilise currencies in relation to some common international standard, to remove barriers to world trade and to raise world prices. Equally important, all were agreed that there

must be an end to the prevailing conflict of national economic policies.

Nothing in these suggestions is really new and indeed it would be surprising if it were so, for ever since the depression began the whole world has been searching for remedies. But it is much to the good that the problems have been clearly realised and frankly stated. Now the real work of the Conference begins, and that is to work out the details and secure the adoption of practical policies which will lead to the amelioration of the world crisis. General Smuts urged that when the delegates had the reports of the technical committees before them, they should not make too much of their political difficulties but should face the issues fairly and squarely on their merits. It is much to be hoped that this will be done. The great need to-day is the restoration of world confidence, and if the Conference can do anything to achieve this, its labours will not have been wasted. To-day the nations are bound together in a world economy wherein the prosperity of each nation ultimately is bound up with the prosperity of the world as a whole.

#### Sir Charles Parsons

*Charles Parsons: his Life and Work.* By Rollo Appleyard. Pp. xiii+334+17 plates. (London: Constable and Co., Ltd., 1933.) 15s. net.

IT is related that when the famous little *Turbinia* was taken to France during the Paris Exhibition of 1900, Augustin Normand, the eminent naval constructor of Havre, after meeting Parsons, remarked of him "Il ne pense qu' a' la turbine; il y pense sans cesse".

For nearly twenty years, Parsons had been absorbed in the development of the steam turbine; for another thirty years it was the chief interest of his life; and it is for his work on the turbine and the turbo-generator that he will be remembered. Although its possibilities were entirely unforeseen by any of his early contemporaries, Parsons' steam turbine led to a revolution in the production of power, in the methods of generating electricity and in the propulsion of ships. In later years his reaction turbine had serious rivals in the impulse turbines of de Laval, Curtis, Rateau and others, but a study of the history of turbines and the many problems connected with them only increases our admiration for his brilliant pioneering work, and reminds us

of the profound influence his investigations had on subsequent developments.

The value of any memoir of Parsons must therefore depend largely on the light it throws upon the inception of his remarkable invention and the steps by which the seemingly insuperable difficulties were overcome, and also upon the effect the introduction of the steam turbine had on the problem of power. Judged by this standard, Mr. Appleyard's book is a most welcome addition to the literature of the subject and one which can be read with pleasure even by those who are not engineers by profession. Parsons himself and his colleagues, from time to time in their various papers and lectures, dealt with the progress of turbine machinery, but to these reviews Mr. Appleyard has been able to add those personal records from which we are able to gain an insight into the methods by which success was attained.

Though Parsons started with exceptional advantages, the path he chose was by no means an easy one and the obstacles he encountered might well have discouraged the most dauntless. But no task was too hard; no problem too complex. He had "immediate insight into requirements" and, as Mr. Appleyard says, "When due thought had been bestowed upon a design, when due care had been exercised in construction, he put his work to the test with determination and courage".

While it may be said that Parsons never ceased to think of the turbine, his versatility as an inventor and his insight into physical problems was shown in many ways. Quite early in his career, following in his father's footsteps, he applied himself to the manufacture of mirrors for searchlights, and towards the end of his life found an outlet for some of his energy in the construction of large telescopes. From long experiments on the artificial production of diamonds, he could turn to the invention of the auxetophone, a form of air-operated loud speaker which was used for a season at the Queen's Hall concerts, and to the "great engineering attack on a problem of geology", the sinking of a shaft in the crust of the earth twelve miles deep.

With all these matters, Mr. Appleyard deals with sympathy and understanding, as he does also with the character and career of Parsons. In some respects the story of Parsons is unique. An aristocrat by birth, at Birr Castle, at Dublin, at Cambridge and at Elswick, he came into contact with men of science and engineers of the first

rank and with these he quickly took his place. It is true he was only one of many who attacked the urgent problem of the high-speed engine, but he was the first to solve successfully the problem of the steam turbine. By the time he was thirty years of age he had made his first turbo-generator, at forty he was applying the steam turbine to propulsion and at fifty he saw his turbine the successful rival of the triple expansion engine on land and sea.

The story of how Parsons lost and then recovered the control of his patents relating to the parallel-flow turbine is of absorbing interest. To Messrs. Clarke, Chapman and Co., with whom for five years, 1884-89, he was a junior partner, the patents without Parsons were of little value; to him they were everything, and when, through the efforts of Lord Moulton, Sir Dugald Clerk and Sir Alfred Ewing, he regained control of them, the future was assured. From that time onwards there was no looking back. At the time of his death, as Mr. Appleyard says, the total output from turbo-generators constructed by the Parsons firm, and by their licencees, for land purposes alone, exceeded thirty million horse power. But this is only half the story, for the horse-power of turbines of the Parsons type constructed for naval vessels and ships of the mercantile marine runs into many more millions.

One or two misprints, such as "Bellis" for "Belliss", and "Sohol" for "Sokol" have been overlooked in the proofs of the book, and for some reason reference is made to "Sir" George and "Sir" Robert Stephenson, which surely is a mistake. These are but trivial blemishes in an admirable memoir.

### Tabular Data of Science

*Annual Tables of Constants and Numerical Data: Chemical, Physical, Biological and Technological.* (*Tables annuelles de constantes et données numériques de chimie, de physique, de biologie et de technologie.*) Vol. 8: *Années 1927-1928.* Part 1. Pp. xl+1101. Part 2. Pp. xxi+1102-2706. 500 francs. Vol. 9: *Année 1929.* Pp. 1+1607. *Tables des matières du Vol. 9, année 1929.* Rédigée par G. Kravtsoff. Pp. xxiv+124. Vol. 9, with Index, 400 francs. (Paris: Gauthier-Villars et Cie; New York: McGraw-Hill Book Co., Inc., 1931-1932.)

THESE volumes of the "Annual Tables", and especially vol. 9 containing the data recorded during 1929, have several features of interest and

importance. Their binding is the familiar dark green cloth that clothed their predecessors, but there are interesting differences in their content. Vol. 1 of the series contained the data published during 1910 and was in many respects an experiment; it was clear that some such annual compilation was an urgent need in every scientific library, but the best way of presenting the data, the best way of arranging chemical compounds of all types and all the editorial details, could only be reached by experiment and with the help of friendly criticism. As the succeeding volumes appeared, alterations and improvements were made. Then the War came and, as happened to most international experiments, publication had to be suspended.

After the War, Dr. Marie and his staff were faced with a terrifying accumulation of data to be sifted, arranged and printed; they must have felt that to catch up with the ever-increasing mass of material was an almost hopeless task. They continued, however, and each volume that has appeared has shown some improvement on its predecessors. With the publication in 1931 and 1932 of the volumes under review, they have caught up with the data to the end of 1929, and have in addition produced a volume, vol. 9, which can be taken as their most polished product incorporating the lessons of nearly twenty years' experience.

The most important and striking feature of this last volume is its accompanying index. Compilers of comprehensive tables of numerical data are faced with one grave difficulty: the material must be arranged on some logical plan and, because of the enormous variety of properties measured and of substances examined, the plan itself must become a trifle complex. Such tables, however, are valueless unless they are used and the user, especially the occasional user, is apt to regard the plan in a rather different light from that intended. It seems to him at times to be a barrier that encumbers his way to the facts that he desires. He must obtain some knowledge of the plan before he can make use of the volume, and if he is in a hurry, and particularly if he cannot find what he wants, the plan, however logical, becomes a source of irritation. (It was in the United States that the reviewer heard a valuable compilation referred to as the "Intentionally Cryptical Tables".) This difficulty is, of course, most marked in a compilation as comprehensive as the "Annual Tables"; Richter's "Lexikon der Kohlenstoff-Verbindungen"

can have one all-embracing plan and a knowledge of it is an integral part of the technique of the organic chemist; but no one plan can embrace all the sections of the "Annual Tables".

This unfortunate state of affairs is, however, completely altered by the existence of an efficient index volume such as that which accompanies vol. 9. In the main work the data are arranged, as they must be, in sections dealing with the various properties of substances and the phenomena they present. The index volume is the complement to the main work and gives alphabetical and formulæ indexes of all the substances examined during the year covered. Thus all users are satisfied, and particularly the user who wishes to know whether the density of a certain compound or the conductivity of a certain solution has been determined; he need no longer wade through lists of densities or of conductivities; reference to the index volume will tell him at once if the data in which he is interested are included or not, and if they are, precisely where to find them.

The index itself requires a system, but the one adopted will commend itself to everyone. It is based on the world's past experience in similar tasks; it incorporates bodily well-established systems such as that of Richter and Stelzner for the organic compounds; it is lucidly explained in the four more important European languages and is helped out by a plentiful supply of polylingual cross-references. The compilation of this index volume must have been a considerable labour, but the reward of gratitude will be great.

Other points to which attention may be directed are, first, that nowadays the whole text is given in both French and English. The advantage gained by this is not so marked in many of the sections dealing with the purely scientific data as it is in the more technical chapters. The vocabulary of the French physicist is to a large extent almost the same as that of his English colleague, their words coming from a common Latin root; but the engineers must at times have difficulties in understanding each other's technical terms, and these difficulties the bilingual text removes. Secondly, it should be noted that libraries or individuals whose interests are confined to one field alone are catered for, in that most of the more important sections can be purchased separately. The third and most important point is the price at which these volumes can be obtained; vol. 9 with its index at the present rate of exchange costs something well under £5 and contains more

than seventeen hundred pages of compressed and complicated printing. This is a ridiculously small sum and it is sincerely to be hoped that the financial state of the world will not lead to the withdrawal of the grants from the various participating countries which make it possible to publish the "Annual Tables" at such a low price.

Finally, it may be noted that the present trend of physics is reflected in the facts that data on emission and absorption spectra occupy more than a quarter of both the volumes under review, and that the Raman effect, which was given three and a half pages of the chapter "Scattering of Light" in vol. 8 (1927 and 1928), has monopolised that chapter in vol. 9 (1929) and has demanded thirteen pages.

T. W. J. T.

### Statistical Tables

*Tables for Statisticians and Biometricians.* Edited by Prof. Karl Pearson. Part 1. Third edition. Pp. lxxxiv + 143. 15s. net. Part 2. Pp. ccl + 262. n.p. (London: Biometric Laboratory, University College, 1930-1931.)

STATISTICIANS have for long been familiar with Prof. K. Pearson's "Tables for Statisticians" as the standard exposition of the theoretical conceptions and practical procedures adopted by the Biometric Laboratory at University College. The handsome and expensive production of the tables, and the abundant introductory matter, were features which, from its first appearance, compensated for the partial or personal tone which characterised the treatment of controversial topics.

In the course of time, as was inevitable, certain extensive tabulations have been found to be of less use than was originally hoped, and others, based on faulty theory, have been shown to be definitely in error. It is the most serious fault of this new edition that no account seems to have been taken of these changes. Thus Tables 17, 18 and 19, concerned with the calculation of the probability of deviations from proportionality in a  $2 \times 2$  table, are printed without change from the first edition, although it is now recognised, almost if not quite universally, that the use of three degrees of freedom in place of one is definitely erroneous.

Part 2, of which this is the first edition, is an even larger volume. The introduction occupies 250 pages, and the tables 262. Many tables supplement or enlarge those given in the first volume,

and it would have been of great advantage to the user if the matter had been re-arranged so as to bring together tables dealing with the same function. Thus the reader of Table 30 of Part I is not told that, under a different title, sixty pages of Part 2 (Tables 8 and 9) contain a fuller and more accurate table of the same function.

The utility of some tables would have been greater had their nature not been disguised by the special terminology of the Biometric Laboratory. Thus a good, though truncated, table of the derivatives of the normal probability function (Table 7) is termed "Table of the First Twenty Tetrachoric Functions", owing to the accident that these functions were at one time used in the Biometric Laboratory for estimating the correlation coefficient from a  $2 \times 2$  table. Others, such as the fifty-seven crowded pages devoted to Table 3 (more than 70,000 entries), seem like elaborate

attempts to make available a cumbersome method of approach to problems already more simply solved.

Among the more useful tables should be mentioned Table 2 of the second part, giving the abscissæ and ordinates of the normal curve, and certain important ratios, arranged as in Prof. Kelley's textbook of "Statistical Method". The table is to ten figures and based on Sheppard's extensive tables, as yet unpublished, of the probability integral. Table 7, which we have already mentioned, will also be useful, though in the introduction the reader is warned against this heresy, in constructing curves from their Charlier expansions.

As a collection of the labours of the Laboratory the work is monumental. Like other ambitious monuments, however, it invites criticism at a number of points.

R. A. FISHER.

### Short Reviews

*Man and Medicine: an Introduction to Medical Knowledge.* By Dr. Henry E. Sigerist. Translated by Margaret Galt Boise. Pp. x+340. (London: George Allen and Unwin, Ltd., 1932.) 12s. 6d. net.

DR. HENRY SIGERIST, who in 1925 succeeded the veteran Sudhoff as professor of the history of medicine in the University of Leipzig and has recently followed Dr. W. W. Welch in the corresponding chair at Johns Hopkins, has written a work which will be of value not only to the medical student for whom it is primarily intended but also to the layman interested in medical history and doctrines.

The work is divided into seven chapters. The first deals with man in his anatomical, physiological and mental and spiritual aspects with special reference to the work of Vesalius, Harvey, Freud and Jung. In the second chapter the sociological aspects of disease and the behaviour of the sick man are considered, with a comparison between the conception of disease in ancient and modern times. In the following chapter, entitled "Signs of Disease", the author shows that symptoms and disease are not identical conceptions but that symptoms are manifestations of disease, occurring in combination or following one another successively during the course of the disease. The fourth chapter is devoted to the consideration of the development of the various conceptions of disease throughout the ages, general theories of disease, the study of special diseases, the course of the disease, and its incidence and mortality. In the fifth chapter the causes of disease are discussed under the headings of external causes such as physical influences, food and drink, bacteriological and mechanical agencies, and internal causes, such

as disposition, constitution and heredity. Medical aid, which forms the subject of the sixth chapter, is considered from the threefold aspect of diagnosis of the diseases, treatment and prevention. The last chapter contains a short historical account of the physician in ancient Egypt, classical antiquity, the Middle Ages, the Renaissance and modern times, a consideration of the subject of sick insurance, professional secrecy and medical ethics.

A word of praise is due to Miss M. G. Boise for the excellence of her translation.

*Architectural Acoustics.* By Prof. Vern O. Knudsen. Pp. viii+617. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 40s. net.

THIS massive volume admirably illustrates the manner in which a specialised physical subject, even in 'non-atomic' physics, may rapidly proceed from a very unsatisfactory rule-of-thumb stage to a stage in which one may obtain some definite measure of guidance from an appeal to fundamental principles. This particular subject, which owes its existence in great measure to the pioneer labours of the late Prof. Sabine, is developed by the author in a very competent and comprehensive manner.

The book is divided into three parts. The first part, consisting of about a hundred pages, is devoted to the study of physiological and physical acoustics. In the second section, the fundamentals of the special part are developed, a series of chapters being devoted to reverberation, and to the absorption, insulation and amplification of sound. This part concludes with a discussion of the acoustics of auditoriums, speech halls and music rooms. The third part deals with the application of these principles to building design.

Two very useful features of the book are a series of problems on which the student may exercise his skill, and a list of clearly phrased definitions of terms used in acoustics, together with an expression of the units in which the quantitative magnitudes concerned are measured. We may not always agree with the author's usage; in particular we note that he is not a member of that guild of stern logicians which insists that a sensation loudness can not be made the subject of measurement. But there is no denying the value of such a list, and it is greatly to be desired that other authors should adopt this very useful practice.

A. F.

*Classical Descriptions of Disease: with Biographical Sketches of the Authors.* By Prof. Ralph H. Major. Pp. xxvii+630. (London: Baillière, Tindall and Cox, 1932.) 30s. net.

THIS fine volume, the composition of which was inspired by Long's "Selected Readings in Pathology" (see NATURE for March 29, 1930, p. 488), contains the original descriptions of various diseases, translated when necessary into English, from classical antiquity down to the present day. After an introduction containing passages from Hippocrates, the work consists of ten parts devoted respectively to classical descriptions of infectious diseases, diseases of metabolism, lead poisoning, diseases of the circulatory system, diseases of the blood, kidney diseases, respiratory diseases, deficiency diseases, allergic diseases and diseases of the digestive system. A short biographical notice is prefixed to each writer's account of the disease.

The extracts are not confined to the works of dead writers but include passages from the works of Charles Nicolle and his collaborators on the transmission of typhus by the louse, of Banting on the internal secretion of the pancreas, of Pierre Marie on acromegaly, of Leo Buerger on thrombo-angitis obliterans and of Herrick on sickle-cell anaemia.

Dr. Major is to be congratulated not only on his selection but also on his excellent translation of a considerable number of the descriptions of disease by foreign writers. The work will be of special value to the large number of readers who take an interest in the history of science, medical and otherwise, but have not the time or the means to consult the original volumes, many of which are difficult of access. The text is liberally interspersed with portraits, facsimile pages and other illustrations.

*The Causes of Accidents: Three Lectures on Recent Research into the Causes of Accidents given at the Royal Society of Arts under the Heath Clark Bequest to the National Institute of Industrial Psychology.* By Eric Farmer. Pp. vii+88. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3s. 6d. net.

IN this important little book Mr. Eric Farmer examines critically all the alleged causes of accidents and concludes that, even allowing for chance and for biased liability as factors, there are some

people who are inherently more liable to accidents than others. As the people with a high accident rate also tend to have a high sickness rate and to be less efficient, he thinks that these are the people who find modern industrial conditions too great a strain. Accident-prone people should, if possible, be employed in occupations where there is little risk. For this to be effective, careful and detailed records of accidents in various occupations are needed and further research along the lines already started by Mr. Farmer into those personal factors which, the evidence shows, play such an important part.

*Physik: ein Lehrbuch für Studierende an den Universitäten und technischen Hochschulen.* Von Prof. Wilhelm H. Westphal. Dritte Auflage. Pp. xvi+596. (Berlin: Julius Springer, 1933.) 19.80 gold marks.

THIS edition is an enlargement of the second, while less important matter has been omitted or compressed. The electrostatic and electromagnetic systems of units are retained, the change to international units having been considered and rejected.

It is a very useful book but somewhat uneven in treatment. For example, thermoelectricity, electrolysis and geometrical optics are less fully treated than electromagnetics, interference and wave theory.

Some parts are very elementary while the more advanced parts such as quantum theory, wave mechanics, etc., are only given in outline. Between these extremes the matter is very good.

*The ABC of Chemistry.* By J. G. Crowther. Pp. xi+248. (London: Kegan Paul and Co., Ltd., 1932.) 4s. 6d. net.

THIS interesting and well-written little book offers a readable summary of some of the broad principles of biochemistry and of the contribution of chemistry to modern civilisation, as is indicated by such chapter headings as "The Breath of Life", "Food", "Vitamins", "Soap", "Dyes" and "Metallurgy". It is accurate in general; but the original synthesis of alcohol is wrongly ascribed to Berthelot, and such obvious misrenderings as "Wolbe", "Erlich", and "Sully" appear in text and index alike. A very generous view is taken of Mayow's contribution to chemistry. The implication (p. 81) that chemical symbols are synonymous with 'jargon' is supererogatory, as is also the prefatory suggestion that teachers of chemistry do not need to make their subject attractive.

*Principles of Pharmacy.* By Henry B. Mackie. Pp. xi+281. (London: J. and A. Churchill, 1932.) 10s. 6d.

THIS is a sound and comprehensive manual which will be found very useful by students of pharmacy. Its scope is indicated by the titles of the main sections: solution, disperse systems, change of state, extraction, enzymes, sterilisation. The book is well illustrated, contains many practical directions, and is provided with a useful bibliography.

## The University of London and the Development of Science

THE laying of the foundation stone of the new buildings of the University of London by His Majesty the King on June 26 will mark, in more than one sense, the beginnings of a new chapter in the development of the University. The centenary of the University of London is still distant by some three years, by which time presumably some part of the great new buildings in Bloomsbury should be in occupation, but the years which have passed since its Charter was granted in 1836 have been years of remarkable development. Beginning as an examining body only—a product of the compromise so dear to British Governments—and occupying for the greater part of its existence an anomalous position in the university world, it has during the present century found itself as a great federal university with a huge student population, a great number of distinguished teachers and investigators, and an impressive and growing record of achievement in scholarship and research.

Limited as it was to the duty of examining candidates who presented themselves for its examinations, the University nevertheless gave scientific education a vigorous impulse by according recognition to subjects which, at the best, had hitherto only been regarded as poor relations in the other universities of Great Britain and, at the worst, had been ignored altogether. This is true not only of the well-known Matriculation examination, which had such a profound effect on secondary education in the nineteenth century, but also of the higher examinations of the University. In medicine, for example, from a fairly early stage, great emphasis was laid on the fundamental pre-clinical sciences. It was the first university to establish degrees in science and thus give academic recognition to the science teaching which was being given in London and the provinces.

The strong interest shown by the University in the recognition and advancement of science was no doubt due very largely to the composition of its governing body. This was appointed during a great part of its existence by the Crown and it included a large proportion of fellows of the Royal Society. Among the 'fathers' of 1836 were Airy, Neil Arnott, Beaufort and Faraday, and it is well known that the last-named played a very active part in the affairs of the University. Later there were such famous names as Hooker and Huxley, Lister, Paget and Sharpey; and among its vice-chancellors were Lubbock and Roscoe.

