NATURE

SATURDAY, FEBRUARY 8, 1930.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

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

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3145, Vol. 125]

Research and Finance in the Study of Man and his Past.

In a note which appeared in Nature of Feb. 1, p. 175, the announcement of the departure of the British Museum's expedition to British Honduras for the purpose of continuing the excavation of Mayan antiquities is coupled with a reference to an appeal by the Director of the Museum for funds to carry on the work and to ensure its continuation. It is held out as an inducement to subscribers, that the sites on which these investigations are being made are within imperial territory, and that this fact gives to British archæologists a security of tenure which they are unable to secure on any prehistoric site in the old world. That this is an element in archæological research of no little importance is indicated by the recent removal of the operations of the British School of Archæology in Egypt to Palestine, as well as by the experience of those who have continued to work in Egypt since changed conditions have prevailed. Even the intensely interesting archæological field which is opening up in India along the Indus Valley is not likely to offer rival attractions to Honduras in this respect, while at any rate investigation on important sites is primarily a function of the Archæological Survey. The Schools of Archæology in Iraq and Palestine operate in mandated territory, while those at Athens and Rome are naturally entirely subject to the regulations for the time being of their hosts. They may at any moment find their activities restricted, as happened in Greece a few years ago when the operations of foreign schools of archæology were limited to two sites in any one year. The expedition to British Honduras, therefore, it is justly claimed, enjoys a unique advantage in that it is working entirely within the boundaries of British territory.

We wish the Director's appeal every success; but while commending it strongly as in every way calling for the generous support of the public, it is in no spirit of criticism that we point out that it inevitably gives rise to a variety of reflections. It may be said without undue partiality that British field work in archæology has proved itself second to none in scientific methods of excavation and in the accurate and painstaking recording and preservation of results. Yet while our archæologists are to the fore in every field in the Old World, the New has been sadly neglected. Students in Britain of the archæology and cultures of America—North, Central, and South—are a small, if distinguished, body. If, however, there is one man who played the

greatest part in establishing the modern study of Central American archæology, it is an Englishman, Dr. A. P. Maudslay, whose remarkable journeys of exploration brought back from the Central American forests, surmounting almost incredible difficulties, a wonderful series of plaster casts of Mayan antiquities which were afterwards presented to the nation.

The magnitude of this work has never been generally appreciated. The density of vegetation in the tropical forest made it a work of intense endurance even to reach the ruins and to clear them from the vegetation with which they were covered; but apart from that, every ounce of the plaster of Paris used in making these large casts was imported from England and carried by the expedition to the sites on which it was used. The total cost borne by Dr. Maudslay himself was at least £10,000, while the labour and time involved by his expeditions will be appreciated when it is remembered that Capt. Joyce's expedition to Pusilhá in 1929 with the aid of a motor tractor took eighteen days to cover a distance of 48 miles by land and river. For Honduras that was good progress. The whole way on land had to be cut through thick vegetation.

With a record of this character behind us in Americanist studies—without reference to the valuable contribution made by Capt. Joyce, both in his synthetic studies of American archæology and his original investigations—it seems incredible that the opportunity should be neglected. The attention of British archæologists should be attracted to a study of such interest and importance. A British school of American archæology should be built up to explore our own territory in Central America. The fields of the Old World offer an attraction which cannot be denied. They are beginning to link up the history of civilisation as a whole in time and space in a manner in which American archæology in its present isolation, apart from diffusionist views, cannot hope to do. The development of scientific method on Old World sites makes them admirable training grounds for the student; but American archæology presents its own problems in method, and it must be remembered that even here stratigraphical problems have to be solved even if the conditions differ, as can be seen in the work of American archæologists in the South-Western States, in Mexico Valley, and in some of the other recent investigations in Central and South America.

Further, in Central America it is difficult to forecast what the future may bring forth, for investigation has still to demonstrate with certainty the beginnings of this culture. The opportunities for discovery seem to be practically unlimited. The short trial aeroplane flight made from Belize recently by Col. Lindbergh showed how many unknown ruins it was possible to sight in an area relatively restricted. When once the facts of the case are appreciated, they require no emphasis to press the need for the formation of such a school, perhaps on the lines of Sir Flinders Petrie's Egyptian school rather than of those at Athens and Rome. The British Museum's expedition, if placed on a permanent basis, might form its nucleus. It would be a graceful recognition of a great piece of work, which is a credit to British archæological studies, if it could in some way be linked with the name of Dr. Maudslay.

