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Scientific Management and Social Problems

THE sixth International Conference on Scientific Management, which opens on July 15, comes at a time when the whole contribution of science not merely to industrial efficiency but also to every aspect of national and social welfare is receiving a searching examination. While on one hand there is a growing recognition that readjustments are required in our political and economic policies to enable us to take full human advantage of this age of science, technology and power production, while most people are disposed to regard a shorter working day or a shorter working week as an inevitable consequence of technological advance and as a desirable if not essential means of securing a wider distribution of leisure, there are strong forces setting in exactly the opposite direction.

The recognition that social control has not kept pace with the social change induced by scientific research and its applications has not always stimulated a resolve to use the full powers of the economy of science, technology and power production which man's genius has created. On the contrary, it has also induced the rise of a defeatism spirit which deliberately renounces many of the advantages with which the application of scientific thought and discovery can endow mankind, and attempts to return to the methods and conditions of the past. There is, in fact, a grave danger of a widespread revolt against science and of a social throttling of research, and the warning of Glenn Frank in "America's Hour of Decision" has a validity far beyond that of the American position of which he was particularly writing.

The obvious futility of attempting to set back the clock of progress should not lead scientific workers into the error of rejecting such warnings superficially. It must be recognised that, in the new civilisation created under the impact of science and technology, social change has so far outstripped institutional change that the survival of our social order has been in serious doubt in more countries than one. Neither a people nor a Government can be hastily condemned if under such conditions it clutches at any method to avert disaster. The task of the scientific worker is thus that of endeavouring to show a more effective alternative. What is required is a concerted effort by scientific workers, in physical and in social science, to plan the prosecution and publication of their research so that the scientific progress of the next twenty-five years shall stabilise and enrich the life of the nation instead of producing further social instability.

The views advanced by Glenn Frank on the situation in the United States deserve the more serious attention because in some countries scientific workers have already lost the freedom which they still enjoy in English speaking countries. Scientific workers must face the fact that the production of new knowledge cannot be regarded as automatically and invariably good. They must also recognise that the responsibility for considering the impact of modern science in modern society is not solely the responsibility of the worker in social science. It is equally the responsibility of the worker in physical science, and careless distinction between social and physical sciences is in fact one of our most serious dangers.

This changed attitude to science is due essentially to factors the influence of which is widespread. A growing dissatisfaction with maladjustments in society, and with the strain on the structure and functions of the political, social and economic

order due to *laissez-faire*, is accompanied by a growing disillusionment with research in which the production of new knowledge is unaccompanied by more effective effort to prevent its application causing more troubles than it cures. These factors alone, according to Dr. Frank, have been even more instrumental than financial stringency in determining the curtailment of expenditure on research in the United States of America in the last two or three years.

The third factor in this attitude to science, the determination to secure better planning and control of political, social and economic developments, enforces the necessity for more effective co-operation between scientific workers themselves. Earlier consideration of the political, social and economic effects of discoveries in the physical sciences or in industrial technology can only be secured by such co-operation. If we are to shorten to any adequate extent the dangerous time lag between the swiftly changing processes of industry and our slowly changing policies, we must develop some means of setting social science to work from the beginning, before social and economic havoc has been produced.

This may well prove an ideal which we cannot entirely realise. However, if it were possible to shorten by even a decade the time lag between technological development and developments in social or economic policy, much would have been done to alleviate distress and maladjustment and to mitigate the opposition to the spread of science. An advance of this kind presupposes the extensive application of scientific thought and methods to fields where they have scarcely begun to penetrate. It is, principally, over-specialised education which has left us so ill-fitted for the mastery of the problems of social management confronting us to-day.

The full significance of the International Conference for Scientific Management can only be appreciated against such a background as this, in the light of a well-founded determination for better planning and more effective control over the whole field of industry and politics, even if there is implied some restraint of scientific effort or change in its direction. Moreover, there are two basic questions on which the Conference may be expected to throw authoritative light and with which its programme indicates it will deal in some measure.

The first of these questions is that of the training of administrators and of securing an adequate and continuous supply of administrators of the requisite quality. The practice of scientific management depends primarily upon the capacity of the administrator, and if the general level of administration whether in industry or the State is to be raised, we cannot continue to rely upon those fortuitous methods of filling the higher managerial posts which have hitherto been the vogue in most industrial and commercial organisations in Great Britain. Some definite efforts must be made to secure a reservoir of personnel with sufficient initial training and experience to form the starting-point for selection for promotion to the higher ranks. This must be supplemented by systematic attempts on scientific lines to select from this reservoir those who give the most promise of qualifying for the higher administrative positions, and to ensure that they receive opportunities for further experience and training where required.

The maintenance of progressive prosperity depends largely on the continuous succession of able administrative leaders. It is also linked with the related problem of the place of the expert in modern government. Here, although in some sections of industry it may be fairly claimed that an adequate solution has been found, in social and political affairs the problem has received nothing like the same attention. All too frequently either the expert is allowed to usurp the place of the administrator and dictate policy to the neglect of other factors and the detriment of management, or, especially where the scientific expert is concerned, the administrator has proved incompetent or indifferent to the scientific factors involved.

It may be taken as axiomatic to-day that statesmanship must rest upon a scientific study of the causes of social problems and a statistical study of the results of social policies. The correlation of expert opinion and knowledge with legislative and executive leadership does not mean that policy should be determined primarily by expert advice. The expert is essentially a specialist in means, not in ends. He indicates the facts upon which a wise decision or policy must be based. As Dr. Glenn Frank points out, "the function of the expert is that of hewer of wood and drawer of water to the statesman". It is the latter whose patience and sense of social needs, values and possibilities, added to a knowledge of the facts, enable him to build up the broad policies required.

The real question at issue is how to provide administrators possessing at once the sense of values and the capacity to assess and interpret the

increasingly technical factors involved in almost every Government decision. The sessions at the Conference to be devoted to management problems arising from Government intervention can scarcely avoid the consideration of this particular question. A certain degree of scientific objectivity at any rate must be secured in public policy, and whether a new orientation of the methods of government as suggested by General Smuts is required, or whether the question is rather one of redressing the educational situation so as to ensure an adequate reservoir of administrators competent to assess scientific and technical factors in government, the matter is one urgently demanding serious study. Only in this way can we attain either the power or the vision to control the forces now at our disposal so as to ensure the maximum advantage to mankind. No less here than in other branches of human endeavour, the fullest freedom to creative thought and effort is an essential element in success, and indeed the only alternative to the renunciation and defeatism already characterising certain nations in this struggle to-day.

Notable Epidemics and their Causes

Some Notable Epidemics

By Dr. H. Harold Scott. Pp. xix + 272. (London: Edward Arnold and Co., 1934.) 12*s*. 6*d*. net.

EPIDEMIOLOGY, after making slow but steady progress for a century or more in Great Britain, as the outcome of the work of the disciples of Sydenham—the so-called 'Annalists'—sustained a severe setback when the Industrial Revolution, with its crowding and neglect of sanitation, facilitated the spread of disease. Dr. John Snow's investigations into the cholera of 1848–49 may thus be said to have inaugurated a new era, making water-borne infection an established reality, and this stimulus, following upon the work of Mead, Pringle, Lind, Baker, Blane, Jenner, Thackrah and the three reports of the Poor Law Commissioners of 1838–39, greatly strengthened the hands of Chadwick and Simon in producing the health crusade of the latter half of the nineteenth century. Almost inevitably, therefore, Dr. Scott's Chapter i commences with an account of the "Broad St. Pump Outbreak" (1854).

It is, perchance, the 'irony of fate' which has determined that Snow's spade-work on this Westminster prevalence, followed as it was by Snow's and Simon's reports on the "Southwark and Vauxhall Water Outbreak" of 1854 and by Netten Radcliffe's report on the "East London Cholera Outbreak" of 1866, firmly established the belief in water-borne disease. There can be no surprise, however, at Sir John Simon's difficulty in accepting "Snow's peculiar doctrine", or his reserve regarding deductions drawn from reports on the cholera prevalences of 1854 and 1866.

A probable explanation of the difficulties in question, as resulting from failure to recognise the possibility of contemporaneous spread by shellfish, appeared in *Public Health* (Jan. 1923, pp. 98–106); moreover, as regards "The Pump", the official inquiry made at the bidding of a Committee for Scientific Enquiries, in 1855, clearly showed that "many cases in the infected districts occurred of persons who were not in the habit of using the pump water". This Chapter i and Chapters ii–vi, in which Dr. Scott deals with water-borne outbreaks of typhoid fever, at Blackburn (1881), Worthing (1893), Maidstone (1897), Lincoln (1904–5) and Bolton upon Dearne (1921) make exceedingly interesting reading; though here, again, there is something to be said (see *Public Health*, Dec. 1921, pp. 57–59) for the view that other influences than the water supplies were also at fault. It must be remembered that some sixty or more years ago, a president of the Society of Engineers was able to trace all cases of typhoid fever coming under his notice, in London, to faulty drains; and that in similar fashion water supplies enjoyed an almost complete monopoly of discredit as regards cholera and typhoid fever for several decades.

Chapters vii–xv present intriguing problems of a like character with reference to milk outbreaks of typhoid fever, diphtheria and scarlet fever; though here the claim to a monopoly for the suspected milk is stronger as a rule than was the case in the water outbreaks—in the case of the "milk-borne enteric fever outbreak" in St. Marylebone (1873), at any rate, the anomalies are, indeed, very disturbing; scepticism was voiced, at the time of the prevalence, and the difficulties, regarding "nursery milk" and "extent of involvement of domestic servants", are instanced on p. 61 of the paper in *Public Health*, Dec. 1921, referred to above.

Chapters xiii and xiv, dealing with outbreaks in which milk infection was traced to disease in milch cows, are particularly interesting. Chapter xv also deals with a milk outbreak, and Chapter xvi with two food-poisoning outbreaks. Then comes the masterpiece, the late Dr. H. T. Bulstrode's report on the "Oysterborne Enteric Fever of the Winchester and Southampton Banquets", of 1902. Hecker (who by a misprint appears as Heckel on p. xi of Dr. Scott's book), the author of "Epidemics of the Middle Ages", commented on the fact that Nature, in isolated epidemics, "never displays herself in all her bearings", but he would doubtless have maintained that Nature very rarely displays herself in *one* solitary bearing. On reaching Dr. Scott's Chapter xvii, however, we come very near to monopoly of infective property by one article of food. Dr. H. T. Bulstrode's report on the two banquets covers the whole ground, leaves no stone unturned, and preceded and followed as it was by his masterly reports on "Oyster and Other Shell Fish Layings", it brought about the remarkable reduction of prevalence of typhoid fever in Great Britain, which is one of the outstanding achievements of public health effort.

Dr. Scott's concluding chapters describe "Outbreaks at Aberdeen, 1919–1926" and "Sonne Dysentery Outbreaks, Aberdeen 1925–26", "Sonne Dysentery Outbreaks at St. Andrews, 1926" and "Sonne Dysentery Outbreaks at St. Pancras and Holborn, 1933".

Prof. W. W. Jameson, in his preface to Dr. Scott's book, writes: "Dr. Scott has performed a real service in producing this book"; the original reports have been so fully described "that the student will lose little, if anything, through inability to refer to the original reports", many of which "are now difficult to obtain". He adds, however, that he hopes "Some may be stimulated to a closer study of those older Reports from which much of the material in this book has been drawn".

Dr. Scott's book calls to mind Wordsworth's poem on "The Solitary Reaper", who sings of "Old unhappy far off things and battles long ago". The reports of Dr. Scott's public health pioneers are not only replete with interest, but also they constitute the foundations upon which rests the preventive medicine of to-day. Surely, then, it may be hoped that Prof. Jameson's wish may materialise and that Dr. Scott's book may prove a great help in letting all budding medical officers of health know that which "Our Fathers have told us".

W. H. HAMER.

Structure of the Eastern Dolomites

Geologie von Cortina d' Ampezzo und Cadore Von Dr. Maria M. Ogilvie Gordon. (Sonderabdruck aus dem Jahrbuch der Geologischen Bundesanstalt, Band 84, Heft 1–4.) Pp. 59–215+18 plates. (Wien: Geologische Bundesanstalt, 1934.) n.p.

THIS work describes the stratigraphy and tectonic structure of the Eastern Dolomites lying between Auronzo on the east and Caprile on the west and between the Drei Zinnen in the north and Cibiano in the south. It is illustrated by an excellent map (1 : 50,000) and by numerous explanatory sections. As stated by the author, greater attention is given to the tectonic structure than to the stratigraphy of the area.

Part 1 relates to the larger portion of the area lying east of the Ampezzo valley. Thirty-five pages are devoted to the stratigraphical succession between the Permian and the Upper Cretaceous, while eighty pages are devoted to the tectonic structure. The pre-Permian quartz-phyllites and the Grödner sandstone are limited to a small area east of Auronzo. The Bellerophon beds and the Werfener beds occupy a considerable area round Auronzo and Lorenzago, also in the Val-di-Cadore in the more denuded eastern margin; the author stresses the importance of Calcareous algæ and foraminifera in the formation of the limestones of the Bellerophon beds. The Mendola Dolomite also shows important algal development. The Upper Trias, notably the Schlern Dolomite and the Dachstein Dolomite, forms the whole of the central and northern portions of the district, and gives rise to important mountain cores with Wengen and Cassian beds clinging to their flanks (in the Cristallo, Sorapis, Marmarole, Antelao and Tofana groups), a few of these being capped by deposits of Lias and Cretaceous rocks.

In the description of the physical and tectonic structure, we are presented with a masterly account of the disturbances which the district has undergone. The detailed account of the various movements as deduced from the author's investigations and study of the work of previous writers makes fascinating reading, and the results are admirably depicted on the geological map and the diagrams accompanying the map.

The district appears to have been originally folded into a series of broad west-east anticlinal and synclinal folds, and these structures can still

be traced in the several strips in the central portion of the area, in the disposition of the mountain ranges composed of Dachstein Dolomite and in the significant anticlinal axis passing through the Tre-Croci Pass. Later movements, however, have disturbed the original simplicity of structure and bent up the mountain blocks into dish-shaped forms, notably the eastern margins of the Marmarole and Antelao. The main lines of movement were originally pointed out by Mojsisovics, and these and subsidiary lines of disturbance are described in detail by the author. The main lines have been given special names and have been traced more or less continuously through the district; they include both thrust-planes and normal and tear faults, indicating a general pressure from north to south. The most important lines are the Rauhtal line in the north, the Antelao line in the centre and the Val Sugana line in the south-east. The two former run in sinuous lines from west to east, while the last runs in a north-east–south-west direction in the neighbourhood of the Val-di-Cadore, and has given rise to a complicated series of tectonic structure. An interesting point is the association of valleys parallel to these lines of dislocation.

The second part of the work deals with the district west of the Ampezzo valley and contains also much of interest in connexion with the structure of the Tofana-Fannes group, the Pelmo range and the effects produced by the western continuation of the Antelao line of disturbance.

The author is to be congratulated on a fine piece of work which forms an important contribution to our knowledge of the structure of the Eastern Dolomites.

Progress of Physics

(1) International Conference on Physics, London, 1934

A Joint Conference organized by the International Union of Pure and Applied Physics and the Physical Society. Papers and Discussions. In 2 vols. Vol. 1: Nuclear Physics. Pp. viii+257. 10*s.*; cloth, 12*s.* 6*d.* Vol. 2: The Solid State of Matter. Pp. viii+183. 10*s.*; cloth, 12*s.* 6*d.* Reports on Symbols, Units and Nomenclature approved by the General Assembly of the Union at its Meeting in London on 5th October 1934. Pp. iv+40. 2*s.* 9*d.*; cloth, 5*s.* (London: Physical Society, 1935.)

(2) The Physical Society. Reports on Progress in Physics

Pp. iv+371+2 plates. (London: The Physical Society, 1934.) To non-Fellows, 12*s.* 6*d.* net.

(1) "THIS conference," remarked the owner of one of the most famous names in the physical science of to-day, "is a very good conference—as conferences go." Approbation from Sir Hubert Stanley is high praise indeed, and certainly the conference which met in London in the first week of October 1934 was unique of its kind. Held under the joint auspices of the Physical Society and the International Union of Pure and Applied Physics, and concerned with topics among the most important of those about which physical science is conversant, it is small wonder that the conference held, for a week, the attention of some five or six hundred members, drawn from almost every European country and from America.

The report of the conference is worthy of the occasion. It is published in three volumes which deal respectively with the solid state, with the present position of nuclear physics, and with certain problems of units and of nomenclature which have been discussed by the Symbols, Units and Nomenclature Committee of the International Union.

Conference reports are apt to be disjointed and—it must be confessed—lifeless; the present volumes are a pleasant exception. The topics are vividly interesting, and the programme has been developed in such a way as to show a very satisfactory coherence in the arrangement of the subjects.

Moreover, the great difficulty which faces the editors and readers is, in this instance, missing. Most readers who are not specialists in a particular branch of physics find that a major difficulty in following the papers presented is due to the authors' bad habit of plunging without apology *in medias res*, assuming in their readers a specialised knowledge which comparatively few possess. It is relatively easy to avoid this. A general introductory survey, indeed in many cases a few sentences of introductory matter, may make all the difference. Specialised matter is not always so esoteric as the non-specialist may suppose—clarity of thought and of expression, the art of beginning at the beginning, a kindly feeling for the other fellow—these are gifts that go far in helping to produce the Perfect Paper.

We hold no brief for nationalism in matters of science—*la chimie est une science française* is a

historic phrase which may well give pause to the enthusiastic nationalist—but, as a matter of plain fact, nuclear physics owes so much to Rutherford, and our knowledge of the solid state to Bragg, that the holding in London of an international conference dealing with these topics was most appropriate, and the conference was specially fortunate in that the discussions on the principal topics were opened by masterly surveys of the problems of nuclear physics and of the solid state contributed by these protagonists—surveys which form the opening addresses of the principal volumes of the conference report, and which serve admirably as introductions to the more specialised topics of the discussion.

It is quite impossible to give a detailed analysis of the contents of the volumes, and we must content ourselves with a brief catalogue of headings. The volume on nuclear physics contains sections dealing with general quantum theory, natural β-decay, artificial radioactivity, disintegration and synthesis of nuclei and elementary particles, and cosmic radiation. That on the solid state is divided into chapters which discuss the structure of molecules and of the ideal lattice, the deviations of real crystals from the ideal lattice structure, and plasticity and strain hardening in crystals. The papers are printed *in extenso*, the discussions are very fully reported, and one need say no more on the contents than that they represent the latest views on the subjects concerned, presented by physicists of international reputation.

The third volume of the report of the Conference—that dealing with symbols, units and nomenclature—may seem rather unexciting in comparison with its fellow volumes, but its subject matter is important, is thoroughly interesting, and presents a few intriguing problems for the physicist of philosophic mind. It is, for example, a little disturbing to the writer of elementary textbooks to be confronted with the statement that "complete agreement as to the definitions of B and H has not yet been reached".

(2) We turn now to the consideration of the first volume of what will, we trust, be a long and successful series of reports which will play an important part in the advancement of physical science. The report on the progress of physics issued by the Physical Society deals mainly with the events of the year 1933, although the fact that most of the surveys are the first of a series has allowed the contributors some measure of latitude, and earlier work, leading up to that of the year with which the reports are mainly concerned, is treated with the appropriate amount of detail. The reports contained in the volume are divided into two main groups—a set of reports which deal with general physics, sound, spectroscopy, optics, heat, X-rays, atomic physics and electrical and magnetic measurements. These titles are more or less permanent, so that reports under these heads will recur annually. The second group consists of a series of reports dealing with matters of topical interest, and the titles of these reports will vary from year to year. Under this head the present volume contains reports dealing with spiral nebulæ, Burgers' theory of turbulence, and electrical phenomena at extremely low temperatures. It has been found desirable to break up some of the reports into sub-sections contributed by specialists under the general direction of an editor. Thus, spectroscopy is split into twelve, X-rays into eight, and optics into five subsections.

It is not easy to settle the scope of such reports. What may be stated at once and decisively is that the reports are *not* mere expansions of *Science Abstracts*. They are popular in that they endeavour to present a review of different departments of physical science which shall be useful to the trained physicist who is not a specialist in the department under review—who wants to know, in fact, what is happening in branches of physics other than his own. They are specialised in that they offer full, critical and detailed accounts of the latest happenings in any particular branch of the subject, accompanied by very complete bibliographical details. An attempt to combine these two outlooks may seem to be courting failure, but it must be confessed that the reports combine these aspects very happily.

It is impossible, again, to deal with this report in detail, and it were invidious to particularise. But we cannot close this review without special mention of the brilliant contributions made by Prof. E. N. da C. Andrade, who deals with the physics of the atom, and by Prof. J. C. McLennan, who writes on electrical phenomena at very low temperatures.

No advanced worker in physical science can afford to neglect this report. The subject matter is extensive and important, the printing and production leave nothing to be desired, the price is low. If succeeding volumes preserve the high standard of the first volume, the success of the venture is assured.

British Scientists of the Nineteenth Century
By J. G. Crowther. Pp. xii+332+12 plates. (London: Kegan Paul and Co., Ltd., 1935.) 12*s*. 6*d*. net.

COMPARATIVELY few historians of science have as yet recognised the powerful influence which social forces have had on the development of science, and it is characteristic of this book that Mr. Crowther sets out to overthrow the idea that scientific knowledge

originates entirely in minds completely detached from mundane affairs and concerned solely with the pursuit of truth for its own sake. He offers instead a picture of the lives of Davy, Faraday, Joule, Kelvin and Clerk Maxwell, in which we see how their characters were moulded by early upbringing, and the way in which their work was determined by various social and industrial influences. In revealing the extent to which other incentives besides the desire to contribute to the advancement of knowledge affected their careers, Mr. Crowther gives us a highly stimulating series of studies which appear appropriately at a moment when scientific workers are considering much more seriously both the social consequences of their work and the social factors which determine its extent or direction.

The selection of four physicists and a physical chemist as the most representative men of science of the century is defended on grounds that there were few outstanding figures in the fields of medicine, geology, botany and zoology during the period, in itself an example of the way in which the sciences which promised the greatest direct contribution to the prosperity of industry were the most richly endowed, while the biological, sociological and psychological sciences, which could offer no such immediate return, were much less generously encouraged. Although the author's opposition to capitalism tends to obtrude at times, it scarcely detracts from the fascination and suggestiveness of what is not merely biography but also to some extent a study of the effect of social conditions on the general development of science during the period.

R. B.

A Text-Book of Physical Chemistry

Vol. 2: Principles involved in Chemical Reactivity. By Dr. J. Newton Friend. Pp. xii+483+3 plates. (London: Charles Griffin and Co., Ltd., 1935.) 24*s*. net.

THERE is a pleasantly classical flavour about the second volume of Dr. Friend's treatise. Most of our old acquaintances are there, and though the ultra-modern physicist, "trained in an atmosphere of rigid economy of mechanical concepts" (an economy, Heaven help him, which leads on occasion to glib outpourings concerning the uncertainty principle, and a discreet silence concerning the mode of action of a locking-nut), may find overmuch of ancientry in the exposition, the student who has attacked the fundamentals of physical chemistry with the aid of Dr. Friend's two volumes will not have a great deal to unlearn. The principal topics to which the ten chapters of the second volume are devoted are thermochemistry, chemical equilibrium, reaction velocity and chemical change in homogeneous systems, combustion in gases, the phase rule, catalysis, electrochemistry, the structure of the atom and of the molecule, and chemical thermodynamics.