But examinations however well designed and governing bodies however distinguished can only indirectly foster and encourage science and learning. The examining University had (and still has) in the Brown Institution a small institute in which some pioneer research work was carried on. Burden Sanderson, Huxley, Sherrington and

Rose Bradford have given lustre to an institution of the existence of which probably few Londoners are aware. In the two great colleges, University and King's, each with a rather longer history than the University in which they were in due course to be incorporated, there were many more leaders in science. University College had from its beginning established chairs in chemistry (the first teaching laboratory in England was opened there in 1828), in geology, botany and zoology. Here, too, were established chairs in anatomy and physiology; and Sharpey, "the founder of modern physiology", sent his two famous pupils Michael Foster to Cambridge and Burden Sanderson to Oxford to spread the new knowledge. In biology, as in chemistry, physics and mathematics, there are again long lists of famous names the mere recital of which would suggest some of the most significant stages in the development of science in the nineteenth century. At King's College there were Lyell, Wheatstone and Daniell; and in those institutions which afterwards were brought together as the Imperial College of Science and Technology were Huxley, Armstrong and Unwin.

Since its reconstitution at the beginning of the twentieth century, when its functions were extended to make it a teaching as well as an examining body, the development and expansion of the University of London, especially in respect of science and medicine, have been on a very large scale. It is only possible here to enumerate some of the happenings of the last crowded years. New courses of study have been planned and new degrees and diplomas instituted. In the colleges, new departments have been called into being and existing departments strengthened, while great institutions such as the London School of Hygiene and Tropical Medicine, devoted primarily to post-graduate work and to research, have started on their course. The building up of a professoriate has been one of the most notable achievements of the University. The number of chairs in all the established physical and biological subjects has been increased and continues to increase, while especially noteworthy is the establishment in the London medical schools of the unit system with full-time directors in medicine, surgery and obstetrics. There are chairs in newer subjects, such as eugenics, genetics, social biology, dietetics, aeronautics, scientific method, chemical engineering and so on, and every academic session sees some addition to their number. The growth in research work fostered by the establishment of research funds and postgraduate scholarships has been not less remarkable. At nearly all the colleges of the University large schemes of rebuilding and extension have been carried out, and the laboratories at institutions such as University College and the Imperial College are among the best in Great Britain or indeed in Europe. The erection

of a University Observatory at Hendon is also a notable departure.

It is not easy to predict the lines of future development of the University, but one thing at all events seems obvious. London is, from the nature of things, destined to become more and more a centre of advanced teaching and research. At University College, King's College and the Imperial College, there are teachers and investigators of great distinction, and there are growing up around them important schools of workers in the various branches of science. This is all to the good; but while the complete severance of teach-

ing from research work would be in many respects unfortunate, there is undoubtedly room for creating more research posts, the occupants of which should be freed from routine teaching. Another direction of advance may be the setting up of special institutions devoted to particular sciences. Either way has much to commend it, but either plan needs very considerable financial resources. Nevertheless, the history of the University of London does not give rise to any fear that the needs of science will be overlooked in the years which lie ahead of it.

#### Excavations at Tell Duweir, Southern Palestine, 1932-33\*

THE first season's work of the Wellcome-Colt Archæological Expedition at Tell Duweir in Southern Palestine under the direction of Mr. J. L. Starkey in 1932-33, has amply justified the selection of this site for exploration. It holds out a strong assurance of substantial additions to knowledge of the archæology of southern Palestine in an obscure period at no distant date. Considerable progress has been made in demonstrating the character and relation of the works which converted the Tell into a strongly fortified position; while the examination of the great stone structure on the summit of the mound, which made Tell Duweir unique as a surface site in Palestine, has been carried to a point which confirms the first impression of its importance.

Before giving an account of the more important results of the excavation, it will not be out of place to mention certain topographical features relating to the Tell. It lies twenty-five miles to the south-west of Jerusalem, twenty-three miles north-east of Gaza, and twenty miles from the sea to the west. The mound, of which the top is 900 ft. above sea level and at a mean height of 130 ft. above ground level, covers 39 acres at its base, while the summit has an area of approximately 22 acres. The average width is 250 metres from east to west and 300 metres from north to south. The remains of a stone revetment, which had encircled the mound, were still to be seen near the summit, while crowning the whole were the imposing remains of the stone buildings, to which reference has already been made.

Tell Duweir has been identified tentatively with Lachish, a strategic strong point of southern Palestine, which offered a strenuous resistance to Joshua, was fortified by Rehoboam, and captured by Sennacherib, and also by Nebuchadnezzar. The siege of the city by the former is depicted on a stone relief from Nineveh which is now in the British Museum. So far, the excavations have produced no positive evidence to confirm the

identification, although it may be said that they have added to its probability.

The main points to which investigation was directed during the season's work were the stone revetment, the works at the south-western corner of the mound—a bastion and, it would appear, the main gateway to the city—the city walls, and the building at the top of the mound, which evidently must have been the central structure of the city keep or fortress. A habitation site on the east side of the Tell and another with a cemetery site on the north-west were examined and the latter cleared.

The clearance of the area at the north-west, which provided the greater part of the cultural objects obtained by the excavation—a lengthy operation which continued during the greater part of the time the expedition was at work—came about almost fortuitously. It arose out of the necessary operation of preparing a place for dumping the earth removed from the mound in the course of the work. It was decided to build a retaining wall which would enable the earth to be terraced and made available for future cultivation. In testing bed-rock for the line of the retaining wall, a number of cuttings were found which, on further examination, proved to be a well and rock-chambers or tombs. The well was choked with boulders, but when it had been cleared, a matter of no little difficulty, potsherds from the filling indicated that it was certainly of Middle Bronze age date. The clearance was eventually carried up to the face of the escarpment, which it was found had been cut back until it was nearly vertical, rendering the fortress practically impregnable from this side, while immediately in front of the cliff was a fosse carefully cut in the rock, running north-east and south-west, and following the line of the rock platform on which the mound stands. The fosse was of considerable depth and was only cleared finally by blasting the boulders which formed part of the filling. A cache of pottery with metope pattern with bird, of the type common at Tell el Ajjul, in the lowest levels at a depth of 38 ft. indicated the Middle Bronze age (Hyksos period) as its date.

The tombs first to be examined were found to

\* This account of the excavations is based upon the reports of Mr. J. L. Starkey, for access to which we are indebted to Sir Charles Marston. The photographs are by Mr. Ralph Richmond Brown, a member of the Expedition.

contain potsherds of Middle or II Iron age date. Many of them had collapsed and had been reused or reroofed in Byzantine times. Both the tombs and the house foundations which lay in the habitation area over the fosse covered a considerable period of time, ranging from Middle Bronze age down even to early Christian times. One tomb can with certainty be attributed to the Hyksos period. House foundations contemporary with the nineteenth dynasty and tombs dating from the eighteenth were discovered.

In addition to the pottery, the objects recovered

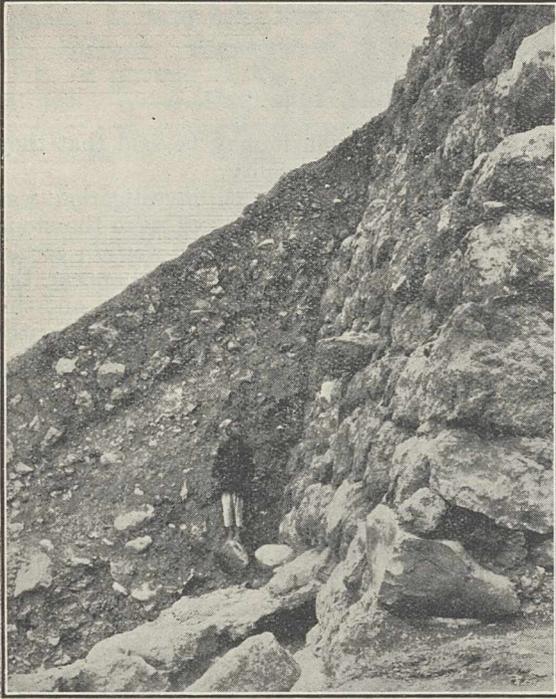


FIG. 1. Section of revetment exposed on north-east side showing stratification of debris. Burnt layer is half-way between boy's head and surface.

from this area included several bronze daggers, bronze toggle pins, bangles, anklets and rings, pottery figurines of Astarte in conventional pose, vases in alabaster and serpentine, beads of various forms and material, seals, and a number of scarabs in steatite, green jasper and carnelian. Some of the steatite examples are of fine workmanship, though of local manufacture. The pottery of certain types affords a link between series found at Jericho and at Tell el Ajjul.

The first of the major operations in the examination of the fortress works was the tracing of the line of the stone revetment. This was first cleared at a point at the north-east corner of the Tell, where eleven courses of fine dry-walling, rising to a height of about 20 ft., were uncovered. Further clearances revealed interesting differences in the method of turning the wall at the four corners. At the north-west a bold sweep was supported by five buttresses with their intervening spaces filled with blocks of stone and lime forming a compact mass, a feature

unique in Palestinian architecture. There was evidence at the north-east corner (Fig. 1) that this part of the fortress had been subjected to concentrated attack by enemy forces. It was found that the approximate height of the revetment actually preserved encircling the Tell was 16½ ft. and its width 6½ ft.

Within the thickness of the revetment at one point a shaft, some eight feet in diameter, was discovered, which proved to be a well, choked with boulders. This at a depth of 26 ft. cut into living rock. Water level was reached at a depth of 122 ft. and bottom at a depth of 140 ft. from the Tell surface. Immediately behind the revetment enclosing the well were traces of three walls, which probably are the foundations of parts of the internal structure of a tower.

The investigation of the area of the great bastion to the south-west proved to be a problem of considerable intricacy owing to the fact that in the removal of the blocks of stone, the dry-walling offered little guidance in following the line of structure. Eventually it was found that there were three walls running south from the great square tower standing out from the lines of fortification, while a fourth at the highest point represented the city wall. The lowest of the walls, which would appear to be contemporary with the lower revetment and of Israelite age date, was a retaining wall at the side of a ramp which carried the road leading into the city up to the gateway, while a second wall was apparently a flanking wall to the road, here 20-25 ft. wide. Of the two gateways, the left jamb of the outer has disappeared. In the walls flanking the inner

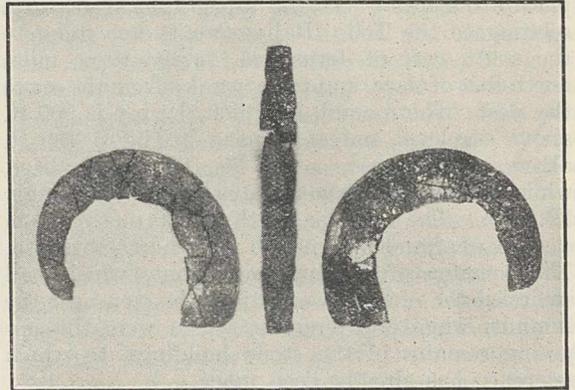


FIG. 2. Bronze crest-mount (two sides) of a helmet, with connecting spacer.

gateway are the remains of towers at a distance of approximately forty-four feet apart. Abutting on one of these was a chamber which probably served as a guard room. Two iron lance-heads found nearby lend support to this view, while it was here also that a bronze crest-mount of a helmet was found (Fig. 2). This still showed traces of cloth and leather fastenings and the rivets by which it was affixed to the casque. Its purpose was determined only after some deliberation; but

its resemblance to this part of the soldier's helmet as shown in the British Museum relief (Fig. 3) proves its character beyond doubt.

It is of interest to note that the defensive walls, here as elsewhere in the fortress, show that the method of defence was by shallow recessments in the wall rather than by the more usual deep re-entry. This corresponds with the form of defence shown in the British Museum relief.

It is possible to do no more than refer to the interesting habitation site on the eastern side of the Tell, which in the nineteenth dynasty marked the most prosperous period of the city's occupation, and yielded evidence of Egyptian contacts, in order to pass on to the examination of the remains at the summit of the mound. This was undertaken towards the close of the season, but sufficient time was available to reveal that here were the ruins of two structures, of which the earlier had been levelled and used as a platform for the erection of the later building. The ruins of this again had been used later by squatters. It was found that the walls of the later and smaller building, which it may be conjectured was the governor's residency, did not follow the lines of the earlier building, with which its plan had no relation. At north and south the levelled portion of the earlier building projected to form a platform. The residency had contained a large number of public and private rooms and offices with an open courtyard. This latter was probably open to the sky, as it was not filled with limestone blocks as were the spaces representing the other rooms. Some of these blocks showed a curvature which points to a barrel-roofing. The dating of this building is not yet fixed archaeologically; but certain considerations point to fourth to fifth century B.C.

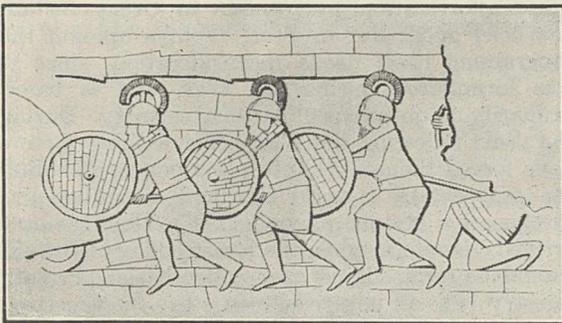


FIG. 3. From bas-relief of the siege of Lachish showing helmets worn by Assyrian soldiers. [By permission of the Trustees of the British Museum.]

Two further problems arising out of the excavation remain to be mentioned. These, it is perhaps not unfair to say, constitute the main contributions of the season's work to the discussion of the historical question raised by Tell Duweir. In examining the defensive works of the fortress and in removing the earth from the face of the revetment, evidence was found that the walls had been breached in two, or possibly three, attacks. The

breaches had been repaired, although usually with little skill or care; but the defences had afterwards been subjected to the effects of a serious conflagration. In the stratification, this conflagration was represented by a stratum consisting of calcined limestone and charcoal in which were the remains of tree trunks of considerable size. It is suggested that earlier breaches in the defences were made during the siege by Sennacherib, dated tentatively at 701 B.C., while the evidence of conflagration bears witness to the more thoroughgoing methods of the army of Nebuchadnezzar in



FIG. 4. West wall of residency lavatory and bathroom, showing sanitary fitting and, on left, drain from bath room.

586 B.C., which, cutting down the trees on the neighbouring hills and in the olive groves, piled the trunks against the walls and set fire to them, utterly destroying the city's defences in its lines of attack.

Attention was directed to the second problem in the course of the excavation by the occurrence of burnt brick in the debris at various points, as well as by traces of burnt brick building in the area of the well in the revetment to which reference has been made above. The problem was resolved up to a point by a section through the city walls near the bastion, where it was found that an earlier system of walls constructed of unbaked mud brick lay on a foundation of stone below the late city walls. The width of the walls, 19 ft., points to their substantial character.

It remains only to mention briefly the result of a complete section taken down to bed rock through a depth of 38 ft. of deposits. This section showed that the deposits of the lowest 10 ft. belonged to early Palestinian culture; and it provided a complete and unbroken series of potsherds from the third millennium B.C. down to the close of the city's occupation. Among the early wares are examples of the almost unknown black burnish ware, hitherto discovered only in the Jordan valley, which shows resemblances to the ware of predynastic Egypt produced by the muffled technique. For this Tell Duweir now affords a new southern limit of distribution in Palestine.

An exhibition of the antiquities found during the excavations will be held in London during July.

## Problems of British Forestry

IN a lecture to the British Science Guild at its annual general meeting held in the Mansion House, London, on June 19, Prof. R. S. Troup discussed the important question of forestry in Great Britain, with special reference to the programme of State afforestation now being carried out by the Forestry Commission, its progress to date, its limitations, and some of the scientific and technical problems following in its train; he also reviewed the question of private forestry and pointed out some of its defects. The significance of British forestry at the present time may be realised from the fact that less than five per cent of the requirements of Great Britain in timber are met from home-grown sources, that the forest capital of the world is being consumed at an alarming rate, and that the shortage of timber which is likely to result may cause much distress in the absence of a supply of home-grown timber.

Dealing with the planting scheme of the Forestry Commission, Prof. Troup explained that the afforestation of large tracts of bare land with species which are in many cases exotic, introduces problems of a complicated nature; these are investigated by a special research branch of the Forestry Commission aided by certain universities and particularly by the Imperial Forestry Institute at Oxford. Among these problems, not the least important are those relating to soil conditions, such, for example, as are met with on the heath lands which form a considerable portion of the area available for forestry: on such lands the soil tends to become degraded owing to the leaching out of the soil nutrients in a climate where precipitation exceeds evaporation, with the result that the establishment of tree-growth is often difficult. In such cases deep ploughing has proved successful on an experimental scale. On peat lands good results have been obtained by draining and planting on square turfs dug out of the drains and placed in an inverted position on the surface of the ground; by this means the turf becomes oxidised and breaks down, liberating nitrogen and other essential nutrients. Experiments in the use of basic slag have given remarkable results on very unfavourable peat soils.

Research in Great Britain on the control of pests and diseases is mainly centralised at the Imperial Forestry Institute at Oxford. In forestry, direct measures for the control of insect pests, such as trapping, grease-banding, and hand-collection may prove too costly, and special attention has to be directed towards preventive measures of a silvicultural character, such as the avoidance of large areas of pure crops, the removal of sickly trees forming breeding centres for noxious insects, and the barking of newly-felled coniferous trees in order to prevent the multiplication of destructive beetles which lay eggs in their bark.

Increased attention is being directed to methods of biological control for dealing with forest insect

pests. In this connexion, an interesting study has recently been made of the life histories of the *Sirex* woodwasps which bore into living coniferous trees, and of their parasites, the large ichneumonid, *Rhyssa persuasoria*, and the smaller cynipoid, *Ibalia leucospoides*. As a result of this work, larvæ of the *Rhyssa* parasite have been exported in numbers to New Zealand by the Parasite Laboratory at Farnham Royal in an attempt to deal with an epidemic of woodwasps in the coniferous plantations there. Similar studies are being made of the parasites of the pine bark-beetle, *Myelophilus piniperda*, and the oak leaf roller moth, *Tortrix viridana*, which causes extensive defoliation and mortality among oak trees.

With regard to fungal and bacterial diseases, important work is being carried out on predisposing causes, among which frost promises to be of more importance than has hitherto been suspected. The oak rot disease caused by the fungus *Stereum spadicum*, which has resulted in extensive loss in the Forest of Dean, furnishes an example of the complicated character of some of these predisposing causes. Investigations carried out so far indicate that the ingress of this fungus is due in part to the fact that, in the days of wooden ships, oak trees were widely spaced to encourage the growth of large branches for the production of curved shipbuilding timber. Later, when wooden ships were abandoned and the value of the trees lay in the bole rather than in the branches, the oaks were left to crowd each other. The lower branches thus died off, and through the dead wood the fungus gained admission to the interior of the bole, causing its decay.

The progress made so far in carrying out the State afforestation programme in Great Britain has been good, but in Prof. Troup's opinion the programme itself needs reconsideration, since it was formulated during the War, and is based primarily on questions of national security. During the years following the War, other weighty factors have forced themselves into prominence, including the prospect of a world shortage of timber and the question of unemployment. The time has now arrived, therefore, when the forest policy of Britain should be reconsidered on a wider basis. Private forestry is in an unsatisfactory state, a large percentage of the private woodlands being unproductive to a greater or less extent, while scientific forest management is the exception rather than the rule. This is probably due in some measure to the fact that most of our woodland estates are too small to form economic units: a possible remedy would be to work on a co-operative basis with trained forest managers in charge of groups of estates. Legislation may even be necessary, as in the case of certain Continental countries, to provide for the management of private woodlands on approved lines and the compulsory reafforestation of felled areas.

## Obituary

SIR ERNEST MOIR, BT.

WE regret to record the death, which occurred on June 14, at the age of seventy-one years, of Sir Ernest William Moir. Born on June 9, 1862, Moir in the early part of his career came into close contact with Fowler, Baker, Arrol, Wolfe-Barry and other eminent civil engineers and during his long and distinguished career as a partner in the firm of Messrs. S. Pearson and Son, Limited, worthily upheld the high traditions of those who, as contractors, are responsible for carrying out works of the greatest magnitude. Both in his presidential address on "Engineering Difficulties" to the Junior Institution of Engineers in December, 1929, and his address entitled "The Interdependence of Science and Engineering, with some Examples", given as president of Section G (Engineering) at the Bristol meeting of the British Association in 1930, he made many interesting references to some of the important undertakings with which he had been associated; and as "the first contracting civil engineer who has been honoured by the British Association", at Bristol he appropriately dealt at considerable length with the economics of engineering construction. Another section of his address was devoted to the bacteriological and entomological sciences and their influence on civil engineering.

Educated first at University College School, and then at University College, London, where he studied under Kennedy and Vernon Harcourt, Moir began his practical training in the yards and shops of Messrs. R. Napier and Sons, Glasgow, of which Dr. A. C. Kirk was the manager. His first important task was the building and launching of the large caissons for the foundations of the Forth Bridge. Joining the staff of Messrs. Tancred, Arrol and Co., he was employed on the construction

of the south cantilevers of the bridge and then through Sir Benjamin Baker was sent in 1889 to New York to assist in the completion of the Hudson River (North) Tunnel which had been started in 1874, only to be abandoned in 1888. It was in connexion with the work on this tunnel that he introduced the use of recompression chambers for men working in compressed air. The use of this medical air lock reduced the death-rate among the staff, which in 1890 had been 25 per cent per annum, to  $1\frac{1}{2}$  per cent.

By this time, Moir had become a member of the firm of Messrs. S. Pearson and Son, of which the late Lord Cowdray (1856-1927) was long the head, and as such he was responsible for the construction of the Blackwall Tunnel beneath the Thames, a difficult piece of work successfully completed in 1897. Afterwards, Moir was connected with the construction of the four railway tunnels under the East River from New York to Long Island and with harbour work at Seaham, Dover and elsewhere. His latest important undertaking was the construction of the great breakwater at Valparaiso, founded in 187 ft. of water. The base of this breakwater consists of a huge bank of deposited sand, while the upper part of the structure is composed of 60-ton concrete blocks interlocked with each other. An account of this work was given to the Institution of Civil Engineers in December, 1931, by Mr. W. F. Stanton.