These matters, however, lie with the future. The British Museum's appeal is of the present. The British Museum appeals for funds for an expedition of exploration in a British Colony! In other words, a great national institution has to appeal to the generosity of the private individual to carry out work which its administration has decided is within its province and for which members of its own staff have been seconded. In this year's expedition the experienced and exceptionally qualified leader is unable to participate, owing, it is presumed, to his official duties as Deputy Keeper; and part of the funds are derived from the generous gift of an American. For this gift we are grateful, but an expedition so essentially British should be able to rely if necessary upon British money.

The case of the Honduras Expedition is not singular. The excavations at Ur, which have produced results epoch-making in their revelation of the early history of civilisation, have also been carried out by an expedition of the British Museum; but although the Museum authorities were well aware of the importance of the site, they did not feel justified in entering upon the financial responsibilities involved by its excavation until a joint expedition was proposed by the Museum of the University of Pennsylvania. Three seasons ago the excavation had to close down prematurely for lack of funds at a most important stage of its work, when the possibility of disturbance during the summer endangered the most momentous discoveries ever made on the site, as was shown immediately the work reopened in the following season.

It scarcely calls for argument that work which is considered sufficiently important to be carried on under the ægis of a national institution such as the

British Museum should not depend for its continuity upon the precarious generosity of the private individual. Such investigations are not undertaken with undue frequency, or without careful consideration of their intrinsic importance and their moment in the general advancement of knowledge. If they are undertaken, it is surely beneath our dignity that the Director should be in such a position that he must appeal to the individual citizen, or even to a foreign benefactor, to provide the funds to carry out what it has been decided after due consideration is a proper function of a national institution.

The Royal Commission on Museums and National Galleries has reported with admirable moderation and discretion; but it has shown that our national collections have been starved. The Report recognises the nation's indebtedness to the private benefactor in the past: it hopes that we may still rely upon the generosity of the individual in the future. Archæological exploration, however, is too often a matter of immediate opportunity, both in site and personnel, to depend upon fortuitous finance. It would be an excellent thing if a commission similar to that on the Museums were appointed to examine the question of State assistance to scientific research in general. Some provision is already made out of national funds for certain branches of research; but the benefits of this provision are practically confined to the physical sciences.

How much is done for the humanistic sciences? What funds are available for anthropology? A line has been drawn at physical anthropology, while the amounts available for archæology from the grants allocated by the Royal Society are, as a rule and relatively, almost negligible. It has been pointed out again and again that, through a lack of funds, enthnographic material within the Empire is being allowed to disappear rapidly as our primitive peoples come into contact with European culture. Archæological material is perhaps in better case; but if so, this is due to private benefaction and a greater interest taken in the subject by the public, who are sometimes prepared to give practical expression to that interest in the form of a subscription. Even so, financial resources are precarious and often inadequate.

The success of the appeal for a School of Archæology in Iraq was almost entirely a success of the personality of the late Miss Gertrude Bell. The appeal of the British School of Archæology in Palestine failed utterly, and that too at a time when the Government had withdrawn its temporary financial support. Here, however, if anywhere, might archæology have looked for sympathy and assistance from the public when it was engaged in investigating the early history of that country in which so many of our religious and intellectual antecedents are rooted. Palestine is the chief spiritual fount of the British peoples, but it is not the only one. We have British schools in other countries to which our civilisation is almost as deeply indebted. The schools at Athens and Rome have been generously supported by subscription and benefaction, but their means have been and continue to be inadequate to carry out fully the programme of instruction and research they have set themselves. Further, in each case they represent the British nation in almost an equal degree with the British Embassy. They provide an intellectual and academic, as well as a social, centre representative of the British nation, for visitors and residents alike. That their work should be endangered or restricted for lack of funds does us as a nation no credit.

The question of the subvention of research in humanistic studies from public funds opens up a wide field upon which it is not possible here to do more than touch. The archæology of Great Britain itself, for example, has its no less urgent needs. While claims on the public purse are many and the country is overburdened with taxation, a plea from any one department of knowledge may easily be set aside as inopportune on grounds of public policy. It is for this reason that for a reasoned verdict on the urgency of the plea we should look to a public inquiry into the present needs of research, especially in the humanistic sciences.