The treatment is throughout clear, concise and elementary. Broadly speaking, the treatise will serve to lay the foundations for an advanced honours course.

A. F.

The Biology of Bacteria: an Introduction to General Microbiology

By Prof. Arthur T. Henrici. Pp. xi+472. (Boston, New York and Chicago: D. C. Heath and Co.; London: George G. Harrap and Co., Ltd., 1934.) 12*s*. 6*d*. net.

THIS book, as explained in the preface, is intended as an introduction to microbiology in its scientific aspects as distinct from its practical applications in hygiene, agriculture and industry. The author, indeed, considers that the lower unicellular micro-organisms present problems sufficiently important to warrant microbiology being considered as a separate branch of biology, distinct from either botany or zoology. At the same time, when dealing with individual organisms, their rôle in the causation of disease, or their importance in agriculture and industry, are adequately described, and immunity, antibodies and antisera, agglutination and the like, are all considered.

After a brief history of bacteriology and some details respecting the microscope, the microbic life of the Protozoa, Algæ, Fungi, Bacteria and other unicellular groups is considered. In these chapters the structure, nutrition, reproduction and other functions of each group are surveyed. The 'ultra-microbes', the finer structure of Bacteria, and the subjects of heredity, variation and metabolism in this group form the subject of several chapters. In this connexion, the author has definite views on the meaning and importance of Gram-staining, holding that the Gram-positive species form a homogeneous group distinct from the Gram-negative species, and bringing them in relation to the Fungi. In the many instances where alternative hypotheses are possible, for example, as regards the nature of 'bacteriophage', these are clearly stated.

The book is well produced and illustrated, and gives an excellent account of the biology of the Bacteria.

R. T. H.

Zur Erforschung des Weltalls: acht Vorträge über Probleme der Astronomie und Astrophysik

Von P. ten Bruggencate, E. F. Freundlich, W. Grotrian, H. Kienle, A. Kopff. Herausgegeben von W. Grotrian und A. Kopff. Pp. x+286. (Berlin: Julius Springer, 1934.) 19.80 gold marks.

THIS is not in the strict sense a popular book. It is, however, an account by a group of well qualified German astronomers of some of the recent researches and outstanding problems in their subject, written for readers with a reasonable knowledge of mathematics and physics. The authors' names are a sufficient guarantee of the quality of the volume. The subjects discussed—methods of astrometry, the physical condition of the stars, their inner constitution and evolution, the structure of the stellar system, the sun—reflect a sound choice from the whole range of astronomical knowledge. The volume arose from a series of eight lectures given to a circle of engineers at Charlottenburg in 1933. It is freely and well illustrated and attractively set out. It fills what is probably a real need in astronomical literature.

Temperature Changes in the Higher Atmosphere

By Prof. E. V. Appleton, F.R.S.

UNTIL some years ago, it was generally thought that the temperature of the stratosphere was practically uniform, and of the order of 220° K. A radical change in such notions was first effected by Lindemann and Dobson who, in 1922, from their study of meteor tracks, showed that the temperature at levels above 60 km. was even higher than that at ground-level. Their conclusions have been adequately confirmed recently in experiments on the anomalous propagation of acoustic waves, on the vertical distribution of ozone with height and, to some extent, by direct temperature measurements in high balloon ascents. There is, then, trustworthy evidence that solar radiation does not pass through the middle part of the atmosphere without warming it, so that we are led to examine, in this connexion, the evidence relating to still higher atmospheric levels, where such heating might be expected to be especially pronounced, since the solar radiation is there most intense and the thermal capacity of the transmission medium least.

Within the last year or so, the study of the diurnal and seasonal changes in upper-atmospheric phenomena by radio methods has indicated that surprisingly high temperatures are attained at great heights (200–400 km.) and that these temperatures vary in a most pronounced manner. These conclusions have been reached by comparing the observed diurnal and seasonal variations of ionisation with those expected according to a simple theory of photo-ionisation by solar radiation. It is now well known that there are two main regions of ionisation in the upper atmosphere, the lower of which (Region *E*) is the Kennelly-Heaviside layer. Now the maximum ionisation content of the Kennelly-Heaviside layer varies with the hour of the day and with the season of the year much as simple theory predicts. For example, the ratio of summer to winter noon maximum ionisation depends on the zenith distances attained by the sun at noon in summer and in winter. For the latitude of Great Britain, a simple calculation shows that the theoretical value of this ratio should be 1·84, and observations made at the Slough Radio Research Station of the National Physical Laboratory and at the Halley Stewart Laboratory, Hampstead, London, yield an experimental value agreeing very closely with this.

This agreement indicates that, at the level of the Kennelly-Heaviside layer (100 km.), there is little change of air density or temperature throughout the year. But above the Kennelly-Heaviside layer there is a much more intensely ionised region, Region *F*, and corresponding measurements in this case provide no such agreement with theory. For example, the critical penetration wireless frequency, by way of which the maximum ionisation is measured, is found to be actually less on a summer noon than on a winter noon, indicating that, in contrast to the results obtained for Region *E*, the maximum ionisation in Region *F* is less on a summer noon than on a winter noon. This result appeared at first sight so startling that some workers concluded that the critical frequency method of measuring atmospheric ionisation was untrustworthy, and that observations made by it could not be accepted. But further work carried out in Great Britain indicates that the method of measurement is trustworthy, and we must face the consequences of these unexpected results. Discrepancies between theory and experiment are always interesting, for from the discrepancy we can often measure the magnitude of the perturbing factor.

Fortunately, in this case, an explanation is to hand. The theory which indicates that summer noon ionisation should be nearly twice that on a winter noon is founded on the assumption that the atmospheric distribution of molecular density with height is constant throughout the year. It is not difficult to show that the abnormally low value of summer noon ionisation density can only be the result of a reduced summer air density at the level in question, otherwise we should have to assume that the solar ionising rays differed in quality from summer to winter. Such a reduced air density can again only be the result of an increased temperature. Putting these ideas into quantitative form, we find that the molecular temperature must be three to nine times as high on a summer noon as on a winter noon, and that the absolute temperature at a level of 300 km. must be at least 1,200° K. on a summer day.

An equally interesting result emerges from the interpretation of the corresponding nocturnal ionisation measurements. When the sun sets, it is found that the rate of decay of Region *F* ionisation, which has been proceeding in accordance with the decreasing zenith distance of the sun, is quite suddenly checked on a winter night. It appears as if there were brought into action a

new source of ionisation, but this is not so. The effect is due to the shrinkage of the outer layer of the atmosphere due to cooling, which brings about a concentration of both molecules and electrons. (Note that wireless methods measure not total ionisation but maximum ionisation per unit volume.) It is found that the concentration of electrons due to upper-atmospheric shrinkage can more than offset the dilution due to recombination processes, and an actual maximum of ionisation content is attained in winter, shortly after midnight. In midsummer no such marked cooling process takes place (for the sun never sets at heights of above 250 km.) and the ionisation (apart from occasional increases which are probably due to a nocturnal ionising agency) is generally found to decay steadily.

The theory of marked temperature changes also suggests an explanation for the curious alteration of structure which Region F undergoes on a summer day. It was shown in 1933 that there is found in our latitudes a subdivision of Region F during daylight in summer. When distinction is necessary we refer to the lower part, which forms a kind of 'step' on the upper part, as Region F_1, while the upper stratum is referred to as Region F_2. Since Region F_1 is found not to exhibit marked temperature changes, it is quite possible that the subdivision is partly, if not wholly, the result of the difference of the temperatures at the two levels, Region F_1 being at the lower temperature and Region F_2 at the higher temperature. According to this view, Region F_2 is, as it were, part of the main Region F forced upwards by expansion. At night, when the atmosphere shrinks, the two regions tend to merge into a single simple region. It is thus not improbable that differences of temperature in the atmosphere, as well as differences in molecular constitution, play a part in causing the composite structure of the ionosphere.

It might appear that these extraordinarily large changes of temperature at high atmospheric levels could not possibly have any influence on wireless communications, but such is not the case. Due to the expansion of the upper atmosphere on a summer day, the maximum electronic density, which determines the shortest wave-length usable in round-the-world communication, is abnormally low, and we are therefore unable to use a valuable range of short wave-length channels. Fortunately, however, Nature provides us to some extent with a form of compensation, for it is found that in summer there is very frequently produced a curious highly-reflecting stratum about the level of Region E, which provides abnormally favourable transmission conditions for short waves. But such conditions do not occur daily and so cannot be relied on wholly to remove the unfavourable conditions brought about by the solar heating and expansion of Region F_2 on a summer day.

Implementiferous Gravels of the Vaal River at Riverview Estates

By Prof. C. van Riet Lowe, Bureau of Archæology, Dept. of the Interior, Johannesburg

TOWARDS the end of April last, Mr. F. W. Webber, chairman of Carrig Diamonds, Ltd., very generously presented a collection of stone implements and a variety of deeply mineralised faunal remains to the Bureau of Archæology recently established at the University of the Witwatersrand. These had been recovered from diamondiferous gravels on the property of Carrig Diamonds, Ltd., at Riverview Estates on the left bank of the Vaal River immediately opposite Windsorton (lat. 28° 20′ S., long. 24° 44′ E.) shown on the accompanying sketch plan (Fig. 1). As similar remains were still being recovered, I immediately requested Dr. S. H. Haughton, director of the Geological Survey of the Union of South Africa, to accompany me to the site with the object of a detailed investigation. Mr. F. W. Webber had kindly offered to accompany and guide us, and an examination of the area was accordingly carried out during the second week in May.

The ancient gravels were found to be extremely rich in implements and faunal remains, and the occurrence, as a whole, unusually interesting and embracing. Until we are in a position to publish detailed reports, however, the following occurrences are noteworthy.

1. The 60 ft. terrace, shown as Site No. 5 on the accompanying 'composite sections' drawing (Fig. 2), comprises a thin layer of gravels that caps the old peneplain some sixty feet above the present flood plain. Inclement weather precluded the possibility of a thorough examination, but in the time at our disposal we were unable to find even traces of the manufacture of stone implements.

2 (*a*). In the lower terrace, actually an old river gravel, marked 'G' on sections 1, 2, 3 and 4 in Fig. 2, we recovered a few heavily rolled Lower Stellenbosch (Chelles plus Clacton type) tools and a great abundance of rolled and unrolled Upper

Stellenbosch (Acheul plus Proto-Levallois type) tools and the completely mineralised remains of a variety of extinct animals which Dr. Haughton will describe when he publishes his geological and other data.

In this Upper Stellenbosch congeries we have further definite proof, were this indeed required, that the so-called Victoria West industry merely represents the factory-site debris of the Upper Stellenbosch culture[1], for in addition to very many fine hand-axes and cleavers worked on flakes, we found numbers of detaching hammers and typical Victoria West cores from which the flakes (large and small) used for these axes and cleavers were struck. Several cores are normal in size, that is,

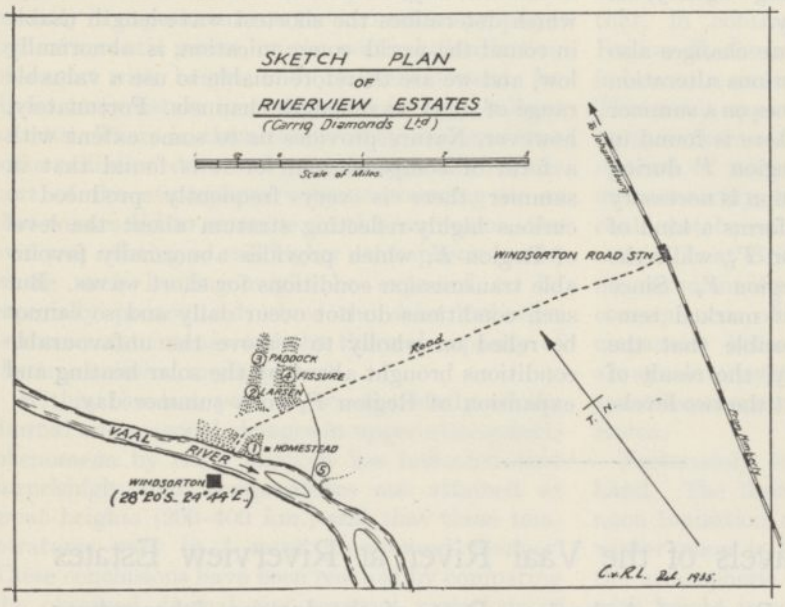

FIG. 1.

up to about 9 in. in length, but others are more than 15 in. long by 8–10 in. broad and deep and up to 150 lb. in weight. Twelve-inch flakes were struck from these great cores—cores frequently trimmed in typical Victoria West fashion *before* the flakes were removed. The materials preferred comprise varieties of Ventersdorp lava and quartzites, the weathering properties of which are entirely different from those of Victoria West (Karroo) dolerites, where insolation is common. No doubt whatever can be cast upon the purposeful shaping of these cores as a preliminary to the removal of the flakes that were ultimately trimmed into hand-axes and cleavers that vary from about three to ten inches in length.

It is this technique that I have in the past referred to as Proto-Levalloisian[2]—a highly specialised technique that enabled the manufacturers to produce axes or cleavers at will—a technique apparently unknown out of South Africa, though, I must confess, I suspect its occurrence in southern India. Once this special technique is understood and it is realised what a great proportion of the tools are cleavers, the necessity for breaking away from the use of such terms as 'Chellean' and 'Acheulean' will be more readily appreciated.

(*b*) The occurrence of rolled and unrolled implements and factory site debris at all levels in the gravels establishes the fact that the makers of Upper Stellenbosch tools occupied the valley before and during the deposition of these gravels. Dr. Haughton is equally satisfied that the animals, the fossil remains of which we recovered, also occupied the valley during this period. The animal remains include horse, buffalo, antelope, at least one large carnivore, hippopotamus, etc.

3 (*a*). Overlying these ancient gravels is a layer of silt and calcareous tufa that varies appreciably in texture and depth. But for a single *biface* (not seen) reported by Mr. Larsen as having been found at a depth of 15 ft. below the natural ground surface at Site No. 2, the silts and tufas of Sites Nos. 2, 3 and 4 appear to be sterile. At Site No. 1, marked 'Homestead' in Fig. 2, the silt is a loose sandy soil that is subject to movement by wind and rain. At Site No. 2 ('Larsen'), the silt is well consolidated and toward the surface passes into a calcareous tufa. The fact that 35-ft. high walls remain vertical without supports is illustrative of the high degree of consolidation. Except for three feet immediately over the gravels, penetration can only be effected by means of picks. This is largely, if not wholly, due to the formation of calcareous tufa in the deposit. Larsen's Site (No. 2) is probably the most interesting.

The diamondiferous gravels occur 35 ft. below the present ground surface and extend laterally over several acres, at a distance of 1–1½ miles from the river. They are reached by vertical shafts through the calcareous tufa and silt, and are 'worked' by means of tunnels. Shafts are sunk at fairly close intervals and intercommunication is maintained until the gravels are 'worked out' or a collapse occurs. We were able to walk about in these underground corridors, and with the aid of torches, to examine the undisturbed gravels in comfort.

At Site No. 3 ('Paddock'), situated about a

quarter of a mile from Site No. 2, the excavation is a huge open hole the walls of which are vertical and the silt therefore obviously also well consolidated. Immediately above the gravels the silt is a fine, clean sand—water-worn and false-bedded. Higher up the calcareous tufa occurs again. All these walls, both in shafts and open excavations, appeared to be sterile.

Between Sites Nos. 3 and 4 there occurs a barren patch, and at Site No. 4 the gravels and silt alternate as shown.

(*b*) At Site No. 1 ('Homestead'), the silt and later loose sand that cover the surface yielded a complete assemblage of Lower Fauresmith (mainly Micoque and Old Levallois type) tools. As this is only the second discovery of Stellenbosch-Fauresmith stratification, it is most important. The first was recorded six years ago[3]. Small and

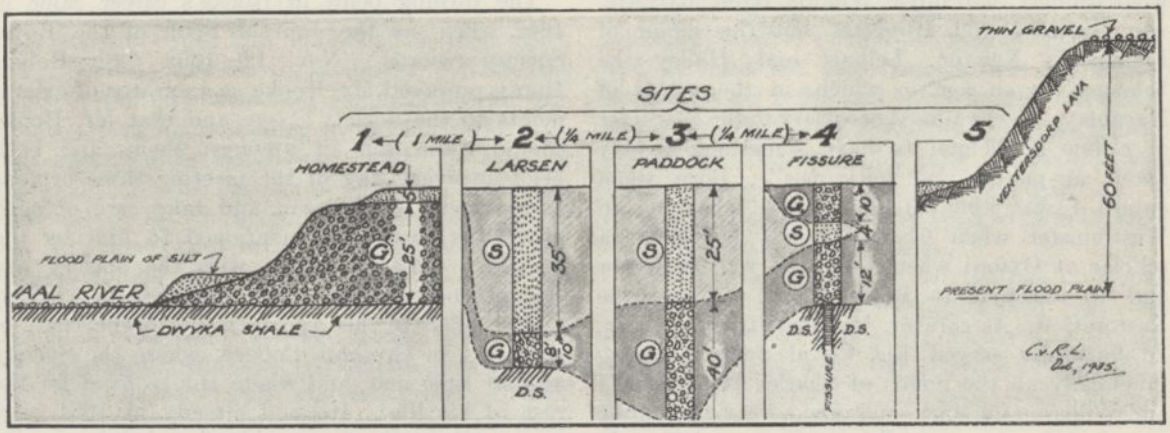

FIG. 2. Composite (diagrammatic) sections of the left bank of the Vaal River at Riverview Estates

well and neatly trimmed hand-axes, two cleavers, a scraper, several Levallois type flakes, fabricators, etc., were recovered—a good assemblage in a stratum very much more recent than the underlying gravels with their Upper Stellenbosch remains. The tools are almost exclusively of indurated shale (lydianite), though lava and quartzite appear also.

4. Lying entirely on the natural ground surface or just below the superficial shifting sands at Site No. 1 and at the foot of the scarp at Site No. 5, I collected deeply weathered Middle Stone Age (Late Levallois cum Moustier type) and slightly weathered remains of the Middle Smithfield (Capsio-Aurignacian type) culture.

The Middle Stone Age material is recognisable, but somewhat nondescript—mainly unworked flakes and a few small and inferior cores—but the Later Stone Age (Smithfield culture) comprises the usual variety and number of duckbill end-scrapers, side- and thumbnail scrapers, one bored-stone, one grindstone and one well-worked elongated phallus-like cylindrical artefact, truncated at one end and nosed at the other, $8\frac{1}{4}$ in. long with a maximum diameter of $2\frac{1}{4}$ in.

SUMMARY OF STRATIFICATION

1. Slightly weathered Middle Smithfield (Capsio-Aurignacian type) and much weathered Middle Stone Age (Late Levallois cum Moustier types) on surface at Site No. 1 and at foot of scarp at Site No. 5.

2. Deeply incrusted Lower Fauresmith (La Micoque cum Old Levallois types) in silt and loose sand capping gravels at Site No. 1.

3. Rolled and unrolled Upper Stellenbosch (Acheul plus Proto-Levallois type) implements and factory-site debris (Victoria West cores ≡ Proto-Levallois technique) and heavily rolled Lower Stellenbosch (Chelles plus Clacton-like flakes) throughout gravels at Sites Nos. 1, 2 and 3.

4. Three heavily rolled Clacton-like flakes of the Lower Stellenbosch recovered from mounds of 'worked' gravels removed from Site No. 4 after excavation. Horizon unknown.

In submitting this preliminary report, I do so with the hope that the larger and more detailed publications will not be long delayed. Dr. Haughton has very kindly undertaken to deal with the geology, palæontology and climatology of the area and the periods affected, and in doing so will, I have no doubt, add weight to my oft-expressed opinion that such closely related major problems as these that do not fall within the strictly specialised field of the prehistoric archæologist *qua* archæologist, should be left entirely to the other specialist or specialists concerned. It is only with the fullest support of the pleistocene geologist that

the archæologist can hope to solve the problems of early human cultures not only in Africa but also elsewhere.

In conclusion, I would like to express my great indebtedness to Mr. Webber and to Messrs. R. W. Hardy and Larsen, who put themselves, their discoveries and vast knowledge of the 'diggings' entirely at our disposal. To Mr. and Mrs. Hardy we are deeply indebted for hospitality during a particularly inclement week.

[1] Van Riet Lowe, C., "Fresh Light on the Prehistoric Archæology of South Africa", *Bantu Studies*, **3**, No. 4, 388; 1929.
[2] "The Prehistory of South Africa in Relation to that of Western Europe", *South African J. Sci.*, **29**, 756; 1929.
[3] Van Riet Lowe, C., "Notes on the Archæology of Sheppard Island", *Ann. South African Mus.*, **27**, 235; 1929.

Tercentenary of Robert Hooke, 1635-1703

OF all the scientific worthies of the seventeenth century, none will be remembered longer than Robert Hooke, whose views and activities influenced the progress of scientific thought and practical physics in an incalculable degree. Somewhat younger than Boyle, Wilkins, Wren, Mariotte, von Guericke and Huygens, but the senior of Flamsteed, Newton, Leibniz and Halley, he belonged to an age in which, in the words of Macaulay, "it was almost necessary to the character of a fine gentleman to have something to say about air-pumps and telescopes". Born when James I was king, Hooke was a schoolboy in Westminster when Charles I was beheaded, a scholar at Oxford when Cromwell was Protector and an assistant to Boyle at the time of the Restoration. As curator, and sometime secretary, he faithfully served the Royal Society during practically all the reigns of Charles II, James II and William and Mary, and died a year after Anne ascended the throne. Affairs of State and Church, however, made little difference to Hooke, and in the main his life was taken up with writing, lecturing and experiment. In the records of the first forty years of the Royal Society, no name is more frequently met with than his, and in his various capacities of curator, Gresham professor of geometry and Cutlerian lecturer on mechanics, he probably delivered more scientific discourses and made more experiments than any other man of his day. His influence was felt both at home and abroad, and the story of his life belongs to the history of our race in the same way as those of his contemporaries Dryden, Locke, Evelyn and Pepys.

Hooke was the son of the Rev. John Hooke, a curate of Freshwater, Isle of Wight, where he was born on July 18, 1635. He was a somewhat delicate child, and was kept at home until his father's death in 1648, when, after a short time with Lely, the portrait painter, he entered Westminster School and thus came under the famous Dr. Busby. Studious and inventive far beyond the average, at eighteen years of age he became a chorister and servitor at Christ Church, Oxford, and during the next eight or nine years gained the friendship of Wilkins, Ward, Willis, Petty, Boyle and other men of science, whose meetings at Oxford had much to do with the inauguration of the Royal Society in 1660.