Appointed a member of the Admiralty Engineering Committee in 1912, from 1916 until 1919 Moir held important positions under the Ministry of Munitions and in 1924-25 was chairman of the Government Committee on New Methods of House Building. He was made a baronet in 1916 and is now succeeded in the title by his younger son, Capt. Arrol Moir.

## News and Views

Prof. Manne Siegbahn

AT a meeting of the Physical Society held on June 16 the tenth Duddell medal was presented to Prof. Wolfgang Gaede (see NATURE of Feb. 11, p. 195). The presentation was followed by the delivery of the eighteenth Guthrie lecture by Prof. Manne Siegbahn, professor of general physics in the University of Uppsala, on "Studies in the Extreme Ultra-Violet and the Very Soft X-Ray Region". It is largely due to Prof. Siegbahn's technical and experimental skill, backed by a wide knowledge of physical science, that our present acquaintance with atomic structure has made such remarkable progress. In 1912, von Laue first gave experimental proof that the X-rays resembled light in all respects except that the lengths of their ether waves were many thousands of times shorter. His method was based upon the supposition that the ordered array of the atoms in a crystal would act upon X-rays just as,

in familiar ways, a grosser array of particles or lines or obstructions of any kind act upon the longer waves of light, so causing such phenomena as the halo round the moon, or the colours of mother of pearl, or the iridescence of wings and wing cases of certain insects. The successful experiment at once opened the way to two separate lines of research, both of which have been rich in results. The first has led to our rapidly growing knowledge of the crystalline state of matter, including the bodies which are crystals *par excellence*. The other was first followed by Moseley and Darwin, who employed the new methods in the investigation of the X-rays themselves.

It was then that Siegbahn, following the same line of research, began his investigations. He effected improvements in the design and construction of apparatus for measuring the wave-lengths of X-rays

which have endowed them with an accuracy comparable with the corresponding optical instruments. It is amazing to look back over the last twenty years to the experiments with which this work began, and to compare their crudity, which nevertheless could not hide their obvious importance or the magnificence of their promise, with the finish of to-day. It is largely to Prof. Siegbahn that we owe the modern precision, and the fulfilment of that promise. His extremely accurate measurements of the lengths of the waves which the various atoms emit, serve as definite indications of their internal structure, and every improvement has brought new and valuable information. Not often has refinement of instrumental design and use brought such a plentiful and immediate harvest. It is interesting to note that it was Ångström, also a Swede, who first realised the accuracy in optical measurements which necessitated the choice of a special unit of length for their description. Ångström himself measured the lengths of waves of light and found them to be a few thousand of his units: the wave-lengths of X-rays are of the order of a single unit.

#### Dr. Michael Polanyi

DR. MICHAEL POLANYI has accepted a chair of physical chemistry in the University of Manchester, and will take up the post at the beginning of the next session. Dr. Polanyi, who is a Hungarian by birth, studied medicine in the University of Budapest and chemistry in the Technical High School of Karlsruhe. After service as surgeon with the Austrian forces during the War, he became assistant to Prof. Hevessy, professor of theoretical chemistry at the University of Budapest. In 1919 he returned to Karlsruhe, since when he has held posts in the Kaiser-Wilhelm Institute for Textile Chemistry, the Technical High School in Berlin, and the Kaiser-Wilhelm Institute for Physical and Electro-chemistry. Dr. Polanyi is a well-known physical chemist. His first notable research was a theory of adsorption, published in 1917; he has also made discoveries in connexion with the structure of cellulose and the mechanical properties of metals and other solids. His present investigations relate to the theoretical and experimental study of reaction kinetics and the mechanism of chemical reactions. It is this line of research which, it is anticipated, he will pursue in Manchester.

#### Johann Jacob Scheuchzer, 1672-1733

THOUGH as a science, the birth of geology dates only from the latter part of the eighteenth century, prior to that many men had been interested in the study of rocks and fossils and had recorded valuable observations. Among these men was the Swiss doctor, Johann Jacob Scheuchzer, the bicentenary of whose death occurs on June 25. Born at Zurich on August 4, 1672, Scheuchzer qualified as a doctor at Utrecht and paid some attention to mathematics. For many years he held a professorship in his native city. His main interest, however, was in natural history and especially in fossils and minerals. He translated Woodward's "Natural History of the

Earth" into Latin and published several works of his own. Included in these was his "Itinera per Helvetiæ Alpinas Regiones" (1702-11), in which for the first time glaciers are mentioned as a subject for scientific investigation. He gave careful descriptions of several glaciers he had visited and explained their movement as a result of the infiltration and freezing of water in cracks and other spaces. He was thus the founder of the theory of dilatation, afterwards advocated by Charpentier and Agassiz. His natural history of Switzerland contains a special chapter dealing with what Scheuchzer thought were fossils left by the Great Deluge, and towards the close of his life he thought he had discovered in the beds at Oeningen, between Constance and Schaffhausen, the skeleton of one of the "infamous men whose sins brought upon the world the dire misfortune". But the supposed *Homo diluvii* was afterwards shown by Cuvier to be a reptile and it was called *Andrias Scheuchzeri* in honour of its discoverer. The specimen was presented to the Teyler Museum at Haarlem.

#### Vivisection of Criminals

THE BISHOP OF DURHAM set the ball of controversy rolling when he delivered the eighth Fison memorial lecture on June 15 at Guy's Hospital on "Ethical Conditions of Scientific Method". After discussing the case for and against vivisection of animals, he submitted the question whether in no case might man be subjected to vivisection in the interest of science. Dr. Henson asked if there was any objection to the vivisection of criminals who, by the law of their country, had been condemned to death. In their case, the issue of inherent rights could not be raised, for these had already been cancelled, and they were dealt with penally on this hypothesis. Why should not the punishment of a criminal take a form which was serviceable to the community? Why should he not at least be given the opportunity of making in this way some atonement for his sins against society? At present, deductions drawn from the responses of the anthropoid apes or even dogs have to suffice, where direct experiment on man would present a speedier route to knowledge. This applies to human physiology, especially of the nervous and digestive systems and in a lesser degree to pathology as regards infectivity and immunity. There is, of course, the possible difficulty to be encountered in finding an experimenter, at any rate in England, who would impose conditions which might not meet with the penal requirements. In any event, the subject bristles with difficulties the discussion of which would take up more space than is available in these columns.

#### International Ornithological Congress

THE eighth International Ornithological Congress is to be held at the University of Oxford in July 1934, under the presidency of Dr. E. Stresemann, of Berlin. The International Ornithological Congress was originally held every five years, but at the last Congress, at Amsterdam in 1930, when the president was Dr. E. Lönnberg of Sweden, it was decided to hold it

every four years. The last meeting of the Ornithological Congress in England was at the Imperial Institute, London, in 1905, with Dr. R. B. Sharpe as president. In 1910 it was held in Berlin, and it was proposed to hold the 1915 Congress at Sarajevo, Yugoslavia, but in the meantime the War broke out and no further Congress was held until 1926, when, mainly through the efforts of Dr. Ernst Hartet, keeper at Tring Museum, it was resumed at Copenhagen. Preliminary arrangements have already been made for the 1934 Congress at Oxford, and the Rev. F. C. R. Jourdain, of the British Ornithologists' Union, has been elected honorary secretary. Dr. P. R. Lowe, of the British Museum, has been elected chairman of the executive committee, which includes Lord Rothschild, Lord Scone, Dr. C. B. Ticehurst, Dr. Sclater, and Messrs. Stuart-Baker and H. F. Witherby, president of the British Ornithologists' Union.

DELEGATES to the Congress will include the leading ornithologists from all parts of the world, particularly Australia, New Zealand, Argentina, Brazil, Japan, India, the United States, Canada, and all European countries. The problem of oil pollution of the sea, whereby hundreds of sea-birds, including many rare species, are annually being destroyed especially on the North Atlantic shores, will be a prominent feature of the section on bird protection, while the practice of 'ringing' as a means of tracing bird migrations will also be discussed. One of the most important items, however, is the project for founding an Institute of Ornithology at the University of Oxford, which it is hoped to develop out of the existing scheme of research in economic ornithology at Oxford, the grant for which expires in September, 1933. The new institute is intended to be a national centre for field ornithologists as the British Museum is for systematists. £8,000 is needed to run the Institute for a preliminary five years while steps are being taken to put it on a more permanent basis. An appeal will be made not only for funds but also for gifts of books, field notes and photographs, etc., for equipping it. It is also proposed to arrange at least one long excursion to study British bird life, and South Wales will probably be chosen as the area to visit though several shorter excursions are to be made. The lectures and papers are to be given in English, French, German and Italian.

#### New Buildings of the University of London

UNDER the title "The New Buildings for the University of London" (The Dryden Press) Mr. T. Ll. Humberstone has published a 'symposium', in which a contribution to NATURE (July 9, 1932, p. 49) is reprinted, followed by an explanation of the plan of the proposed buildings by the architect (illustrated), and expressions of opinion from architects and laymen and a supplementary note by Mr. Humberstone himself. It will be remembered that Mr. Humberstone in his original article, after a brief summary of past difficulties and controversy connected with the accommodation of the University, expressed certain

misgivings in regard to the suitability of the proposed buildings, especially in relation to the provision for scientific research. These views are now supplemented by critical comments from others. Prof. S. D. Adshead, professor of town planning in the University, for example, remarks that "if only on account of its rigidity—the system must fail". In his supplementary note, Mr. Humberstone reverts to his previous contention that the University buildings should make provision for an institute for scientific research, pointing out the unsuitability of the scheme, as well as the unnecessary expense involved, for the purpose, and discusses the bearing of the conception of the University as a federation upon the development of facilities for research as part of the equipment and organisation of the University, as distinct from its constituent colleges.

#### San Diego Museum

LOCAL patriotism flourishes perennially in the United States. As part of a campaign "Know your San Diego", Mr. Malcom J. Rogers, curator in anthropology in the Museum of San Diego, has recently broadcast a lecture, in which he gave an account of the origin and growth of the collections. The nucleus of the museum was an exhibit at the Panama-California Exposition of 1915-16. The organisers of the exhibition, in consultation with officials of the U.S. National Museum, spent some three years in getting together a collection to illustrate the origin, racial types and culture of man. Expeditions were sent to Asia, Africa, South America, the Pacific and the Arctic for material and the collections then made were housed in the only permanent building in the exhibition, the California Quadrangle, which is still its name, as it had been intended from the first that what, it was hoped, would be a unique educational exhibit, should "not be a thing for the moment, but an enduring institution for the benefit of the people of San Diego and its visitors". At the close of the exhibition the collections were transferred to a permanent Museum Association in trust for the people of San Diego. Dr. Edgar L. Hewett, of the Archaeological Institute of America, who had been responsible for this department during the exhibition, was made the first director of the Museum. Constant additions have been made to the collections, which are now so extensive that it is possible only to show the exhibits in rotation. They are arranged departmentally, to illustrate man's origin (by casts), physical types, and culture in the past and present. The archaeology of Central America and the Mayas is abundantly illustrated, the most striking and best-known buildings and monuments being represented by replicas. The pride of the Museum, however, is the collection from the southwestern States and, more particularly, that from Southern California, the latter being unique and beyond question the most complete in existence.

#### Bird Life on Ailsa Craig

A REPORT on bird life on Ailsa Craig was submitted to Ayr County Council on May 30, the Earl of Glasgow presiding, following a communication from the

Scottish Office. The report, prepared by Lieut.-Commdr. G. H. Hughes-Onslow, Barr, and Mr. T. Smith, Maybole, recommended that protection be given to guillemots, razor-bills, puffins, kittiwake gulls, and oyster catchers, and also to black guillemots, stormy petrels and fulmar petrels, which have been observed in pairs on the Craig but have not yet nested there, although they have nested on the neighbouring mainland. Protection was not recommended for solan geese or gannets, the stock of which is sufficiently large, nor for the greater black-backed gulls, lesser black-backed gulls, herring gulls, and cormorants, which are so numerous all around our coasts and so destructive to fish and other life as not to merit protection. Regarding the practice of shooting birds from boats, the reporters agreed with the Secretary of State for Scotland that prohibition could not be enforced. The practice, however, should be discouraged. The comparatively few eggs collected by the tenants on the island has no effect on the bird life. The report was adopted for submission to the Scottish Office.

#### Peterhead Sealers and Whalers

IN the January-February number of the *Scottish Naturalist*, No. 199, 1933, Dr. Robert W. Gray continues his very interesting account of "Peterhead Sealers and Whalers: A Contribution to the History of the Whaling Industry", begun in 1932 (September-October). Peterhead first sent a whaling vessel to the Greenland Sea (the "Greenland" of the old sealers and whalers, the Spitsbergen Sea, the ocean between Greenland and Spitsbergen) in 1788, and a Greenland whaling ship sailed out of Peterhead for the last time in 1893. Dr. Gray, whose grandfather and father both commanded whaling ships, possesses original log-books containing a large amount of reliable information as to the whaling in the latter portion of this period and has gathered together data from many sources relating to the earlier years, beginning with the tiny *Robert*, the pioneer vessel. Up to the year 1814 the fishery had been pursued generally in the more northerly regions, but after this the boats began to explore southwards. From 1825 the Peterhead ships went mostly to the Davis Straits and the whales of the Greenland sea were left alone for a time. In 1837 the whalers returned to the north and both northern and southern fishing was continued, the northern fishery in some years proving very successful. A great deal is to be learned by reading this article, the present portion going up to the year 1874. In that year, according to the log-book of the *Eclipse* it was an open season, northerly winds prevailed in April, May and June, there was a strong south-westerly drift and the edge of the ice lay far west. The ice was drifting south at the rate of twenty to thirty miles a day, and at the end of the voyage it was estimated that more than 300,000 square miles of ice drifted south out of the Arctic Ocean in three months.

#### Electrical and Rubber Equipment on the Farm

THE supply of electricity to rural areas is continually extending so that increasing numbers of

farmers are interested in this alternative method of lighting their farm buildings and conducting power operations in and around the homestead. In these circumstances a visit to a farm carrying a good equipment of the ordinary machinery as well as a complete electrical installation gives an excellent view of the possibilities. At Rothamsted, a thoroughly up-to-date electrical equipment has been supplied by the General Electrical Co., Ltd., and means are provided for making exact comparisons of electricity and oil as sources of power for farm operations. On June 19 a demonstration of the plant was arranged for a party of experts and farmers. The visitors were conducted round the farm buildings and examined a large number of power operations in progress, the motors ranging from 20 h.p. down to  $\frac{1}{2}$  h.p. according to the nature of the work. A very complete and efficient lighting system was demonstrated and electricity was in use for water heating, sterilising, and various other stationary processes. First-hand information with regard to the engineering details and performance of the machinery was also available. A demonstration of a number of uses of rubber on the farm was arranged by the Dunlop Rubber Co., Ltd. Various types of rubber flooring for stables, cowsheds and piggeries were on view. The visitors also examined the performance of heavily laden farm carts equipped with low-pressure rubber tyres and rubber-tyred tractors at work on the arable land.

#### Scottish Marine Biological Station, Millport

THE Scottish Marine Biological Association's annual report on the work of its laboratory at Millport on the Firth of Clyde, for the year 1931-32, has recently been issued (Glasgow: 185 St. Vincent Street). The Association is to be congratulated on the large measure of success which is attending the important though highly specialised researches upon which its small staff of four is actively engaged. Their work has received high commendation from H.M. Development Commissioners and other interested organisations well qualified to assess its value. Over and above the important work on *Calanus finmarchicus* (see NATURE of June 10, p. 843) which is being done, the results of a considerable number of other researches carried out by the station staff and visiting workers have been published in the course of the year. Chief among these must be mentioned several important memoirs by Miss Marshall, Mr. Orr, and Dr. Nicholls, embodying the results of their researches while members of the Australian Great Barrier Reef Expedition of 1928-29. In common with all other organisations in Great Britain and other countries, the Millport Laboratory has been adversely affected by the present economic depression. The block grant originally voted to it by H.M. Treasury—on condition that a proportional sum be raised independently from other sources—was considerably cut down, and the local contributions fell short of the required amount by fully £100. It is greatly to be hoped that the state of financial stringency which still exists will not be allowed unduly to restrict the activities of this and similar institutions.

### Institution of Electrical Engineers' Wiring Regulations

THE booklet on "Regulations for the Electrical Equipment of Buildings" (price 1s. net) published by the Institution of Electrical Engineers has proved a great boon to the industry. It replaces many rules and regulations published by supply companies and insurance companies. The ninth edition was published in May 1927 and the tenth edition is in active preparation. The new edition will contain rules relating to electric signs and to the new luminous discharge tube installations. These new rules have been approved by the representatives of those interested and by the Council of the Institution of Electrical Engineers. They deal very thoroughly with possible risks of fire and the precautions necessary to avoid risk of shock. These rules are now issued in advance of the tenth edition in a supplementary booklet. Copies of this supplement can be obtained free of charge, for insertion in existing copies of the Regulations, on application to the Secretary of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

### Home-Grown Timber in Great Britain, 1930

THE Forestry Commission has issued a small pamphlet on home-grown timber (Report on Census of Production of Home-Grown Timber, 1930. H.M. Stationery Office. Dec. 30, 1932). The object of the pamphlet is to contrast the production or utilisation of timber in Great Britain in 1930 with the amount used in 1924. With this object, schedules were issued to woodland owners who had furnished returns in 1924. The census shows that there has been a falling-off between 1924 and 1930, both in respect of the volume and value of the material produced. As regards volume, there is a difference of 14 per cent, the decline being from 55,985,000 cub. ft. in 1924 to 48,057,000 cub. ft. in 1930. The value of the material utilised has fallen in the same period from £2,036,000 to £1,545,000, representing a reduction of nearly 12 per cent. Prices ruled higher in England than in Scotland or Wales, but were certainly low as a whole, especially for the fine hardwoods such as oak (16*d.* per cub. foot in England with an average for Great Britain of 15*d.*; and 22½*d.* for ash in England with an average of 21*d.* for Great Britain—both for timber of saw-mill size). A little more than one-fourth of the total volume of material produced during 1930 consisted of the three fine hardwoods, oak, beech and ash (a total of 12,934,700 cub. ft.) and the figures demonstrate that the bulk of the fellings of these three valuable species were made in England, where 8,120,900 cub. ft. (out of the 12,934,700 cub. ft.) were cut, of which 6,194,200 cub. ft. were oak. Some of the fellings being made in these English woodlands are of the worst lumbering type—unchecked clear-felling and disposal of all that is saleable, the area being left clogged with rubbish and in a most unsightly state. It may be suggested that the time has arrived when a law prohibiting this type of unchecked lumbering, which has done such extensive harm to forest tracts throughout the globe, is urgently needed.

### Cultivated Oaks

SIR OSCAR WARBURG and Mr. E. F. Warburg have published details of the oaks in cultivation in Sir Oscar's garden at Headley, Epsom, and elsewhere in the British Isles ("Oaks in Cultivation in the British Isles", *J. Roy. Hort. Soc.*, 58, Pt. 1, pp. 176-189, Feb. 1933). The account is copiously illustrated with many clear photographs of herbarium specimens and the various species of the genera *Lithocarpus* and *Quercus*, which all come under the general category of 'oaks', are described in detail. Three sub-genera of *Quercus* are recognised—*Cyclobalanopsis*, *Erythrobalanus* and *Lepidobalanus*. A useful list at the end of the article sets forth the common name, the group and the area of origin in non-technical, as well as in botanical, language. Several notes on some South American oaks and garden forms help to clear up difficulties of classification, and a fairly extensive bibliography is added.

### A Polish Guide to Zoology

THE Polish Institute for the Promotion of Science and Letters is publishing a "Handbook for Self-Education" (Poradnik dla Samoúków) under the general editorship of Prof. S. Michalski, and vol. 10 (554 pages), dealing with histology, animal physiology, embryology and comparative animal psychology, has just been issued (Warszawa. Imienia Mianowskiego. 18 zlotys). This is the second section on zoology and contains contributions from Profs. Maziarski, Bialisiewicz and Godlewski, whilst Miss Bohn-Drzewina's article on animal psychology, originally written in 1929, is very fittingly appended. The object of this publication is to guide students (and lecturers) in their reading and to direct attention to general principles, to the historical developments and especially to the literature of each branch of the subject. It is not intended to supplant any of the standard textbooks but to supplement them. It is noticeable that the authors are most familiar with German treatises on the various branches of zoology under consideration, but some French and, more rarely, English works are cited and listed in the bibliographies. The work will prove useful to those Polish students who, for any reason, do not enjoy close contact with their lecturers, and it has apparently been compiled with that object in mind.

### Veterinary Research in the Union of South Africa

THE eighteenth report of the Director of Veterinary Services and Animal Industry, Onderstepoort, Pretoria, contains matter of value to the veterinarian and agriculturist. Several papers deal with parasitic and virus diseases of animals, and considerable space is devoted to the subjects of mineral deficiency and metabolism and to plants poisonous to stock. Mr. Bedford contributes an exhaustive synoptic check-list and host-list of ectoparasites found on South African mammals, birds, and reptiles, and Mr. Steyn has continued his observations on the effect of sulphur on merino sheep. A ration of 5 gm. of sulphur thrice weekly improves the condition of the sheep and

increases the wool yield from an average of 8.4 lb. to an average of 11.625 lb. It also increases resistance to prussic acid, and may be of value in reducing 'geilsiekte', a poisoning that arises from ingestion of certain plants in which a cyanogenetic glycoside is present. The report, in two parts, is admirably produced and illustrated (Government Printer, Pretoria, 20s.)