Mendelism and Anthropology.

Heredity in Man. By Prof. R. Ruggles Gates. Pp. xiii + 385. (London: Constable and Co., Ltd., 1929.) 24*s*. net.

A BOOK with a title "Heredity in Man" will attract the attention of the many who are interested in human affairs, and who have been made aware of the proven usefulness of the contributions of the science of genetics to the practices of animal and plant breeding.

It will appeal strongly to such as hold the view that the further evolution of man, and therefore of society, will take the form of the conscious and deliberate manipulation by man of the attributes of his environment and of the mechanisms that are himself. These will agree with the statement in the preface that a knowledge of human heredity

must form the basis of any enlightened attempt to influence the future development of the human race. This is the point of view of the ardent eugenist, who would seem to advocate the application of stock-breeding practices for the prevention of the continued existence of undesired types.

The book will be read by the student of political science as well as by those politicians, professional and amateur, who, nowadays, so eagerly seek biological endorsement for their own peculiar prejudices. To-day it is not uncommon, when the politician speaks, to hear the views of some biologist. If, for example, in a country, changing economic and political circumstances make it desirable on the part of those presently in power to limit the numbers of immigrants from countries where a lower standard of living and different habits and manners obtain, the official reason that is commonly given in explanation of such an attitude and for such a policy is one that is based on the teachings of those biologists who preach the view that certain races or racial types are genetically superior.

Reading this book, the eugenist who seeks encouragement for policies of a positive kind, and the politician who seeks an authority that he may quote, will be disappointed, for Prof. Ruggles Gates avoids discussion of the implications of genetic fact, contenting himself with the presentation of what has been said and what has been thought, and leaving the task of weaving these facts into considered policies to other people, probably less able than himself.

The book will be read by the physician who seeks an answer to the question now frequently put to him, 'Should we two with such-and-such family histories, or with such-and-such personal disabilities, marry and have children?' It is true that now the domination of bacteriology in medicine is waning, medical practitioners are studying much more thoroughly the rôle of inheritance in the etiology of disease, and that this new and intensified interest is revealed in the quality of their writings. But though the doctor will find in this book a very complete compilation of what has been recorded and of what has been said of the mode of inheritance of physical defect and derangement, he will probably decide that the author too frequently goes beyond the human subject for his examples—there are at least a hundred references to inherited characters in animals other than man—and he will certainly find that in a very great many instances of such inherited abnormality he can obtain nothing that will help him to answer categorically the question that is asked. This, unfortunately, must necessarily be so, for the majority of the records of family histories have been taken by such as have been untrained in genetical methods and relate all too commonly to individuals introduced solely through anecdote. But even though Prof. Ruggles Gates advises but rarely, as when, for example, he states, quoting Macklin, "13 per cent of pupils in blind schools are blind through cataract. They should obviously not have children . . .", such facts as are known are fairly given, and these will permit the physician himself, having read the book, to present a reasonable opinion.

It is accepted that, socially, the inherited physical defects and derangements are not so important as are the mental. The reason for this would seem to be that a greater proportion of the physical are either curable or are of a kind that do not seriously handicap their exhibitors in competition with their fellows. The fact that polydactyly is inherited is of interest and of scientific importance, but no one would advocate legislation which would deny parentage to the polydactylous. The condition does not seriously handicap its exhibitor, and, in any case, the extra digit in each succeeding generation can be cut off. Red-green blindness is an inherited character, and unless parentage is denied to such as carry in their hereditary constitutions the factors responsible, it will spread slowly but surely through a population. But although it cannot be cured, it is not, in present circumstances, a serious handicap. It can therefore be disregarded. It is only when a defect is incurable and when it renders its exhibitor unable successfully to compete with his fellows that it constitutes a problem. The simplest method of solving this would of course be to find a cure, and doubtless, as time passes, advances in medical science will give to mankind the power to repair hereditary deficiencies and to prevent many forms of genetic defect.