The turning point in Hooke's career came in 1662 when, as the Journal Book of the Royal Society records, "Nov. 12, 1662. Sir Robert Moray proposed Mr. Hooke as a curator of experiments to the Society . . . and that Mr. Hooke should come and sit amongst them, and both bring in every day of the meeting three or four experiments of his own, and take care of such others, as should be mentioned to him by the Society". His connexion with the Society was strengthened next year by his election as a fellow, and in 1665 by his appointment to the chair of geometry in Gresham College, where the Society at that time met, and where Hooke lived for the rest of his life. He had already in 1664 been appointed to the lectureship founded by a city merchant, Sir John Cutler, Bt., and thus at thirty years of age Hooke found himself established in surroundings which must have appeared to him as congenial as those at the Royal Institution did to Faraday a century and a half later.

Of Hooke's versatility, originality and inventiveness ample evidence is to be found in his writings, but new and valuable information as to his activities in early middle life is contained in the "Diary", the recent publication of which we owe to Mr. H. W. Robinson and Mr. W. Adams. This diary covers the years 1672–80, when, in addition to his other appointments, Hooke was one of the surveyors of the City of London. The biographical index to the diary contains several hundreds of names, among them most of his scientific contemporaries.

Hooke himself was at once a physicist, an astronomer, an inventor, a mechanician and an architect. To horologists he is known for his application of the balance spring and the invention of the anchor escapement; by engineers he is remembered for his universal joint and his views

on elasticity; as an instrument maker he made improvements in thermometers, barometers, air pumps and microscopes, and he devised sounding apparatus for sailors and calculating machines. He was the first to describe the cellular structure of plants and the first to suggest the use that might be made of fossils in revealing the history of the earth. He had advanced views on gravity, colours and light, respiration, combustion and the nature of heat. His "Micrographia", published when he was thirty years of age, was the first major treatise on the microscope and microscopy. His "Attempt to prove the motion of the Earth" was published in 1674; his "Description of Helioscopes" in 1676; his "Cometa" in 1679. Many of his lectures and writings, however, were only published after his death. They are all full of pregnant suggestions, and as Dr. Singer says: "No Englishman of science has outlined so many and so variously important discoveries".

It was the Great Fire of London in 1666 which led Hooke to become an architect. While the ruins of the city were still smouldering, he produced a plan for rebuilding it. Although his plan was approved by the Royal Society, it was not adopted; but on October 4, 1666, the City made him one of its surveyors. Henceforth much of his time was taken up in attending committees, superintending the rebuilding of houses and designing structures such as the Bethlehem Hospital, Moorfields, Montagu House, which stood on a site now covered by the British Museum, the Merchant Taylors' Hall, and numerous churches and private residences. It was from this work that he accumulated the large sum of money which he intended to bequeath for the purpose of erecting a library, repository and laboratory for the Royal Society, a project which, however, came to nothing owing to his failure to make a will.

"There is a peculiar fascination," said Lord Oxford, "in trying to pierce through the gloom which veils the life-history of some of the most famous of our race." In endeavouring to do this in the case of Hooke, the newly-published "Diary" will be of the greatest interest. Hitherto opinion has been largely influenced by the remark of his biographer, Richard Waller, who said that "his temper was melancholy, mistrustful and jealous, which more increased upon him with his years". Always somewhat of a valetudinarian, Hooke had his share of troubles, and the picture of him as a lonely old bachelor in his somewhat neglected apartments in Gresham's decaying mansion in Bishopsgate Street no doubt is a true one. But in the "Diary" he is seen as a man of forty, mixing freely with his fellows, meeting at many coffee-houses and taverns, discussing a hundred different matters. His friend John Aubrey, the antiquarian, writing about this time, said of him: "He is of middling stature, somewhat crooked, pale faced; and his face but little belowe, but his head is large; his eie is full and popping, and not quick; a grey eie. He has a delicate head of haire, browne, and of an excellent moist curle. He is and ever was very temperate and moderate in dyet, etc. As he is of prodigious inventive head so he is a person of great vertue and goodness."

There is, unfortunately, no portrait of Hooke. Neither is there any monument to him. He died in Gresham College on March 3, 1703, and a day or two later, in the presence of the fellows of the Royal Society, was carried across Bishopsgate Street to St. Helen's and there laid to rest in the chancel. The exact site of his grave is not known, but at the west end of the Nun's Choir of the church is a window of five lights to ten Worthies of St. Helen's, among the names of whom is that of Robert Hooke.

Obituary

Prof. Alice Werner, C.B.E.

WE regret to record the death, which took place at Welwyn Garden City on June 9 at the age of seventy-five years, of Prof. Alice Werner, emeritus professor of Swahili and Bantu languages in the University of London.

If the study of questions relating to the African in Great Britain has been determined largely by the influence of Mary Kingsley, the study of the Bantu languages and mentality as an academic subject owes no less to Prof. Werner. She was born at Trieste on June 26, 1859, and educated at Newnham College. An unusual gift for languages and an absorbing interest in certain aspects of the mentality of the less-sophisticated peoples drew her to Africa. From 1893 onward, she lived there for some time at first with the Scottish Mission at Blantyre in Nyasaland, and afterwards in South Africa, where she was deeply influenced during her study of the Zulu language and people by the Misses Colenso, the daughters of the famous Bishop of Natal, and laid the foundation for that sympathetic understanding of the Bantu peoples which was such an outstanding feature in her academic and literary work. A second visit to Africa took place in 1911, when she spent two years as Mary Ewart travelling scholar of

Newnham College in visiting various peoples in East Africa. On her return in 1913 she was made a research fellow of her college.

Miss Werner's most important services to African scholarship date from 1899, when she opened a school for the study of African languages in Westminster, which was afterwards transferred to King's College and recognised by the University of London, while Miss Werner became successively lecturer, reader and professor. On the opening of the School of Oriental Studies of the University of London in 1917 she was appointed lecturer in Swahili and Bantu, and the position these studies now hold in the School is due to her enthusiasm and untiring energy.

In 1930, Miss Werner became emeritus professor, after receiving the degree of D.Litt. in 1928. In 1931 she was awarded the Silver Medal of the African Society, of which she was a vice-president at the time of her death, and in the same year was made a C.B.E.

Miss Werner was the author of a number of works dealing with African languages and folklore, among the best-known being "African Mythology" (1926) and the scholarly and at the same time delightful "Myths and Legends of the Bantu" (1933), while "The Structure and Relationship of the African Languages" (1930) sums up the results of many years study of material gathered at first-hand as well as critical examination of the work of other scholars. Miss Werner was a constant contributor to the periodicals of learned societies and the reviews. She wrote with a light touch which was derived from a thorough mastery of a wide range of knowledge; and, if an exacting critic, she was ever kindly, and her criticism constructive.

News and Views

Cultural Succession in the South African Stone Age

A PRELIMINARY report by Prof. C. van Riet Lowe on a discovery of faunal remains and stone implements of early man in the diamondiferous gravels of the Vaal River (see p. 53) is the first account in any detail to reach Great Britain of a firmly established archæological succession in the early stone age cultures of South Africa, which, it is safe to predict, will be a standard of reference in future research. From the evidence of five sites on the Riverview Estates, a diagrammatic section of stratification has been constructed which shows a regular chronological succession of cultures in the Lower, Middle and Later Stone Ages from 'Chellean' to 'Capsio-Aurignacian'. Points of special significance emerging are the identification of the much discussed so-called Victoria West industry, with its gigantic stone cores, as the factory *débris* of the Upper Stellenbosch of Lower Palæolithic age; the occupation by man of the Vaal River Valley both during and after the deposition of the old river gravel—the full significance of this will appear on publication of the palæontological evidence; the confirmation of the chronological relation of Upper Stellenbosch and Fauresmith cultures, the latter being shown by stratigraphic evidence to be of much later age; and the local specialisation in South African cultures and technique, which renders inept the application of a West European terminology. While the author refrains from broader inference, pending the opinion of experts on geological, climatological and palæontological evidence in a report now in preparation, the conclusion is warranted that this discovery will have more than local significance, especially as a contribution to the study of the great hand-axe culture, characteristic of Africa, but of highly specialised technique in South Africa, and distributed from Great Britain to India and even beyond.

Presentation of the Albert Medal to Sir Robert Hadfield

H.R.H. THE DUKE OF CONNAUGHT, president of the Royal Society of Arts, presented the Society's Albert Medal for 1935 to Sir Robert Hadfield on July 8 "for his Researches in Metallurgy and his Services to the Steel Industry". In making the presentation the Duke of Connaught said: "It gives me very particular pleasure on this occasion to present the Albert Medal of the Royal Society of Arts, a very high honour, which was founded in memory of my father, to one who has been a personal friend and a charming next door neighbour of mine in the south of France for many years. Your labours in the application of scientific research to the great steel industry have contributed greatly to its progress. As far back as 1882, by the discovery of manganese steel, you opened a new chapter in the history of metallurgy, and this remarkable alloy, which has found many uses in engineering and in mining, has also stimulated research into the causes of its unique hardness, and into the structure of the alloys of iron. As an industrialist, you have given great encouragement to scientific research in metallurgy by your example, and you have consistently upheld the view that the future of industry in this country is closely bound up with the attention which it gives to research". Sir Robert Hadfield, in accepting the Medal, expressed his gratification at the honour conferred on him by the Society and reaffirmed his faith in the value of research. Speaking in particular of metallurgy, he referred to the fact that among the previous recipients of the Medal were Bessemer and Siemens. For himself, he said that during his life he had done his utmost along with many others "to raise metallurgy from an empirical art to a true and important branch of modern science. I venture to add without fear of contradiction that the study and practice of metallurgy is no longer empirical but

is now based on scientific and orderly lines and has become just as much a part of science as engineering, chemistry and physics".

Retirement of Prof. A. Morley Davies

AFTER more than thirty years' service as demonstrator, lecturer and assistant professor, Dr. Arthur Morley Davies will shortly retire from the Department of Geology of the Imperial College of Science and Technology and readership in the University of London. Opportunity was taken by his colleagues in the Department to make him a presentation on Tuesday, June 25. Prof. Boswell recalled that Prof. Davies joined the College fifty-one years ago, and became a member of a stimulating group of students which included such well-known figures as H. G. Wells, R. A. Gregory, A. T. Simmons, A. E. H. Tutton and A. V. Jennings. Tribute was paid to Prof. Davies for his long and devoted services to geology, to the College and to learned societies. The Royal Geographical Society conferred honorary fellowship on him, and the Geological Association honorary membership, as a mark of appreciation of his help and counsel during many years; and the Geological Society awarded him its Murchison Fund and, later, its Lyell Medal in recognition of his original work. Prof. Davies is the author of text-books of geography, local geology, palæontology and, recently, of two volumes on the Tertiary faunas, which will long remain a standard work of reference.

Memorial to Sir Patrick Geddes

THE Outlook Tower, standing on the Castle Hill, Edinburgh, was intended by the late Sir Patrick Geddes to express and exhibit stages of social development, using the history and geography of Edinburgh and Scotland as particular illustrations, and passing from them to the British Empire, the United States of America, Europe, and the world as a whole. The Tower was founded by him in 1892 as a type museum of geography, history and sociology and as a centre of civic and regional study; and it will always be associated with his name. There could be no more appropriate means of commemorating Sir Patrick Geddes' work and influence than by establishing the Outlook Tower upon a permanent basis, and thus enable it further to be developed as an active centre for the dissemination of his ideas. With this end in view, a memorial, signed by a number of his friends and admirers, has been circulated, inviting contributions and asking also for the loan of any original letters or personal reminiscences, which with a considerable body of material already collected will be classified and edited so as to be available to students of civics and sociology. As Geddes was the apostle of town and regional planning, and devoted his life to promote intelligent and stimulating relationships between man and his environment, we hope that the response to the appeal now made will be ready and generous. Contributions should be sent to Sir Thomas B. Whitson, 21 Rutland Street, Edinburgh, and letters or other personal communications bearing upon Sir Patrick Geddes' life and work to the honorary secretary, Outlook Tower, Castlehill, Edinburgh.

Gas-Storage of Fruit

FIVE coolers, specially made to complete the equipment of the experimental refrigerated chambers at the Ditton Laboratory of the Department of Scientific and Industrial Research, were presented to the Laboratory on July 5. Three of the coolers were given by Mr. S. W. Mount, of Patricksbourne, Canterbury, on behalf of a number of British fruit-growers who are owners of gas-stores; the other two by Lord Dudley Gordon on behalf of Messrs. J. and E. Hall, Ltd., refrigerating engineers of Dartford, by whom the coolers were designed and made. Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, in accepting the gift on behalf of the Department, said that it indicated the confidence of those concerned in the fruit-growing industry in the work of the Department.

IN the course of his remarks Sir Frank Smith said that English apples do not do so well in cold storage as those from some other parts of the world; they are liable to rapid wastage on removal from store as the direct result of exposure to the low temperature. Fortunately, the Department has been able to find a solution of this difficulty, namely, 'gas-storage'. At a temperature of 41° F., with the oxygen in the atmosphere reduced to 10 per cent, and with the carbon dioxide raised proportionally to 10 per cent—a result which can be simply achieved by controlled ventilation in a gas-tight store—the Bramley's Seedling can be kept in first-rate condition for so long as twelve months. The first commercial gas-store in Great Britain was built by Mr. Mount in 1929; to-day there are some forty gas-stores in operation with a total capacity of about 400,000 bushels. Gas-storage as a method of preserving fresh fruit is only in its infancy. During the 1934–35 season, home-grown pears, of the variety Conference, were kept in gas-storage at the Ditton Laboratory for some months, with highly promising results. The Laboratory has also carried out preliminary experiments on the gas-storage of tomatoes, and again the results have been sufficiently promising to warrant development.

Conference on Folk-Dancing

A CONFERENCE on folk-dancing, which is being held in London on July 15–20 in connexion with an International Folk-Dance Festival, will afford an exceptionally favourable opportunity for the comparative study of this survival of European folk art and ritual. Students from all parts of Europe, it is stated in a preliminary announcement by a correspondent of *The Times* in the issue of July 6, will be present, and will discuss selected and especially significant dances still found among the peasantry of the remoter parts of Europe. These will be illustrated in many instances by dancers of the country of origin, who are attending the conference

specially for the purpose. Thus Roumania will be represented by the seasonal hobby-horse dance performed by the Cališari with their heavy bells. The dance and its numerous seasonal parallels in other parts of Europe will be demonstrated and discussed by Prof. Vula. A Bulgarian theme, the 'spring maiden' of folk dance and song, will be analysed by Mme. Raina Katzarova, of the Ethnographical Museum, Sophia, who will illustrate her argument with movements by Bulgarian dancers. The interesting form of the sword dance found in Piedmont, with its singular combination with the maypole ritual and its resemblances in detail to the sword dance of Britain, will also be shown and afford an opportunity for comparison with a presentation of the Austrian sword dance, which has given evidence for an alternative explanation of the dance to that generally accepted. Britain, the Netherlands, France and Norway are among other countries providing material for discussion. The international folk-dance festivals which have been held in London in recent years have provided much interesting material for consideration, but on this occasion the conjunction of a conference dealing with study of the rituals, of which the dances preserve the evidence, should do much to advance the scientific study of this important department of primitive religion. The Conference will meet at the Cecil Sharp House, Regent's Park, London, N.W.1.

North East Coast Institution of Engineers and Shipbuilders

THE North East Coast Institution of Engineers and Shipbuilders will celebrate its jubilee on July 16–19 at Newcastle-on-Tyne. The Institution held its inaugural meeting on November 28, 1884, and from then until the present time has been one of the most active bodies concerned with the advancement of the sciences of engineering and shipbuilding not only in Great Britain, but also throughout the world. Representatives will attend the meeting from the leading British kindred societies and allied bodies, and also from France, Germany, Holland, Italy, Japan and the United States. The papers to be presented at the meeting will deal with the history of engineering during the past fifty years in the following sections: liners, cargo ships and tankers, coasters, marine turbines, reciprocating steam engines, marine boilers, marine heavy-oil engines, and recent progress in electrical and general engineering. Dr. John T. Batey will preside at the meetings. A pleasurable feature will be the presentation of acknowledgments to founder members. Notable among these are Sir George B. Hunter, Mr. J. Denham Christie, Prof. R. L. Weighton and Mr. W. G. Spence (the initiator and first honorary secretary of the Institution). The honorary fellowship of the Institution will be conferred upon the following: Mr. George Stephen Baker, superintendent of the William Froude Laboratory; Vice-Admiral Sir Harold A. Brown, engineer-in-chief of the Fleet; Sir Cecil Algernon Cochrane, chairman of Armstrong College Council, 1923–35; and Sir Arthur William Johns, director of naval construction.

Ultra-Violet Transmitting Glass

SPECIMENS of ultra-violet transmitting plate glass produced by Messrs. Pilkington Brothers Ltd., of St. Helens, Lancashire, show a region of high transmission in the region near 3650 A., with an almost complete opacity to the visible spectrum except in the extreme violet, where the transmission is, however, said to be only about 1 per cent. Tested with a powerful spark source and a monochromator, the claims of the makers were found to be justified. The transmission in the ultra-violet was comparable with that of an 'ultra-violet' glass from another source, the cadmium line near 3610 A. being freely transmitted; but whereas Messrs. Pilkington's new glass showed no transmission in the visible region when tested with a pocket spectroscope, the other glass showed a marked transmission band in the red. The glass can be manufactured in large sizes; specimens have been submitted of thickness 8 mm. and 11 mm. respectively. In view of the increasing importance of fluorescence tests, and other applications of ultra-violet radiation, numerous uses should be found for it, since its opacity to visible radiations should facilitate the distinction between genuine fluorescence and effects of reflected light. It may be worth noting that in very thin layers this new glass is of a blue-green colour. A prism of small angle ground to a very thin edge should make a very pretty example of dichromatism.

Scent and the Weather

HITHERTO, success in hunting has depended largely on popular omens of hunting conditions and on the practical experience of Masters of Hounds. The relation of scent and the weather formed the subject of a recent scientific study (see NATURE, April 14, 1934, p. 548). Now a meteorological officer of the Royal Air Force (R. G. Veryard) has supplied information enabling the Master to arrange place and time of meet to fit in with the best scenting conditions. In a pamphlet issued by the Masters of Foxhounds Association of India (Lieut.-Col. C. J. R. Turner, 47th Sikhs, Chaman, Baluchistan. 3 rupees), although specially written for the Peshawar Vale Hunt, he discusses many points which are of more than local interest. An inversion, or low lapse-rate of temperature, involving a restriction of the upward motion of eddies, is mainly favourable for good scenting conditions. The author does not agree with Mr. Budgett's view that for scenting conditions to be good the ground must always be warmer than the air, because a superadiabatic lapse-rate near the ground causes atmospheric turbulence which dissipates even scents which were quite strong initially. The number of good and bad scenting days are approximately equal during a calm, but, with a moderate wind, up to 3 on the Beaufort scale, the rate of evaporation is increased and scent may be good. If the air is less than 30 per cent saturated, scenting conditions are likely to be poor. Scent is more likely to be good if the soil is moist than if it is dry. The best hunting conditions in Peshawar obtained when the air temperature registered between 40° and 65° F.,

that is, in the morning. A general survey of meteorological conditions over the hunting season undoubtedly resulted in better sport, scenting conditions being predicted with fair accuracy for particular days. It is suggested that, from a study of the meteorological elements in relation to scent, a Master of Hounds will be able to frame suitable questions, the replies to which will give him a good idea how he can benefit by the information.

Micro-Climatology

A NEW quarterly journal entitled *Bioklimatische Beiblätter der Meteorologischen Zeitschrift* made its appearance last year. It is a joint production of the German and Austrian Meteorological Societies, and is edited by Drs. W. Schmidt of Vienna and F. Linke of Frankfort a. M. A specimen number (Band 1, Heft 3) has been received from Dr. Schmidt. It sets out to deal with observations made in such a way as to represent the climates actually experienced by various living organisms; in other words, to portray the so-called micro-climates. Micro-climatology is a comparatively new subject, and one which has a scope that is great in proportion as there are innumerable problems of a biological nature to which it has some application. Among the papers in this specimen copy is one by F. Steinhauser which is a good example of micro-climatology: it is a study of the special temperature conditions which the dwellers in large towns experience out of doors, conditions which are different from those prevailing in neighbouring open country, and which are of biological importance to the people concerned. Another paper, by W. Kühnelt, deals with the general significance of climate for the animal kingdom. These are both largely surveys of work done by those engaged on those special questions; in another, by Dr. Linke, one of the editors, a brief survey is given of the pioneer work of W. F. Tyler on the psychological effects of various degrees of relative humidity combined with high temperature, founded on studies made in Shanghai, from which Tyler drew lines of equal discomfort termed 'hythers' on a temperature and relative humidity diagram.

Chemical Industry in the United States

THREE hundred years ago, there was established in Boston "a strange combination of druggist's shop, metallurgist's workroom, chemist's laboratory, and alchemist's den" which may fairly claim to have given birth to the American chemical industry. It was the enterprise of John Winthrop the younger, who at the age of twenty-five years had gone from Suffolk to Massachusetts as assistant to his father, an important Puritan leader, and governor of the Company of the Massachusetts Bay. Becoming Governor of Connecticut for a time, the son later returned to England and renewed contacts with British men of science, returning afterwards to America and resuming his public service. His medicinal prescriptions became famous; he mined for lead, tin and copper; he manufactured salt, glass and iron; he produced potash, saltpetre, alum, wood pitch and tar, and indigo; he built up the first scientific library in America; and he promoted the first American chemical stock company. In celebration of the tercentenary, the American journal *Chemical Industries* has published a supplement entitled "Chemical Industry's Contribution to the Nation: 1635–1935", a pleasantly presented and lavishly illustrated issue of 176 pages, which surveys the progress of chemical industry in the United States and includes a list of important commercial chemicals manufactured in that country. The chapter describing the *raison d'être* and public service of the Chemical Foundation opens with the following statement: "The establishment of a self-contained synthetic organic chemical industry in the United States is the only thing of substantial value which we got out of the war. Its establishment meant more to the American people than reparations or territory. . . . The value of this industry to the American people is inestimable."

International Broadcasting Union

ACCORDING to a report in *World Radio* for July 5, the International Broadcasting Union concluded its annual meeting on June 26, at Warsaw. Representatives of broadcasting organisations in twenty European States and in the United States of America were present. It was stated during the course of the session that the potential audience of listeners at the beginning of June has reached at least 200 millions. Among the more important business of the conference was the decision to organise a limited number of international programmes each year, in the form of discourses in which direct contact will be established between the greatest contemporary leaders in science and art, and listeners in the various countries of the Union. The progress in technical precision in broadcasting stations in recent years is illustrated by the results obtained at the Union's central observation laboratory in Brussels. Whereas ten years ago stations were known to fluctuate a few thousand cycles per second from their normal frequency during the course of a few hours, to-day the principal European stations do not fluctuate more than one or two cycles in a month from their established frequency, which in many cases is of the order of one million cycles per second. This meeting formally marked the conclusion of the first ten years of the Union's activities; and it witnessed also the passing from the office of president of Vice-Admiral Sir Charles Carpendale (a controller of the B.B.C.) who has been president of the Union since its foundation. Very warm tributes were paid to Sir Charles for his services in the cause of international broadcasting. The new president of the Union is M. Maurice Rambert, administrateur-délégué of the Société Suisse de Radiodiffusion.