#### Health of the Navy during 1931

THE statistical report of the health of the Navy for the year 1931, by the Medical Director General, Vice-Adm. R. St. G. S. Bond, states that there was an increase in the incidence of disease as compared with the five years' average and with 1930, largely due to an increase in influenza of nearly 2,000 cases. Malaria and venereal diseases declined markedly. Nine cases of undulant fever were reported from the Mediterranean station. It is remarked that undulant fever has increased among Maltese civilians, and in consequence a Government commission is considering the possibility of introducing the compulsory pasteurisation of goats' milk at a central distributing station and the prohibition of retail sales as at present transacted by driving the goats from door to door. Only five cases of enteric fevers were reported.

#### Index Veterinarius

THE first number of the *Index Veterinarius*, covering the indexing done at the Imperial Bureau of Animal Health during the first quarter of 1933, will be issued during the summer. This work will be a complete index to publications relating to veterinary research and public health administration and education. An annual volume, which will be in crown quarto size, will run to about 1,600 pages; and a number, consisting of about 400 pages, will be issued each quarter. About 10,000 references will be indexed each year, each reference being suitably cross-indexed alphabetically both under the names of authors and subjects and, with cross-indexing, there will be about 50,000 insertions in a volume. The price of the *Index* is £4 a volume (four quarterly issues) including postage. Orders should be sent to the Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, Surrey, England.

#### Library of the London School of Hygiene and Tropical Medicine

THE London School of Hygiene and Tropical Medicine has issued a second edition, compiled by the librarian, Mr. Cyril Barnard, of the "Hand List of Periodicals" contained in the Library on January 31, 1933 (Wightman and Co., Ltd., Dugdale Street, S.E.5. 1s. 3d.). The arrangement of entries is alphabetical by titles, according to the rules adopted in the "World List", and the "World List" numbers are added to all the periodicals which are contained in that publication. An index of societies and institutions is appended, with the number in the list of the periodicals attached to each entry.

#### Service for the Blind

THE Report of the Librarian of Congress for 1932 witnesses to the effort being made to meet the needs of blind readers in the United States. The number of blind readers who borrowed embossed material during the year was 3,225, and the library collection now contains 24,824 items. An attempt is made to furnish blind readers with the best literature in all fields of knowledge which, on account of the financially unprofitable nature of embossed printing, they have hitherto been unable to obtain. The type of book suitable for transcription is limited, since works the value or attractiveness of which rests largely upon illustrations, are barred. But within the limits, the special accessions, which began with Woodrow Wilson's "George Washington" and contain, on the scientific side, works by Jeans, Maeterlinck, Arthur Keith, Harvey-Gibson, Russell and others, make a notable list of 126 works in Braille and 31 in Moon type.

#### Preservation of Metallic Objects in Museums

MUSEUM curators are often faced and baffled by the problem of dealing with objects of metal which have deteriorated through exposure, and tend to go from bad to worse when placed on exhibition. They will find a very useful guide to the most satisfactory methods of treatment in a paper by Dr. Alexander Scott in the *Museums Journal* of April (p. 4), where, in addition, hints are given for making brittle substances flexible, for using hydrogen peroxide in restoring degraded flake white to its original colour, for treating foxed prints and removing oil stains.

#### Collection and Preservation of Animals

THE National Museum of Canada has just published a work on "Methods of Collecting and Preserving Vertebrate Animals", which ought to prove useful to travellers and holiday-makers who wish to add to their pleasures that of contributing to the knowledge of their country's fauna (Nat. Mus. Canada, Bulletin No. 69, Biological Series, No. 18, Ottawa, 1932). While less compact and less convenient in size for carrying than the well-known British Museum collectors' handbooks, Mr. R. M. Anderson's book has the advantage of being more thorough in its treatment and of containing a large number of illustrations showing steps in the progress of skinning. In separate chapters it deals with the collecting and skinning of mammals, birds, reptiles, amphibians and fishes, and a special chapter describes the collecting of skeletons. There are 135 pages of descriptive matter, a very complete index of 5 pages, 46 illustrations, and the cost is only 25 cents.

#### The late Lieut.-Col. A. W. Alcock

IN connexion with the obituary notice of the late Lieut.-Col. A. W. Alcock in *NATURE* of April 22, Dr. B. Prasad, of the Zoological Survey of India, states that Col. Alcock's association with the Indian Museum began at the end of the survey season of 1888-89, for with the beginning of the south-west

monsoon the surgeon-naturalist used to come every year for the recess period to the Indian Museum, to work out his collections. During the four years of his appointment as the surgeon-naturalist, Alcock spent every recess season in the Indian Museum, and it was during this time and as a result of his association with J. Wood-Mason, then superintendent of the Indian Museum, that Alcock developed his interest in Crustacea. In April 1893, Alcock was appointed officiating superintendent of the Indian Museum, and was confirmed in this appointment in May on the death of Wood-Mason; he held the appointment as professor of zoology in the Medical College of Calcutta as a subsidiary charge. The dates given in the obituary in *NATURE*, which differ slightly from those quoted by Dr. Prashad, were taken from Col. Alcock's own diary.

#### Announcements

PROF. R. G. HARRISON, professor of comparative anatomy at Yale University, will deliver the Croonian lecture before the Royal Society on June 29, at 4.30. The title of Prof. Harrison's lecture will be: "The Origin and Development of the Nervous System studied by the Methods of Experimental Embryology".

MR. K. S. KRISHNAN, reader in physics in the University of Dacca, has been elected secretary of the Indian Association for the Cultivation of Science, 210 Bow Bazar Street, Calcutta, in succession to Sir C. V. Raman. Mr. Krishnan has also been appointed the Mahendralal Sircar research professor in physics of the Association.

THE Medical Research Council, acting for the Rockefeller Foundation, has awarded travelling fellowships for the academic year 1933-34 to the following: Mr. H. W. Fullerton, Department of Medicine, University of Aberdeen; Miss M. H. Roscoe, Lister Institute, London; Dr. D. Sheehan, Department of Anatomy, University of Manchester; Dr. S. Zuckerman, Department of Anatomy, University College, London. Dr. Sheehan's fellowship is tenable at Montreal; the others at centres in the United States.

THE annual field meeting of the Association of Economic Biologists will be held on July 14 at the University of Reading. Visits will be made to the University Horticultural Station, the Agricultural Botanic Garden and the National Institute for Research in Dairying. Further information can be obtained from Prof. R. H. Stoughton, The University, Reading.

THE fifty-second annual meeting of the Society of Chemical Industry will be held at Newcastle-on-Tyne on July 10-14, under the presidency of Dr. R. H. Pickard, who has chosen for the title of his presidential address "The Industrial Use of Textiles". Several discussions have been arranged by the various groups of the Society. Further information can be obtained from Mr. J. W. Craggs, 4, St. Nicholas Buildings, Newcastle-on-Tyne, 1.

THE fourth International Congress for Applied Mechanics will be held at Cambridge on July 3-9, 1934. All persons interested in the subject are invited to attend and submit papers. It is suggested that the subjects be grouped as follows: rational mechanics, including vibrations of structures and machines; mechanics of fluids, including turbulence, the boundary layer, heat transfer and compressible fluids; materials, including elasticity, plasticity, fatigue and crystal structure; water waves, including resistance and stability of ships and seaplanes. Further information can be obtained from the Secretary, Fourth International Congress for Applied Mechanics, Engineering Laboratory, Cambridge.

THE prospectus of the German Chemical Plant Exhibition ('Achema VII') to be held in Cologne on May 18-27, 1934, has recently been issued. The annual general meeting of the German Chemical Society and other scientific and technical societies will be held in Cologne at the same time. The preparations which have been made from the point of view of technical organisation in the interests of all those taking part in this Exhibition are fully set forth in the prospectus, a copy of which may be obtained free of charge on application to the 'Dechema', Deutsche Gesellschaft für chemisches Apparatewesen E.V., Achema-Geschäftsstelle, Seelze bei Hannover.

WE have received the first number of a new *Journal of the Chinese Chemical Society*, which is to appear quarterly, the editor being Mr. C. L. Tseng, of the National University of Peking, Peiping, China. This contains several original communications, in English, including studies on Chinese natural products.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An inspector of wireless engineering to the Air Ministry—The Secretary, Air Ministry, Adastral House, Kingsway, London, W.C.1 (June 26). Temporary civil engineering assistants for the Directorate of Works, War Office—The Under-Secretary of State (C.5), War Office, London, S.W.1 (June 28). A city engineer and surveyor of the City of Bradford—The Town Clerk, Town Clerk's Office, Bradford (July 1). A woman assistant chiefly in organic and inorganic work at the Air Ministry, Kidbrooke—The Secretary (I.E.2), Air Ministry, London, W.C.2 (June 30). A technical assistant on the scientific staff of the Fishery Board for Scotland—The Secretary, Fishery Board for Scotland, 101, George Street, Edinburgh, 2 (July 5). A University reader in zoology at Birkbeck College—The Academic Registrar, University of London, S.W.7 (July 10). An assistant curator of the Royal Albert Memorial Museum, Exeter—The Town Clerk (July 12). A teacher of machine drawing, electricity and mathematics at the Chatham Junior Technical School—The District Education Officer, 15, New Road Avenue, Chatham. A head of the Physics Department of the Swansea Municipal Technical College—The Director of Education, Education Offices, Dynevor Place, Swansea.

## 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.]

## Electron Polarisation?

SOME years ago I published, in collaboration with Mr. H. Jones<sup>1</sup>, a paper in the course of which certain experimental observations were recorded on electrons which had passed through hydrogen gas and had suffered therein two inelastic collisions. Certain arguments were based on these observations from which a determination of the probability of effective collision was obtained. In some very recent work in this laboratory, I have been attempting to use the same method in the case of helium, using apparatus of a very much more refined character. Briefly, narrow electron beams are used of velocities between 50 and 400 volts which pass through helium at low pressure making elastic and inelastic collisions on the way. The beam can be oriented at various angles with respect to fine slits through which, at the zero

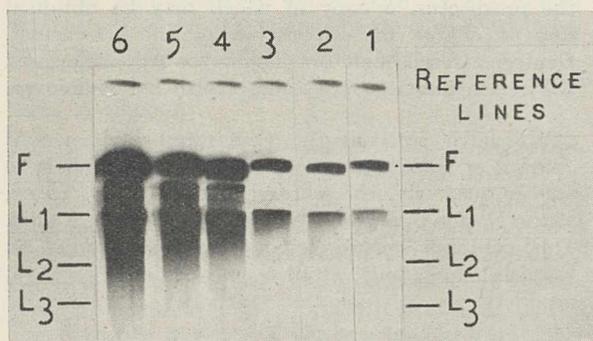


FIG. 1. Magnetic spectra of 300 volt electrons making inelastic impacts in helium. Second inelastic collisions occur only with small probability.

angle, the beam passes. After the beam has passed through the slits, they enter a magnetic field at right angles to their path, are deflected through 180°, and are then recorded photographically on a film. The film on development shows a magnetic spectrum, exhibiting not only the full velocity line (*F* in Fig. 1) corresponding to those electrons which have proceeded straight through the slits from the gun or have suffered only elastic collisions on the way, but also at lower velocities various narrow lines corresponding to energy losses, the most probable of which I have previously shown to be that corresponding to the transition  $1^1S_0 - 2^1P_1$ . This loss line ( $L_1$ ) is quite intense and the probability of a collision of the type necessary to produce this loss has been accurately measured in this laboratory at various impact energies.

It occurred to me to try to obtain, by lengthening the time of exposure, a mark on the film corresponding to two collisions of this kind. I refer to this line on the film as  $L_2$ . It appears to be difficult to get it. At zero angle the probability of its production—that is to say as measured by the ratio of the intensities  $L_2/L_1$  corrected, of course, for the disparity of the paths of the *F* and  $L_1$  electrons—is much less than the corresponding ratio  $L_1/F$ . Very careful observations have been taken in order

to eliminate all possible experimental 'snags', but there is no doubt that at zero angle and at velocities of several hundred volts the effect occurs. At the same time, it is a striking fact that the  $L_3$  loss corresponding to three collisions is obtainable, and in fact the probability  $L_3/L_2$  is much greater than is to be expected from a simple point of view.

The experiment has been extended from zero angle and it appears that the  $L_2$  loss at three or four hundred volts reaches a maximum intensity at three or four degrees, but at thirty degrees is entirely absent in spite of the very high intensity of  $L_1$ .

These are remarkable facts and one explanation which suggests itself, with due diffidence in view of the smallness of relativity spin on the quantum theory, is that the inelastically scattered electrons from helium are polarised. It seems clear that they are in some manner different from the original electrons which leave the electron gun, for had they been precisely similar the probability of a further inelastic collision would have been precisely the same.

I propose to extend these observations to larger angles than thirty degrees and to gases other than helium.

Some results are shown in Fig. 1. There are twelve different exposures on this film, the six lines at the top having been taken with a smaller magnetic field to serve the purpose of reference lines for intensity measurement. The six spectra shown below are of increasing times of exposure from right to left. The absence of  $L_2$  is to be noted (though it is just visible in 5)—and the presence of  $L_3$  in 5 and 6. The photographs lose a good deal in reproduction.

The University,  
Leeds.

June 12.

<sup>1</sup> *Phil. Mag.*, 1928.

R. WHIDDINGTON.

## Structure of the Molecule of 12-Phosphotungstic Acid

THE structures and formulæ of the heteropoly acids have long been a subject for speculation. In 1929, Pauling<sup>1</sup>, on theoretical grounds, proposed a structure for the molecules of the 12-heteropoly acids, which gave the formula of 12-phosphotungstic acid as  $H_3[PO_4.W_{12}O_{18}(OH)_{36}]nH_2O$ .

The structure of 12-phosphotungstic acid has recently been found in this laboratory by X-ray analysis, using the powder method. The phosphorus atom is at the centre of a regular tetrahedral group of four oxygen atoms, and each tungsten atom is approximately at the centre of a distorted octahedral group of six oxygen atoms. The complex acidic anion is a co-ordinated structure consisting of a central  $PO_4$  group surrounded by twelve  $WO_6$  groups as a shell, linked together by shared oxygen atoms. The arrangement differs from that proposed by Pauling. The complex anion is found by experiment to be  $PW_{12}O_{40}^{3-}$  and has the point group symmetry  $Td$ . The twelve  $WO_6$  octahedra are arranged in four groups. Each group consists of three  $WO_6$  octahedra arranged round a trigonal axis, so that the co-ordinates of the three tungsten atoms are of the type  $(a, a, b)$   $(a, b, a)$   $(b, a, a)$ , with two co-ordinates equal, referred to the rectangular axes of cubic symmetry, with origin at the centre of the central phosphorus atom.

Fig. 1 shows the arrangement of one group of three  $WO_6$  octahedra relative to the  $PO_4$  tetrahedron. Considering at first only this one group of three octahedra, there is one oxygen shared in common between the three  $WO_6$  octahedra and the central

PO<sub>4</sub> tetrahedron, and each octahedron shares two other oxygens, one with each of its two neighbours. Thus each octahedron has two edges shared, one with each of the two neighbouring octahedra. Four such groups of three octahedra are arranged round the central PO<sub>4</sub> tetrahedron in tetrahedral symmetry, so that each oxygen of the PO<sub>4</sub> tetrahedron is now an oxygen already shared between three WO<sub>6</sub> octahedra.

The complete acidic anion PW<sub>12</sub>O<sub>40</sub><sup>-3</sup> is shown in a simplified form in Fig. 2. It will be seen that each WO<sub>6</sub> octahedron, besides sharing two oxygens with octahedra in its own group of three, also shares two oxygens with octahedra in other groups. In the complete acidic anion each WO<sub>6</sub> octahedron consists of one oxygen shared between three WO<sub>6</sub> octahedra and one PO<sub>4</sub> tetrahedron, four oxygens shared between two WO<sub>6</sub> octahedra, and one oxygen unshared with other polyhedra. The twelve tungsten atoms lie on a sphere with the most even distribution possible, each tungsten atom being equidistant from four other tungsten atoms.

In the partially dehydrated acid examined, which contained six or seven molecules of water of crystallisation per molecule of acid, these acidic anions pack together with body-centred cubic symmetry, of point

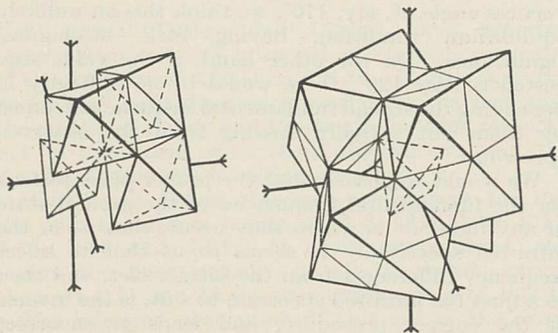


FIG. 1. Arrangement of one group of three WO<sub>6</sub> octahedra relative to the central PO<sub>4</sub> tetrahedron.

FIG. 2. Complete complex anion, PW<sub>12</sub>O<sub>40</sub><sup>-3</sup>.

group symmetry T<sub>d</sub><sup>2</sup>. The edge of the unit cube is 12.14 ± 0.005 Å. The water of crystallisation packs in the interstices between the anions. The agreement between observed intensities and those calculated for this structure is good, and proves its correctness.

This structure gives the formula of the molecule of 12-phosphotungstic acid as H<sub>3</sub>PW<sub>12</sub>O<sub>40</sub>. The formula of the acid is perhaps best written H<sub>3</sub>P(W<sub>3</sub>O<sub>10</sub>)<sub>4</sub>·nH<sub>2</sub>O, to indicate that the anion is a modified PO<sub>4</sub><sup>-3</sup> tetrahedral group, in which each of the four oxygen atoms has been replaced by a W<sub>3</sub>O<sub>10</sub><sup>-2</sup> group, each W<sub>3</sub>O<sub>10</sub><sup>-2</sup> group consisting of three WO<sub>6</sub> octahedra sharing oxygens with other octahedra. This formula agrees with the mass of chemical evidence. This work will shortly be published elsewhere in more detail.

It has been proved that the molecule of several other 12-heteropoly acids also have this type of structure, which is apparently the structure for the whole series of the 12-heteropoly acids. This examination of other acids is not yet complete. Work is also in progress on the structures of other hydrates and salts of the heteropoly acids. J. F. KEGGIN.

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May 10.

<sup>1</sup> Pauling, L., *J. Amer. Chem. Soc.*, 2, 51, 2868; 1929.

### Bands in the Thermoluminescence Spectrum of Fluorite from Obira, Japan

THE natural thermoluminescence spectrum of almost colourless fluorite from Obira consists of six distinct narrow bands, namely, α<sub>1</sub>, α<sub>2</sub>, α<sub>3</sub>, β<sub>1</sub>, β<sub>2</sub> and β<sub>3</sub>. Denoting the wave number by ν, it has been confirmed experimentally that ν<sub>β<sub>1</sub></sub> - ν<sub>α<sub>1</sub></sub>, ν<sub>β<sub>2</sub></sub> - ν<sub>α<sub>2</sub></sub>, ν<sub>β<sub>3</sub></sub> - ν<sub>α<sub>3</sub></sub> are constant, therefore it seems to be plausible to separate the six bands into two groups, α<sub>1</sub>, α<sub>2</sub>, α<sub>3</sub> and β<sub>1</sub>, β<sub>2</sub>, β<sub>3</sub>.

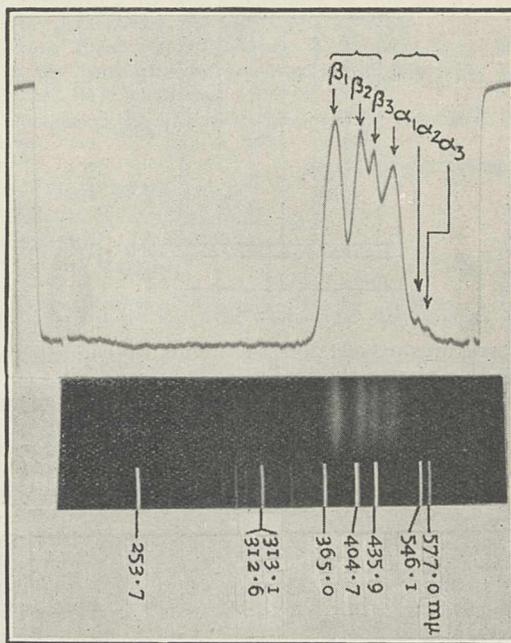


FIG. 1. Above, photometric curve of natural thermoluminescence spectrum. Below, spectrum of natural thermoluminescence and of mercury.

This is indicated in Fig. 1 and the accompanying table. From these results the energy levels assumed in the fluorite phosphor are as shown in Fig. 2.

α-group	λ(mμ)	ν (cm. <sup>-1</sup> )	β-group	λ(mμ)	ν (cm. <sup>-1</sup> )
α <sub>1</sub>	478	20900	β <sub>1</sub>	380	26300
α <sub>2</sub>	542	18500	β <sub>2</sub>	420	23800
α <sub>3</sub>	574	17400	β <sub>3</sub>	436	22900

$$\Delta \nu_1 = \nu_{\beta_1} - \nu_{\alpha_1} = 5400$$

$$\Delta \nu_2 = \nu_{\beta_2} - \nu_{\alpha_2} = 5300$$

$$\Delta \nu_3 = \nu_{\beta_3} - \nu_{\alpha_3} = 5500$$

$$\Delta \nu \text{ mean} = 5400$$

When the specimen was heated until all natural thermoluminescence disappeared and then irradiated by X-rays (from a Coolidge tube with a molybdenum anticathode, working at 10 milliamperes and 40 kilovolts), it gives, as will be seen in Fig. 3, the thermoluminescence spectrum, the wave-lengths of which coincide with those of the natural thermoluminescence. A comparison of the two photometric curves reproduced in Figs. 1 and 3 shows, however, that there is a remarkable change in the relative intensities of the bands; in the natural thermoluminescence the intensity of the α-group bands is weaker than that of the β-group, while in the restored thermoluminescence the former is definitely stronger than the latter. Further, in each group the longer

the wave-length of the band, the weaker the intensity, and this relation remains always unchanged.