Since most of the inherited and undesirable mental characters are presently incurable, since we do not know the chemistry of normality, and because they render the individual a burden to himself and, more particularly, to his fellows, they constitute a very serious social problem. For example, Prof. Ruggles Gates quotes Goddard, who states that 50 per cent of all paupers and of all prostitutes are feeble-minded, and accepts the statement that feeble-mindedness is, in the majority of instances, an inherited character, behaving as a simple Mendelian recessive. Here again Prof.

Ruggles Gates studiously avoids any discussion of the implications of this statement. Surely, if it is accepted that feeble-mindedness is commonly a hereditary character, behaving in inheritance as a simple recessive, the methods to be adopted to prevent the multiplication of such stocks are obvious. Surely it is reasonable that those who read a book such as this should expect therein a statement of the views of the author concerning such a matter as this. Possibly, Prof. Ruggles Gates is of the opinion that it is the task of the biologist to present the facts, and not for the biologist alone to discuss policies based on these facts. Many will agree with this view. But the biologist to-day cannot refuse to make his contribution toward the construction of policies that affect mankind. It is probable that Prof. Ruggles Gates holds the view that before the biologist can advise action he must be in possession of all the pertinent data. The fact that only some 30 pages out of a total of some 380 are devoted to a discussion of mental characters in man will show how very little is known of those normal and abnormal characters which are so important socially.

It is only as one approaches the end of the book that one realises that Prof. Ruggles Gates's interest in human heredity is directly related to his activities as an anthropologist. Throughout the book he neglects the interest of the politician, the physician, and the eugenist, though he continually refers to matters of profound interest to them, and for the reason that undoubtedly he is addressing himself to the anthropologist. He treats the subject of racial crossing mainly from this angle, and discusses all too briefly the general policy of such intermixtures. From the very insufficient and haphazard crosses that have been made he concludes—as would be expected from one with genetical knowledge—that the melting-pot conception is now discredited, and that segregation of independently inherited characters occurs even after thousands of years.

It is entirely satisfactory to know that through such a book as this the genetic point of view will be introduced into anthropological literature, and there is no doubt that in writing this book Prof. Ruggles Gates has rendered great service. But anthropologists are few, and politicians, physicians, and eugenists are many, and it is to be hoped that Prof. Ruggles Gates will now address the large audience that awaits him. The geneticist has contributions of the utmost importance to make, and it is highly desirable that we should know what Prof. Ruggles Gates, as a geneticist, has to say upon such questions as, for example, the effect of emigration and immigration upon the Scottish stock; the worthiness of our present information concerning feeble-mindedness; the validity of the argument concerning racial genetic superiority. There are scores of questions such as these that are puzzling the minds of those who are guiding the destinies of Great Britain, and they can only be answered when the biologist has made his contribution.

Having read the book carefully, one suffers from a feeling of regret that the author has quoted the opinions of others so much and presented his own so infrequently, for, without doubt, Prof. Ruggles Gates can bring to the discussion of this subject of human heredity, fresh points of view that would be exceedingly stimulating. F. A. E. CREW.

Science and Art of Lubrication.

The Principles and Practice of Lubrication: a Manual for Petroleum Technologists, Students, Engineers, Oil Salesmen, etc. By Prof. Alfred W. Nash and Dr. A. R. Bowen. Pp. xi+315+29 plates. (London: Chapman and Hall, Ltd., 1929.) 15*s.* net.

IN the opinion of the authors, lubrication is no longer an art; for to secure efficiency it is now necessary to understand the scientific principles upon which the proper choice of lubricating oils and greases depends, and also the laws upon which the proper design of bearings is based. Engineers in the past have had to rely wholly upon their practical experience when dealing with lubrication problems; but of recent years scientifically conducted experiments have shown what the actual conditions are under which lubricated bearings run. One of the most satisfactory features of such research work has been that whilst engineers interested in lubrication problems are more inclined to study the teachings of scientific discovery, scientific workers are more desirous of assisting the practical man to ascertain the causes of the difficulties met with in practice; with the result that it is now possible to produce a manual, such as the one we are considering, dealing with the subject rather as a science than as an art. However, it must not be forgotten that, although much has been accomplished, there remain some peculiar frictional phenomena which cannot be satisfactorily accounted for.

The practice of lubrication is essentially the interposition between two surfaces in rubbing contact, of some fluid or soft solid, which will sufficiently reduce the frictional resistance to prevent

them from heating and injuring each other. The various types of friction are treated of in Chap. ii., and are classified under two headings as follows :

UNLUBRICATED SURFACES.