Television in Germany

THE Berlin correspondent of *World Radio* states that although the German Broadcasting Company inaugurated its experimental high-definition television service on March 22 last, suitable receivers are not

yet available to the public, and when they are produced they will cost £30–£100 each. Both the German Post Office and the Broadcasting Company are, however, eager to provide the public with means whereby they can form an opinion of the entertainment value of the new service. Accordingly, the Post Office has opened a televiewing room in Berlin where reception is demonstrated every morning. Also, in co-operation with the German Listeners' Association, four similar rooms have been opened in other parts of the city where the public can witness the reception of the evening programmes. No charge is made for admittance, although to prevent undue crowding, tickets are issued and the attendance of each person is limited to half an hour. Thus during an evening programme of one hour and a half, three groups of 40–50 persons can have a demonstration at each centre. It is intended to extend these free facilities so that television, even in its present stage, will not be limited to the small group of persons who are financially in a position to buy apparatus.

Visibility Distance of Pedestrians

TESTS were carried out last year by the Massachusetts Highway Accident Survey with the object of finding out by actual experiment the distance at which the driver of a motor vehicle can see a pedestrian who is walking along the side of a highway at night. The tests are analysed and discussed in a paper by P. Moon and R. C. Warring (*J. Franklin Inst.*, March). The principal conclusions arrived at are that the visibility of a pedestrian walking along a highway at night is increased by roughly 50 per cent by showing a small area of white such as a handkerchief. Three reflector buttons, such as those employed in reflecting type highway signs, worn with dark clothing increase the visibility distance by 100 per cent, the same as that produced by a large area of white. It was found that the maximum safe speed at night was approximately 30 m.p.h., but if there was no glare from passing cars it was 40 m.p.h. These speeds are the optimum values. The time lag of the driver seems to vary between 0·5 sec. and 1 sec. even when the surprise element is lacking. On unlighted roads the type of the pavement and the speed of the car have little effect on the visibility distance. The tests show that it is advisable not to have the candle-power of the headlamps less than 32. Experience shows that depressing the headlamp beams so as to diminish glare reduces the visibility distance. Another important conclusion is that highway lighting does not increase visibility distance unless the average luminosity of the pavement is above the chromatic threshold, which is generally taken to be of the order 0·05 lumen per square foot.

The *Camionale* Genoa-Serravalle for Lorry Traffic

THE handling of the large import and export traffic of Genoa is a problem that has been studied by many Italian Governments. A satisfactory solution has now been found. A full description of the first section of the new motor road for heavy lorries (*camions*) called the *Camionale* is published in *Engineering* of June 28. The electrification of the railway from Genoa to Roneo over the Giovi mountain range in 1916 increased the capacity of the line more than four times. When this proved insufficient, a more direct electric railway was projected between Genoa and Arquata, necessitating the construction of a tunnel ten miles long through the Giovi mountains. The development of motor road transport and the success of the *autostrada* connecting Milan and Como, Naples and Pompeii, etc., created a new situation. The autostrada are characterised by the absence of practically all crossings and have minimum gradients and curves of long radius. No pedestrians are allowed on them. The new motor road, or Camionale, will ultimately join Genoa with Milan and Turin, and the projected electric railway has been abandoned. The Camionale starts from a large square near the Port of Genoa and traverses the Promontorio and Belvedere Hills by means of two long tunnels. After passing through many further tunnels, the road passes over the Montanesi torrent by means of a picturesque viaduct. In the Littorio tunnel, 2,926 ft. in length, the road reaches its highest altitude, 1,255 ft. above sea-level, at a distance of 13 miles from the terminal square at Genoa. The terminus at Serravalle Scrivia is 31 miles distant from Genoa. The geological conditions made the construction of the Camionale very difficult. The width of the road is 10 metres (32 ft. 10 in.). The total cost of construction of the Camionale is about 3½ million sterling at the present rate of exchange.

Australian Institute of Agricultural Science

IN January 1935 the Australian Institute of Agricultural Science was inaugurated, with Prof. A. E. V. Richardson, of the Waite Institute, as its first president. The presidential message states that "the major work of the Institute will be the development of an *esprit de corps* among the members of the profession throughout the Commonwealth, and in assisting in the formation of a public opinion which will insist that the agricultural and pastoral resources of Australia should be developed by the best known methods and utilised to the best advantage attainable". The constitution provides for periodical meetings of the Institute and its local branches, and also for the publication of a journal of which the first number has now appeared (vol. 1, No. 1, March 1935). It is intended that this journal shall be devoted to the publication of leading articles, reviews of present states of knowledge, research papers, technical notes and other items of a professional and general nature. The current number gives some indication of the wide field of interests it is proposed to cover. Contributed articles deal with agricultural science in the Soviet Union, and with rural relief and agricultural extension. The economic side is catered for by an article dealing with commerce and agricultural research and also by abstracts of a discussion on "Plant Quarantine" at the Melbourne meeting of the Australian and New Zealand Association for the Advancement of Science. The technical notes deal with various problems in agricultural plant physiology, entomology and pathology, while a column of

personal notes will help to keep the members of the Institute in touch with one another. If the present programme is continued, both the Institute and the *Journal* should help to fill the need that has long been felt for an organisation, commonwealth in scope, through which the views of the agricultural profession can be expressed.

Monographs of Physiology

THE rapid advance in our knowledge in every branch of scientific inquiry makes it difficult or impossible for investigators to follow the work which is being carried out in other fields than their own in any great detail. Even in their own particular sphere, they must rely for their knowledge of the literature to a certain extent upon the abstract and review journals. For this reason, we welcome the short monographs on different subjects which are now being published in Paris: the earlier series dealt with problems of physics and physical chemistry, but during the past year various monographs on physiological questions have been issued (Actualités Scientifiques et Industrielles. Nos. 113, 135 and 136, 178 and 179. 1934. Paris: Hermann et Cie). No. 113 in the series, by T. Cahn and J. Houget, gives a short account of the biochemistry of muscular contraction. The four chapters deal with the chemical changes occurring in a muscle extract, in an isolated muscle and in the intact animal during muscular work: the fourth summarises our knowledge. There are no references. Nos. 135 and 136, by Z. M. Bacq, give short accounts of sympathicomimetic substances and of the hormones and vitamins: bibliographies are included. The first gives a brief account of substances which produce the same, or similar, effects in the body as stimulation of the true sympathetic nerves, and discusses their mode of action. The second reviews briefly our present knowledge of the hormones and vitamins, especially from the point of view of the minuteness of the quantity which is active in the body. Nos. 178 and 179, by F. Kayser, deal with the biochemistry and physiology of creatine and creatinine, including their metabolism in health and disease. The subject is treated more fully than in the other monographs and the bibliography occupies about one third of each volume. Each gives an excellent review of our present knowledge of the functions of these compounds in the body, and is worth perusal by those interested.

University Degrees in Engineering

THE series of articles in the *Engineer* on "University Degrees in Engineering", to which we directed attention some time ago, have now been republished as a booklet (London: Morgan Brothers (Publishers), Ltd., 1*s*.). The author of the articles is Dr. T. W. Chalmers, and the survey has been prepared from information contained in official publications of the nineteen universities of Great Britain and Ireland. The survey does not pretend to cover all the essential features of the regulations, and matters connected with matriculation and entrance examinations have been excluded. The booklet should prove of use to everyone interested in engineering education.

Rabies in South Africa

IN the *Onderstepoort Journal of Veterinary Science and Animal Industry* for October 1934 (3, No. 2, p. 335), attention is directed to the increase in South Africa in the incidence of rabies in 1933 over 1932. The disease occurs, and appears to be spreading, among the small wild carnivora (*Viverridæ*). The disease was definitely proved in twenty animals, and in addition nine calves and three cows almost certainly died from it. There were six cases in man, transmitted once by a dog, twice by the domestic cat, once by a wild cat, and twice by the yellow mungoose (*Cynictis*).

The Case for Vivisection

AN article with this title, by a 'layman', Mr. J. Alderson, appears in the Research Defence Society's journal the *Fight against Disease* (No. 2, 1935). The author points out that experiments on animals in Great Britain are rigorously controlled by Act of Parliament; but it is his conviction that were there no such Act, vivisection would be carried out just as humanely as it is now, for a love of animals and abhorrence of wilful cruelty are as evident among medical men as among other citizens. He concludes by stating that he feels he must support and defend the work on account of the discoveries made through experiments on animals, and that whenever relevant information can be so obtained, it is our duty to encourage and support it.

Nutrition Research at the Mellon Institute

DURING 1934, Dr. Gerald J. Cox and Miss Mary L. Dodds, working on a fellowship at Mellon Institute of Industrial Research, investigated fundamental causes of tooth decay. Their work suggested the existence of a factor which, if present in the diet during a critical period of tooth formation, will aid in the construction of teeth resistant to decay. This research is to be continued, along broad lines, through a grant for a period of one year from the Buhl Foundation of Pittsburgh. The investigation, which will be known as the Institute's multiple fellowship on nutrition, will be carried on by Dr. Cox as senior fellow, Miss Dodds as the junior incumbent, and W. E. Walker as the assistant, in the Department of Research in Pure Chemistry of the Institute. It is planned first to determine definitely whether or not this factor actually exists, and, if so, its nature, properties, distribution and extraction. Secondly, studies will be made of physiological processes which are likely to influence the development of dental caries.

Award for Research in Fruit Growing

IN 1920 Miss L. Jones-Bateman of Cae Glas, Abergele, presented to the Royal Horticultural Society a valuable silver-gilt replica of the Warwick Vase, to be used for the encouragement of fruit production. It has accordingly been decided to offer it triennially for researches in the growing of hardy fruits, figs, grapes and peaches in the open or under glass, and it is available for award in 1935. Candidates

should submit accounts of their work by October 31. The work dealt with must have been carried out by the candidate in the United Kingdom mainly during the past five years. Further particulars may be obtained from the Secretary, Royal Horticultural Society, Vincent Square, Westminster, S.W.1.

Rockefeller Medical Fellowships

THE Medical Research Council announces that the following awards of travelling fellowships for the academic year 1935–36 have been made on behalf of the Rockefeller Foundation of New York: Dr. D. F. Anderson, professor of midwifery and gynæcology, Anderson College of Medicine, Glasgow; Mr. N. R. Barrett, demonstrator of anatomy and chief assistant to the Surgical Unit, St. Thomas's Hospital, London; Mr. A. C. P. Campbell, clinical tutor in medicine, Royal Infirmary, Edinburgh, and assistant lecturer, Department of Pathology, University of Edinburgh; Mr. D. H. K. Lee, Sharpey Scholar, Department of Physiology, University College, London; Mr. J. E. A. O'Connell, demonstrator in anatomy, St. Bartholomew's Hospital Medical School, London; Mr. R. Walmsley, assistant in anatomy, University of Edinburgh. All the fellowships awarded this year are tenable in the United States.

International Medical Post-Graduate Congress

THE seventh International Medical Post-Graduate Congress of the Tomarkin Foundation, New York, which has been organised under the auspices of the Université Libre de Bruxelles, will be held at Brussels on September 12–19 and at Spa on September 20–October 2. The proceedings at Brussels will include an international commemoration of Pierre Curie and Mme. Curie by a discussion on cancer, in which the Tomarkin Foundation will be assisted by the International Union against Cancer, and communications on tropical, subtropical and infectious diseases, and neurology; while the Spa meeting will be devoted to diseases of the cardio-vascular system and diseases of the blood. Papers on miscellaneous topics will be read at both meetings. The subscription terms are as follows: Full Congress, 80 belgas; half Congress, (Brussels or Spa), 50 belgas; single section, 30 belgas. On termination of the Congress, a visit will be paid to the principal Italian universities (Milan, Pavia, Bologna, Florence and Rome) and the most important sanitary institutes. The tour will last 10–12 days and the inclusive fare will be about 1,500 lire. Further information can be obtained from the Secretary, Tomarkin Foundation, 97 rue aux Laines, Bruxelles.

Announcements

PROF. JEAN LEPINE, Dean of the Lyons Faculty of Medicine, has been elected a member of the French Academy of Moral and Political Sciences.

THE Secretary of State for the Colonies has made the following appointments: Mr. J. M. Taylor, to be chief fruit inspector, Palestine; Mr. A. H. Weir, senior assistant conservator of forests, to be assistant deputy conservator of forests, Nigeria; Mr. A. E. Colman-Doscas, agricultural field officer, Federated Malay States, to be State agricultural officer, Johore; Mr. J. C. Nauen, horticulturist, Bermuda, to be assistant curator, Gardens Departments, Straits Settlements; Mr. R. O. Williams, assistant director of agriculture, Trinidad, to be chief horticultural officer, Palestine.

THERE are at present fourteen different localities in the Soviet Union for squadrons of sanitary aviation, and their number will be considerably increased in the course of the year. The Moscow squadron which was established in the spring of 1934 has already flown 534 hours and covered 67,680 kilometres in transporting 28 sick or wounded persons, 34 doctors, 48 litres of blood for transfusion and 500 kgm. of medical apparatus.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A probationary assistant lecturer in mathematics in University College, Bangor—The Registrar (July 15).

A lecturer in mechanical and civil engineering in the Technical College, Sunderland—The Chief Education Officer, Education Offices, 15, John Street, Sunderland (July 16).

A resident tutor (male) in geography at the Borough Road College, Isleworth—Principal (July 17).

A junior forestry inspector in the Department of Lands, Irish Free State—Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (July 18).

A teacher with qualifications in zoology, botany and chemistry in the Northampton College of Technology—Secretary, Education Office, Northampton (July 18).

An assistant teacher of mining subjects in the Doncaster Technical College—Secretary, Education Offices, Doncaster (July 19).

A woman lecturer in mathematics and biology or geography in the Swansea Training College for Women—The Director of Education, The Guildhall, Swansea (July 19).

An assistant to the secretaries of the Institution of Professional Civil Servants—Honorary Secretary (July 20).

Assistant civil engineers in the Civil Engineer-in-Chief's Department, Admiralty and H.M. Naval Establishment—The Civil Engineer-in-Chief, Admiralty, London, S.W.1 (July 31).

An assistant lecturer in physiology in University College, Cardiff—The Registrar (Aug. 31).

An assistant in the Department of Mechanical Engineering, Guildford Technical College—The Director.

An assistant lecturer in civil engineering in the Battersea Polytechnic, London, S.W.11—The Principal.

An inspector of machinery in the Mines Department of the Gold Coast Government—Crown Agents for the Colonies, 4 Millbank, S.W.1, quoting M/3793.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 71.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Quantum Mechanics and Physical Reality

IN a recent article by A. Einstein, B. Podolsky and N. Rosen, which appeared in the *Physical Review* of May 15, and was reviewed in NATURE of June 22, the question of the completeness of quantum mechanical description has been discussed on the basis of a "criterion of physical reality", which the authors formulate as follows: "If, without in any way disturbing a system, we can predict with certainty the value of a physical quantity, then there exists an element of physical reality corresponding to this physical quantity".

Since, as the authors show, it is always possible in quantum theory, just as in classical theory, to predict the value of any variable involved in the description of a mechanical system from measurements performed on other systems, which have only temporarily been in interaction with the system under investigation; and since in contrast to classical mechanics it is never possible in quantum mechanics to assign definite values to both of two conjugate variables, the authors conclude from their criterion that quantum mechanical description of physical reality is incomplete.

I should like to point out, however, that the named criterion contains an essential ambiguity when it is applied to problems of quantum mechanics. It is true that in the measurements under consideration any direct mechanical interaction of the system and the measuring agencies is excluded, but a closer examination reveals that the procedure of measurements has an essential influence on the conditions on which the very definition of the physical quantities in question rests. Since these conditions must be considered as an inherent element of any phenomenon to which the term "physical reality" can be unambiguously applied, the conclusion of the above-mentioned authors would not appear to be justified. A fuller development of this argument will be given in an article to be published shortly in the *Physical Review*.

N. BOHR.

Institute of Theoretical Physics,
Copenhagen.
June 29.

Isotopic Constitution of Palladium and Gold

THESE two elements are among the few from which positively charged atoms have not been obtained by means of volatile compounds introduced into the electrical discharge or by means of anode rays. In a letter in NATURE[1], the possibility of using the ions from a high-frequency spark was pointed out. With the mass-spectrograph [recently described in NATURE[2]] it was found that palladium consists of six isotopes with atomic masses 102, 104, 105, 106, 108, 110. They could be compared with doubly-charged platinum and gold atoms which were present as a slight impurity. The four middle components are about equally strong; the one at 110 is weaker, and the lightest at 102 is the faintest.

From its atomic weight 197·2 and the behaviour of other elements of odd atomic number, it was anticipated that gold would have two isotopes at 197 and 199, one about ten times the intensity of the other. It was somewhat of a surprise to find that no second component could be found. Exposures were made with 300 and 500 times the time required to show the main line, and failed to show any trace of a heavier isotope. It is thus very probable that gold has only one component, and that the accepted atomic weight is too high.

A. J. DEMPSTER.

University of Chicago.
June 12.

[1] NATURE, **135**, 542; 1935.
[2] NATURE, **135**, 993; 1935.

Platinum Isotopes and their Nuclear Spin

Using a water-cooled hollow cathode of a new design, the hyperfine structure of the arc lines of platinum λλ 3408 and 3042 A. have been studied. These two lines have a common lower level $5d^96s^2a^3F_4$; and the similarity of their structure patterns leads to the conclusion that in neither case is the upper level split. The lines have the following structure:

Wave-length (in I.A.)	Classification[1]	Structure (in cm.$^{-1}$)
3408·13	$5d^96s^2\ a^3F_4 - 5d^96s6p\ z^5D^0_4$	+ 0·161 (5), 0·000 (18), − 0·086 (7), − 0·176 (1), − 0·314 (4). (vide Fig. 1)
3042·75	$5d^96s^2\ a^3F_4 - 5d^96s6p\ z^5G^0_4$	+ 0·162 (5), 0·000 (18) − 0·087 (7), − 0·174 (1), − 0·314 (4).

An examination of the structure leads to the unique inference that the three central components 0·000 (18), − 0·086 (7) and − 0·176 (1) have to be ascribed to the even isotopes 196, 194 and 192 respectively, the remaining two components being due to the odd isotope 195 with a nuclear spin of $\frac{1}{2}h/2\pi$. The centre of gravity of the latter components falls at − 0·050 cm.$^{-1}$ between the bright components due to 196 and 194. The deeper level $5d^96sa^3D_2$ shows no measurable isotopic displacement. The hyperfine levels in platinum are inverted. These results are confirmed by the analysis of eight other arc lines of platinum, namely, 2998, 2929, 2734, 2719, 2705, 2702, 2659 and 2650 A. Neglecting

isotopes of small abundance, the isotopes of platinum, purely from hyperfine structure data, in decreasing order of their relative abundance, are 196 (18), 195 (9), 194 (7) and 192 (1). The relative isotopic abundance given above is from eye-estimates of the intensities of the components and is to be checked by microphotometric measurements.

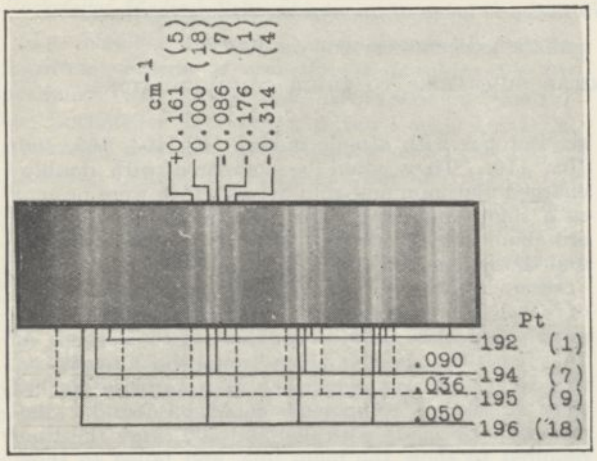

FIG. 1. Structure pattern of Pt I λ 3408·13 A. ($a^3F_4 - z^5D^0_4$) obtained by a Hilger quartz Lummer plate, 3·45 mm. thick and 20 cm. long.

Platinum exhibits a positive isotope shift, that is, the heaviest isotope lies deepest. The nucleus of platinum can be considered as having 39 α-particles, with neutrons to make up the mass number. The observed positive isotope shift is consistent with our previous generalisation[2] that even atomic number "elements whose nuclei contain an odd number of α-particles exhibit positive isotope shift and those with even number a negative displacement".

Details will soon appear in the *Proceedings of the Indian Academy of Sciences*.

B. VENKATESACHAR.
L. SIBAIYA.

Department of Physics,
University of Mysore,
Central College,
Bangalore.
June 8.

[1] Livingood, *Phys. Rev.*, **34**, 185–198; 1929.
[2] Venkatesachar and Sibaiya, *Proc. Ind. Acad. Sci.*, **1**, 8–13; 1934.

Selective Absorption of Slow Neutrons

IN our letter of April 12[1], we mentioned that the absorption of slow neutrons by iodine was apparently greater when the induced β-ray activity of an iodine detector was used as a measure of the number of neutrons transmitted than when detectors of silver or rhodium were employed. We have now confirmed this selective absorption and have extended the measurements to absorbers of silver and of copper, where analogous though somewhat less marked selectivity is found. The accompanying table shows the activity (expressed as a fraction of that obtained in the absence of the absorber) when hollow cylinders of silver (1·0 gm. cm.$^{-2}$), copper (4·5 gm. cm.$^{-2}$) and iodine (2 gm. cm.$^{-2}$) were placed in turn around various detectors, themselves in the form of hollow cylinders. A layer of cadmium, sufficiently thick to absorb nearly all slow neutrons striking it, was always placed inside each detector during irradiation, so that when the absorber was in place, neutrons reaching the detector must have passed once, and only once, through the absorber. The irradiation was performed within a 4 cm. cavity in a large block of wax, the source being at 9 cm. from the centre of the cavity. It seems clear that different nuclei prefer neutrons of different velocities.

Detector \ Absorber	Silver	Copper	Iodine
Silver (25 sec.)	0·50 ± 0·03	0·72 ± 0·04	0·85 ± 0·05
Silver (150 sec.)	0·51 ± 0·03	0·70 ± 0·04	0·95 ± 0·06
Copper (5 min.)	0·62 ± 0·05	0·72 ± 0·045	0·89 ± 0·06
Copper (10 hr.)	—	0·62 ± 0·05	0·90 ± 0·07
Iodine (25 min.)	0·72 ± 0·025	0·76 ± 0·025	0·68 ± 0·03
Rhodium (44 sec.)	0·69 ± 0·025	0·80 ± 0·04	0·91 ± 0·04
Silver (25 sec.) 'Cold' neutrons	0·41 ± 0·03	—	—

In connexion with the effect of temperature on the properties of neutrons, which we reported in our last letter and which is supported (at least as regards several elements) by recent work of Fermi and his collaborators[2], we should like it to be made clear that numerical values of the ratio of the activities induced by neutrons of different 'temperatures' are significant only with respect to the geometrical conditions of the particular experiment in question. An important factor is the thickness of the hydrogenous layer the temperature of which is altered. If this layer be thin in relation to the mean free path for *scattering* of the thermal neutrons, a new 'temperature' cannot be set up; if, on the other hand, the layer be so thick that there is a large chance that a thermal neutron will be *absorbed* in passing through it, the observed change in the induced activity will be a differential effect of the changes in absorption coefficients of the wax and of the specimen. It might be possible to obtain rough values for the free paths for scattering and absorption from observations of the temperature effects with layers of different thicknesses. The thickness of the detector may also be of great importance; for example, 'cold' (90° K.) and 'warm' neutrons were allowed in turn to fall on the *outer* surface of a hollow silver cylinder the wall thickness of which was one millimetre. No difference in the activities of the *inner* surface could be observed, though a very thin silver cylinder under identical conditions showed an increase of 17 per cent at the lower temperature. It is clear that the thermal neutrons are much absorbed in a millimetre of silver, so that with a thick specimen the increased activity is mainly confined to the outer layers.