The specimen treated with X-rays to restore its thermoluminescent power, emits, when heated, the bands belonging to the  $\alpha$ -group at temperatures lower than 200° C. On the other hand, the bands belonging to the  $\beta$ -group are emitted only when the

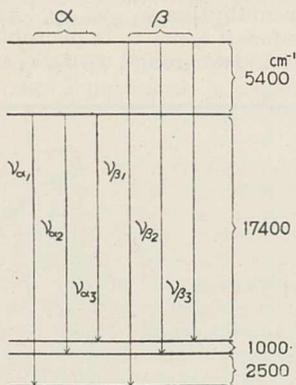


FIG. 2.

temperatures exceed 200° C. Thus we can separate these two groups thermally.

It is also of interest to note that the oxides of rare earths extracted from this specimen were proved to be colourless and extremely small (0.004 per cent) in amount.

Similar investigations were carried out on several

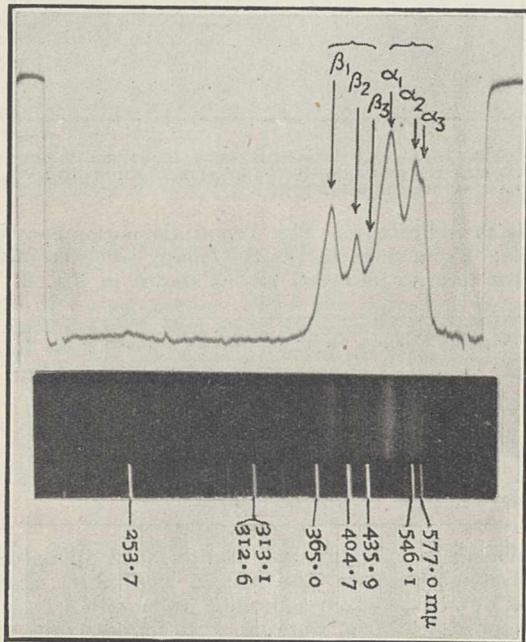


FIG. 3.—Above, photometric curve of thermoluminescence spectrum restored by exposure to X-rays. Below, spectrum of restored thermoluminescence and of mercury.

other specimens of fluorite, but such regular results as the above have not so far been obtained.

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March 10.

### Form and Vibrational Frequencies of the Nitrogen Dioxide Molecule

MESSRS. HARRIS, BENEDICT AND KING in a recent letter<sup>1</sup> have criticised our deductions and experimental data for nitrogen dioxide. They raise points of general interest which therefore merit reply.

We would first point out that our work on the structure of triatomic molecules has led to certain conclusions which apparently make it possible to predict the normal structure of such molecules. It seems that if the electrons available for molecular binding are insufficient to occupy the necessary molecular properfunctions, as they are in the case of an odd molecule, the structure of the latter is probably that of the next higher molecule, and with the addition of electrons this structure opens out<sup>2</sup>. Thus water (H<sub>2</sub>O) and chlorine monoxide (Cl<sub>2</sub>O) have a vertical angle in the neighbourhood of 90°, but chlorine dioxide (ClO<sub>2</sub>) is like sulphur dioxide (SO<sub>2</sub>) with 120° for this angle. If this rule holds, nitrogen dioxide (NO<sub>2</sub>) will be like carbon dioxide (CO<sub>2</sub>) and the nitrite ion in aqueous solution, which are rectilinear.

It is difficult to know what is the structure proposed by our critics. If by slightly bent, they mean a vertical angle of, say, 170°, we think this an unlikely equilibrium condition, having little mechanical significance. On the other hand, if the value suggested is near 120°, there would be no difficulty in perceiving the second fundamental frequency assumed by them but actually missing from the observed spectrum.

We would emphasise that the proper place to look for the fundamental frequencies of the ground state of any molecule is where they occur, that is, in the infra-red spectrum. It seems to us that to select frequency differences from the ultra-violet, and then to adjust the infra-red spectrum to suit, is the inverse of the correct procedure, and leads to incorrect results as in the well-known case of chlorine dioxide<sup>3</sup>. It is by this method, however, that Harris, Benedict and King assume the fundamental frequencies of 751 cm.<sup>-1</sup> and 1321 cm.<sup>-1</sup>; as these authors have only examined the infra-red spectrum between 1 and 4 μ, whereas our results extend to 18 μ, they have still less justification for their assumptions and criticisms. By the courtesy of Prof. T. M. Lowry, we have been privileged to see a proof of the results of Sutherland's recent examination of the spectra of NO<sub>2</sub> and N<sub>2</sub>O<sub>4</sub>: in agreement with our measurements, the first of these frequencies is present in N<sub>2</sub>O<sub>4</sub>, but disappears completely in NO<sub>2</sub>; the second is missing from our spectrum, but is shown by Sutherland to be due to formation of sodium nitrite on the rocksalt windows in the cases where it has been recognised. Since a strong band does exist at 641 cm.<sup>-1</sup>, it is better to take this as a fundamental frequency, particularly since Harris, Benedict and King admit that all their bands can be accounted for by our assignments.

These investigators also apply certain deductions of Gerhard and Dennison to show that the intensity of an expected Q branch is small. On further reading, they will see that the work cited deals with the symmetrical rotator, and has no connexion with the present case. If the molecule were like sulphur dioxide or chlorine dioxide, the Q branch would be very powerful.

The complex spectra observed in the ultra-violet may be due to other easily excited electronic states, and since the frequency differences observed do not

occur in the infra-red, they must be so. Furthermore, if nitrogen dioxide ( $\text{NO}_2$ ) loses its odd electron it will have the sulphur dioxide ( $\text{SO}_2$ ) structure with the obtuse vertical angle.

Finally, we fail completely to understand why the term 'molecule' should not be applied to  $\text{N}_2\text{O}_4$ . To attribute the existence of this substance to a "short-lived partnership" between two  $\text{NO}_2$  groups is contrary to the chemical and physical stability of the molecule, which leads and has a life altogether different from such physically stable and spectroscopically well recognised molecules as  $\text{OH}$ ,  $\text{CH}_2$ , etc. The underlying assumption of the authors leads to the undoubtedly erroneous statement that all the frequencies of  $\text{NO}_2$  appear in  $\text{N}_2\text{O}_4$ . With the formation of a new molecule we have new fundamental modes of vibration, and new frequencies.

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A. B. D. CASSIE.

University College,  
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May 3.

<sup>1</sup> NATURE, 131, 621, April 29, 1933.

<sup>2</sup> Cassie, NATURE, 131, 438, March 25, 1933.

<sup>3</sup> Bailey and Cassie, *Proc. Roy. Soc., A*, 137, 622.

RECENTLY Bailey and Cassie<sup>1</sup> have reported observations on the infra-red absorption spectrum of the gas mixture of  $\text{NO}_2$  and  $\text{N}_2\text{O}_4$ . Harris, Benedict and King<sup>2</sup> have directed attention to the fact that the results of Bailey and Cassie are, in some respects, not in agreement with their observations and the results of previous investigators.

Bailey and Cassie obtained a spectrum for this gas with absorption bands at 15.6, 13.4, 7.92, 6.17, 5.75, 3.22 and 2.91  $\mu$  at room temperature, and report the disappearance of all the bands except those at 6.17 and 15.6  $\mu$  at a temperature of 100° C.

The infra-red absorption of this gas in the range 2  $\mu$  to 16  $\mu$  has been investigated by me. Bands were found at 15.6, 13.3, 7.85, 7.28, 6.14, 5.7, 3.89 and 3.3  $\mu$  at room temperature. These bands were then examined at temperatures ranging from 3° C. to 150° C. The bands at 3.89, 5.7, 7.85 and 13.3  $\mu$  were decreased in intensity as the temperature was increased and disappeared entirely at 150° C. They are therefore attributed to  $\text{N}_2\text{O}_4$ . The bands at 3.3, 6.14, 7.28 and 15.6  $\mu$  remained at the higher temperatures and were decreased in intensity as the temperature was lowered, and are therefore ascribed to  $\text{NO}_2$ . These experiments were carried out with considerable care and the results can be stated with some degree of certainty.

If the bands at 7.28  $\mu$  ( $\nu_1 = 1373 \text{ cm.}^{-1}$ ), 15.6  $\mu$  ( $\nu_2 = 641 \text{ cm.}^{-1}$ ), 6.14  $\mu$  ( $\nu_3 = 1628 \text{ cm.}^{-1}$ ) are taken as the fundamental frequencies of the  $\text{NO}_2$  molecule, the 3.3  $\mu$  band can be accounted for as the overtone,  $\nu_1 + \nu_3$ . This selection of frequencies is consistent with an obtuse isosceles triangular structure with an apex angle of about 115°, when the bonds between the N-atom and the respective O-atoms are assumed to be equal. The spectrometer used did not permit resolution of any of the bands into rotational fine structure, and therefore no definite conclusions regarding the structure of the  $\text{NO}_2$  molecule can be derived from these observations.

These results are somewhat in agreement with those obtained by Harris, Benedict and King from the absorption spectra of this gas in the visible and ultra-violet, and substantiate their argument that

the structure of the  $\text{NO}_2$  molecule is not linear. The frequency,  $\nu_1$ , which they give as 1321.1  $\text{cm.}^{-1}$  probably corresponds to the band at 7.28  $\mu$  (1373  $\text{cm.}^{-1}$ ) observed by the author in the infra-red. This band, as predicted by Harris, Benedict and King, is less intense than the other two fundamentals, and apparently was not observed by Bailey and Cassie. However, it does not appear probable that the frequency at 751.1  $\text{cm.}^{-1}$ , which Harris, Benedict and King assign to  $\nu_2$ , the deformation frequency, is a fundamental of  $\text{NO}_2$ , since the infra-red band at 13.3  $\mu$  corresponding to this frequency is due to  $\text{N}_2\text{O}_4$  and is not present in the spectrum of  $\text{NO}_2$ .

From these considerations it appears very likely that the fundamental frequencies of the  $\text{NO}_2$  molecule are 641, 1373 and 1628  $\text{cm.}^{-1}$ .

Details of the above results will be published elsewhere.

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May 11.

<sup>1</sup> Bailey and Cassie, NATURE, 131, 239, Feb. 18, 1933.

<sup>2</sup> Harris, Benedict and King, NATURE, 131, 621, April 29, 1933.

### Crystal Structure of Vitamin B<sub>1</sub> and of Adenine Hydrochloride

CRYSTALS of vitamin B<sub>1</sub> (hydrochloride) from various sources have been examined. All have been found to be substantially identical in form and X-ray patterns. A very slight difference in optical properties may, however, point to the existence of a variable amount of impurity in solid solution. The angle between the *c* axis and the principal direction  $\gamma$  is 19° 40' ± 20', 19° 20' ± 20', 19° 20' ± 20' and 19° 0' ± 20' in four specimens prepared respectively by Windaus and Tschesche, Jansen and Donath, and Peters (two specimens separated at different pH). The crystals were monoclinic, tabular on *b* and slightly elongated along *c*, showing faces (010), (110), (011), and sometimes (1 KT) and (2 KT). The cell dimensions are: *a* = 12.62 Å.; *b* = 20.53 Å.; *c* = 6.96 Å.;  $\beta = 66^\circ 5'$ . The space group is probably  $C_{2h}^5 - P2_1/a$ . Assuming four asymmetric molecules per cell and the measured density 1.43, the molecular weight is 358, in good agreement with 355 calculated from the formula of Windaus<sup>1</sup>,  $\text{C}_{12}\text{H}_{18}\text{O}_2\text{N}_4\text{S}, 2\text{HCl}$ . The optical properties are: optic axial plane *b*,  $\gamma$  is 19° 20' from *c* in acute angle; optic axial angle large, undetermined, sign probably negative, birefringence high.

Combining the indications, it is possible to form some idea of the size and shape of the molecule. The molecules must be flat, of dimensions some 8 Å. × 10 Å., suggesting conjugated ring structure; they must be nearly in (20 $\bar{1}$ ) planes and form a double layer parallel to (010). The intensities of (020)*m*, (040)*m*, (060)*st* show that the heavy atoms S, Cl do not both lie at the ends of the molecule. Beyond that it is impossible to go at present, but if alternative chemical formulæ could be prepared, there exists enough X-ray data to discriminate between them.

As mentioned in recent letters to NATURE<sup>2</sup>, there is a close resemblance between the crystals of vitamin B<sub>1</sub> prepared by Peters, and adenine hydrochloride. This has been fully confirmed by our crystallographic investigations. In external form and optical

properties the two crystals are identical. The only difference that could be detected was that the  $B_4$  crystals, of which not more than 0.01 mgm. was available, appeared slightly inhomogeneous, one component possibly differing from the others, and from adenine hydrochloride by at most 0.3 per cent in spacings.

The crystals were monoclinic, tabular on  $c$  and slightly elongated along  $b$ , showing faces (001), (100), (011) and (110). The cell dimensions are  $a = 8.71 \pm 0.015$  A.;  $b = 4.80 \pm 0.005$  A.;  $c = 20.00 \pm 0.05$  A.;  $\beta = 62^\circ 0'$ . There are four molecules of the hydrochloride and two of water per cell. The space group is probably  $C_{2h}^4 - P2/c$ . It may, however, be  $C_8^2 - Pc$ , as some crystals seem hemihedral, though there is no trace of pyroelectricity. In either case the molecules are asymmetric. The optical properties are: optic axial plane  $b$ ,  $\gamma$  is  $8^\circ$  from  $c$  in obtuse angle; optic axial angle medium; sign positive; high birefringence. This is a typical structure for condensed ring molecules arranged in two layers with their principal directions nearly parallel to the  $c$  axis, and their ring planes inclined  $30^\circ$ – $40^\circ$  out of the (100) planes.

This investigation would seem to suggest that the substance showing  $B_4$  activity can only exist as an impurity in the crystals prepared by Peters. There are three possibilities:

- The impurity is in the form of an amorphous material adsorbed on the crystals, or if it is in solid solution it must either:
- be present in extremely minute quantities; or
- itself be a substance closely allied to adenine hydrochloride.

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D. CROWFOOT.

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Cambridge.  
May 24.

<sup>1</sup> A. Windaus, R. Tschesche and H. Ruhkopf, *Nach. Ges. Wiss. Göttingen*, 342; 1932.

<sup>2</sup> R. D. Heard, H. W. Kinnersley, J. R. O'Brien, R. A. Peters and V. Reader, *NATURE*, 131, 617, April 29, 1933. R. Tschesche, *Ber.*, 66, 581; 1933.

### Mitogenetic Radiation of Nerve

IN his paper entitled "The Physical Nature of the Nerve Impulse" published in the Supplement to *NATURE* of April 8, Prof. A. V. Hill has criticised a series of papers on mitogenetic radiation which have appeared from my laboratory. Although my name is not mentioned, I wish to reply as I bear complete responsibility for the whole series.

My first remark refers to Prof. Hill's description of our technique. He confines himself to the method of checking the effect—counting the cells—whereas the investigations described in the papers of Kalendaroff and Braines, quoted by Prof. Hill, had been made solely by the mycetokrit method, the experimental and control yeast suspensions being centrifuged in calibrated tubes (mycetokrites), that is, by a method analogous to the so-called hæmatokrit. The detailed description of this method given by both authors was accompanied by photographs illustrating a successful experiment. The same method had been also partially used by Schamarina. This omission by Prof. Hill is, to my mind, of great importance, because if in the case of counting the cells one might suspect the investigator of being

subjective, not doubting his *bona fides*, then the subjective moment in the results with mycetokrit would mean open-eyed falsification of the experiment. The results described in the papers quoted had actually been based on a large number of experiments (approximately 1,200 by Kalendaroff, 400 by Braines, 100 by Schamarina).

My second correction would be the following. Only two papers out of four were mentioned by Prof. Hill, whereas two others have been passed over in silence. How is this silence to be understood? If Prof. Hill did not object to them, then at least one of the papers criticised—that of Kalendaroff—was rehabilitated, because both those unmentioned contain nerve radiation spectra nearly identical to those described by Kalendaroff. If, on the contrary, Prof. Hill did not consider them trustworthy, then he certainly should not have missed the opportunity of utilising them to convince the reader that our work was fantastic.

Let us pass now to Prof. Hill's remark about Schamarina's paper. The argument: "When two impulses start at opposite ends of the nerve they meet in the middle and stop, but again the whole of the nerve has gone through the active phase. If radiation is given out as the result of nerve activity, its emission should occur equally in the two cases" seemed to Prof. Hill quite indisputable, whereas neither Schamarina nor any other author ever stated that there existed or had been proved a simple constant relation between the nerve disturbance and radiation; that is, that the excitation and the chemical processes in the nerves should always be followed by radiation which could be detected by our means. On the contrary, in different passages of Kalendaroff's paper, as well as in my introduction, there was pointed out the unexplained fact that different spectra which had to be considered as elementary (such as glycolysis, action of phosphatase, etc.) only appeared partly in the nerve radiation. A most striking example of this kind was the indication made by Kalendaroff of the absence of the glycolytic spectrum between the electrodes, where the disintegration of sugar no doubt occurred, perhaps even in a higher degree. From the above it follows only that our data and in particular those given by Schamarina contain some facts not yet explained. It may be considered as a commonplace, that with each discovery bringing explanations of the hitherto unexplained, new problems, sometimes more complicated ones, arise. Even the alternative: "If the results are true, we need a new picture of the propagated disturbance in the nerve" put forward by Prof. Hill, is not to be feared. There is no reason why this picture should remain unaltered or its substitution by a new one bring disaster on science.

My last remark concerns Braines's paper on the disappearance of blood radiation after fatigue. It is not quite clear whether Prof. Hill doubts the existence of blood radiation itself. Blood radiation as a constant phenomenon has been proved by a number of German and Italian workers. What seemed most strange to Prof. Hill was the fact that "After seven hours' work the girls were completely exhausted", but this conclusion has been created by the author himself. Braines said nothing of "the girls being completely exhausted"; indeed, in his abstract he pointed out that his method for testing fatigue was available for work of moderate difficulty, by which he emphasised that such was his estimation of his chief results (109 experiments).

The case of sixteen hours' work had been treated separately and gave different results.

Prof. Hill's final remark, about radiation from the eyes, might remain undiscussed, but for a possible misunderstanding which might arise from his statement that "The girls apparently had only to look at the yeast cells to set them dividing". Actually, a duration of two minutes with intermittent excitation had been necessary, which means a radiation dose presenting a considerable value on the mitogenetic scale (see my monograph). Radiation emitted by the cornea had been proved heretofore by different investigators of my laboratory in many hundreds of experiments.

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### Pelvic Filaments of *Lepidosiren*

IN Mr. G. E. H. Foxon's opinion<sup>1</sup> the experiments which we made in Marajó are insufficient to prove that the function of the pelvic filaments of *Lepidosiren* is to emit oxygen, although he fully admits that our evidence proves that oxygen was given out by the filaments when the fish bearing them was placed in deoxygenated water. He considers that it is more probable that under natural conditions the filaments are concerned with the respiration of the parent.

Mr. Foxon's first argument is that the eggs are scattered at random in a single layer over the floor of the breeding burrow and that the smooth surface of the egg-shells makes it physically impossible for them to be piled up in a heap round which the parent could be coiled up. Dr. Carter, who saw the nests himself in Paraguay, states that they are made of dead leaves and grass, collected by the parent and taken into the burrow, and that among these plant materials the eggs are laid. He also states that the male which guards the nest is found coiled round the mass of leaves and eggs in an expansion at the end of the burrow. In Marajó, nests were brought to us each consisting of a mass of weed and plant debris within which the eggs were contained. The fishermen who brought our specimens informed us that the nests were taken from the end of the burrow, and we found that the eggs in them were alive and developing. Our evidence from the Amazonian region is thus in agreement with that of Dr. Carter from Paraguay.

Mr. Foxon's second argument is that repeated visits to the surface, which would have to be made if the male were in any way a means of supplying oxygen to the young, would be seriously detrimental to the welfare both of the male and of the offspring; to the former because the filaments might be bitten off by an enemy, to the latter because, in the absence of the male, enemies might enter the nest and devour eggs and young. He concludes therefore that the male remains in the nest and respire by means of the filaments. He regards the filaments as a means of diminishing the need of frequent absences of the male from the nest.

Mr. Foxon omits to discuss or even to mention the question whether there is enough oxygen in the water in the burrow to provide for the respiration of the male through the filaments, or even any oxygen at all, and the other essential question, that of the respiration of the larvæ. Carter and Beadle found

from their experimental researches in Paraguay that there was scarcely ever a measurable amount of oxygen in the water at the bottom of the swamp at the season and in the region in which the nests of *Lepidosiren* were made, that the water in the nest-burrows would therefore contain scarcely any oxygen or none at all, unless a supply was obtained from the parent fish. In Marajó we made no special investigation of the oxygen content of the water at the bottom of the swamp where *Lepidosiren* nests were found. The few tests we made of water from the bottom of shallow swamp-pools gave from 0.39 to 0.95 c.c. oxygen per litre. On the other hand, we often used water which had been deoxygenated by enclosing a small fish in it to the exclusion of air, and the average amount of oxygen left at the death of the fish was 1.5 c.c. per litre. It is certain from all the evidence we have, that the water in the nest-burrow of *Lepidosiren* is much below this, if not actually zero.