(*a*) *Dry Friction.*—This represents friction between perfectly clean, dry, solid surfaces.

(*b*) *Rolling Friction.*—A term applied to such reactionary force as is found between solid surfaces separated by balls or rollers.

LUBRICATED SURFACES.

(*c*) *Boundary Friction.*

(*d*) *Fluid Friction.*

In the case of fluid friction the surfaces are entirely separated from each other by a comparatively thick film of the lubricant. Beauchamp Towers' experiments on journal friction are clearly described, as also are the investigations of Osborne Reynolds concerning the cause of the separation of the shaft and bearing surfaces by a film of oil under pressure. When the rubbing surfaces are flat they separate only slightly, and a comparatively thick fluid film does not form. Michell's method of causing such a thick lubricating film to accumulate is figured and described. The coefficient of friction of bearings resting upon such viscous films is very small, so small indeed that the heat developed by friction escapes freely by conduction and convection, and there is no undue rise of temperature. The authors, however, point out that, as evidenced by wear, very few bearings in practice can be working at all times under conditions of complete fluid friction, as there is no wear when such conditions prevail. On this account all bearings, even when they have been designed so that they are in most conditions of running separated by a lubricating viscous film, must be supplied with an oil which has a low coefficient of static friction, so as to keep them cool when boundary conditions of friction supervene.

Boundary friction receives a good deal of attention from the authors, the experimental work of Sir William Hardy and others being cited. When viscous liquids or greases are spread over surfaces in rubbing contact, the resulting threshold or static friction is not found to bear any regular relationship to the viscosity of the lubricant, except when members of chemical series, such as the paraffins or alcohols, are contrasted the one with the other. Engineers have always recognised this, and have regarded as lubricants only those liquids with small threshold frictions. Thus, quite apart from its viscosity, a liquid, to be a good lubricant, must possess marked 'oiliness'. Clean solids in rubbing contact also have widely different threshold frictions; that is, they vary in 'unctuousness'. In practice the lowest frictions are obtained by using solids for the rubbing surfaces which have marked unctuousness, with lubricants of marked oiliness.

Specific gravity and viscosity are dealt with in Chap. iii., methods for their determination being described, and apparatus illustrated.

In Chap. iv. the design and lubrication of bearings are discussed. As both animal and vegetable lubricants possess the property of oiliness much more markedly than mineral oils, the authors consider that the importance of the property of unctuousness in bearing metals cannot be overestimated, a good bearing metal often enabling a moderately oily lubricant to work satisfactorily. Indeed, this chapter is sure to prove useful to the engineer.

Chap. v. deals with the source, methods of manufacture, preparation, and composition of lubricants, as well as their compounding and blending. In the following two chapters the chemistry and the chemical and physical testing of lubricants are considered. Here (p. 191) the authors rightly remark: "It has already been pointed out that the best judgment of the value of an oil is made from a test in the machinery for which it is intended; such a test can constitute the only reliable guide to the durability and lubricating value of the oil. However, there are certain chemical tests which should be made before the oil reaches the engineer, and these tests, although not deciding the lubricating power, give important information upon the degree of refining of the oil, its mineral, fatty, or compound nature, and also the impurities or adulterants."

The mechanical testing of lubricants in special machines is considered in Chap. ix. Mechanical friction tests being the only fair means of ascertaining the lubricating value of oils, they are most satisfactorily made by using one or other of the many forms of mechanical oil testing machines which have been devised to reproduce as closely as possible the conditions met with under various practical conditions of work. Thus we have here described machines for determining unctuousness and oiliness, and others for conditions when these and viscous film conditions are combined.

The manual has been well produced, the type being clear, and the illustrations numerous and good. R. M. D.

Modern Light.

Müller-Pouillets Lehrbuch der Physik. Elfte Auflage. Herausgegeben von A. Eucken, O. Lummer und E. Waetzmann. In fünf Bänden. Band 2: *Lehre von der strahlenden Energie (Optik).* Herausgegeben von Karl Wilhelm Meissner. Zweite Hälfte, Erster Teil. Pp. xvi + 929-1708 + 19. Zweite Hälfte, Zweiter Teil. Pp. xv + 1709-2392. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1929.) 87·50 gold marks.