Measurements of the ratio of the activity at 90° K. to that at 290° K. have given the following figures:

Copper (5 minute period), 1·25 ± 0·05; silver (25 sec.), 1·17 ± 0·04; iodine (25 min.), 1·10 ± 0·03.

The thickness of wax cooled was in these experiments 2·2 cm., and the geometry was otherwise slightly different from that of the earlier measurements, in which we found ratios of 1·26 and 0·84 for silver and iodine respectively. We had not previously investigated copper. The decrease which we previously found with iodine has turned out to be due to the presence of boron in the glass container, We have found, using both iodine and silver detectors.

that the absorption of slow neutrons by boron is greater for cold than for warm neutrons. A similar increase occurs in the absorption coefficient of silver, as is shown in the table, while a small increase in the absorption by cadmium has been found by Dunning and his collaborators[3].

The Radium Committee of the Medical Research Council has again most kindly given us, through Prof. S. Russ, supplies of radon for the sources used.

J. R. TILLMAN.
P. B. MOON.

Imperial College of Science
and Technology,
London, S.W.7.
June 27.

[1] NATURE, **135**, 904; 1935.
[2] *Ric. Scient.*, June 1935.
[3] *Phys. Rev.*, **47**, 888; 1935.

Absorption Continuum due to Quasi-Molecules of Calcium in Dwarf Stars of Type *M*

I FOUND several years ago that the dwarf stars of type *M* show a singular depression between the line λ 4227 and the *G* band. This phenomenon appears to be intimately connected with the intrinsic luminosity of the stars, and forms a criterion which can be used with low dispersion to a very faint limit in apparent magnitude. As the effect is therefore of considerable importance, I have arranged to study it more closely in slit spectra of larger dispersion by comparing a typical giant and a typical dwarf of type *M*. The stars chosen are:

Boss 3584, $gM2$, abs. mag. − 0·5 (Mount Wilson spectroscopic value),

Boss 2935, $dM2$, abs. mag. + 10·7 (Mount Wilson spectroscopic value).

The Cassegrain spectrograph on the 40-inch Grubb reflector of the Stockholm Observatory was used in the one-prism combination with a fine slit. The photographic energy curves of the two stars were obtained in great detail. The run of the observed differences between *B* 2935 and *B* 3584, when minor fluctuations due to various lines are eliminated, are illustrated in Fig. 1. The observed absorption continuum in B 2935 extends from λ 4227 in a very asymmetrical way, mainly towards long wave-lengths, and is noticeable between the wave-lengths λ 4120 and λ 4650. The results are entirely confirmed by analysis of the two stars with a slitless spectrograph of low dispersion.

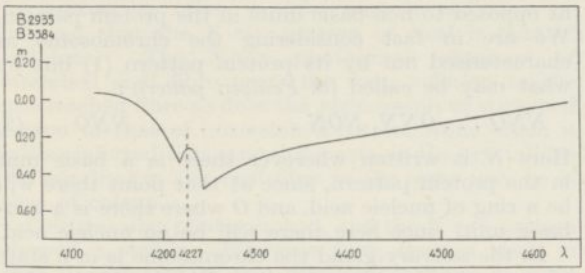

FIG. 1.

A clue to an understanding of the phenomenon is probably the continuous spectrum around the resonance line of Ca, λ 4227, which has been observed by H. Hamada[1] to extend between λ 3980 and λ 5100, and is ascribed by him to a quasi-molecule of calcium, which in the excited state consists of one atom in the $4s^1S_0$ level and one in the $4p^1P_1$ level. In our case, where the spectrum of the quasi-molecule appears in absorption, the original state should be two atoms in the ground level $4s^1S_0$. The energy of one of these atoms may be raised by absorption of a light quantum $4s^1S_0 - 4p^1P_1$, at a time when the two atoms lie close to one another. Since the polarisation effects on the potential curve are stronger in the excited state than in the unexcited state, the difference in energy between the two levels will shift from the normal value for the resonance line. The most common case of large distances between the atoms corresponds to the maximum of absorption at the resonance line itself. It is clear that the strength of the continuous absorption will be highly dependent on the average density of the Ca gas, and thereby on the gravity g at the surface of the star. We should, in fact, expect the mass coefficient of absorption at a point in the continuous spectrum of the quasi-molecule to vary in direct proportion to the density of neutral Ca gas, which with equal numbers of neutral atoms in the respective atmospheres should mean a variation proportional to g. However, the variation with g will be increased considerably by the greater number of neutral atoms of calcium in the atmosphere of the dwarf, which is evident from the behaviour of the arc lines of calcium. The values of g for the giant and the dwarf will stand in a proportion of about 1 : 4,000 to each other.

The absorption continuum in question will be largely responsible for the great intensity and marked asymmetry of the line λ 4227 when observed with low dispersion. The intensity and asymmetry increase rapidly with decreasing absolute brightness of the stars in the main series[2].

BERTIL LINDBLAD.

Stockholm Observatory,
Saltsjöbaden.
June 3.

[1] NATURE, **127**, 555; 1931. *Phil. Mag.*, **12**, 50; 1931.
[2] Cf. J. Ramberg, *Astron. Iakttagelser och Unders. å Stockholms Observatorium*, **11**, No. 13; 1934.

Origin and Nature of the Egg Case in the Crustacea

THE origin and nature of the membranes which surround the eggs of decapod Crustacea and the means whereby the eggs are attached to the pleopods of the female have both hitherto been obscure. Herrick[1,2] gives a good review of the literature. Following up previous work (Yonge[3]) on the function of the tegumental glands in the decapods, I have found that the eggs are surrounded by two secreted membranes. The inner of these gives positive reactions to every chitin test; the outer is undoubtedly composed of the same material as the cuticle which everywhere forms the outer layer of the integument, and is secreted by the tegumental glands (for details see Yonge[3]).

The ovarian egg possesses neither of these membranes, being surrounded only by a vitelline or primary egg membrane. Eggs obtained as they left the oviduct of a laying lobster possessed only the inner, chitinous membrane. At this period the epithelial cells in the oviduct are greatly elongated and resemble the chitinogenous epithelium at the time when this is secreting new chitin: they clearly secrete this inner membrane. The so-called cement

glands, which occur in great numbers on the pleopods of the female only, and resemble in all respects the tegumental glands, secrete the outer membrane. This not only surrounds the eggs but also attaches them, by a twisted strand, to the pleopods. I have shown (Yonge[2]) that the cuticle secreted by the tegumental glands must have a very low surface tension, and this property would explain how the secretion from the cement glands wraps round the eggs and attaches these to the pleopods. Further evidence was obtained by experiments on the swelling of the eggs in various solutions, which agrees with work (unpublished) on the permeability of the uncalcified integument in *Homarus*.

Identical conditions were found in both Astacura and Brachyura, while Miss M. L. Mawson, who has been working under my direction, finds similar conditions in *Chirocephalus*. Here also the oviduct secretes a thin chitinous membrane, while unicellular glands opening into the uterus add a rugose coat giving the major reactions of the cuticle. Here the eggs are not attached but the restricted permeability of the cuticle, chitin alone being freely permeable (Yonge, unpublished work), is probably of supreme importance in protection. The presence of the cuticle will also permit of hatching by osmotic forces (see Needham[4] for literature).

Conditions in the Insecta provide an interesting parallel. Wigglesworth[5] has shown that in *Rhodnius* the integument consists of an epicuticle, closely resembling the cuticle of the Crustacea, and an underlying endocuticle which is chitinous. But both are formed by the epithelium, the dermal glands secreting the exuvial fluid (the function of which is performed by wandering cells in the decapods, Yonge[3]). Wigglesworth suggests that the œnocytes synthesise some of the non-chitinous constituents of the integument, and it seems probable that they are at least analogous with the tegumental glands of the Crustacea. They persist in the adult but are active only in the female, when he further suggests they form the material of the exclusively non-chitinous egg-case, which is probably similar to the outer membrane of the Crustacean egg.

Tegumental glands in the Arthropoda are organs of the greatest importance. In the Decapoda alone they secrete the cuticle, the protective and/or cementing membrane of the egg, and the material which secures the statoliths (Lang and Yonge[6]). They are being extensively investigated in this laboratory.

C. M. YONGE.

Department of Zoology,
University,
Bristol.
June 21.

[1] Herrick, *Bull. U. S. Fish. Comm.*, **15**, 1; 1896.
[2] Herrick, *ibid.*, **29**, 149; 1911.
[3] Yonge, *Proc. Roy. Soc.*, B, **111**, 298; 1932.
[4] Needham, "Chemical Embryology", Cambridge, 1931.
[5] Wigglesworth, *Quart. J. Micr. Sci.*, **76**, 269; 1933.
[6] Lang and Yonge, *J. Mar. Biol. Assoc.* (in the press).

The Chromosome Micelle and the Banded Structure of Chromosomes in the Salivary Gland

GREAT interest has been aroused in cytological circles by the discovery that individual chromosomes in the salivary glands of *Drosophila*, *Sciara*, *Chironomus* . . . may be characterised by successions of light and dark bands and regions which are arranged in definite patterns[1].

I have recently made suggestions[2,3] as to the molecular structure of chromosomes, being guided as regards material by the behaviour of chromosomes in the mitoting cell and the requirements of genetics, as regards treatment by our present knowledge of the structure of coarse animal and vegetable fibres[4]. It is interesting to notice that the molecular structure postulated provides also a simple explanation and interpretation of the banded structure of these giant chromosomes.

The chromosome has protein and nucleic acid constituents. I locate the genetic identity of a chromosome in its characteristic protein constituent and define the *protein pattern* of an individual as a sequence of protein molecules of the classical type—peptide linked amino acids—

. . . NH.CO.CH*P*.NH.CO.CH*Q*.NH.CO.CH*R*.NH . . .

placed end to end in salt linkages. The protein pattern may therefore be expressed in terms of side chains . . . *PQR* . . . and in the most general case of n molecules end to end may be written in the form of a sequence of sequences of units

$$A_1B_1C_1 \ldots X_1Y_1Z_1,\ A_2B_2C_2 \ldots, \ldots, \ldots X_nY_nZ_n \quad (1)$$

The essential requirement of genetics—that 'genes' form a linear array—is thereby met, and interpreted: the genetic identity of a chromosome resides in the nature of its protein pattern and this is expressible in a one-dimensional sequence.

To maintain this linearity of specification, we envisage the chromosome micelle, so far as the protein constituent is concerned, as an aggregate of identical sequences of molecules, the protein patterns, lying side by side. Owing to the large preponderance of basic acids in these molecules and the consequent high degree of ionisation for $p\mathrm{H} < 9$, say, these will lie on and themselves constitute a quasicylindrical surface. The molecules of nucleic acid[5], which possess four acidic centres of ionisation, for $p\mathrm{H} > 4$, say, will form salt linkages[6] with quartets of basic side chains belonging to parallel and neighbouring protein molecules. Owing to the azimuthal symmetry required by genetic considerations, the nucleic acid will polymerise in rings around the micelle. Where there are basic residues in the protein complex, there will be rings of nucleic acid; where basic residues are lacking, nucleic acid rings will also be lacking.

The Feulgen reaction, which is specific for nucleic acid, has long been recognised as a method for studying the morphology of chromosomes. For our micelle, the use of the Feulgen reaction means that attention is directed, not to the chemical nature of the chromosome in general, but only to the distribution of basic as opposed to non-basic units in the protein pattern. We are in fact considering the chromosome as characterised not by its protein pattern (1) but by what may be called its *Feulgen pattern*:

$$NNO \ldots ONN,\ NON \ldots, \ldots, \ldots NNO \quad (2)$$

Here N is written wherever there is a basic unit in the protein pattern, since at that point there will be a ring of nucleic acid, and O where there is a non-basic unit, since here there will be no nucleic acid.

In the salivary gland the chromosome is in a state of very considerable extension. We should therefore expect it when properly treated[7] to show up, specially favourably, the detailed alternation of basic and non-basic units in the protein pattern which characterises the individual chromosome. The salivary chromosome is a compound structure consisting of a group

of homologous chromosomes in parallel. Where there is a high density of nucleic acid associated originally with each constituent chromosome, this will show up as a dark region; where the density is less there will be a less dark region; when the density falls too low, no dark region at all will be visible.

We therefore interpret the banded structure of the salivary chromosomes as due to the alternation of basic and non-basic units in the protein pattern and as such providing a picture—though an incomplete one—of the chemical situation. This interpretation is being worked out in detail. To illustrate the orders of magnitude involved, it may be added that when the chromosome micelle is fully extended, 100 entries in the protein or Feulgen pattern represents a length of 0·035 microns and that the average number of rings of nucleic acid in the case of clupein nucleate is one per 4·9 angstroms, giving about two thousand rings per micron[6].

The fact that chromomeres seen in the early stages of meiosis stain more deeply than the intermediate regions also allows of interpretation on these lines and accords well with the suggestion recently made[3] that in the contraction of chromosomes the differential distribution of nucleic acid along the length of the chromosome plays an important part.

D. M. WRINCH.

Girton College, Cambridge, and
Mathematical Institute, Oxford.
June 18.

[1] T. S. Painter, *J. Hered.*, **25**, 464–476; 1934. C. W. Metz and E. H. Gay, *Proc. Nat. Acad. Sci.*, **20**, 617–621; 1934. H. J. Muller and A. Prokofieva, *C.R. Acad. Sci. de l'U.R.S.S.*, **4**, 78-83; 1934.
[2] NATURE, **134**, 978; 1934.
[3] NATURE, **135**, 788, May 11, 1935.
[4] K. H. Meyer and H. Mark, "Der Aufbau der hochpolymeren organischen Naturstoffe", Leipzig, 1930. W. T. Astbury and H. J. Woods, *Phil. Trans. Roy. Soc.*, A, **232**, 333–394; 1933. D. Jordan Lloyd, *Biol. Rev.*, **7**, 254–273; 1932. *ibid.*, **8**, 463–481; 1933.
[5] P. A. Levene and L. W. Bass, "Nucleic Acids", New York, 1932.
[6] D. Jordan Lloyd, *J. Int. Soc. Leather Trades' Chemists*, 245–258; 1933.
[7] R. L. King and H. W. Beams, *J. Morph.*, **58**, 577–588; 1934. P. Ch. Koller, NATURE, **135**, 69, Jan. 12, 1935.
[8] K. Linderstrøm-Lang, *Trans. Faraday Soc.*, **31**, 324–335; 1935.

Molecular Structure in Sisal, Coir and Oak

IN the course of an investigation on the general morphology and anatomy of *Agave sisalana*, X-ray photographs were taken in the Department of Physics, by courtesy of Dr. Leonard Huxley, of the fibres, and also of those of *coir*.

The X-ray photograph of sisal fibres (Fig. 1*a*) showed a pattern, which agrees with that obtained for cotton by other workers, and it can thus be inferred that the X-ray pattern of sisal is that of cellulose. The X-ray photograph obtained of stretched sisal fibre bears the same relation to the unstretched fibre as does the photograph of stretched cotton to that of unstretched cotton, from which it is also inferred that stretching acts on the crystallites (or micelles) in the sisal fibre in the same way as in that of cotton.

Coir was also photographed, and the X-ray pattern showed a striking difference from that of sisal, in that it consisted of two cellulose patterns at right angles to each other (Fig. 1*c*). These patterns were placed at 45° to the vertical. The coir pattern may be interpreted either as one spiral of crystallites, which runs at an angle of 45° round the fibre, or as two distinct spirals, which are at right angles to each other, but each running at 45° round the fibre and in opposite directions.

The part, if any, played by lignin has been investigated by chlorinating the lignin in the fibre by the Cross and Bevan method, and further by the removal of the lignin. No difference was shown in the X-ray pattern obtained from fibres treated in this way (Fig. 1*b*), except that the chlorinated fibres gave a less *intense* negative.

As sisal fibres have been shown to contain a somewhat low lignin component, coir fibres were chosen for comparative investigation, as containing a relatively high lignin percentage, and these similarly were chlorinated. Here, also, the photograph obtained from the treated fibres showed no difference in form from that of the untreated fibre. In both coir and sisal, however, the chlorinated fibres gave a less intense negative.

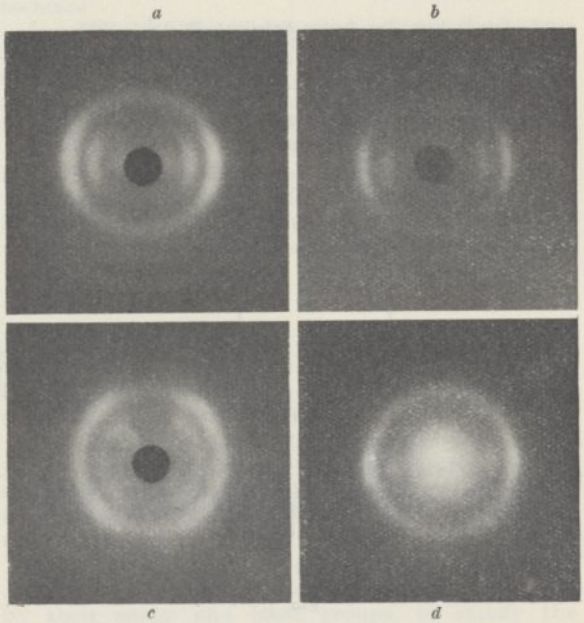

FIG. 1. X-ray photographs, taken by J. Hewitt, with fibre axis at right-angles to the X-ray beam. *a*. Sisal fibre. *b*. Delignified sisal fibre. *c*. Coir bristle. *d*. Heartwood of oak.

In a further test of the negative X-ray properties of lignin, that is, of its amorphous character, the wood of oak has been used, as having one of the highest known percentages. The photograph obtained showed, as in sisal and coir, a cellulose pattern, in which, however, the equatorial spots were sharp and not drawn out into arcs (Fig. 1*d*). It is inferred that the cellulose crystallites in oak lie parallel to the longitudinal axis of the tracheids and that they are almost perfectly orientated. This is not the case in pine wood, as illustrated by K. Freudenberg[1] in a model from the tracheids of pine. The model would suggest a photograph with two cellulose patterns at right angles to each other. The photograph of oak (Fig. 1*d*), however, agrees, to some extent, with the photographs of B. Schmidt[2] for the summer wood of ash and the spring wood of fir. Also, the almost perfect arrangement of the crystallites in oak as here recorded agrees with the statements of S. Pienkowski[3], that the cellulose crystallites are the more perfectly arranged in compact woods.

The X-ray investigations reported above show that sisal fibres have the X-ray pattern already known in cotton and therefore attributable to

cellulose. The double cellulose pattern found in coir admits at any rate of two interpretations.

The photographs, obtained after chlorination and other treatments, support the view that lignin is amorphous. The lesser intensity of the photographs may, however, have significance.

The results obtained from the wood of oak differ from those shown by the model of *Pinus* presented by Freudenberg, which, however, admits of a different interpretation, but they are probably consistent with those of Schmidt for ash and fir, and also would appear to support Pienkowski's statements (loc. cit.) concerning compact woods.

E. N. MILES THOMAS.
JOSEPH HEWITT.

Department of Botany,
University College,
Leicester.

[1] K. Freudenberg, *Der Papier Fabrikant*, **30**, 189; 1932.
[2] B. Schmidt, *Z. Phys.*, **71**, 696; 1931.
[3] S. Pienkowski, *Z. Phys.*, **63**, 610; 1930.

Registration of the Ionisation Curve of a Single α-Particle

IF an α-particle from a preparation *A* (Fig. 1) passes through a hole in the electrode *B*, it produces ions in the space between *B* and *C*. The ions drift with constant velocity in the homogeneous electric

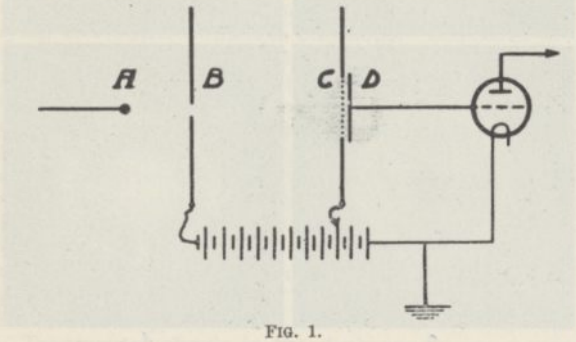

FIG. 1.

field between the electrodes. When the ion column has reached *C*, it passes through the meshes in the grid and produces a current $i(t)$ to the electrode *D*, which is connected to a four-valve amplifier. This current $i(t)$ would be expected to give a good picture

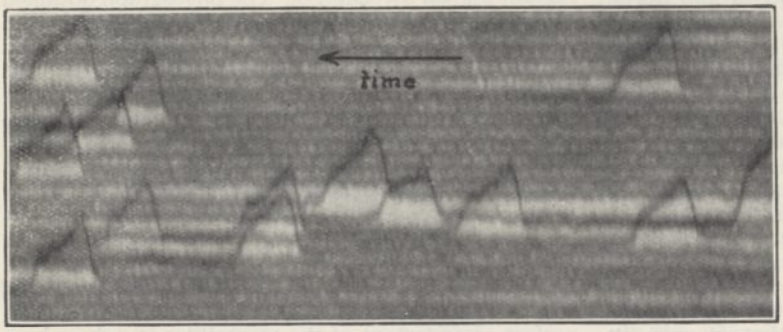

FIG. 2.

of the ionisation curve. But as *D* has a capacity and is well insulated, the tension to be amplified is proportional to $\int_0^t i(t)\,dt$. Therefore, in order to obtain the ionisation curve after the amplification, we must differentiate the tension curve, and this is done electrically between the third and the fourth valve by the help of a resistance-capacity device having a very short time-constant.

The amplifier is connected to an oscillograph and the light-sensitive film or paper is placed on a rotating cylinder. The zero position is moved during the revolutions.

Fig. 2 shows an oscillogram obtained in this way. The α-particles which have depicted their ionisation curves in it, came from a very weak polonium preparation placed 2 cm. from *B*, so that the ionisation curves represent the last 2 cm. of their path.