Carter found that the larvæ kept their external gills for 45 days after hatching and therefore probably remained in the nest for that period. Additional oxygen could not be obtained from the water outside the burrow, and the only possible conclusion is that if the male did not visit the surface at frequent intervals to fill its lungs with air, both it and the larvæ would die of asphyxia in a much shorter period than 45 days, or even 45 hours.

The conditions in the experiments carried out by us in Marajó were essentially similar to the natural conditions to which the male *Lepidosiren* and the larvæ are subjected in the nest-burrow. The male in the burrow is free to visit the surface at the necessary intervals, while the male in our experiments could inspire at will. The male in our experiments gave off oxygen from its vascular filaments to deoxygenated water in a glass tube, the male in the nest-burrow with air in its lungs must necessarily give off oxygen to the water in the burrow, which contains less oxygen per litre than the water in our tubes.

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D. M. REID.

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June 2.

<sup>1</sup> NATURE, 133, 732, May 20, 1933.

IN the last paragraph of their letter, Messrs. Cunningham and Reid state, "The male in the burrow is free to visit the surface at the necessary intervals . . ." This is what I deny. The male is not free to visit the surface but must remain on guard over the young. All who have collected *Lepidosiren* material agree that the male *guards* the offspring. Prof. Agar<sup>1</sup> has written: "The eggs are placed at the end of the burrow, and the male lies in the passage leading to it, ready to defend his home with his powerful teeth—as I proved unintentionally on my own person, by putting my hand into a burrow from which I thought that the male had been driven out. I quickly drew it out again with my little finger cut open." In the next sentence, Prof. Agar continues: "The devotion of the male lungfish is truly admirable, for he stays in the nest the whole time, from the moment the eggs are laid till the young are ready to leave the nest, a period of about seven weeks."

With regard to the amount of oxygen in the swamp water, it was found both by Prof. Graham Kerr and by Dr. Carter<sup>2</sup> that eggs and larvæ lived satisfactorily and continued their development when kept in pots and in holes in the ground, both of which were filled with swamp water; no means of supplying oxygen to this water was found necessary, so it must be that the amount of oxygen in the swamp water is enough to supply the needs of the young Lepidosirens. In this connexion I am not disposed to regard as final the estimations of the oxygen present in the swamp waters of the Chaco as determined by Dr. Carter and Mr. Beadle, for Mr. Beadle<sup>3</sup> has since shown that these figures are subject to a correction which may be so great as 1 c.c. of oxygen per litre.

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June 10.

<sup>1</sup> *Proc. Roy. Phil. Soc. Glasgow*, 1909.

<sup>2</sup> *Proc. Roy. Phil. Soc. Glasgow*, 1928.

<sup>3</sup> *J. Linn. Soc. Zool.*, 38, 258; 1932.

### Magnetic Quenching of Tellurium Fluorescence

THEORETICAL considerations on magnetic quenching of iodine fluorescence have been given by Van Vleck<sup>1</sup>. His theory explains the effect as the breaking down of a selection rule (which forbids the radiationless dissociation), in the vicinity of the state represented on the Franck-Condon diagram as the crossing of a stable and an unstable curve.

A similar effect was investigated in this work for visible resonance series of tellurium ( $\text{Te}_2$ ). The

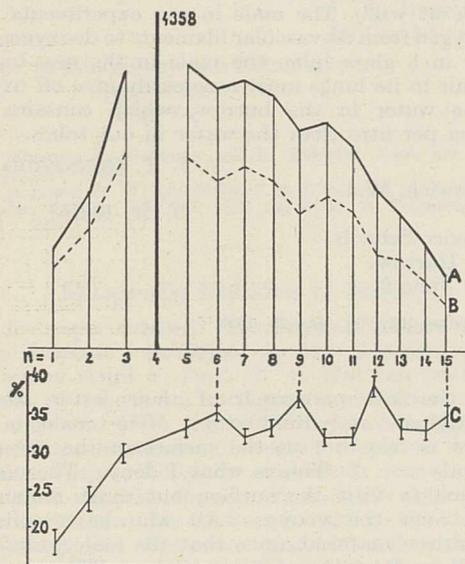


FIG. 1. Curves B and A represent the distribution of intensity in the series of  $\lambda 4358$  in a field of 26,000 gauss and in its absence respectively. Curve C indicates the percentage of quenching and the short vertical lines the probable error of its determination. For  $n$  see formula (1).

potential curves of  $\text{Te}_2$  are not known very exactly but the works of Heil<sup>2</sup> and Hirschlaff<sup>3</sup> permitted the inference that there exist possibly conditions necessary for magnetic quenching. Moreover, the comparatively large atomic weight suggested that the spin-orbit interaction might appear sufficiently strongly to be the deciding factor between stable and unstable states. The resemblance of tellurium to other

elements of the sixth column of the periodic classification suggested the possibility of ascribing the visible resonance series to  $^3\Sigma - ^3\Sigma$  transitions.

The electromagnet used in that work gave, in the volume occupied by the tube, a field up to 28,000 gauss. Special arrangements—a detailed description will appear later—made it possible to obtain various pressures and temperatures, the vapour being mostly superheated. The fluorescence was excited with the mercury lines  $\lambda\lambda 4358$  and 4046, and its intensity found with a Moll microphotometer.

The clearest results were obtained with vapour at saturation pressure for a temperature of  $480^\circ - 520^\circ \text{C}$ ., and superheated to  $620^\circ \text{C}$ . The times of exposure were not longer than two hours, which assured a good stability of temperature. The differences of intensity for two exposures in identical conditions were found experimentally to be smaller than 1-2 per cent. The resonance series<sup>4</sup> of  $\lambda 4358$ :

$$\nu = 23,930 - 250.4n + 0.53n^2 \dots (1)$$

was measured for 11 Stokes and 3 anti-Stokes lines. The quenching in a field of 26,000 gauss amounted to about 35 per cent, and as is seen from Fig. 1, was smaller for anti-Stokes lines than for Stokes lines. The second, fifth, eighth and eleventh Stokes lines ( $n = 6, 9, 12, 15$ ) which in an unperturbed series have weaker intensity than the mean intensity of their neighbouring lines, were more quenched (35-39 per cent) than the others (32-33 per cent). Neither result is in accord with the supposition that only the excited state is influenced by the field. The quenching of the resonance series of  $\lambda 4046$  was measured only for the second and fourth lines and amounted to 15 per cent. Other lines were too weak to be investigated or were reabsorbed.

The magnetic quenching of fluorescence, hitherto known for iodine alone and now established for tellurium, indicates the existence of a more complicated mechanism of the effect than had been supposed.

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University, Warsaw.  
May 12.

<sup>1</sup> J. H. Van Vleck, *Phys. Rev.*, 40, 544; 1932.

<sup>2</sup> O. Heil, *Z. Phys.*, 74, 18; 1932.

<sup>3</sup> E. Hirschlaff, *Z. Phys.*, 75, 315; 1932.

<sup>4</sup> B. Rosen, *Z. Phys.*, 43, 69; 1927.

### Number 60 in Time Measurements

WITH reference to the note in NATURE of March 4, p. 299, may I point out that the cycle of 60 years does not appear to date back before the Han dynasty (say 200 B.C.), and that the cycle of 60 before that date only occurs in the actual records as applied to days, probably back to about 2000 B.C. There are traces of a 10-day period in the ritual records and this may predate the 60-day period. T. Fergusson considered the 60-years period to have been borrowed from India and to be the cycle of conjunctions of Jupiter and Saturn in the same geocentric longitude, but beyond the fact that Szuma ch'ien used some queer foreign names for the years of the 60 cycle, there is no real evidence.

HERBERT CHATLEY.

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April 25.

## Research Items

**Vai Script.** The results of an investigation of the origin of the script of the Vai people of West Africa is recorded by A. Klingenheim in *Africa*, vol. 6, pt. 2. The existence of the Vai script was first reported by F. E. Forbes, a naval officer, in the middle of the nineteenth century. S. W. Koelle, a German missionary, who published an account of the Vai language in 1854, met a native, Momoru Doalu Bukere, who claimed to have invented the script as the result of a dream. European scholars have attributed Vai signs to an origin in European letters, arbitrarily selected to represent syllabic values. Sir Harry Johnston detected Arab influence. Others follow Koelle in recognising the pictorial character of certain signs. Dr. Momolu Massaquoi, a member of the Vai people, is of the opinion that they used a few rude signs expressing concepts before a syllabary was introduced. Other scripts of such a type are found in West Africa. No documents of this character now exist among the Vai, as they were probably written on perishable material. Bukere's invention would appear to have been the substitution of the phonetic syllabary for the older pictorial system then probably in a state of transition. The syllabary possesses two classes of signs: (1) original signs, which go back to a particular picture; (2) derived signs, that is, derived from the original signs by the use of diacritical marks. Among the original signs are representations of particular people, people performing certain actions, spirits, parts of the body, animals and plants, objects of material culture, and symbols for abstract concepts. A special interest of the script lies in the fact that it expresses nuances of pronunciation, and refinements which the study of African linguistics has shown to be essential, while giving an African people's own view of their phonetics.

**Yuman Ethnology.** The University of California for some years past has had in progress a programme of research on the Yuman family, a distinctive block of tribes of some importance living around the head of the Gulf of California, which previously had been neglected in anthropology. Mr. E. W. Gifford, in contributing a unit element on the Cocopa, a tribe who lived on the Lower Colorado (*Univ. Calif. Pub. Amer. Arch. and Ethnol.*, 31, No. 5) to these studies, outlines the principal results which have been obtained by the work of the last ten years. The total Yuman territory falls into four natural tracts, each forming a region of distinctive geographical features, each inhabited by a group of tribes whose culture was roughly uniform. So far as known at present the languages fall into groups, corresponding fairly closely to the cultural and geographical divisions. The first group, called by the Spaniards Cochina, held the desert central part and a considerable part of the southern portion of the Californian peninsula. So far as known, they are extinct and merged in the Mexican population. Knowledge of them depends upon documentary evidence. The second area is mountainous and desert, comprising the northern end of the peninsula and a strip of the southern edge of the American State of California. This is the area of the Digueño. The third region is the flood-plain valley of the Colorado from about Needles to the mouth of the river, in which was a string of specialised tribes dependent mainly on agriculture—Mohave, Halchidhoma, Yuman proper, Kohuana, Halyik-

wamai and Cocopa with the Maricopa. East of the Colorado the fourth group of the Yuma held most of north-west Arizona. These were the Yavapai, Walapai and Havasupai. The culture of the Cocopa, the subject of Mr. Gifford's study, is on the same basic pattern as in the other great Colorado river tribes, Mohave and Yuma, although enmity between them was chronic.

**Antimony Poisoning from Enamelled Vessels.** The Ministry of Health has issued a leaflet (Mem. 171/Med.) on the occurrence of three extensive outbreaks of antimony poisoning due to the use of enamelled vessels, fortunately without fatal results. Acid drinks were prepared in the vessels, in one case from 'lemonade crystals' which contained tartaric acid, in the two other instances from fresh lemons. Antimony oxide is widely used, in the place of tin oxide, as an opacifying agent in the enamelling of hardware of inferior quality on account of its comparative cheapness. The vessels in which the lemonade had been prepared in these outbreaks were examined and it was found that the enamel coating had been attacked and disintegrated by the acid, and the lemonade contained a quantity of antimony in solution.

**Crystalline Style in Gastropods.** In a paper (Reports, Great Barrier Reef Exped., vol. 1, No. 10, 1932) in which C. M. Yonge describes the feeding and digestion in the gastropod molluscs *Pterocera* and *Vermetus*, a list is given of the genera of gastropods in which crystalline styles are known to occur. In this list are stated the habitat, the feeding mechanisms, the nature of the food and the character of the style sac—whether it is in free or in restricted communication with the intestine or is separate from the latter. Of the forty-one genera in the list, seventeen are marine, four are found in brackish water, seventeen in fresh water, two are amphibious and one (*Pomatias*) is terrestrial, largely subterranean. The general conclusion is reached that in the Gastropoda the style is restricted to herbivorous feeders but is not present in all of these. It is confined to those which feed by ciliary mechanisms or by the slow but almost continuous action of a radula. The style assists in the passage of a continuous stream of finely divided food through the gut, and in the effective mixing of food and enzymes in the stomach; by its slow dissolution in the stomach it is admirably fitted for the liberation continuously of very small quantities of enzyme. The different relations between the style sac and the intestine are regarded as correlated with the habits of the respective animals and not as having a taxonomic significance.

**Plant Virus Research.** An up-to-date account by Dr. Kenneth N. Smith of the present status of plant virus research, together with an extensive bibliography, is given in *Biological Reviews* (vol. 8, p. 136). A perusal of the review gives the general reader an insight into the difficulties which confront the workers in this field. In the first place, the physical properties of the different viruses are by no means uniform. The thermal death points vary from 80° to 90° C. for tobacco mosaic to 42° C. for spotted wilt of tomato, and whereas the former can withstand diluting to 1 in 10<sup>4</sup>, the potato mosaic group

are inactivated by quite a small dilution. Further, some viruses retain their infective power *in vitro* for a year or more, while others become innocuous after a storage period of hours only. Of special interest is the section dealing with recovery, carrying power, resistance and immunity. Some authentic cases of recovery are recorded, but the plants were susceptible to reinfection with the same virus. Resistance to a specific virus has been found among individuals of a species or among certain varieties of a plant normally susceptible to that virus, but no development of immunity has been demonstrated. As regards immunological reactions of tobacco mosaic virus, separate antisera are produced in rabbits to normal sap from healthy tobacco plants and to virus sap from mosaic plants. Appropriate quantities of the antiserum to the virus sap completely inactivate the virus sap in this case. Emphasis is laid on the importance of classifying the virus rather than the disease it causes, as hitherto too much stress has been laid on symptomatology alone.

**Geology of Rangoon.** In his report on "The Geology and Underground Water of Rangoon" (Government Printing Office, Rangoon, 1932, pp. 78, with geological and other maps and sections), Mr. P. Leicester presents the results of a detailed geological investigation of the origin, distribution and behaviour of the underground water which supplies the needs of Rangoon; and makes a series of recommendations for its conservation and future exploitation. Special attention is directed towards the prevention of influx of saline water from the river and the associated deltaic deposits. The work involved the making of a geological map of the area, and this in turn has yielded evidence of oscillations in the levels of land and sea during the Quaternary, comparable with those experienced in Europe during the glacial periods. The rising of the geo-anticline of the ridge that terminates at the Shwe Dagon Pagoda was followed by a fall in sea-level of 250-300 ft., corresponding to the lowering of sea-level of 40 fathoms over the Sunda Shelf described by Molengraaff. Fluctuating recoveries are noted, due perhaps to alternating retreat and advance of the ice-caps. More recently there have been uplifts of the land, witnessed by the formation of denudation terraces, while the latest changes of all are referred to a slight rise in sea-level followed by slight uplifts related to the still growing geo-anticline. These recent movements, marked by earthquakes, appear to take place along fault planes on the western limb of the anticline of the Dagon ridge.

**Ice in the Weddell Sea.** Tabular icebergs of twenty miles or more in length have been noted from time to time by various antarctic expeditions, but in recent years their number seems to have increased in the Weddell Sea and the South Atlantic, especially the Scotia Sea. In an article in the *Geographical Journal* for May, Mr. J. M. Wordie and Dr. Stanley Kemp discuss recent records of these bergs and their significance. Treating reports by trading vessels of large bergs with commendable caution and confining their arguments chiefly to reports from whalers and expedition ships, the authors conclude that the unusual number of these bergs indicates some exceptional occurrence in the Weddell Sea. On the eastern side, Coats Land, excepting the Stancomb Wills promontory, would not be likely to yield many huge bergs since it seems to rise into high land not far

from the sea. The Stancomb Wills promontory could not account for all these bergs even if it had completely broken up, as is possible. The Filchner or Weddell barrier at the south of the sea is certainly in an unstable state but is relatively low and these huge bergs are very lofty. There remains only the unknown south-western side of the Weddell Sea, which on account of heavy pack-ice has never been approached. Messrs. Wordie and Kemp suggest that these bergs come from that coast and indicate extensive changes in that region and the loss of thousands of square miles of barrier ice. These changes may have considerably improved the chances of penetrating that unknown quarter.

**Eddy Diffusion.** The mathematical treatment of eddy diffusion in the atmosphere demands a knowledge of analytical methods not possessed by the majority of meteorologists, including professional meteorologists. This is unfortunate in view of the great importance of eddy diffusion in many meteorological problems, for example, those involving the transference of heat, moisture, and dust particles, to mention a few. A number of papers dealing with these problems have been written by Taylor, Chapman, and others in Great Britain. The latest work on the subject, by O. F. T. Roberts, of the University of Aberdeen (*Mem. Roy. Met. Soc.*, 4, No. 37), deserves the attention of those interested in the subject. In it the author starts with the hypothesis that the density distribution due to scattering satisfies a functional equation expressing uniformity of scattering power, and shows that from this it can be deduced that the square of the standard deviation of matter scattered from a plane source varies as the time. The method followed in reaching this conclusion is extended so as to show the manner in which this density distribution may differ from that due to the assumption of an eddy scatter analogous to that which arises from thermal diffusion in a solid body. A similar result for homogeneous scattering in three dimensions is derived by further analysis, and finally the scatter from a fixed point or line into a medium with uniform mean flow.

**Penetrating Rays from Thunderclouds.** Schonland and Viljoen (*Proc. Roy. Soc.*, May) have looked for a connexion between South African thunderstorms and the discharges of a Geiger-Müller counter shielded with iron. The counter discharges and the abrupt electric field changes due to lightning discharges were recorded side by side on a chronograph tape, and special care was taken to ensure that no spurious coincidences were produced by the mutual influence of the recording amplifiers. A statistical analysis of the records showed that for some storms there was a pronounced probability of a counter impulse coinciding with a lightning discharge. A further examination reveals that the probability of counter impulses is slightly increased in the few seconds which precede a flash. None of these effects was observed with storms distant less than 30 km. from the station—with nearer storms there was apparently a reduced probability of counts during the time when the strongly charged cloud was overhead, in agreement with earlier work of Schonland. The upward projection of 'runaway electrons' in the intense electric fields of thunderclouds has been suggested by Wilson. These electrons may be deflected in the earth's magnetic field and produce the results now discovered.

**Fluorescence of Zinc Oxide.** An investigation by Beutel and Kutzelnigg (*Sitzungsber. Wien. Akad. Wiss.*, 141, 437; 1932) shows that the fluorescence of zinc oxide preparations is a specific property and is not due to traces of foreign metals as impurities. The effect is diminished by powdering the preparation, and the colour of the light is affected by the temperature to which the oxide has been heated. An intensive green fluorescence is obtained with preparations ignited in a reducing atmosphere, whilst the oxide obtained by decomposing the carbonate at 300° shows a dark brown fluorescence. A minimum of fluorescence strength was found with preparations heated at 600°, and the effect disappears when oxide obtained by heating the nitrate is strongly ignited. No definite relation between physical properties and fluorescence could be established.

**Copper Age in Ancient China.** Further analysis (cf. *NATURE*, 131, 243; 1933) of three ancient halberds similar to those found on the Yin site at Honan, made by Tsurumatsu Dono (*Bull. Chem. Soc. Japan*, April), showed that one was almost spectroscopically free from tin, another contained only 0.60 per cent of tin, whilst the third contained 2.19 per cent. In the first, 15 per cent of lead was present, in the second 0.58 per cent and in the third 5.85 per cent. Arsenic was either absent or present only as a trace. Since the three objects were almost identical in appearance, it is concluded that the introduction of bronze poor in tin occurred in a transitional period which came between the copper and bronze ages and that this period was very short. The paper contains complete chemical analyses and microphotographs of structure. The close similarity in composition between ancient Chinese and Sumerian bronzes is noteworthy.

### Astronomical Topics

**Radial Velocities of Variable Stars.** Dr. P. W. Merrill contributes an article on this subject to *Popular Astronomy* for April. He refers to the former idea that these were dwarf stars approaching extinction; a study of their proper motions showed that the variables are in most cases remote, so that they are now reckoned as giants, not as dwarfs. The radial velocities are important for giving an estimate of their true speeds, since the thwart velocities are generally too small to determine accurately. It has been observed in many cases that the bright lines visible at maximum show a velocity of approach of about 15 km./sec. relatively to the dark lines. It is concluded in the article that the latter give the true speed of the star, and that the difference arises from an outward motion of heated gases. A strong argument for this is afforded by the close double star X Ophiuchi; one component is variable, the other of constant light; at maximum the spectrum of the former is observable, at minimum that of the latter; the dark lines in both stars give the same radial velocity,  $-70\frac{1}{2}$  km./sec., while the bright lines in the variable give  $-83\frac{1}{2}$ . A similar argument is drawn from R Aquarii and its companion nebula. In some faint variables the bright lines only are measurable. A correction is applied to these to deduce the true velocity of the star. A statistical study then shows that the variables, as a whole, have a mean speed of 37 km./sec. relatively to the other stars, this speed being towards a point in the southern hemisphere nearly opposite the solar apex.

**Microphotometry of the Solar Spectrum from 4040 to 4390 Å.** In the first part of a recent paper (*Annals Solar Physics Observ., Camb.*, 3, Part 2), Dr. R. v. d. R. Woolley develops the mathematical theory, following Eddington's earlier investigations, of the occurrence and the relative intensities of the dark lines in the solar spectrum, on the hypothesis of selective scattering in the sun's atmosphere. The modification of the scattering coefficient due to the Doppler effect is also considered. The observations described in the second part are based on plates recently taken by Evershed at Ewhurst. A plate was cut in two; one half was exposed by Evershed, the other half was standardised photometrically at Cambridge, the two

halves being afterwards developed together. The spectrograms were then examined with the Cambridge microphotometer. The tables give the multiplet identification, the central intensity and equivalent breadth of the lines in the part of the spectrum examined. In the third part, Dr. Woolley gives a full discussion of multiplet intensities, the calibration of Rowland's scale of intensities and the classification of solar lines according to contour.