THESE important contributions to the literature on optics have been produced under very adverse conditions. The initial responsibility for their production was assumed by O. Lummer, who arranged the division of the work and its distribution among various contributors. Unfortunately, Lummer died in July 1925, when the work was in an advanced stage and the first half-volume of "Die Lehre von der strahlenden Energie" was already in the press. The first half-volume, therefore, appeared in 1926, and the two books which form the second half-volume are now before us. The long interval of time between the appearance of the first and second half-volumes is due partly to the withdrawal of many of Lummer's associates from active participation in the work, and partly to the need for considerable revision and enlargement of the articles which were ready for the press at the time of Lummer's death, in order to bring them up-to-date.

In spite of these serious difficulties, the new editor, K. W. Meissner, has produced two books which will be regarded by all teachers of physics as extremely valuable contributions, although it must be recorded that their contents are overwhelmingly drawn from German sources. As Lummer's original plan of production had more or less to be maintained, there is some slight overlapping, but only one or two important points have been omitted from the work. The books are profusely illustrated, and many of the illustrations have great pedagogical value.

Meissner commences the new half-volume with a short section on plane polarised light, which is followed by sections on double refraction, rotation of the plane of polarisation, and the crystal optics of X-rays, by E. Buchwald. The mathematical treatment of the Fresnel wave theory is rather condensed, but we appreciate the clear explanation of the way in which a modern polarimeter should be used. On photometry the English reader has excellent sources of information in his own tongue, but the article contributed by H. Kohn is not without distinction. His discussion of Lambert's law is particularly good, as also are his descriptions of modern spectro-photometers and colorimeters; we wish, however, that he did not consider it necessary to express the pentane lamp as 10/9 Hefner unit. The apparatus and technique for the investigation of the whole spectrum are described in a series of articles by Czerny, Gehrcke, Hettner, and Meissner. The methods described for producing spectra include the explosion of wires and King's carbon furnace. Czerny and Hettner are also responsible for an excellent article on black body radiation, although the experimental portions do not take into account work carried out later than 1926, and no modern American experiments are described. The theoretical portions have, however, been brought up-to-date by W. Pauli, who, incidentally, emphasises that the Compton effect provides a proof that the pressure of radiation is discontinuous. R. Minkowski completes the first book with a long chapter on the theory of reflection, refraction, and dispersion, in which adequate attention is paid to modern developments.

The second book opens with an introductory chapter on the fundamental ideas of the quantum theory applied to atomic structure. Although this introduction is very good, it would not excite enthusiasm were it not for the fact that to it are added sections on the magnetic properties of electrons and on the new wave mechanics. These additions increase the value of the chapter enormously, although it is felt that more attention could well have been paid to the experimental aspects, and, for example, some mention made of G. P. Thomson's work. The reader will have little difficulty in following the excellent summary of Heisenberg's theory of the helium spectrum, which led directly to the prediction of the two forms of hydrogen.

A short description of the production of spectral lines by G. Hertz is the prelude to lengthy contributions by F. Paschen and A. Kratzer, who respectively describe in detail the structure and origin of line and band spectra. The investigation and theory of the Zeeman effect are very ably summarised by E. Back, whose work with intense magnetic fields is so well known. D. Coster is responsible for the treatment of X-ray spectroscopy. He gives a historical outline of its development, and then describes in detail the design of modern X-ray tubes and spectrographs for research purposes. He discusses the bearing of Bohr and Stoner's ideas on the experimental results and devotes considerable attention to the continuous X-ray spectrum and to the phenomena of dispersion.

Of all the German workers on radioactivity, few can be better qualified to write on X-rays than Fräulein Lise Meitner. Her contribution is brief and to the point, but would be improved by the provision of more diagrams. The contributions of R. Ladenburg on magneto- and electro-optics are very impressive. R. W. Pohl deals with photo-electricity, but his treatment of the main phenomena is rather of the nature of a summary. This is mainly because he confines himself to the purely optical aspects of photoelectricity. We would certainly have expected some reference to the work of Auger in the section on the photoelectric effect in gases, for there exists at least one excellent summary of this work in German. B. Gudden is responsible for the articles on fluorescence and phosphorescence. They cover a wide field, but the average English reader will be surprised at the smallness of the space devoted to the effect of collisions of the second kind on the fluorescence of gases. He will also be surprised at the frequent omission of names from the index to the half-volume, but this will only slightly diminish his respect for an excellent work.