It seems quite possible to register H-particles in the same way. Then, if the oscillogram is calibrated, it tells us at once the kind of the particle (height of the ionisation curve) and the length of its track (proportional to the length of the ionisation curve). Therefore, if the ionisation chamber is given a geometrical form adapted for very weak preparations, this instrument may be useful for the study of nuclear reactions.

A more detailed report will appear shortly.

HANNES ALFVÉN.

Physics Laboratory,
University, Uppsala.
May 30.

Properties of Crystalline Magnesium Oxide

ARTIFICIALLY produced crystals of magnesium oxide (MgO) are now available commercially; since they are formed as a by-product in a commercial process, they are not expensive. Our samples were obtained from the Norton Company, Worcester, Mass., U.S.A. Most of the pieces of crystal are about 1 cm. × 1 cm. × 0·5 cm., but a few larger specimens up to 3 cm. × 3 cm. × 1 cm. are produced. Some specimens are quite clear, some are slightly yellow, and some are a little cloudy. The clear specimens are transparent to λ 2200. The crystal belongs to the cubic system, but most specimens show some double refraction owing to residual strains.

Brice and Strong[1] found the crystals to be resistant to attack by lithium, sodium, potassium and calcium. We have made quantitative tests by heating the crystal with various metals in small evacuated tubes; the tubes were kept at the specified temperatures for 1 hour. Potassium (400° C.), sodium (500° C.), lead (1,050° C.), magnesium (1,100° C.), and aluminium (1,100° C.) had no effect; calcium (1,050° C.) and copper (1,100° C.) etched the surface slightly. Thus the crystal is much more resistant than glass or quartz to penetration by metal vapours. X-ray analysis shows[2] that the crystal has a close-packed structure, which probably accounts for this property.

The material can be ground and polished by using successively graded emery, tin oxide and rouge. Windows can be sealed into soda glass of high expansion coefficient. (The coefficient for the crystal is 11×10^{-6}; our glass—determined by Messrs. Yates and Roulston—has a coefficient of $9{\cdot}6 \times 10^{-6}$ in the range 0°–100° C.) The glass appears to wet the crystal when molten, and adheres well when cold, forming a vacuum-tight seal. It is important that the edges of the crystal should be polished before

sealing in. As the cutting, polishing and sealing take some time, it is desirable to select, with a polariser, specimens comparatively free from strain. With the above precautions the probability of failure is small.

We wish to thank Prof. Brice, through whose courtesy we obtained samples before the material was regularly available.

R. W. DITCHBURN.
J. HARDING.

Physical Laboratory,
Trinity College,
Dublin.
June 21.

[1] *Bull. Amer. Phys. Soc.*, **9**, No. 6, 6, Dec. 1934.
[2] W. P. Davey and E. O. Hoffman, *Phys. Rev.*, **15**, 333; 1920. W. Gerlach and O. Pauli, *Z. Phys.*, **7**, 116; 1921.

Electrical Units and the I.E.C.

THE interesting note on Electric Units in NATURE of July 6, p. 15, is perhaps too definite in one important particular.

It is recognised that in addition to the three accepted units of length, mass and time a fourth unit is required for the specification of electrical quantities.

Prof. Giorgi, as is well known, desires the adoption of one of the International Units, and I understand prefers the International Ohm. But no decision on this point was reached at the recent I.E.C. meeting. In a letter dated June 27, 1935, and sent to me as chairman of the S.U.N. Commission of the International Union of Pure and Applied Physics, Dr. Kennelly, chairman of the Electric and Magnetic Units Committee of the I.E.C., after referring to possible quantities for the fourth unit, writes:

"It was decided that the choice should not be made before consulting the International Union of Physics S.U.N. Commission and the Comité International des Poids et Mesures Comité Consultatif d'Electricité".

He asks that the matter should be brought to the attention of the S.U.N. Commission of the International Union "as it would evidently be most regrettable if the choice and definition of the fourth fundamental and practical unit should lead in the future to incomplete agreement between the Practical Electrical Units used in Physics and in Electrotechnics".

Accordingly, I am taking steps to bring the matter to the attention of the S.U.N. Commission. A difference between the standards of the physicist and the engineer would be not merely regrettable but a disaster of the first order.

R. T. GLAZEBROOK,
Chairman of the Commission on Symbols, Units and Nomenclature of the International Union of Pure and Applied Physics.

Ballards Oak,
Limpsfield,
Surrey.
July 6.

Points from Foregoing Letters

PROF. NIELS BOHR announces his disagreement with the recently-expressed opinion by Prof. A. Einstein, B. Podolsky and N. Rosen that the quantum mechanics description of physical reality is incomplete, owing to the uncertainty principle, which states that the position and velocity of a particle cannot both be accurately known at the same time.

Using the ions from a high-frequency spark, Prof. A. J. Dempster has analysed palladium and gold by means of the mass-spectrograph. The results show six isotopes for palladium and the only one component for gold. The atomic weight of gold, if it has no isotopes, should be an integer, and the accepted value (197·2) may have to be revised.

Prof. B. Venkatesachar and L. Sibaiya identify certain components in the arc spectrum of platinum with its various isotopes (at. wt. 192, 194, 196, 195) and estimate roughly their relative abundance. As shown by the positive isotopic shift of the spectral components, the heaviest isotope lies deepest, as is generally the case in nuclei containing an odd number of alpha particles, of which platinum has 39.

Mr. J. R. Tillman and Dr. P. B. Moon find that the absorption coefficients of silver, iodine and copper for slow neutrons vary with the detector used. This indicates that the elements in question absorb selectively neutrons of different velocities. The authors also give the ratio of the activity at 90° and 290° K., and point out some of the factors that must be considered when determining the effect of temperature on the activity of the neutrons.

From the difference in the spectra of a typical giant star and a typical dwarf star (due to absorption of light in the region of wave-lengths 4100–4600 A.) Prof. Bertil Lindblad infers the presence of excited calcium molecules and deduces that the value of the gravitational constant g for the giant and the dwarf is in the ratio 1 : 4000.

The nature and origin of the membranes surrounding the eggs of the lobster and the means whereby the eggs are attached to the swimming limbs of the female are described by Prof. C. M. Yonge and compared with conditions in other marine animals.

Dr. D. M. Wrinch draws a picture of a chromosome as a sequence of protein molecules linked end to end by their acidic and basic groups, to satisfy the essential requirements of genetics that genes form a linear array. She interprets the banded structure of the salivary gland chromosome of the fruit fly as due to the alternation of basic and non-basic units in the protein pattern.

Dr. E. N. Miles Thomas and Mr. J. Hewitt describe the X-ray patterns of sisal, coir and oak. Sisal gives the usual cellulose pattern; the coir pattern may be interpreted either as one spiral of crystallites or as two distinct spirals at right-angles to each other, running in opposite directions at 45° round the fibre. In oak, the crystallites appear to lie parallel to the longitudinal axis of the wood cells (tracheids) and are almost perfectly orientated. The effect of chlorination upon the X-ray patterns supports the view that lignin is amorphous.

An apparatus by means of which the ionisation produced by a single alpha particle or by a proton can be directly registered is described by Dr. Hannes Alfvén. It may prove useful in the study of nuclear reactions leading to atomic disintegrations.

Prof. R. W. Ditchburn and Mr. J. Harding describe some properties of crystalline magnesium oxide, which is now commercially available. The crystal can be polished and sealed into soda glass, and is very resistant to attack by metal vapours.

Research Items

Stone Age Survivals in Ireland

A MOUSTERIAN tradition surviving into the Campignian is very clearly exemplified in the industry of Rathlin Island investigated by Mr. C. Blake Whelan. The dangers of chronological assumptions based on comparative typology are here exposed on the periphery of 'neolithic' migrations. A striking example is afforded by a cordate or sub-triangular hand-axe of fine grained stone, a surface find from one of the numerous late prehistoric stations spread over the Rathlin uplands (*Antiquaries J.*, **15**, 2), to which it is highly unlikely that a date earlier than 2500–2000 B.C. can be assigned. This dating is all the more probable in the light of the results of excavation, although the survival of the use of implements of fine grained rock to at least as late as the final Bronze Age or early Iron Age (500 B.C.) admits of a much later dating. It would be difficult to find a better example than this specimen of the survival of Levallois and Mousterian technique, upon which Goury, the present writer and others have based the postulate of an eastern focus at which, uninfluenced by any Upper Palæolithic technique, the Mousterian evolved into the Campignian and, moving westward, absorbed and devised new forms which preserved the heavy aspect of the ancestral technique. The specimen under notice is a faithful reproduction of the cordate or sub-triangular hand-axe of cave Mousterian universally figured as type specimens of this epoch some sixty thousand years earlier.

Divination in Melanesia

AMONG the Tanga people, who occupy islands off the coast of New Ireland, Mandated Territory of New Guinea, great ritual importance is attached to death, and at one time a divinatory ceremony was practised when sorcery was suspected as the cause. One such ceremony, which took place long ago, has been described in detail to Mr. F. L. S. Bell by two aged men who themselves had taken part (*Man*, **90**; 1935). It was performed in connexion with the unaccountable death of a young woman. The instrument of divination was a bamboo pole, about thirty feet long, to which was attached a bunch of highly perfumed leaves, believed by the natives to be a strong aphrodisiac. The ceremony was termed "Several men fish for the ghost", and it was believed that the leaves served as bait. The pole was raised on the shoulders of five or six men, who were distant relatives of the deceased. They then carried it to the place at which the woman was born, as the most likely spot at which her ghost would be found. When the pole became heavy on their shoulders as they marched, it was believed that they had encountered the ghost. It then fled to her husband's house, whither they followed it. Twenty men then clung to the pole, headed by one of the woman's cross-cousins, who began to question the ghost. It was essential that no one within the forbidden degrees should touch the pole, otherwise the ghost would not answer. The ghost was asked who was responsible for her death, individuals being mentioned by name. When the guilty person was named the pole began to vibrate violently and was drawn towards the interior of the house, the efforts of the twenty men, however strong, being unable to prevent it. When the pole ceased to vibrate the men withdrew and the pole was placed by the side of the woman's grave. No punishment followed, except the ill-repute of being a sorcerer and consequent ostracism.

Identical Twins

IN a lecture on twins (*Eugenics Rev.*, **27**, No. 1), Dr. J. A. Fraser Roberts reviewed the modern work on this subject. He favours a genetical rather than a physiological theory of identical twinning. A quiescent phase of the embryo occurs in the badger as well as the armadillo, but in the badger identical twins are unknown. Some identical human twins show mirror-image phenomena, but this is not true of the twins that are most nearly identical. It appears that mirror-image twins are due to a somewhat later separation of the embryo into two. The intelligence quotient of identical twins is not so largely inherited as stature and other physical characteristics. Nevertheless, it is concluded that even here heredity is more than three times as important as environment. Reference is made to the studies by Newman of twins reared apart, and it is suggested that similar comparisons should be made of twins reared together. The need for more accurate records of twin births by physicians is emphasised. Psychological studies should be made of the comparative effects of training on twins, following Gesell. The ideal would be a register and 'follow up' of all twin births.

Agranulocytic Angina

THIS is a rare disease characterised by severe sore-throat or tonsillitis ('angina') with fever and prostration, and frequently fatal. It was first described in 1922 by Werner Schultz (*Deutsch. med. Wochschr.*, **48**, 1495), and a review on the subject by Dr. E. W. Adams, with bibliography, has been recently issued by the Ministry of Health (Rep. on Pub. Health and Med. Subjects, No. 76. London: H.M. Stationery Office, 1935. 6*d*. net). A remarkable and characteristic feature of the disease, from which it derives its name, is a diminution in the number of leucocytes or white blood-cells from the normal of 10,000–12,000 to 1,000 or less per c. mm. of blood, with an almost complete disappearance of the polynuclear leucocytes ('granulocytes'), which normally constitute 75 per cent of the total leucocytes. About a thousand cases of the disease have now been described, of which only twenty-two have been recorded in the British Isles. It is more common in females, and the fatality in the earlier cases was more than 90 per cent. The causation is obscure, but evidence suggests the action of some toxic agent. Much accumulated evidence points to a connexion with the use of the drug 'amidopyrine', and a case appears to have been made out incriminating the benzamine group of drugs. Dr. Adams has collected 140 cases, with 74 deaths, following the administration of amidopyrine, and two single doses of 10 grains and 5 grains of this drug have been found to cause an immediate and striking diminution in the granulocyte and total white blood-cell counts. Pentose nucleotide appears to exert a curative action, the mortality in cases treated with this agent being only 25 per cent.

New Sponges from the Puerto Rican Deep

DR. M. W. DE LAUBENFELS has described twenty-seven new species of sponges from the Puerto Rican Deep (Johnson Fund. Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. Smithsonian Miscellaneous Collections, **91**, No. 17. Dec. 1934). Nearly one fourth of the total number of sponges collected by this expedition were new. Many of them may have been collected and described before, but unrecognisably, because in the descriptions made more than fifty years ago very little attention was paid to those microscopic characters that to-day are considered of primary importance. All the new species belong to the Demospongiæ, and these belong to 17 families, of which 4 are new, and 26 genera, of which 11 are new. Only a few species belonging to the Calcarea (or Calcispongiæ) and somewhat more of the Hexactinellida (or Hyalospongiæ) were found, and apparently no new species of either of these two orders. A final report is in progress which will include these.

Aphid Transmission of Strawberry 'Yellow-edge' Virus

The constant association of 'yellow-edge' disease of strawberries with the presence of the tarsonemid mite (*Tarsonemus fragariæ*) led to an investigation, by Mr. A. M. Massee, as to whether the mite was a vector of this particular virus disease (*J. Pomol. and Hort. Sci.*, **13**, No. 1, pp. 39–53, March 1935) which showed that this relation does not hold. The strawberry aphis (*Capitophorus fragariæ*), however, is proved to transmit the disease to healthy plants in the month of June, though there is some doubt about its ability to do so in late July and August. The tarsonemid mite causes severe damage on its own account, and frequently masks the appearance of virus symptoms.

Observations on *Sorghum*

Two short papers which have appeared in *Current Science* of February, 1935, describe "Bulbils in *Sorghum*" and "*Sclerospora* Sp. and Suppression of the Awn in *Sorghum*". The former article, by G. N. Ramgaswami Ayyangar and V. Panduranga Rao, of the Millet Breeding Station, Coimbatore, India, announces the discovery of vegetative bulbils in place of grains in a small percentage of the progeny of a cross between single-seeded and double-seeded *Sorghum*. The second paper is by G. N. Rangaswami Ayyangar and P. V. Hariharan, and describes the symptoms of attack by a species of *Sclerospora* fungus. This has the effect, among other actions, of suppressing the awns of *Sorghum*. The leaf-blade is the most susceptible part of this plant in attack by *Sclerospora*, and as the awn has been considered homologous with the leaf blade, it seems natural that the awns should be suppressed, yet curious that organs of such divergent morphology should be attacked so specifically.

Petroleum Fuels in Canada

THE Mines Branch, Department of Mines, Canada, in co-operation with the Dominion Fuel Board, has recently issued Bulletin No. 759 on deliveries of fuel oil, kerosene, gasoline and petroleum coke in Canada during the last few years. In this statistical survey, fuel oil comprises all grades heavier than 42° A.P.I.; kerosene, the white and amber grades ranging from 42° to 47° A.P.I. plus distillate oils coming within these ranges; and gasoline those grades having 55° A.P.I. or lighter as their gravity. Statistics collected are presented in the form of eight tables showing gallons of the four classes of petroleum fuels marketed in Canada and their distribution in the provinces in 1932 and 1933; the amounts of fuel oil and kerosene delivered in the provinces and a classification of their specific uses; the sales of gasoline (and motor fuel) in Canada by provinces, and finally data of petroleum coke deliveries for domestic and industrial heating. Several interesting facts emerge from these statistics. In 1933, deliveries of petroleum products in Canada for fuel purposes amounted to 945 million Imperial gallons, of which 419 were fuel oil, 42 kerosene and 484 gasoline. Of the fuel oil delivered, 27 per cent was used for domestic heating, 21 per cent for industrial heating, $3\frac{1}{2}$ per cent for tractor fuel and nearly 49 per cent for locomotive and bunker fuel. Of the kerosene delivered in 1933, representing approximately one twentieth of the aggregate of petroleum fuels, 54 per cent was accounted for by domestic heating, 37 per cent by tractor fuel and 9 per cent by general uses. As regards gasoline, statistics of sales show that in 1933 approximately 88 per cent was sold for motoring purposes and 12 per cent for other general uses.

Measurement of Solar Radiation

PROFESSIONAL Note No. 68 of the Meteorological Office, by Mr. H. L. Wright, contains comparisons between readings of the following instruments made at Kew Observatory in July–November 1927: (1) the Gorczynki pyrheliometer, (2) the Campbell-Stokes sunshine recorder, (3) the black bulb thermometer *in vacuo*. Of these three instruments, only the first represents a serious attempt to deal quantitatively with solar radiation; the second allows a rough estimate to be made of the length of time during which the radiation is above the minimum required to scorch the card of the recorder; the third purports to give a measure of the maximum intensity of the solar radiation each day by recording the highest temperature reached by a specially blackened maximum thermometer in a glass-walled chamber from which, as far as possible, all air is removed. Official meteorology, in Great Britain at least, has not of late taken the black bulb thermometer seriously, and the records of this instrument do not appear in the regular official publications. Among the comparisons is a diagram showing daily totals of radiation obtained with the pyrheliometer plotted against the estimated durations of bright sunshine given by the Campbell-Stokes instrument. This shows that the average daily rate at which radiation is received at a surface normal to the sun's rays at Kew under the best conditions is 0·95 gm. cal./cm.^{2} per minute, that is, about half the solar constant. The highest instantaneous rate was 1·43 gm./cal. on September 24, 1927, in polar air behind a depression over the North Sea, with the barometer down to 985 millibars and rising briskly. Comparisons between the widths of the burns on the cards of the sunshine recorder and the associated rates of radiation give an exponential relationship, the rate of radiation being proportional to e raised to the power $0{\cdot}64\ w$, where w is the width of the burn. The recorder was found to be insensitive to radiation of less than about 0·2 gm./cal. The figures relating radiation to the black bulb

readings are of interest mainly in that they show how well founded are the official objections to the latter instrument. It appears that the maximum rate of radiation for a given black bulb maximum is much less in July and August than in October and November.

A New Theory of Atmospheric Electricity

IN a long paper, published in the March issue of *Terrestrial Magnetism and Atmospheric Electricity*, Ross Gunn develops a new theory which claims to explain the generation of electric charges in clouds as well as many cognate phenomena. The theory depends on what its author calls "some preliminary and not very well-controlled experiments . . . devised and carried out as a result of certain theoretical considerations". A small 'pill-box' of thin sheet tin was connected to an electrometer. An iron disc was reduced to the temperature of carbon dioxide snow and quickly placed inside the pill-box. As the box cooled, water condensed on the outside and the box acquired a negative potential, about $-0{\cdot}1$ volt; then, as the pill-box warmed up, condensation ceased and after a minute or two the potential became positive. Gunn accepts the experiment as sufficient demonstration that condensation produces negative electrification of the water and positive electrification of the air, whilst evaporation produces positive electrification of the water and negative electrification of the air. Other investigators have looked in vain for such results of condensation and evaporation. Gunn assumes that these processes go on in the clouds and says that when raindrops are formed in an ascending current, the drops acquire negative charges whilst the positively charged air passes up to the top of the cloud. It may be remarked that the Ross Gunn cloud, like the Wilson, would have a positive charge above, and a negative charge below. Whether clouds of this type really predominate is a question which should have been settled long ago.

The Rectifier Photocell

A RECENT article by G. P. Barnard (*Proc. Phys. Soc.*, May) gives working details of the preparation of a new selenium-sulphur photo-cell of the 'Sperrschicht' type and an account of its properties. Photo-cells of this general type are obtainable commercially, but hitherto there has been no account sufficiently detailed to allow the construction of a cell for any special purpose. The cells were made by coating iron discs with the molten selenium-sulphur mixture, annealing, and sputtering lightly with gold, silver or platinum. The heat treatment of the films is critical; the active layer consists of selenium embedded in a matrix of sulphur-selenium eutectic in which the sulphur enters the selenium lattice. Theories of the behaviour of the cells have been given by A. H. Wilson and by Frenkel and Joffé. Both theories involve the assumption that in the system metal–semiconductor–metal there is a definite gap at one of the interfaces. The experimental behaviour of the cells is rather complicated because the illuminated cell behaves as a source of E.M.F. shunted by one resistance and placed in series with another. The behaviour varies, therefore, with the characteristics of the external circuit. It is expressed in the paper by sets of curves, and compared where possible with theory. The spectral sensitivities of some of the cells were measured.

Migration of Sodium on Tungsten

R. C. L. BOSWORTH (*Proc. Roy. Soc.*, A, May 1) has investigated the mobility of adsorbed sodium atoms. A patch of alkali atoms was sprayed on to a tungsten strip as positive ions from a Kunsman filament, and the movements of the sodium were followed by exploring the strip with a sharply defined spot of light and making use of the photo-electric effect of the sodium-covered surface. It was first found that an active patch decayed with time, apparently due to a migration of sodium into the intercrystalline cracks of the tungsten. The sodium could be partly recovered by heating the strip to 1,300° K., and, after about 10^{17} atoms had been deposited per sq. cm., the strip was saturated and the surface layer remained stable. When a patch had been obtained, it was found that it spread over the surface at an appreciable rate at room temperature and more rapidly at 800° K. At the latter temperature the strip is approximately uniformly active after 5–10 seconds. The temperature variation of the diffusion process is used to obtain an 'activation energy' for the migration process. The results are interpreted by supposing that a sodium atom may take up the activation energy of about 0·25 volt and pass into a mobile state in which it can migrate for considerable distances, either over the surface or into the cracks.

Stellar Motions

IN "A Preliminary Note concerning a New Theory of the Motions of the Stars" (*Proc. Nat. Acad. Sci.*, **21**, 143; 1935), J. Schilt describes what might better be called a new empirical analysis of these motions. He has first taken known rectangular velocity-components $\dot{X}$, $\dot{Y}$, $\dot{Z}$ of A-type stars, and chosen his $\dot{Z}$-direction in such a manner that *the density of velocity-points has maximum gradient in this direction.* He then fixes attention on the $\dot{Z}$-velocities, rather than on the velocity components in the preferential direction determined in the more usual way by use of the velocity-ellipsoid. The $\dot{Z}$-velocity component for any star is expressible in terms of the angle between the direction of the star and the Z-axis, and the observed values of its parallax π and of its radial and proper motions. Schilt finds that it can be represented statistically as the sum of one of two constant values, and an 'expansion' term proportional to the Z-co-ordinate. The resulting relation can be solved for π, thus giving a new expression which may be used to obtain statistical parallaxes of stars from a knowledge of their velocities. The author has verified that a formula of this type is successful in a large number of cases in giving parallaxes in agreement with trigonometric values. He claims that it makes it possible to gain insight into the 'giant' part of the Hertzsprung-Russell diagram, where spectroscopic and trigonometric parallaxes are not available. He further considers that his analysis gives a better account of the distribution of radial velocity than does the 'double wave' representation suggested by the theory of galactic rotation. However, from the theoretical, as opposed to the empirical, point of view, the work must ultimately be tested in the light of some very general considerations regarding the properties of arbitrary velocity distributions, which have lately been brought forward by E. A. Milne (see *Observatory*, **58**, 167, June 1935).