Publications of the U.S. Naval Observatory (Washington). Vol. 13, of 365 pages, of these Publications, contains the observed positions of sun, moon, planets and stars, obtained from observations with the 9-in. transit-circle. The observations of the sun extend from 1918 until 1925, those of the moon from 1913 until 1925. The results are compared with the predictions of the American Ephemeris; in the case of the moon there is a further comparison with an improved ephemeris, in which some corrections to Brown's tables have been applied. In the case of Mars, Ross's corrections to Newcomb were introduced into the ephemeris in 1922, but their effects have been carried back to 1913.

The next item in the volume is a catalogue of 9,989 standard and intermediary stars, between the north pole and declination  $-36^\circ$ ; they were observed in the years 1913-1926; the positions are reduced without proper motion to 1920. Proper motions have been determined for all the stars. They are given to three or four decimals of a second of time, and to two or three of a second of arc. There follows a catalogue of 2,438 standard stars, and a comparison of the observed positions with those of Greenwich, Boss and Eichelberger.

Full details are given of the methods of observation. The transits were recorded by hand-tapping; the passage over fixed wires. Meridian marks were used as a check of the azimuth of the instrument. A diagram shows an interesting correlation between the changes of azimuth of the marks and the motion of the pole determined from the observations for latitude variation. A printing chronograph was used for recording the transits, the times for each wire being read to 0.02 sec.

### Nature of Dental Caries

IN a recent paper on the cause and nature of dental caries, J. J. Enright, H. E. Friesell and M. O. Trescher describe experiments designed to elucidate the part played by local factors in the etiology of this disease (*J. Dental Res.*, 12, 759; 1932). The authors first discuss the two chief theories of causation and point out that Miller's bacterio-chemical theory does not explain all the facts. For example, carious areas produced artificially by acid have not simulated natural caries in certain particulars; the carious process may halt for indefinite periods and, finally, dirty mouths are frequently free from caries. After a review of the relation of diet to dental caries, the authors conclude that improper diet is at least an important predisposing factor in the causation of tooth decay, since diets rich in vitamins A, C and D and yielding an alkaline ash, when utilised systematically during the period of development, produce teeth less liable to decay. After eruption, the structure of the enamel cannot be changed by factors acting from the pulp, because there is no circulation in this structure. Moreover, the ameloblasts, the enamel-forming cells, are lost at the time of eruption.

Clinical observation shows that caries begins at the surface of the tooth and only at certain parts of the surface, namely, in pits and fissures, and on the buccal, labial and proximal surfaces near the gum. It does not commence in areas which are scoured by the food during mastication.

In their first experiments, the authors investigated the action of lactic and citric acids at different pH values upon the enamel of isolated teeth *in vitro*. They found that artificial caries might simulate natural caries exactly, that all solutions between pH 4 and 8 etched enamel and that different enamels varied in their susceptibility to the action of the acids. Further experiments were carried out with the same solutions to which tricalcium phosphate had been added to saturation, since saliva is supersaturated with regard to this salt. It was then found that etching of enamel only occurred in solutions more acid than pH 5. It was also noticed that incipient

carious areas were insoluble in acid, apparently because they contained an increased amount of organic material: it is suggested that this explains why the natural process often comes to a stop, even when acid-producing bacteria are contiguous to the lesion.

In the authors' second series of experiments, cultures were taken from carious areas and from similar regions in the mouths of persons immune to caries and grown on blood agar and acid galactose-whey broth. Another examination of the same mouths was made 3-9 months after the first: a close correlation was found between the presence of lactobacilli on the first occasion and the advance or development of caries in the interval. The strains of lactobacilli obtained could be divided into two chief groups: Group 1 usually produces a smooth colony and acid without gas in glucose, galactose, levulose, maltose, lactose, sucrose, mannitol, sorbitol, dextrin and salicin, but no acid or gas in raffinose, arabinose, xylose or inulin. Organisms of this group grow at 15° C. and are agglutinated by a Group 1 rabbit antiserum. Group 2 usually produces a rough, fuzzy type of colony, and acid in glucose, galactose, levulose, maltose, lactose, sucrose and raffinose. This type may or may not produce acid in dextrin; it usually does not produce acid or gas in arabinose, xylose, mannitol, sorbitol, salicin or inulin. Strains of this type do not grow at 15° C. and are not agglutinated by Group 1 antiserum. Lactobacilli of intestinal origin can also be divided into two similar groups. The strains of Group 1 were the most commonly found in the mouth.

The evidence adduced in this paper confirms the view that caries is directly due to the growth of lactobacilli in the mouth, the acid produced decalcifying the enamel. Growth of the organisms and close contact of the acid with the teeth are favoured by the presence of food debris in their pits and fissures and between them. The authors state that tests on the results of reducing the number of organisms in the mouth are now in progress and will be reported later.

### Fishery Research in Newfoundland

FOLLOWING upon a preliminary survey of the Newfoundland fishing situation and a report on it to the Empire Marketing Board and to the Newfoundland Government, a scheme providing for a five-year period of fishery research in Newfoundland was drawn up. Half the cost of installation and subsequent maintenance of the Laboratory is, by agreement, borne by each of these two bodies. The objects of the scheme are the investigation of the life-histories of the principal commercial fishes with the view of gaining a clearer understanding of their movements and natural fluctuations, and the improvement of some or all of the existing methods of processing and marketing of the fish and fish products. By-products and their possible utilisation also come within the scope of the investigations.

The Laboratory is situated in the outport of Bay Bulls, some 18 miles south of St. John's. It is housed in part of certain spacious fishery premises which, fortunately, were available for this purpose. The buildings are fronted by wharves standing in

water up to 20 ft. deep, so that steam trawlers can berth hard by the laboratory premises. Thus situated, right by the water's edge in an active fishing centre, and in the closest juxtaposition with a commercial concern, the Bay Bulls Laboratory appears to enjoy unique facilities for prosecuting fishery research—opportunities which it shows every indication of utilising to the full.

The scheme came into operation on April 1, 1931, and a report\* upon the Laboratory's first full year's work has now been published, the main object of which is to indicate the general trend and progress of the various researches already under way.

In accordance with the scheme, the work of the Laboratory follows two main lines which may for convenience be termed (a) biological and (b) applied.

\* Reports of the Newfoundland Fishery Research Commission. Vol. 1, No. 4: Annual Report for 1931. (St. John's, Newfoundland: Newfoundland Fishery Research Commission, 1932.) 1 dollar.

In the biological investigations the aim has been, during the first year, to make a rapid survey of the marine fauna and its inter-relationships in the waters supporting or directly connected with the fishing activities of Newfoundland. Much work has already been accomplished, and great strides are being made in piecing together the life-histories of the caplin, salmon, Newfoundland herring, haddock, cod, lobster, shrimps and prawns. Particular attention has been given to the short-finned squid (*Illex illecebrosa*), a highly important animal commercially in that it is the staple bait for the fall cod fishery. If it does not arrive in very large numbers, this fishery is a failure and up to one-third of the year's catch is lost. In 1930 and 1931, for example, Newfoundland was bereft of much of its fall fishery owing to shortage of this squid for bait.

In addition to the above, extensive hydrographical observations have also been carried out, the results of which already show that the Newfoundland area is one where contrasting, as well as rapidly changing,

physical conditions of sea-water have a profound influence on the fauna.

On the processing or applied side, investigations are being carried out on the properties of Newfoundland cod liver oil from the point of view of marketing possibilities. The processing of dried codfish, bacterial infection of fish products, and preparation of fish meals, fish glue, and soaps from many sources are also receiving attention.

The report closes with some conclusions and recommendations which might well be adopted by the various firms and departments concerned in the improvement of the Newfoundland fisheries; and in an appendix there is published a very useful "First List of Fishes in the Newfoundland Fishing Area".

Judging from the contents of this report and some technical papers already issued, there can be little doubt that the Director and staff of the Bay Bulls Laboratory are attacking with great vigour and remarkable success the numerous problems with which they are confronted.

### South-Eastern Union of Scientific Societies

THE thirty-eighth annual congress of the South-Eastern Union of Scientific Societies was held at Norwich on June 7-10 under the presidency of Prof. E. J. Salisbury, Quain professor of botany at University College, London. The occasion was the first time that the Union has met for its congress in the extreme north of its area, and the attendance was well up to the average.

Prof. Salisbury's presidential address on "The Influence of Man on Vegetation" showed that there are two sides to man's interference with the native flora, elimination and introduction. The relative biological isolation of the British Isles ceased when human intercourse between Great Britain and the Continent began. The idea is prevalent that the chalk downs of the south-east were grassland from time immemorial, but the grounds for this assumption appear quite inadequate. Chalk hills are not unsuited for tree-growth. Neolithic man cultivated even the crests of the hills, and the chalk may have been the nursery of English agriculture. Stress was laid on man as an unconscious agent in dispersal. The rôle of man in this respect has been neglected. Dispersal by birds seems a legitimate subject for examination, but the seeds of plants carried by man in the mud of his feet and his clothes have not received sufficient attention.

After the depauperisation of the British flora during the Glacial period, neolithic man must have brought seeds of weeds with his flax and corn in the absence of all modern screening methods. Calculations show that of the 288,857 cwt. of clover and grass seed imported in 1912, 2-6 billion weed-seeds from abroad were sown in Great Britain. The unconscious carrying of seeds by man was strikingly illustrated by an experiment on the dust collected in sweeping out the pews of two selected churches. Samples of the dust were sown, each sample being about four ounces in weight. The germinating plants in any one sample varied from one to fourteen, about 90 per cent being grasses. Possibly clothed in skins, neolithic man may have carried seeds for considerable distances, even as now Prof. Salisbury finds that man is carrying about viable seeds in his turned-up trousers after a walk on Chesil Beach or

on a Hertfordshire common. In the latter case, a walk produced 110 grasses and three dicotyledons.

In a paper by Mr. Hugh Ramage on "Applications of the Spectroscope to Biology" some of the results of research by this means were given. Strontium was detected in the genital duct of the edible snail and manganese was a prominent element in its liver. It was found that, on examining 146 specimens, copper and iron were always present. The highest concentration of silver was found in the liver and kidney of *Pinna pectinata*. Silver was present in every liver of crabs and lobsters examined. Cæsium was always found in the liver of the common scallop. Examination of sea-water always revealed 0.004-0.005 per cent of strontium, which appears to place strontium as the ninth element in order of abundance. Copper was found in all human tissues and occurs in greatest concentration in foetal tissues and foetal livers. Rubidium occurs in the heart and striated muscles. Silver appears to be a normal constituent of the thyroid and the tonsil. The edible mushroom yielded copper and silver. Some fungi contain rubidium. The highest percentage of rubidium (dry weight) was found in *Cantharellus cibarius*, namely, 0.21; and of silver, 0.20 in the skin of a specimen of *Psaliota campestris*.

Investigations as regards insect immigration have been carried out since the inauguration of the special committee of the South-Eastern Union in 1932, and there are now thirty light-vessels and light-houses with their observers engaged in the work, with some hundreds of inland observers. Useful records have reached Capt. T. Dannreuther and Dr. C. B. Williams, who are responsible for the collating of such records. The Large White butterfly has been observed by L. G. Sharman, of the East Dudgeon light-vessel, for some years. He has seen a stream of these butterflies every year about the middle of June. In 1931 about thirty an hour were seen passing over the ship from east to west. Near Alston, G. Bolam observed a passing band of Small Garden Whites on June 25, 1932. They were steadily pursuing a northerly course at the rate of about a dozen a minute. These are cited as showing the records that it is hoped observers will send in from all parts of

the country, with the view of the further elucidation of the immigration problem.

Among the more general papers read at the Congress were "Rural Surveys; Change and Decay and Rebirth" by W. P. D. Stebbing; "Pond-Life, with Special Reference to the Rotifera and Polyzoa", by H. E. Hurrell; "Evolutionary Sequence Amongst Desmids", by Prof. F. E. Fritsch; "The Viking Period", by P. D. Kendrick; "The Relationship of Geology to the Scenery of the Weald", by F. H. Edmunds; and "The Pliocene and Pleistocene Deposits of Norfolk", by J. E. Saintry.

A very full programme of excursions to places of scientific interest was carried out during the Congress. It was announced that the Congress for 1934 will be held at Reading, under the presidency of Prof. H. L. Hawkins, professor of geology in the University of Reading.

### University and Educational Intelligence

CAMBRIDGE.—Dr. G. D. H. Bell, of Selwyn College, has been appointed University demonstrator in agricultural biology.

A university demonstratorship in chemistry is vacant. Information concerning it may be obtained from Mr. H. Thirkill, Clare College, to whom applications should be submitted before June 30.

D. Thoday of Trinity College and Dr. F. H. Constable of St. John's College have been approved for the degree of Sc.D.

Dr. K. A. C. Elliott, Beit fellow, has been elected to a fellowship at Selwyn College.

LONDON.—The following degrees have recently been awarded: D.Sc. degree in botany to Mr. C. L. Huskins (King's College) for eight published works on genetics and cyto-genetics; D.Sc. degree in plant physiology to Mr. E. Ashby (Imperial College—Royal College of Science) for nine works, including four papers on "The Interaction of Factors in the Growth of *Lemna*", and two papers on "Studies in the Inheritance of Physiological Characters"; D.Sc. degree in vital statistics to Hilda M. Woods (recognised teacher at the London School of Hygiene and Tropical Medicine) for nine works on medical statistics and epidemiology; D.Sc. degree in zoology to Cherukad Cherian John (Imperial College—Royal College of Science) for a thesis entitled "On the Anatomy, Habits and Development of *Spadella Cephaloptera*" (*Quart. J. Micro. Sci.*, Feb. 1933); D.Sc. degree in chemistry to Mr. A. G. Francis (private study) for four independent publications, entitled (1) "Report on the Investigations carried out by the Experimental Staff of the Departmental Committee on Ethyl Petrol"; (2) "Presence of Barium and Strontium in Natural Brines"; (3) "The Recovery of Radium from Luminous Paint"; (4) "3:4-di-*p*-nitrotetraphenylfuran"; together with four conjoint subsidiary contributions.

To meet the growing demand for biological teaching in schools, a diploma course in biology will shortly be instituted at the University of Leeds, chiefly to meet the needs of teachers qualified in the physical sciences. The course will extend over two years and it is proposed to begin it on October

3. Lectures will be given on one evening a week and Saturday mornings. Further information can be obtained from the Registrar of the University.

ON the recommendation of the Scientific Advisory Committee of the Lady Tata Memorial Fund, the following awards of scholarships, open to graduates of any nationality for research work on diseases of the blood, with special reference to leucæmia, for the academic year 1933-34 have been made: Dr. W. Büngeler, University of Frankfurt-on-Main; Dr. L. Dolschansky, University of Berlin; Dr. M. C. G. Israëls, University of Manchester; Dr. C. Oberling, Faculty of Medicine, Paris.

AT a recent council meeting of the Association of University Teachers the position of the recently displaced teachers in German universities was discussed. The Association recorded its continued adherence to the fundamental principle of freedom of opinion and teaching in academic life and stated that it is ready to co-operate in affording facilities at British universities for such displaced teachers, provided that special funds are made available for the purpose. The Executive Committee of the Association appointed a sub-committee to keep in touch with other groups having similar aims, of which the convener is Prof. R. J. Tabor, Imperial College of Science and Technology, South Kensington, London, S.W.7.

WE have received from Armstrong College, Newcastle-upon-Tyne, the report for 1931-32 of the College Standing Committee for Research. This report demonstrates that the researches aided by the Committee's grants, which amounted during the year to £586, are bearing excellent fruit. In addition to giving a list of a hundred publications, the report particularises some results of special interest. A notable addition to the resources of the Physics Department was made possible by a grant of £842 from the Rockefeller Foundation towards the cost of a reflecting echelon interferometer, the research committee undertaking to find the remainder (£300) of the price. An investigation dealing with the use of high-frequency fields to raise body temperatures gave such promising preliminary results that the Medical Research Council made a grant for its continuance. Incorporated in the report are accounts of the work of the Northern Coke Research Committee and the Electrical Engineering Committee of the College.

"The Broad Highway of Soviet Education", as shown to a party of twenty men and women interested in education, is described in a pamphlet recently published by the Society for Cultural Relations between the Peoples of the British Commonwealth and the U.S.S.R. The tour, which took place more than a year ago, included a series of visits and receptions in Leningrad, Moscow, Kharkov (where part of the visit was filmed) and Kiev. The compulsory seven-years school in two stages, 8-12 years and 12-15 years, is said to be based upon correlation with working life. The schools are commonly attached to factories and, so far as possible, all practical work is productive: one of the schools visited was found to be self-supporting. Continued education is provided in technical and factory-apprentice schools for the stage 15-18 years. Higher education is conducted chiefly in single-faculty institutes intended to turn out technical experts in factories, and other specialists.

Qualification for admission generally includes two years' experience of factory life and two or three years of a workers' preparatory course embracing a wide variety of subjects. The writer of the report, Mr. C. A. Harrison, education officer of Messrs. Cadbury Bros., suggests that educational contacts may serve to bridge the gulfs which separate the Soviet system from the rest of the world. He was impressed while in Russia by the apparent prevalence of what he describes as a "wholesome" dread of embroilment in war coupled with a determination to be prepared.

## Calendar of Nature Topics

### Fourth 'Buchan Cold Spell'.

June 29—July 4. It not infrequently happens that June in England brings an interval of dull weather separating the sunshine of May from the heat of July. In Great Britain at least, the soubriquet of 'flaming June' appears to be a misnomer. On the whole the fluctuations of temperature in June are relatively slight, and the general tendency is for a steady warming up throughout the month without any marked set-backs. At Greenwich the 90-year averages from 1841 to 1930 show that this rise is interrupted by a short period of steady temperatures from June 29 until July 1, but this is too slight to be dignified by the name of a 'cold spell' and there is no reason for supposing that it will be repeated in future years.

### Nile Flood

The River Nile is very low during April, May and the early part of June, reaching its minimum at Khartoum about May 11. In June heavy monsoonal rains begin to fall on the mountains of Abyssinia, and throughout July, August and September, immense quantities of water are discharged into the Blue Nile. The main Nile commences to rise rapidly towards the end of June, reaches its maximum level about September 4, and remains high until some time in October. The water fills the irrigation channels and covers much of the flood plain, on which silt is deposited, forming a soil of great fertility. This annual flood is the most important event of the Egyptian year, and river gauges have been maintained since early times to measure its progress and height. Before the building of the great dams, the crops of Egypt were so dependent on the annual flood that the gauge readings were used as a basis for assessing taxation.

### Migration and Plumage Coloration of Birds

During the summer months there occur on the mud-flats and sandbanks of northern Holland many wading birds belonging to species which normally should have been at their breeding places in the north of Europe or Asia. A first impression would regard them as immature birds, but G. J. van Oordt has shown that many wear adult summer plumage or some modification of it. On June 23 and 27, 1927, he collected seven knots and fifteen turnstones on the island of Vlieland, and since the very last of the migratory individuals pass through in the end of May or in the first days of June, these were real summering birds (*Tijdschr. Ned. Dierkundige Vereen.*, Ser. 3, 1928, p. 25). Examination showed that the testes of most of the individuals collected were

inactive, having formed no spermatocytes, and that although the plumages of such birds varied much, they all possessed in various degrees the feathers of adult summer plumage. Three birds were found to have a relatively large number of spermatocytes and in them the plumage was almost or quite identical with the adult summer phase. From these observations, it would appear that the absence of urge to migrate as well as the failure to replace winter by summer plumage was associated with inactivity of the gonads and that summer plumage in male birds cannot develop until spermatogenesis has started and many spermatocytes have been formed.

### Spat-Fall and Shore Populations

In June and July occurs the spat-fall of many shore molluscs, when rock surfaces, seaweeds, and the sand itself begin to be deluged with a rain of minute individuals on the point of settling down after their free-swimming larval life. They are often very small—the shells of recently settled mussels measure about 0.3 mm.—but the number is very great, and this and their rapid growth make them important elements in the shore population. Indeed they have proved to be a nuisance to many coastal towns, for intake pipes have become blocked by the growth of mussels which have settled in them from the passing current. The late Sir William Herdman reckoned that on the seashore about 120,000 mussels might go to the square yard, and Richard Elmhirst finds a similar number on the piles of Keppel Pier at Millport, upon which about 60,000 individuals of the beautiful plumose anemone (*Metridium senile*) also find foothold. At Millport the numbers of the acorn barnacle (*Balanus balanoides*), a crustacean, are still greater. Elmhirst states that in late April the cyprid larvæ may occur 300 to the litre close inshore when swarming in to settle down (*Glasgow Naturalist*, 1932). These small larvæ may settle 200 to the square inch, or more than a quarter of a million a square yard. A heavy mortality, due largely to the molluscs *Purpura* and *Littorina* ensues, so that by autumn they are reduced to 15,000 a square yard. But even the dead ones have contributed to the circulation of organic matter in the shore area.

### The Ice Bridge: A Correction

The paragraph under this heading in NATURE for April 15, p. 557, requires some modification. The harbours and waterways of the system of American "Great Lakes" are frozen or blocked by ice, and in Lake Superior ice-fields often extend beyond the range of vision from shore, but in most winters much open water remains, especially in the lower part of Lake Michigan. In February 1904 the lakes were almost completely ice-covered, but this is exceptional.

In many parts of the northern hemisphere the winters of the twentieth century have been generally milder than those of the latter half of the nineteenth, and ice conditions may also have become less severe, but precise information is difficult to obtain, as the greater power of steamers and the extended use of ice-breakers would suffice to keep navigation open longer than formerly. The record of 300 ships held up at one time, which is quoted in the "Gulf of St. Lawrence Pilot", was first published in 1888, and therefore must refer to sailing or low-powered craft, but the actual date of the occurrence cannot now be traced. For the reasons stated, such an occurrence is unlikely to recur.