International Astronomical Union.

International Research Council: International Astronomical Union (Union Astronomique Internationale). Transactions of the International Astronomical Union. Vol. 3: *Third General Assembly held at Leiden, July 5 to July 13, 1928.* Edited by F. J. M. Stratton. Pp. ix + 348. (Cambridge: At the University Press, 1929.) 15*s.* net.

THE third volume of the *Transactions* of the International Astronomical Union, embodying an account of the proceedings at the third general assembly held at Leyden in July 1929, is a valuable document which, in its general form, closely resembles the previous volumes. It opens with the reports of the executive committee and the various commissions of which the Union consists, which were circulated to members before the meeting and formed the basis of discussion. The modifications and decisions which were made at Leyden have, however, been included so far as possible without incurring heavy expenditure on printing, so that this part of the *Transactions* differs to some extent from the reports issued before the meeting.

The volume under notice forms, in fact, a fairly complete statement of the present position of the programmes of research in the various departments of astronomy. For actual completeness, however, Part 3 also must be consulted, which gives an account of the meetings of each commission at Leyden, with the recommendations adopted. Part 2 deals with the inaugural ceremony and opening general assembly, and Part 4 with the closing general assembly. Most of the material in the first four sections is given in English. In Part 5 the several resolutions adopted by the Union are collected in a classified form and given in French. A number of appendices record the statutes of the International Research Council and the International Astronomical Union, the names of members of the committees and commissions, and other cognate information.

It is much to be hoped that the efforts of the Union to standardise the procedure of astronomers in certain matters hitherto left to individual choice will meet with the success they deserve. Such matters as the definition of the galactic system of co-ordinates, the form adopted in publishing astronomical papers, and the abbreviations by which recognised publications, societies, etc., are represented, have been given serious and praiseworthy attention by the respective commissions, and their recommendations, if generally adopted, would greatly facilitate the work of astronomers. In particular we would mention the recommendation, already adopted by some editors, that every astronomical paper should be accompanied by a short summary. The Union has, of course, no power to enforce its desires on these points, and this is an additional reason why attention should be specially directed to them.

To those who were fortunate enough to attend the Leyden meeting, this volume will come as a welcome reminder of a delightful experience, and to astronomers everywhere it will be an indispensable guide. Prof. Stratton is to be congratulated on well maintaining the high standard set by previous volumes.

Our Bookshelf.

Practical Design of Simple Steel Structures. By David S. Stewart. (The Glasgow Text-Books, edited by G. Moncur.) Vol. 1: *Shop Practice, Riveted Connections and Beams, etc.* Pp. xv + 183. 12*s.* Vol. 2: *Plate Girders, Columns, Trusses, etc.* Pp. xv + 215. 16*s.* (London: Constable and Co., Ltd., 1929.)

TEXT-BOOKS on structural engineering are now so numerous that justification for a new one must really be difficult to find. The field is certainly amply covered by many excellent treatises, the names of which will at once suggest themselves to the student and the practitioner. In the majority

of these publications, however, theoretical considerations are paramount, sometimes to the exclusion of all others. Guided by their instruction, the student would be fully equipped to design structures on correct scientific principles. But, in actual practice, there are divergences from theoretical considerations on various grounds, and this aspect of the subject is generally but slightly touched upon. In the case of the present volumes, such a defect does not exist, and they are to be welcomed as a most valuable vade-mecum to the inexperienced and the beginner. They are full of practical hints and directions of sound economical value, such as (to mention only a few) the limitations in the rolling of steel plates and sections, and the extras chargeable on excess sizes, the deterrent effect of meticulous drawings and specifications on the obtainment of reasonable quotations, the loss due to scrap material, etc. Some of the hints appear to affect minor details, but the cumulative effect is considerable. Perusal of the work, with its clear appreciation of the practical aspect of structural design, was a distinct pleasure.