Geological Survey and Museum

CEREMONIAL OPENING OF NEW MUSEUM

ON Wednesday, July 3, H.R.H. The Duke of York performed the opening ceremony of the new Museum of Practical Geology in Exhibition Road, South Kensington. A description of the building and its principal exhibits appeared in NATURE of June 29 (p. 1060).

His Royal Highness was received at the door of the Museum by the Mayor of Kensington. The official party that accompanied the Duke to the platform were: The Right Hon. W. G. A. Ormsby-Gore, First Commissioner of H.M. Office of Works, Lord Rutherford, chairman of the Advisory Council for Scientific and Industrial Research, Sir Patrick Duff, secretary of H.M. Office of Works, Mr. J. H. Markham, the architect, Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, Sir John Flett, the director of the Geological Survey, and Dr. W. F. P. McLintock, the curator of the Museum.

Mr. Ormsby-Gore, in inviting His Royal Highness to declare the Museum open to the public, said that the Geological Survey of Great Britain is the oldest national geological survey in the world. It was instituted for the purpose of preparing copies of the Ordnance Survey maps geologically coloured so as to be of service to science and industry by providing an accurate representation of the geology of Great Britain. The Museum of Practical Geology developed out of the collection by the Survey of specimens of rocks, minerals and fossils, and was first opened to the public in 1841. It was soon found that the importance of the collection warranted the erection of a building designed to display the work of the Survey and the application of geology to the arts and industry, and in the year of the Great Exhibition the building in Jermyn Street was opened by the Prince Consort. The new Museum was commenced in 1929 and was substantially completed in 1933, when it was required for the World Monetary and Economic Conference. The cost of the building was some £220,000, and a lease of the Crown site of the old premises had been granted at a rent which considerably exceeded the interest on the capital sum expended on the new building.

The Duke of York said that the new building makes a notable and welcome addition to the great museums erected on the land provided for the encouragement of science, art and industry by the wise foresight of the Prince Consort. With the Science Museum on one side and the natural history section of the British Museum on the other, it provides a suite of scientific exhibits unequalled in any other country. In 1683 the Duke of York, later James II, opened the Ashmolean Museum at Oxford, which contained the first British geological collection. In 1835, as a result of the work of Henry de la Beche, the Geological Survey was founded as the first official organisation of its kind. To-day there are more than 120 official geological surveys in different parts of the world, to many of which, and particularly those in other parts of the Empire, the Geological Survey of Great Britain has been a parent. He was glad to know that a large number of delegates from abroad had come to celebrate the centenary of the Survey.

The Museum was well filled with a large and representative gathering that included British, Colonial and foreign geologists who had been invited to participate in the ceremonies. The new Museum was much admired and it was generally acknowledged that no geological survey in the world has better offices, library and laboratories and a more satisfactory museum. Some of the directors of geological surveys took many notes of the organisation and arrangements of the exhibits, and they were particularly struck by the effort that has been made to attract the interest of the non-geological public.

On Wednesday evening, July 3, the Geological Society of London gave a reception to the foreign and Empire delegates in its rooms in Burlington House.

CENTENARY OF THE GEOLOGICAL SURVEY

On Thursday, July 4, at 11 a.m., a meeting was held in the hall of the Royal Geographical Society to celebrate the centenary of the Geological Survey of Great Britain. Lord Rutherford of Nelson occupied the chair, and was accompanied by Sir Frank Smith and Dr. T. F. Sibly, representing the Department of Scientific and Industrial Research and the Geological Survey Board.

In a brief introductory speech, Lord Rutherford commented on the great progress which the knowledge of geology has made in the last hundred years and the distinguished part which British geologists have played in furthering the growth of the science. He cited the names of William Smith, Lyell, Sedgwick, Murchison, Darwin and others as founders of geology, and expressed his thanks to the foreign, Dominion and Colonial geologists who had accepted the invitation to assist in the celebration.

The overseas and British delegates then responded to their names and were presented to the chairman.

The list of delegates is much too long to be given in full as it contains more than two hundred names, of which 85 were from foreign countries. Mention, however, may be made of a few selected names. The Belgian delegation was very representative, including Prof. Renier (Brussels), Prof. Fourmarier (Liège), Profs. Halet, Legraye, Van Straelen and Thoreau. Prof. Robert represented the Geological Survey of the Belgian Congo. From France arrived Profs. de Margerie, Jacob (Paris), Léon Bertrand (Paris), Fallot (Nancy), Dubois (Strasburg), Roman (Lyon), Besairie (Madagascar), Bétier (Algeria), Legoux (French West Africa). The German delegation was led by Prof. von Seidlitz (Director, Geological Survey of Prussia) and included Profs. Stille, Cloos, Hirmer, Angenheister and Schmidtgen. Among others present were Madsen (Denmark), Gavelin and von Eckermann (Stockholm), Laitakari (Helsingfors), Kettner (Prague), Crema (Italy), Loczy de Locz (Hungary), Morozewicz (Poland), Royo y Gomez (Madrid). The Swiss representatives were Profs. Lugeon, Buxtorf and Staub, and much interest was taken in the two Russian delegates, Prof. Ferodowsky (Moscow) and Prof. Karpinsky, the president of the

Academy of Sciences in Leningrad, who is in his ninetieth year and had flown to London, accompanied by his daughter. From the United States there came Dr. Day of the Geophysical Laboratory of the Carnegie Institution of Washington; Dr. Matthews, Johns Hopkins University, Baltimore; Profs. Rice (Harvard), Moore (Kansas), Marquis (Washington), Leith (Wisconsin), Anderson (Stanford), Leuschner (Berkeley). From Canada, Profs. Coleman (Toronto), Adams (Montreal), Atkinson (Saskatoon). Among other distinguished Empire geologists present were Grabham (Sudan), Haughton (Pretoria), Richards (Queensland), Kitson (Victoria), Pascoe (India), Lightfoot (Southern Rhodesia), Seymour (Dublin), Mellor (Johannesburg), Scrivenor (Malaya) and Raeburn (Nigeria).

Thereafter, Sir John Flett, director of the Geological Survey and Museum, gave an address on the history and functions of the Geological Survey. He outlined briefly the state of geological science in the year 1835 when the Survey was founded, and remarked on the brilliant assemblage of geologists then living in London, among whom were Buckland, Murchison, Sedgwick, Lyell, Greenough, Fitton, MacCulloch and De la Beche. Much interest was being taken in geological maps. William Smith's famous map had appeared in 1815. Greenough's map was issued in 1820. A desire for still better maps was strongly felt and with the support of Colby, director of the Ordnance Survey, a deputation of prominent members of the Geological Society of London represented to the Prime Minister the value of geologically coloured maps on the scale of one-inch to a mile. Consent was obtained and the work was entrusted to Henry de la Beche. The work began in Devon and Cornwall, spread thence to Wales and eastwards to the London district and the Midlands. By 1860 it had reached the Lancashire and Yorkshire coalfields, and in 1883 the original survey of England and Wales was finished. Simultaneously, the Geological Surveys of Ireland and Scotland had been active both in field work and in publication. De la Beche was remarkably successful in enlisting able and enthusiastic assistants, among whom Ramsay, Aveline, Selwyn, Logan and Jukes did imperishable work.

De la Beche died in 1855 and was succeeded by Sir Roderick Murchison, who was an active and efficient director. He was followed by Sir Andrew Ramsay, equally skilled in the field and with the pen, who had been De la Beche's loyal lieutenant. Sir Archibald Geikie in turn held control until the end of last century. What is known as the 'Old Series' of hand-coloured geological maps was essentially the product of the labours of the staff under these leaders. In 1901 Sir Jethro Teall took up the reins, followed by Sir Aubrey Strahan. Many improvements were made in all departments of the service and the present type of colour-printed maps was introduced.

At first under the Board of Ordnance, then under the Woods, Works and Forests, then under the Board of Trade and the Science and Art Department, soon transferred to the Board of Education, and since 1919 under the newly constituted Department of Scientific and Industrial Research, the Geological Survey and Museum has pursued an even course.

De la Beche started to exhibit geological specimens, maps, models and mining apparatus in rooms in Craig's Court about 1837. The old Museum of Practical Geology in Jermyn Street was opened by the Prince Consort in 1851. It is now in process of demolition. This furnished an opportunity to realise De la Beche's ambition to found a School of Mines resembling the famous institutions of the Continent, and in this also he was successful. After preliminary vicissitudes the School achieved a great reputation and many famous names are found in the lists of its staff. Forbes, Huxley, Playfair, Frankland, Warington Smyth, Percy, Stokes, Tyndall, Le Neve Foster, were among the professors. The men who were privileged to study under them are justly proud of their School and its great traditions.

The School of Mines outgrew its accommodation at Jermyn Street and was transferred by stages to South Kensington, where now it occupies commodious buildings adjacent to the Science Museum and the Geological Survey and Museum.

The practical applications of geology were never absent from the mind of De la Beche. He established a Mining Record Office for collecting statistics of output and plans of mines. His chemists also attacked many practical problems, such as British iron ores and steam coals for the Navy. Science was for him not a lonely virgin but the fruitful partner of industry. Could he return to-day and see how widely his influence has spread, even he might be astonished. The old collections of Jermyn Street have fertilised the Science Museum, Bethnal Green Museum, Science Library, School of Mines, Mines Department, Imperial College and the Victoria and Albert Museum. All of these contain material that can be traced to his assiduous and enterprising activities. His successors, though their energies are less widely dispersed, maintain close connexion with practical problems. Water-supply, engineering, fuel research, agriculture, mining, architecture, transport, all call for geological information and receive their due share of attention.

At the conclusion of the director's address, the chairman called upon some of the delegates to speak. Prof. Coleman (Toronto), Prof. Matthews (Baltimore), Prof. de Margerie (Paris), Prof. von Seidlitz (Berlin) and Prof. W. W. Watts (London) in turn expressed their appreciation of the work of the Geological Survey, and the services it has rendered to geological science and to the prosperity of Great Britain.

In the evening at 7 o'clock the staff of the Geological Survey and the members of the Dining Club of the Geological Society entertained the Overseas delegates and their wives to dinner at the Rembrandt Hotel. The Company numbered 220 and only two speeches were delivered. Sir John Flett as chairman proposed the toast of the guests, which was responded to by Dr. A. L. Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington and vice-president of the National Academy of Sciences of the United States.

Thereafter the company proceeded to Lancaster House, where a Government reception was held. The guests, numbering more than a thousand, were received by the First Commissioner of H.M. Office of Works and Lady Beatrice Ormsby-Gore.

On Friday, July 5, a series of excursions to districts of geological interest, specially conducted by officers of the Geological Survey for the benefit of those who attended the celebrations, left London. The selected localities are Edinburgh and the Forth Valley, Bristol and South Wales, and the Isle of Wight. Each excursion is to last for a week, and descriptive programmes and itineraries have been specially prepared.

Hydraulic Couplings and Torque Converters

IT is indicative of the interest being taken by engineers in the comparatively recent hydraulic method of transmitting torque and to the importance attached to its development that three papers on this subject were read during April and May before the Institution of Mechanical Engineers. Its application, as the fluid flywheel, to automobile drives has attracted to it the attention of a much wider public than the engineering profession.

Some misconception is prevalent regarding this method of transmission. While it is rightly understood that power is transmitted from one disc—the 'driver' or 'impeller'—to another quite unconnected disc—the 'runner'—by the action of the oil which is kept in circulation, it is assumed by many that the oil is enabled to do this by acquiring some quality of lateral resistance due to an extraordinary degree either of shear resistance or of viscosity imparted to it by the circulatory velocity. In fact, however, the explanation is much simpler. The 'impeller' disc acts on the oil as a centrifugal pump imparting kinetic energy to it, and discharges it into the 'runner' disc, which operates as a turbine and receives energy from the liquid. Its discharge goes back to the impeller for the next cycle of energy transfer.

In his paper "Recent Developments in Hydraulic Couplings" (*Proc. Inst. Mech. Eng.*, April 26) Mr. Harold Sinclair explains the fundamental differences between the two systems of hydraulic transmission—the displacement or hydro-static system and the turbo or hydro-kinetic system, to which latter these couplings and converters belong—and the main advantages of the turbo system. Following a brief historical survey from the pre-War speed transformers originated by Dr. Föttinger for marine turbine propulsion, he outlines the elements of the theory on which this type is based. Proceeding mainly in a descriptive and explanatory vein, the author devotes the bulk of his paper to the development of the Vulcan-Sinclair Coupling. This is a modification of the Vulcan marine type to meet the conditions of industrial and automotive service, and particulars are given of its application in three distinct forms: (1) the scoop type for constant speed motors driving variable speed machines, (2) the traction type, including the fluid flywheel, for variable speed engines and motors, and (3) the ring valve traction type for both constant and variable speed engines.

In "Voith Turbo Transmissions" (*Proc. Inst. Mech. Eng.*, May 3) Dr.-Ing. Wilhelm Hahn discusses the application of torque converters and hydraulic couplings. The former, having in addition to the two discs—the 'impeller' and the 'runner'—a stationary guide ring, is enabled to step up the value of the torque and so is capable of overcoming a high starting resistance. After examining theoretically the relationship between power, torque and speed in a torque converter and considering the conditions for maximum efficiency, he suggests that, to attain as nearly as possible to the ideal torque curve, the torque converter be used for starting up and that, at the appropriate moment, a change-over be effected to the direct drive of a hydraulic coupling.

The necessity for this change-over and the duplication it involves arises from the practical difficulty of fitting the converter with variable blades on the stationary ring so that it is adaptable to all conditions. In "Progress in Design and Application of the Lysholm-Smith Torque Converter" (*Proc. Inst. Mech. Eng.*, May 3), Messrs. Haworth and Lysholm discuss the theory of blade friction and the results of experiments. The main points to be provided for in design are set forth and the results of experiments showing the effects of various blade angles and wheel diameters are given, together with the results of several applications, including a 1,000 h.p. variable blade converter.

Taken together, the three papers give a very good picture of the present position in this practically new method of fluid transmission.

The National Museum of Natural History, Paris

THE National Museum of Natural History, Paris, which was founded by Guy de la Brosse in May 1635 on the site of the Jardin des Plantes—"Le Jardin du Roy"—by an edict of Louis XIII, celebrated its tercentenary in Paris during the last week of June. The celebrations commenced on June 21 with a reception of the delegates by the director and the professors of the Museum, but the most impressive part of the various ceremonies was the *séance solennelle*, which was held in a special marquee erected in the Jardin des Plantes on the afternoon of June 25. This ceremony was attended by about 570 French and foreign delegates, representing 35 academies, 71 universities, 117 scientific institutions and 110 scientific societies, and was honoured by the presence of M. Albert Lebrun, the President of the Republic. The Minister of Education, M. Mario Roustan, presided, and the delegates presented their addresses at the commencement of the *séance*.

Speeches were made by M. Paul Lemoine, director of the Muséum National d'Histoire Naturelle; by the Governor-General, M. Olivier (president of the Society of Friends of the Museum); by M. Alfred Lacroix (member of the Institute and professor at the Natural History Museum), speaking in the name of the Academies; by M. M. Caullery (member of the Institute and professor at the Sorbonne), in the name of the French delegates; and by Sir Arthur Hill (director of the Royal Botanic Gardens, Kew),

in the name of the foreign delegates. The proceedings concluded with a speech by M. Mario Roustan, the Minister of Education.

Sir Arthur Hill, after referring to some of the distinguished botanists who had made the name of the Museum famous throughout the world, concluded a noteworthy speech, which brought the whole company to their feet, with the following words :

"Tous ceux-ci—et beaucoup d'autres—ont fait rayonner leur lumière sur le monde entier, au travers de ce Temple Renommé, le Musée National d'Histoire Naturelle.

"M. le Président, permettez à un botaniste de vous rappeler la fameuse parole de votre grand philosophe Pascal : L'homme fut perdu et trouvé dans un Jardin. Dans le premier jardin, le Jardin d'Eden, l'homme ouvrit la porte de la Science en mangeant le fruit de l'arbre de la connaissance du Bien et du Mal. Pouvons nous exprimer l'espoir que, non-seulement en France, mais au travers du monde entier, malgré les temps si troublés que nous traversons, unis dans un même idéal de tolérance et d'harmonie, les chercheurs de la Vérité verront leurs efforts récompensés par la découverte de cet autre arbre—'L'Arbre de Vie', dont les feuilles nous assureront la Paix eternelle, parmi les Nations ?

"M. le Président, je prie mes collègues Délégués de se joindre à moi, et, debouts, de rendre hommage à la mémoire de ceux qui ont fait le nom de ce Musée si grand, et d'offrir avec moi nos meilleurs vœux pour la continuité de la prosperité et la gloire du Musée National d'Histoire Naturelle."

In the evening there was an official banquet attended by some seven hundred guests, and the Earl of Crawford spoke on behalf of the British delegates.

Another event of the week was the opening of the Grande Galerie de Botanique du Jardin des Plantes, the erection of which was assisted by a grant from the Rockefeller Foundation. This magnificent new building consists chiefly of the herbarium, which is one of the largest in the world. The building is fire-proof and the herbarium cabinets are constructed of metal. There is very limited table space, and most of the research work is carried out in the adjoining private rooms and laboratories, several of which have been set aside for the use of visitors. There is, moreover, particularly good accommodation for workers on the lower cryptogams, some seven rooms being set aside for algology, and an equal or larger number for mycology. Including more or less loosely attached workers, there is a large staff, but the new herbarium laboratories are also used by university students in connexion with research for degree theses.

Visits were paid to the Château of Chantilly and various museums, as well as to the zoological parks at Clères and Vincennes and the experimental grounds and laboratories of M. Vilmorin. The celebrations in Paris were very pleasantly brought to a close by a garden party at the Élysée, when the President of the Republic and Mme. Lebrun received the delegates.

At the end of the festivities an excursion was made to Mont Saint-Michel, Saint-Malo and Dinard, and at Dinard the new museum and aquarium, recently completed, was formally opened in the presence of a large number of the delegates.

Thanks to M. Lemoine, the director of the Museum, to Dr. Jeannel, who was acting as secretary, and his assistants, the arrangements for the celebrations were admirably carried out.

A very interesting exhibition of portraits of all the distinguished botanists, zoologists and others connected with the Museum, together with a fine collection of old prints and pictures and many other objects connected with the history of the Museum, had been arranged in the Exhibition Hall of the recently completed herbarium and botanical laboratories referred to above.

Academies, universities and scientific institutions from all over the world sent delegates to the celebrations. The following institutions, among others, of Great Britain, were represented : Royal Society (Earl of Crawford and Balcarres and Dr. C. Tate Regan) ; British Museum, Natural History (Earl of Crawford and Balcarres, Dr. C. Tate Regan and Mr. J. Ramsbottom) ; Royal Botanic Gardens, Kew (Sir Arthur Hill and Mr. A. D. Cotton) ; British Association (Mr. J. Ramsbottom) ; and the Linnean Society of London (Mr. J. Ramsbottom and Prof. G. D. Hale Carpenter).

Biological Distribution of Molybdenum

PROF. H. TER MEULEN, of Delft, continues his studies on the distribution of molybdenum in the organic world, with the help of Miss H. J. Ravenswaay (*K. Akad. Wet. Amsterdam, Proc.*, **38**, i ; 1935 ; see also NATURE, **130**, 966 ; 1932). Finding in various samples of Dutch East Indian tobacco no less than 0·5–0·7 mgm. of molybdenum per kgm., he went on to determine the molybdenum content of the soil in a number of tobacco plantations. In some the amount was small, 0·01–0·07 mgm. per kgm. ; in others it was ten times as much, 0·12–0·3 mgm. ; and the latter were always the best plantations, growing the best tobacco.

Next, Prof. Ter Meulen extended some former studies of the seasonal variation of molybdenum in leaves ; he finds in about a dozen different trees that the amount per kilogram, or per 1,000 leaves, either remains constant or sometimes increases considerably, from the young leaves of spring until the autumn leaves are about to fall. In other words, the molybdenum does not migrate from the old leaves to the other tissues of the plants, but merely returns with the fallen leaves to the soil. The horse-chestnut is an exception ; here the amount of molybdenum in the leaves decreases in September and still more in October. But the horse-chestnuts themselves contain this element in considerable amount, and have, in all probability, withdrawn it from the leaves.

A third interesting point is a comparison of the molybdenum content in the brown and green varieties of *Prunus*, hazel and beech. Leaves were plucked on the same day, and the molybdenum estimated in mgm. per kgm. of moisture-free material. The curious and striking result was that in all three species the brown-leaved varieties were found to contain about twice as much molybdenum in their foliage as the green ones.

Still more recently, Prof. Ter Meulen has studied the molybdenum content of human teeth, sound and carious, and finds the sound teeth to be very much richer in molybdenum than the unsound. In all these cases it seems natural to suppose that the molybdenum is playing its part as a catalyst, and as such it would seem to be of widespread use and importance.

Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor announces that he has received a letter from Sir John D. Siddeley offering to the University the sum of £10,000, spread over a period of seven years, to help the development of aeronautical research and to assist the work of Prof. Melvill Jones and his associates in the Sub-Department of Aeronautics in the University. No specific conditions are attached to the offer, but Sir John Siddeley suggests that it may be found best to allow a considerable proportion to accumulate to form a capital endowment and to use the remainder for immediate purposes.

The Harkness Scholarship for 1935 has been awarded to Miss D. H. Rayner, of Girton College.

The Frank Smart Prizes are awarded to M. F. Mare of Newnham College (Botany) and D. W. Ewer, of Trinity College, and R. S. Sturdy, of Trinity College (Zoology and Comparative Anatomy).

LONDON.—University Postgraduate Travelling Studentships of the value of £275 for one year have been awarded to R. G. R. Bacon (Imperial College—Royal College of Science) and to A. E. J. Went (Imperial College—Royal College of Science). Mr. Bacon proposes to carry out chemical research in the University of Zurich, and Mr. Went will study the ecology of the mackerel in Norway.

The University Studentship in Physiology of the value of £100 has been awarded to R. A. Gregory (University College), who will carry on physiological research at University College.

OXFORD.—Lord Nuffield has given £16,000 for the purposes of the new institute for medical research. This is additional to the Radcliffe Observatory buildings and their surrounding land, which he bought when it was proposed to remove the observatory to South Africa. The institute is now to be called the Nuffield Institute for Medical Research.

In 1936 the Halley Lecture is to be delivered by Prof. P. M. S. Blackett and the Herbert Spencer Lecture by Emeritus Prof. J. A. Smith.

The Osler Memorial Medal for 1935, for the most valuable contribution to the science, art or literature of medicine made by an Oxford medical graduate, has been awarded to Dr. A. F. Hurst of Magdalen College.

SHEFFIELD.—The following appointments have recently been made: Dr. Francis Davies, reader in anatomy in King's College, University of London, to be professor of anatomy, in succession to Prof. C. J. Patten, who is retiring; Mr. R. T. Percival, to be lecturer in metallurgy (founding); Mr. John S. Bennett, to be assistant lecturer in metallurgy (founding).