## Societies and Academies

## DUBLIN

Royal Irish Academy, April 24. P. J. NOLAN: The influence of condensation nuclei and dust particles on atmospheric ionisation. Fair conformity with Wright's conclusion that dust particles play an important part in the equilibrium of atmospheric ionisation is obtained from a re-examination of previous work. A theoretical basis for the equilibrium equation  $q = \zeta n \sqrt{Z}$  is proposed. The combination coefficients of small ions with dust particles and with large ions are deduced. R. F. SCHARFF: The past wanderings in Europe of two African animals. The manner in which the hippopotamus and the bivalve mollusc *Corbicula* seem to have entered Europe from the south-east in late Pliocene times is described. They probably travelled along the great Rift Valley from Central Africa to Palestine when the Red Sea was still a river valley. The area of the Ægean Sea, while still unsubmerged, afforded an easy passage between Asia Minor and Greece and thus on to Italy and Malta. Their remains occur everywhere in Italy, France and Belgium, but the hippopotamus never crossed the Rhine. Eventually, in the early Pleistocene, both species passed into England, when it was part of the Continent. Special comment is made on the significance of the British distribution of both animals.

## EDINBURGH

Royal Society, May 15. NORMAN H. W. MACLAREN and THOMAS H. BRYCE: The early stages in the development of *Cavia*. A sequel to an earlier memoir by Maclaren. The study was recently resumed in the light of specimens examined in the living state and for more advanced stages of results obtained after intra-vitam staining with trypan blue. A number of blastocysts at earlier stages than those hitherto known are described; the mode of implantation is re-examined; the fate of the part of the uterus to the anti-mesometrial side of the site of implantation is demonstrated; and the significance of the observation that after a preliminary destructive phase the endometrium lining the decidual cavity comes to be packed with maternal cells containing trypan blue granules is discussed. P. F. KENDALL and H. BRIGGS: The formation of rock joints and the cleat of coal. By means of frequency charts for a number of the chief coalfields of Great Britain and the United States, it was shown that the main cleating and jointing system has a north-westerly direction. In some coalfields, such as Yorkshire or Durham, the north-westerly orientation is remarkably consistent; in others, such as Scotland, it is less definite, though the majority of the values obtained have a north-westerly trend. The authors' records also show that that direction was also maintained over great periods in geological time. The forces responsible for jointing have therefore to be looked for among those incident on the earth's crust down to and including the present time. The Mid and East Lothian coalfields have been specially studied to trace the connexion between cleat and joints and the faults known to exist in that field; and the effect of faulting on jointing was discussed. The joints and cleat were induced by rapidly alternating torsional stress applied to the earth's crust in a direction approximately parallel with the equator. It is concluded that the alternating torsional stress is due to tidal action, and that the

long-continued alternation of stress so applied eventually caused failure of a bed through fatigue. MARY G. CALDER: Notes on the Kidston collection of fossil plant slides. (2) The anatomy of the axis of *Bothrodendron mundum* Williamson sp. Certain previously undescribed anatomical features of the aerial stem of *Bothrodendron mundum* are discussed and illustrated. The more important of these are variation in the pith cells, occasional occurrence of marked xylem perforations in the stele, hyphal structure in the middle cortex in certain specimens, and the occurrence in some stems of a ring of cortical tracheidal strands, having no apparent connexion with the outer surface of the stem or with the leaf traces. H. W. TURNBULL: Matrices and continued fractions. By the method of matrices it is possible to form the reciprocal of a certain continuant determinant which was first studied by Sylvester. This leads to new expressions for the derivative of a function  $f(x)$  as a continued fraction. A series, the  $n$ th term of which involves the square of the difference between  $f(x)$  and its  $n$ th convergent, is discussed. J. L. GRAY and PEARL MOSHINSKY: Studies in genetic psychology (1). Correlation between collateral relatives with respect to intelligence. The correlation with respect to intelligence as measured by the Otis group advanced test for pairs of sibs between the ages of nine and twelve and a half is  $0.35 \pm 0.05$ . For pairs of first cousins the coefficient is  $0.16 \pm 0.06$ . This investigation, carried out with the same test on children selected in the same way as in Herrman and Hogben's study of twins, establishes the existence of a significant difference between the correlation of fraternal twins and ordinary sibs. The possible existence of sex-linked gene differences with respect to intelligence and the effect of order of birth in the family are also discussed.

## PARIS

Academy of Sciences, May 8 (*C.R.*, 196, 1345-1444). A. DE LA BAUME PLUVINEL and D. BARBIER: The observation of the total eclipse of the sun on August 31, 1932. Observations made at Louiseville, in Canada. Photographic, photometric and spectrographic observations of the corona were made, the results of which are detailed. RENÉ MAIRE, ETIENNE FOËX and GEORGES MALENÇON: The etiology of 'bayoud', a disease of the date palm. A fungus, named *Cylindrophora albedinis*, was isolated from the diseased tissues in 1930 by Maire and Kilian, but no fructification. The mycelium had been met with in the natural state, and attempts at infection were always negative. The formation of intravascular conidia has now been observed and it appears clear that this fungus can be regarded as the agent of 'bayoud'. Some varieties of date palm appear to be resistant to the disease. FRANK SCHLESINGER was elected *Correspondant* for the Section of Astronomy in succession to the late Prof. H. H. Turner. LUCIEN CHAMARD: The paratangent of an ensemble equidistant from a point ensemble. G. EHRESMANN: A theorem relating to locally projective spaces and its generalisation. PAUL DELENS: Certain problems relating to Finsler spaces. ARNAUD DENJOY: Rectifiable curves. ANDRÉ FOULLADE: The iteration of certain linear functional substitutions. CAIUS JACOB: Some mixed problems in a circular ring. F. CHARRON: An accelerometer with a rolling contact. EDOUARD CALLANDEAU: The elastic state of a welded assemblage. ANTOINE MAGNAN and CLAUDE MAGNAN:

A hot wire apparatus for the study of the air movements produced by the flapping wing of a bird or insect. The number of beats per second varied from 17 for the Japanese nightingale to 128 for the humblebee. The records appear to prove that the current of air is continuous and not interrupted at the end of each beat of the wings, at least in insects. J. DUFAY and SSU-PIN LIAU : The absorption of light in interstellar space. From the study of various spectral types of stars, it is shown that there is no statistical relation between the colour indices and the absolute spectroscopic magnitudes, but that there exists an appreciable correlation between colour index and distance. LOUIS FILLIÂTRE and PIERRE VERNOTTE : The defects of elasticity of metals. The damping of torsion oscillations. JEAN GUASTALLA : Researches on an equation of state for monomolecular films. EMILE SEVIN : Synthesis of the works of Newton, Fresnel and Maxwell. R. BOSSUET : The examination of minerals for the alkali metals. An application of the spectroscopic method described in a previous communication. The rare alkaline metals are found in potash feldspars and micas. Contrary to the views of Barbier, but in agreement with the results of W. Vernadsky, rubidium and lithium are found in orthoses and microclines. Thus the method for classifying the potash feldspars given by Barbier fails. MARCEL SCHWOB : The dispersion of electrical double refraction of ethyl ether. G. LIANDRAT : The internal photoelectric effect in liquid dielectrics. RENÉ AUDUBERT : The electrochemical properties of electrodes photosensitised with copper salts. RENÉ ARDITTI : Study of the system sulphuric acid, magnesium sulphate, water. W. GRAFF : Thermal analysis of the system chlorine, boron trichloride. The thermal analysis gave no indication of a new chloride and consequently of no valency of boron higher than three. RENÉ DUBRISAY and MLE. PAULETTE DROUOT : Some phenomena of surface chemistry. DESMAROUX : The stability of the nitrocelluloses : the distinction between the decomposition due to internal combustion and the decomposition due to saponification. ALBERT PORTEVIN and PAUL BASTIEN : Contribution to the study of the casting of ternary alloys. F. FRANÇOIS : The precipitation of antimony iodide and its hydrolysis. In the presence of sufficient sulphuric acid, potassium iodide precipitates a red iodide of antimony,  $SbI_3$ . This is readily hydrolysed to oxyiodide. PIERRE DUBOIS : The action of hydrogen peroxide on permanganate. The substances obtained by this reaction have no fixed composition, varying between  $MnO_{1.58}$  and  $MnO_{1.88}$ . ADRIEN KARL : The preparation of the metallic tungstates. Tungstic anhydride dissolves readily in fused common salt giving sodium tungstate (readily soluble in water) and chlorine. G. GIRE : The thermal decomposition of the magnesium silicides. The magnesium silicide obtained by synthesis at  $450^\circ C.$  is not stable above  $500^\circ C.$  : at  $550^\circ C.$  it decomposes into magnesium and the silicide  $Mg_3Si_2$ . M. TIFFENEAU, MLE. JEANNE LÉVY and F. KAYSER : The unsymmetrical influence exerted by an asymmetric carbon in the action of an organomagnesium compound on an aldehyde function. The preparation of a single diastereoisomer. R. PAUL : A molecular transposition accompanying the dehydration of tetrahydrofurfuryl alcohol. RAYMOND QUELET : The synthesis of the chlormethyl derivatives of *p*-bromanisol and of the nitroanisols. J. COLONGE : The generalisation of the method of condensation of ketones by mixed aminomagnesium

compounds. PAUL FLEURY and RAOUL PARIS : The comparative action of periodic acid on the  $\alpha$ - and  $\beta$ -glycerophosphoric acids. P. CARRÉ and D. LIBERMANN : The chlorides of alkylsulphurous acids. M. CHATELET : A pyridine-iodine molecular association. Pyridine forms an unstable molecular compound with iodine with the composition  $I_2(C_6H_5N)_2$ . MLE. MADELEINE ROY : The alteration in castor oil by heating. The oxygen of the air is the chief cause of alteration of the oil. C. L. SAGUI and A. JOURDAN : Some data on the genesis of colloidal pyrrhotite and of other minerals in the mine of Bottino. R. BUREAU : The rapid variation of atmospherics at sunrise. JEAN CHEVRIER : Magnetic measurements in Syria. L. EBLÉ : The variation of the horizontal component of the earth's magnetic field round about days of magnetic calm. L. TUWIM : A new method for the direct determination of the natural angular distribution of the cosmic rays. C. T. POPESCO : A perennial bean obtained by grafting. MLE. M. L. VERRIER : The static refraction of the eye in the cephalopods. HENRI BEAUVALET : The experimental study of digestion in selachians. FONTAINE and MME. BOUCHER-FIRLY : The alkaline reserve of the blood in fishes. MAURICE RANGIER : A form of elimination of uric acid. GASTON MENIER : The apparatus studied and used at Noisiel since 1875 for lowering the temperature of the air and at the same time freeing it from dust.

## ROME

Royal National Academy of the Lincei, Jan 22. F. ENRIQUES : Continuous series composed of rational involutions of groups of points on an algebraic surface. A. MYLLER : Geodetic conics. F. TRICOMI : Determination of the asymptotic value of a certain integral. P. DIENES : The displacement of an *n*-tuple, and a new interpretation of Ricci's rotation coefficients. G. KRALL : Variable parameters and asymptotic previsions in some problems of celestial mechanics. G. LAMPARIELLO : The analytical nature of the solutions of canonical systems integrable by quadrature. G. VRANCEANU : The geometrical interpretation of mechanical systems. C. ALESSANDRI : The apparent velocity of the surface propagation of earthquakes in relation to the hypocentral depth. The determination of the depth of the hypocentre from time data or, more specifically, from the differences between the times of arrival at different places of a given phase of the longitudinal seismic waves, is considered. An expression is derived which indicates that, in general, the superficial velocity of propagation will appear greater when the depth of the hypocentre is great. Various numerical applications of this result are given. G. PONTE : Volcanic fumaroles. Evidence is cited which renders improbable the general opinion that volcanic eruptions are produced by the elastic force of the gases contained in the magma. So far as it has been carried to the present time, study of the phenomena bearing on fumarolic exhalations indicates that, with the exception of sodium and potassium chlorides—which originate directly from the magma—these exhalations are produced by the action of atmospheric agents on the magma at various temperatures. C. DEI : The sensitivity and the approximation of measurements of the amplification coefficients of triodes. The methods considered are those of Miller, Appleton, and Lo Surdo. G. EIBENSCHÜTZ : The nature of electrodynamic forces. The possibility of deducing mathematically the production of an electrodynamic force from the move-

ment of electrons in a conductor is demonstrated. R. DE FAZI: The chemical constitution of cholesterol, and a new isomeride of cholesterol. The action of hydrochloric acid on cholesterol under various conditions yields, in addition to the known cholesterol hydrochloride melting at  $158^{\circ}$ – $158.5^{\circ}$ , two other hydrochlorides, with melting points  $136^{\circ}$ – $137^{\circ}$  and  $124^{\circ}$ – $126^{\circ}$ . These have now been converted into isomerides of cholesterol. The structural formulae of these cholesterol isomers are discussed. P. PRATESI: The action of alkaline hypiodites on the pyrrolic aldehydes. In their behaviour towards alkaline hypiodites, the 2- and 3-aldehydo-derivatives of pyrrole exhibit analogy to the ortho- and para-aldehydes of phenol and to the naphthol aldehydes. The pyrrole-3-aldehydes lose the aldehyde group as formic acid, iodine entering the molecule to form the corresponding iodo-derivatives in almost quantitative yield. Pyrrole-2-aldehydes are less stable towards hypiodites than their 2-isomerides; pyrrole-2-aldehyde itself gives hepta-iododipyrrolyl. A. QUILICO and A. DI CAPUA: Aspergillin, the spore pigment of *Aspergillus niger* (2). When extracted with dilute ammonia and precipitated with acid, aspergillin forms shining black lumps showing brown reflection and is insoluble in the ordinary organic solvents, except pyridine, although it gives up 12–14 per cent of its weight to methyl or ethyl alcohol. When heated, it behaves similarly to certain oxypyrrole blacks and it always contains a small proportion (about 0.2 per cent) of iron. Elementary analysis gives the ratios C : H : O = 5 : 4 : 2. Its molecule contains a hydroxyl group and methyl, ethyl and other derivatives have been prepared. A. ROSSI: The crystalline structure of the compound  $\text{LaAl}_4$ . This compound crystallises in the dimetric system and cleaves readily along the pinacoid faces (001). For the unit cell the value of  $a_0$  is probably 13.2 Å, and the ratio  $c : a$ , 0.77. On the assumption that the unit cell contains 16 molecules, the density is calculated to be 3.69, which agrees moderately well with the pycnometric value, 3.86. The symmetry class is not determinable with certainty. T. LIPPARINI: *Rzehakina epigona* (Rzehak), a foraminifer of archaic type in the Bologna Tortonian. T. CARPANESE: The mineral deposits of Monte Rosso di Verra (Monte Rosa group) (2). Owing to its marked crossed dispersion, its associations with olivine, and the orientation of the two minerals in these associations, the titanolivine of Monte Rosso is more nearly analogous to that of Val Malenco than to the titanolivines and titanohumites of other deposits. The optical properties of the amphibole present indicate that this mineral is a form intermediate to green hornblende and actinolite.

## Forthcoming Events

Tuesday, June 27

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Annual General Meeting. Capt. T. A. Joyce: Presidential Address.

Thursday, June 29

ROYAL SOCIETY, at 4.30.—Prof. R. G. Harrison (professor of comparative anatomy at Yale University): "The Origin and Development of the Nervous System studied by the Methods of Experimental Embryology" (Croonian Lecture).

ASSOCIATION OF TECHNICAL INSTITUTIONS, June 29–July 1.—Summer Meeting at the Municipal College of Technology, Manchester. Sir Hugo Hirst: President.

## Official Publications Received

### GREAT BRITAIN AND IRELAND

Observations made at the Royal Observatory, Greenwich, in the Year 1931, in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson. Pp. viii+A62+B7+Cix+C74+D64+E49+19. (London: H.M. Stationery Office.) 30s. net.

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1932. Part 1. With Report of the Geological Survey Board and Report of the Director. Pp. iv+98. (London: H.M. Stationery Office.) 2s. net.

Journal of the Chemical Society. May. Pp. iii+469–557+viii. (London: Chemical Society.)

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July, 1932. Pp. 78. (Reading.)

Annals of the Natal Museum. Edited by Dr. Ernest Warren. Vol. 7, Part 2, May. Pp. 145–301+plates 7–15. (London: Adlard and Son, Ltd.) 17s. 6d. net.

### OTHER COUNTRIES

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Edited by K. K. Sen Gupta. Vol. 4, No. 4, December 1932. Pp. 119–174+plates 9–12. (Calcutta.) 6 rupees.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 72: Varieties of Wheat in Australia; a Catalogue, with Pedigree or Source, and a Genealogical Chart showing the Relationships of the More Important Varieties. By J. R. A. McMillan. Pp. 28. Bulletin No. 73: A Soil Survey of the Nyah, Tresco, Tresco West, Kangaroo Lake (Vic.), and Goodnight (N.S.W.) Settlements. By J. K. Taylor, F. Penman, T. J. Marshall and G. W. Leeper. Pp. 47+4 maps. (Melbourne: H. J. Green.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 84, 1932. Pp. iii+536+33 plates. (Philadelphia.) 6.25 dollars.

The Academy of Natural Sciences of Philadelphia. Review of 1932. Pp. 16. (Philadelphia.)

University of California Publications in American Archaeology and Ethnology. Vol. 31, No. 6: Ethnology of the Nisenan. By Ralph L. Beals. Pp. iv+335–410+plates 40–41. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 70 cents. Svenska Linné-Sällskapets Årsskrift. Årgång 16, 1933. Pp. v+154. (Uppsala.)

Bulletin of the American Museum of Natural History. Vol. 67, Article 1: A New Fossil Snake from the Notostyloids Beds of Patagonia. By George Gaylord Simpson. Pp. 22. (New York City.)

Mellon Institute of Industrial Research. Bibliographic Series, Sixth Supplement to Bulletin No. 2: A List of the Books, Bulletins, Journal Contributions and Patents by Members of the Mellon Institute of Industrial Research during the Calendar Year 1932. By Lois Heaton Pugsley. Pp. 10. (Pittsburgh, Pa.)

Journal of the Indian Institute of Science. Vol. 16A, Part 1: Rhaponticin, and Anthraquinone Derivatives from *Rheum emodi*, Wall. (Indian, or Himalayan Rhubarb). By M. Ghose Mohiuddin and M. C. Tummim Kati. Pp. 9. 12 annas. Vol. 16A, Part 2: Constitution of the so-called Dithiourazole of Martin Freund. Part 5: Isomerism of Hydrazodithiocarbonamides, Iminothiothiazoles and Di-R-Iminothiothiazoles, by Sahara L. Janniah and P. C. Guha; Part 6: Isomerism of Hydrazomonothiocarbonamides, Iminothiothiazolones and Monothiothiazolones, by S. L. Janniah and P. C. Guha. Pp. 11–27. 1.4 rupees. Vol. 16B, Part 1: Taylor's Frequency Tripler. By P. Rajagopal Pillai and F. N. Mowdawalla. Pp. 18. 1 rupee. (Bangalore.)

Proceedings of the Imperial Academy. Vol. 9, No. 4, April. Pp. vii–viii+143–195. (Tokyo.)

Indian Institute of Science. Investigations on the Spike-Disease of Sandal. 7: Report of Progress made during the Half-Year ending March 31, 1933. Edited by M. Sreenivasaya. Pp. 21. (Bangalore.)

Tanganyika Territory: Geological Survey Department. Bulletin No. 5: The Hydrology of Lake Tanganyika. By C. Gillman. Pp. ii+27+2 plates. (Dar es Salaam: Government Printer.) 3s.

The Establishment of Aleurites Fordii (Tung Oil) in the Ranchi District of Chota Nagpur. By Dorothy Norris and H. T. Bates. Pp. 13+1 plate. (Nankum: Indian Lac Research Institute.)

Canada: Department of Mines: Mines Branch. Canadian Limestones for Building Purposes. By M. F. Goudge. Pp. ix+196. (Ottawa: F. A. Acland.) 30 cents.

U.S. Department of Agriculture. Technical Bulletin No. 351: Life History of the Angoumois Grain Moth in Maryland. By Perez Simmons and G. W. Ellington. Pp. 35. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 82, Art. 16: New Termites from India. By Thomas E. Snyder. (No. 2957.) Pp. 15+1 plate. Vol. 82, Art. 19: West African Snails of the Family Achatinidae in the United States National Museum. By Henry A. Pilsbry. (No. 2960.) Pp. 6+2 plates. (Washington, D.C.: Government Printing Office.)

Southern Rhodesia. Geological Survey Bulletin No. 22: The Geology of the Central Part of the Mazoe Valley, Gold Belt. By R. Tyndale-Biscoe. Pp. 120. (Salisbury.) 3s. 9d.

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 34, Part 1: Genetical and Cytological Studies on an Inter-specific Hybrid of *Hibiscus esculentus* L. and *Hibiscus manihot* L. By Torao Teshima. Pp. 155+8 plates. (Tokyo: Maruzen Co., Ltd.)

Field Museum of Natural History. Anthropology Bulletin No. 30: The Races of Mankind; an Introduction to Chaucer's Keep Memorial Hall. By Henry Field. Pp. 40+9 plates. (Chicago.) 25 cents. Annuario della Reale Accademia d'Italia. 4: 1932–1933. Anno 1932. Pp. 453+10 plates. (Roma.) 25 lire.

The Parliament of the Commonwealth of Australia. XI Annual Report of the Council for Scientific and Industrial Research for the Year ended June 30, 1932. Pp. 64. (Canberra: L. F. Johnson.) 3s.