THE following studentships and scholarships for 1935 have been awarded by the Royal Commission for the Exhibition of 1851, the name of the recommending university or college being given in brackets: *Senior Studentships*. Dr. Dorothy Hill (Cambridge), for research in geology at the University of Cambridge; S. F. Boys (Imperial College of Science and Technology, London), for research in physical chemistry at the University of Cambridge; Dr. H. Dickson (Imperial College of Science and Technology, London), for research in botany at the Imperial College; Dr. J. Walker (St. Andrews), for research in organic chemistry at the University of Oxford; Dr. W. C. Price (University College, Swansea), for research in physics at the University of Cambridge. *Overseas Scholarships*. R. C. Rose (Alberta), for research in physical chemistry at University College, London; Dr. A. B. Van Cleave (McGill), for research in physical chemistry at the University of Cambridge; J. S. Marshall (Queen's University, Kingston), for research in physics at the University of Cambridge; A. M. Crooker (Toronto), for research in physics at the University of Cambridge or the Imperial College of Science and Technology, London; J. R. Price (Adelaide), for research in organic chemistry at the University of Oxford; J. C. Bower (Melbourne), for research in physics at the University of Cambridge; J. W. Mitchell (New Zealand), for research in physical chemistry at the University of Oxford or King's College, London; Dr. H. A. Shapiro (Cape Town), for research in physiology at the University of Edinburgh. A number of senior studentships and overseas scholarships have been renewed for further periods.

Science News a Century Ago

European Aeronautical Society

UNDER the above heading, in *The Times* for July 14, 1835, was the following advertisement: "First Aerial Ship, the Eagle, 160 feet long, 50 feet high, 40 feet wide, manned by a crew of 17; constructed for establishing direct communication between the several capitals of Europe. The first experiment of this new system of aerial navigation will be made from London to Paris, and back again. May be viewed from 6 in the morning till dusk, in the dock-yard of the Society, at the entrance of Kensington, Victoria-road, facing Kensington Gardens, near the first turnpike from Hyde-park-corner. Admittance every day of the week 1s.; children half price."

A sketch and description of the airship appeared in the *Mechanics' Magazine* of July 18, 1835. The balloon or gas holder, it was said, was composed of 2,400 yards of cotton lawn, thoroughly varnished, and contained 7,000 cub. ft. of gas. The car was 75 ft. long and from it were worked the wings with which the machine was to be propelled.

The Scientific Association of Germany

IN its "Weekly Gossip on Literature and Art", the *Athenaeum* of July 18, 1835, said: "The Annual Meeting of the Scientific Association of Germany is to be held this year at Bonn on the Rhine, from the 17th to the 27th of Sept. At the meeting last year at Stuttgart, Dr. Christian Frederick Harless, Privy Councillor of Prussia and Professor of Medicine in the University of Bonn, and Dr. Jacob Noeggerath, one of the Directors in Chief of the Council of Mines for the Rhenish Provinces of Prussia, were respectively chosen President and Secretary of the ensuing meeting.

"The Geological Society of France meets in the beginning of September at Mezières and after examining the country there and around Namur, Liège and Aix-la-Chapelle joins the German Association at Bonn.

"There will be sufficient time to go to Bonn after the meeting of the British Association in Dublin, and we hope that our country will be worthily represented. . . . We know that, in the true spirit of German hospitality the Committee are anxious to provide

comfortable quarters for all strangers ; but the town is small, and therefore they should get as early advise as possible. Letters should be addressed to Prof. Noeggerath."

The German Association was formed some years before the British Association, and Brewster, writing to Phillips on February 22, 1831, said : "It is proposed to establish a British Association of men of science similar to that which has existed for eight years in Germany, and which is now patronized by the most powerful sovereigns of that part of Europe."

Darwin in Peru

ON July 19, 1835, Darwin records that the *Beagle* anchored in the Bay of Callao, the seaport of Lima, the capital of Peru. Callao he found 'a filthy, ill-built, small seaport', while, owing to the troubled state of affairs, he was able to see little of the country. "I cannot say," he wrote, "I liked the very little I saw of Peru ; in summer, however, it is said that the climate is much pleasanter. In all seasons, both inhabitants and foreigners suffer from severe attacks of ague. This disease is common on the whole coast of Peru, but is unknown in the interior. The attacks of illness which arise from miasma never fail to appear most mysterious. So difficult is it to judge from the aspect of a country, whether or not it is healthy, that if a person had been told to choose within the tropics a situation appearing favourable for health, very probably he would have named this coast. The plain round the outskirts of Callao is sparingly covered with a coarse grass, and in some parts there are a few stagnant, though very small, pools of water. The miasma, in all probability, arises from these : for the town of Arica was similarly circumstanced, and its healthiness was much improved by the drainage of some little pools. . . . In all unhealthy countries the greatest risk is run by sleeping on shore. Is this owing to the state of the body during sleep, or to a greater abundance of miasma at such times ?"

Faraday on Tour in Switzerland

THE year 1835 was not one of Faraday's periods of great activity. It was in fact a time of rest and recuperation between the electrochemical researches, which were completed, and those on electrostatics, which he began to think of in November 1835. There is no entry of any kind in his Diary after April 27 until August, and in the month of July he was on a holiday tour in Switzerland with his wife and brother-in-law, George Barnard. The need for relaxation after a long period of hard work had evidently been felt, for in a letter he wrote to Magrath from Switzerland on July 19, he speaks of "occupation, fatigue and rheumatism". In the same letter he says : "We had a rough passage to Dieppe from Brighton, so rough that we found the French people wondering that we had ventured, but were so unhappy in our sickness as to be quite unconscious of everything else".

The party travelled by Rouen and Paris to Geneva, where Faraday met Prof. De la Rive again, and then to Chamonix and on for a tour of the mountain scenery. "We are almost surfeited with magnificent scenery", he wrote to Magrath ; and again : "No artist should try to paint Mont Blanc ; it is utterly out of his reach. He cannot convey an idea of it". They were back in England in August, for on August 6 the Diary entries begin again.

Societies and Academies

DUBLIN

Royal Irish Academy, June 25. H. L. MOVIUS, JR. : An excavation in the diatomaceous deposit of the Lower Bann Valley. The site, which was excavated in June 1934 by the Harvard Archæological Expedition to Ireland, lay at the base of an extensive deposit of diatomite where some thirty hearths were discovered. Implements of flint in addition to three polished stone axes were found. Typical of the industry are pointed flakes with a superficial tanging of the bulbar end. The site never served as a place of permanent habitation, since the hearths show evidence of seasonal floodings by the river. A nearly complete pot from quite near the site has proved to belong to the Windmill Hill family of Neolithic ware, according to Prof. V. G. Childe. The archæological evidence points to about the beginning of the second millennium B.C. as a rough date for the culture. Such a view is substantiated by Prof. K. Jessen's palæobotanical studies at the site, and on the basis of his work Late Atlantic to Early Sub-Boreal time is probable. As a whole, the industry seems to be an indigenous North Irish development derived from earlier coastal elements which had come in contact with a fully developed neolithic civilisation.

PARIS

Academy of Sciences, May 27 (*C.R.*, 200, 1805–1892). The president announced the death of Hugo de Vries, *Correspondant* of the Academy. ARMAND DE GRAMONT : An optical inverter. CHARLES CAMICHEL, JEAN PARMENTIER and LOUIS ESCANDE : Contribution to the study of liquid veins : multiple solutions : non-commutative operations. Experiments carried out on reduced models and on the Vives-Eaux barrage on the Seine. RENÉ MAIRE and LOUIS EMBERGER : The vegetation of the western Anti-Atlas. MARC KRASNER : The theory of the ramification of ideals. EMILE VAULOT : The application of the calculus of probabilities to the theory of telephone traffic. P. J. MYRBERG : The determination of the type of a simply connex Riemann surface. PIERRE BOOS : The general integral of certain differential equations considered as a function of the constants of integration. CARLO MIRANDA : A new criterion of normality for families of holomorph functions. NIKOLA OBRECHKOFF : The summation of the ultra-spherical series by the method of arithmetical means. GEORGES VALIRON : A generalisation of Schottky's theorem. EUGÈNE BLANC : Monotone multiform correspondences. GÉRARD PETIAU : A form of the equation of the photon. JULIEN KRAVTCHENKO : The validity of solutions of the problem of [ships'] wakes. F. CHARRON : Various utilisations of the bifilar suspension. L. DUNOYER : The principal cause of the inferiority of spirit-levels compared with liquid baths. JEAN P. E. DUCLAUX : The influence of light on the anodic polarisation of tungsten. ROBERT GUILLIEN : The electrical double refraction of liquid oxygen and nitrogen. MME. IRÈNE CURIE, HANS VON HALBAN, JR. and PIERRE PREISWERK : The artificial creation of the elements of an unknown radioactive family, during the irradiation of thorium by neutrons. MLLE. H. ZAVIZZIANO : The co-precipitation of protactinium with titanium. Titanium dioxide, formed by the hydrolysis of titanium

sulphate solutions, carries with it the whole of the protactinium in solution, and is better adapted for this purpose than the substances hitherto employed. VICTOR LOMBARD and CHARLES EICHNER : The large and sudden variation in the permeability of palladium to hydrogen at a temperature just below 200° C. Palladium foil loses 99·95 per cent of its diffusive power to hydrogen by cooling from 225° C. to 125° C. The critical temperature, which varies slightly with the purity of the metal, is between 180° C. and 190° C. The author regards this not as being due to a change of state of the metal but as a change of behaviour of hydrogen towards the palladium. MLLE. NIUTA KLEIN : Study of the inequalities of the index of refraction of a glass. ELIE RAYMOND : A method for the quantitative separation of nickel and cobalt. ANDRÉ DE PASSILLÉ : The thermochemistry of the ammonium arsenates. PIERRE BRAUMAN : The isoamyloxyvanadylsalicylates. ALFRED MAILLARD : The hydrogenation of anthracene. The addition of hydrogen to anthracene is a reaction similar to the hydrogenation of naphthalene; the addition takes place in stages and the reactions are reversible. E. VELLINGER and G. RADULESCO : The use of cracked spirit in internal combustion motors. The unsaturated hydrocarbons are valuable in preventing knocking, but the tendency to gum formation is objectionable. The latter can be removed by adding stabilisers such as polyphenols : that this addition prevents gum formation has been confirmed by experiment. GEORGES DUPONT and RAYMOND DULOU : The presence of active secondary butyl alcohol in certain fusel oils. A sample of propyl alcohol, sold as pure, was found to contain 17 per cent of active secondary butyl alcohol. JEAN WYART : The crystalline structure of paratoluidine. STOYAN PAVLOVITCH : The petrographical study of the peridotites of the Zlatibor massif (Western Serbia). GILBERT MATHIEU : The age of the primary series without fossils of Vendée. JEAN MICHEL : Observations on the projections in the chalk between Tréport and Ault. ADOLPHE LEPAPE and GEORGES COLANGE : The composition of the air of the stratosphere. The air of the stratosphere has the same composition as at the ground-level and it would appear that the atmosphere has sensibly the same composition throughout. L. DONCIEUX and J. CUVILLIER : The Foraminifera of the lower Lutetian in the south of the Arabian desert. GEORGES ADAM NADSON : Hereditary variations produced experimentally in yeasts. Starting with a single yeast cell, under the influence of the X-rays various new stable strains of yeasts have been obtained. These yeasts are so distinct that, if found in Nature, they would be classified not only as different species, but even as distinct genera. The distinctive characters have been maintained after several years of culture. EMILE MIÈGE : The indigenous cultivation of the potato in the mountainous regions of Morocco. The potato has been cultivated for a long period in the mountain regions of Morocco. In spite of the primitive methods, two crops a year with high yields without degeneration have been obtained. These results show the favourable effect of cultivation at a high altitude. LÉON BERTIN : The *Oxystomus* of Rafinesque is a distinct form among the leptocephalian larvæ. ALPHONSE LABBÉ : The silicogen function in the Silicoderms. JAMES BASSET, STEFAN NICOLAU and MICHEL A. MACHEBŒUF : The action of ultra-pressure on the pathogenic action of some viruses. JACQUES PARROD : The formation of hydrocyanic acid and urea by the oxidation of cellulose, in ammoniacal solution, at laboratory temperature. MLLE. HÉLÈNE WINOGRADSKY : The nitrifying micro-flora of activated sludge of Paris. E. GRASSET : Preliminary results on the treatment of human tuberculosis by means of living formolised lysates of B.C.G. and tuberculous bacillus.

BRUSSELS

Royal Academy (*Bull. Classe Sci.*, **31**, No. 4, April 6). L. GODEAUX : (1) Researches on the cyclic involutions belonging to an algebraic surface. (2) The order of the rational correspondences between two surfaces each of genus one. TH. DE DONDER : Application of quantum mechanics to generalised statistical mechanics. L. HENRIOT : Electromagnetic moments. A discussion of the vectors torque and momentor in Lorentz's electromagnetic theory and a comparison with the results of Maxwell's theory. G. BOULIGAND : On certain linear classes of functions. M. WINANTS : Solution of the problem (a_0, IV, 1). J. GÉHÉNIAU : Generalisation of the formulæ of excess of Weierstrass deduced from the theorem of independence of Hilbert – De Donder. YVONNE DUPONT : De Donder's thermodynamic synthesis applied to the Nernst and Ettingshausen transverse effects (2). GEORGETTE SCHOULS : Application of statistical mechanics to the thermodynamics of a gas. Theoretical considerations leading to a calculation of the molar entropies of chlorine, bromine and iodine, allowing for the energy of vibration. J. M. DELFOSSE and R. GOOVAERTS : Raman spectrum of silicobromoform. Comparison of the Raman effect in silicobromoform with that in chloroform, bromoform and silicochloroform. H. WUYTS and R. VERSTRAETEN : Optical analysis and rotatory power of the glycothiodiazolines. M. FLORKIN : Influence of the cryoscopic depression of the exterior medium on that of the blood and urine of *Anodonta*. B. ROSEN and M. DÉSIRANT : Researches on the molecular spectrum of selenium vapour. H. SAUVENIER : Some remarks on the subject of the interpretation of the shift towards the red of the spectral lines of nebulæ. M. NICOLET : Identification of the lines of neon in the spectrum of *B* stars. M. LEGRAYE : Note on a particular fuel in the Fammenian of the Couthuin region. J. MELON : Analysis and optical properties of thoreaulite.

GENEVA

Society of Physics and Natural History, May 16. M. GYSIN : Copper minerals of Kinsenda (Belgian Congo) (2). Presence of two varieties of chalcosine. Studying the minerals of Kinsenda (Belgian Congo), the author has observed two varieties of chalcosine, a blue chalcosine, isotropic, formed by hypogene replacement of primary bornite, and a white chalcosine, granular, anisotropic, formed by supergene replacement of blue chalcosine and of chalcopyrite. E. BRINER and M. CARCELLER : Catalytic action of oxidation exercised by ozone in the oxidation of hydrocarbons. E. CHERBULIEZ and R. WEIBEL : Action of sulphur on water below 100° C. and the geological significance of this reaction. P. WENGER, C. CIMMERMANN and C. RZYMOWSKA : The gravimetric micro-estimation of potassium in the presence of sodium by means of chlorplatinic acid. The authors specify the conditions of F. Emich's micromethod for the determination of potassium in the presence of ten times the quantity of sodium, and have

established a micromethod based on the work of Smith and Gring. C. CIMMERMANN and P. WENGER: The micro-estimation of zinc by means of anthranilic acid. The authors have worked out a rapid and exact micromethod based on the use of this reagent.

LENINGRAD

Academy of Sciences (*C.R.*, 2, No. 1, 1935). I. VINOGRADW: On approximation by means of rational fractions having powers of total numbers for denominators. V. IGNATOVSKIJ: The Laplacean transformation. L. RADZISHEVSKIJ: Contribution to a general theory of linear functional equations. V. KUPRADZE: A generalised 'principle of radiation' in the theory of elasticity. L. LEIBENSON: (1) The theory of the turbulent boundary layer. (2) The energy form of the integral condition in the theory of the boundary layer. A. MITKEVITCH: The influence of mechanical vibration on the subsequent manifestations of magnetic viscosity. V. IPATJEV and W. TRONEV: The separation of metals of the platinum group by hydrogen under pressure. M. KABATSHNIK and M. KATZNELSON: Amination of alkaloids with sodium and potassium amides. A. KLEBANSKIJ and K. CHEVYCHALOVA: Synthesis of β-chlorpropionic acid by condensation of phosgene with ethylene. P. BORODIN and M. GADD: An investigation of the radioactivity of the springs of the Ilmen district and of Lake Turgoyak (South Urals). M. CLAIRE: Some notes on the hydrogeology of the springs of the Ilmen district and of Lake Turgoyak (South Urals). V. LEVSHIN and M. ALENCEV: Researches on the phosphorescence of calcites. J. SALKIND, S. SONIS and N. BLOCHIN: Studies in the synthesis of vitamin A. (1) The action of magnesium-bromvinyl-acetylene on the β-ionone. (2) Biological properties of the product of synthesis. Z. KATZNELSON: The sources of development of the latero-ventral part of the body muscles and of the tail muscles in Amphibia. V. DONTCHENKO and N. MEDVEDEV: A case of dependence of success of interspecific hybridisation upon a single gene. DONTCHO KOSTOFF: Changes in karyotypes induced by centrifugation. V. CIVINSKIJ: The effect of fruiting upon transpiration. N. KALABUKHOV: The physiological peculiarities of the mountain and the plains sub-species of the forest mice (*Apodemus sylvaticus ciscaucasicus* Ogn. and *A. sylvaticus mosquensis* Ogn.).

MELBOURNE

Royal Society of Victoria, April 11. AUSTIN B. EDWARDS: Three olivine basalt-trachyte associations and some theories of petrogenesis. Investigation of the olivine basalt-trachyte associations in three Tertiary igneous provinces, in Victoria, at Otago in New Zealand, and at Kerguelen Island, supports the theory advanced by W. Q. Kennedy that alkaline lavas are the normal product of differentiation of an olivine-basalt magma, so long as there is no undue amount of contamination by contemporary syntexis. Desilication of basaltic magma by its assimilation of calcareous sediments has not occurred in either of the three provinces. In the absence of an immediately previous orogeny, such alkaline rocks will develop in a continental region as readily as in an oceanic region; but an orogeny appears to provide conditions favourable to large-scale assimilation of siliceous and argillaceous sediments, with an accompanying production of andesitic types.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, July 14

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. Burton: General Tour of the Museum.*

INTERNATIONAL CONGRESS FOR SCIENTIFIC MANAGEMENT, July 15–19.—Sixth Congress to be held in the Central Hall, Westminster, S.W.1.

July 15 at 12. Opening of the Congress by H.R.H. the Prince of Wales.

Official Publications Received

Great Britain and Ireland

Annual Report of the Council to the Members of the City and Guilds of London Institute, to be presented at the Yearly Meeting in May 1935. Pp. liii+112. (London: Gresham College.)

The National Central Library 19th Annual Report of the Executive Committee, 1934–35. Pp. 57. (London: National Central Library.)

Other Countries

U.S. Department of Agriculture. Technical Bulletin No. 463: Biological and Ecological Factors in the Control of the Celery Leaf Tier in Florida. By E. D. Ball, J. A. Reeves, B. L. Boyden and W. E. Stone. Pp. 56. (Washington, D.C.: Government Printing Office.) 10 cents.

Agricultural Experiment Station of the Rhode Island State College. Bulletin 247: Blackhead (Entero-Hepatitis) Investigations. By John P. Delaplane and Homer O. Stuart. Pp. 16. (Kingston, R.I.: Rhode Island State College.)

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser. Serie Fiskeri, Bind 10, Nr. 1: Cod Marking Experiments in the Waters of Greenland, 1924–1933. By Paul M. Hansen, Ad. S. Jensen and Å. Vedel Tåning. Pp. 119. (København: C. A. Reitzels Forlag.)

Zoologica. Vol. 19, No. 3: A Second List of Antillean Reptiles and Amphibians. By Thomas Barbour. Pp. 77–141. (New York: New York Zoological Society.)

Ceylon Part 4: Education, Science and Art (G). Administration Report of the Marine Biologist for the Year 1934. By A. H. Malpas. Pp. G7. (Colombo: Government Record Office.) 10 cents.

Kungl. Sjökarteverket, Stockholm. Ergebnisse der Beobachtungen des Magnetischen Observatoriums zu Lovö (Stockholm) im Jahre 1931. Pp. 95. (Stockholm.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 87: 1. On the Rotation of the Plane of Polarization of Long Radio Waves, by Dr. A. L. Green and Dr. Geoffrey Builder; 2. A Field-Intensity Set, by Dr. A. L. Green and H. B. Wood; 3. Measurements of Attenuation, Fading and Interference in South-Eastern Australia, at 200 Kilocycles per Second, by G. H. Munro and Dr. A. L. Green; 4. A Frequency Recorder, by Dr. D. F. Martyn and H. B. Wood. (Radio Research Board, Report No. 6.) Pp. 58. Bulletin No. 88: 1. The Propagation of Medium Radio Waves in the Ionosphere, by Dr. D. F. Martyn; 2. The Characteristics of Downcoming Radio Waves, by Dr. D. F. Martyn and Dr. A. L. Green; 3. The Influence of Electric Waves on the Ionosphere, by Dr. V. A. Bailey and Dr. D. F. Martyn; 4. Long Distance Observations of Radio Waves of Medium Frequencies, by Dr. D. F. Martyn, R. O. Cherry and Dr. A. L. Green. (Radio Research Board, Report No. 7.) Pp. 63. Bulletin No. 89: 1. Simultaneous Observations of Atmospherics with Cathode Ray Direction-Finders at Toowoomba and Canberra, by G. H. Munro, Dr. H. C. Webster and A. J. Higgs; 2. Atmospheric Interference with Reception, by W. J. Wark. (Radio Research Board, Report No. 8.) Pp. 61. Pamphlet No. 54: Thrips Investigation; Some Common Thysanoptera in Australia. By H. Vevers Steele. Pp. 59. (Melbourne: Government Printer.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 87. South American Land and Freshwater Mollusks, 9: Colombian Species. By Henry A. Pilsbry. Pp. 83–88. (Philadelphia: Academy of Natural Sciences.)

Bulletin of the American Museum of Natural History. Vol. 68, Article 5: The Taxonomy of the Genera of Neotropical Hystricoid Rodents. By G. H. H. Tate. Pp. 295–447. (New York: American Museum of Natural History.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 27: Combing of Good Quality Indian Cottons. By R. P. Richardson and Dr. Nazir Ahmad. Pp. 31. (Bombay: Indian Central Cotton Committee.)

Nigeria. Sessional Paper No. 17 of 1935. The Nigerian Goldfield. By Dr. W. Russ. Pp. 11. (Lagos: Government Printer.)

Catalogues

A Catalogue of Scientific Periodicals and Publications of Learned Societies and Public Institutions. (No. 506.) Pp. 68. (London: Bernard Quaritch, Ltd.)

Sands, Clays and Minerals. Vol. 2, No. 3, June. Pp. 160. (Chatteris: Algernon Lewin Curtis.)