In a short notice it is only possible to deal very briefly with the contents of the volumes, but a summarised statement is as follows: Vol. 1 consists of eleven chapters dealing with rolled sections for structural purposes; drawing office; template loft and the works; fastenings, pitches, and simple riveted joints of plates; flange plate splices; splices for angles, joists, and channels; splices for the web plates of plate girders; eccentric riveted connexions; wind pressure—factors of safety; beams and the design of a joist and channel crane gantry girder. Vol. 2 has nine chapters dealing with plate girders; design of a 40-ft. span gantry girder; axially loaded columns and their foundations; non-axially loaded columns; design of a 55 ft.-span roof truss; roof trusses; portal trusses and workshops; design of a lattice girder footbridge; and design of a 70-ft. span through railway bridge. Full details of the designs are given and many examples are worked out in detail, both in symbols and numerically. Altogether, excellent volumes and cordially to be recommended.

B. C.

An Introduction to the Study of Map Projections. By J. A. Steers. Second and revised edition. Pp. xxiii + 204. (London: University of London Press, Ltd., 1929.) 8*s*. 6*d*. net.

THIS little book is, in the main, what it professes to be, and is written chiefly for those students of geography who have but little knowledge of mathematics. For that reason the study is cast largely in an elementary geometrical form, and mathematical symbols are, where possible, avoided. The plan of the book includes chapters on the properties of projections, their systems, the measurement of areas, the use of scales, and then a description and explanation of the more common projections, especially those to be found in atlases, and those of practical use in topography. Given the limitations imposed on himself by the author, the book fulfils its purpose, and its appeal to the non-mathematical student is evidenced by the fact that this second edition has been called for three years after the issue of the first.

A few matters might perhaps be considered by the author before the preparation of a third edition. The use of the word 'normal' instead of the usual term 'polar', for that particular case of zenithal projections, seems to be an unnecessary alteration in established practice. The statement on p. 170 that the 6-inch maps of the Ordnance Survey are plotted by rectangular co-ordinates from a central meridian, might give the impression that there is one such meridian, whereas these maps are plotted by counties or groups of counties. At the beginning of the book appears a classification in which all projections which are not zenithal, conical, or cylindrical are boldly dumped together as conventional—a possible arrangement, but not commonly accepted. Finally, it may be as well to sound a note of warning against the habit of looking at map projections from a purely geometrical point of view. No thoroughly sound understanding of the beautiful subject of map projections can be arrived at through geometrical constructions.

A History of the Birds of Essex. By William E. Glegg. Pp. xxxv + 342 + 20 plates. (London: H. F. and G. Witherby, 1929.) 25*s*. net.

THIRTY-NINE years ago Mr. Miller Christy's well-known work on "The Birds of Essex" was published, and advances in the technique of identification as well as some changes in the status of the birds themselves have taken place during the intervening years. This new volume, which takes account of the changes and deals critically with the older as well as with new records, must therefore supplant in most respects the earlier work as the text-book of Essex ornithologists. The avifauna of the county is now known to comprise 281 forms, of which 95 are breeding birds, 26 are regular winter visitors (although it will be noted that in each of these figures there is a discrepancy between the statements on pp. xxiv and xxxiv), and 160 are birds of passage or irregular visitors.

In connexion with each species are given the records of local occurrences and distribution, migration movements and their dates. The book contains just the information that the local naturalist demands, and the introduction, which with advantage might have been very considerably extended, places parochial details in a more general setting.

Chemistry of Pulp and Paper Making. By Edwin Sutermeister. Second edition, rewritten. Pp. x + 565. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 32*s*. 6*d*. net.

THE new edition of this valuable work, which first appeared in 1920, has been carefully revised and brought up-to-date. In incorporating the fresh material, the author has continued his useful practice of giving the original sources of his information in footnotes. The work is admirably printed and illustrated, and it will be welcomed by an increasing number of chemical workers in the pulp and paper industry.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The 'Wave-band' Theory of Wireless Transmission.

THE article on this subject in NATURE of Jan. 18 by Sir Ambrose Fleming is scarcely a complete statement of the usually accepted 'wave-band' theory, and unless the more complete aspects of this theory and their significance with respect to the number of wireless telephone stations that can operate on a given range of wave-length, and with regard to the possibilities of the extensive use of television, are correctly stated, it is to be feared that misconceptions will arise.

The so-called 'side-bands' are more than a mere mathematical conception. Their existence admits of the simple experimental demonstration of taking a resonance curve of a selective receiver with an unmodulated, and then with a modulated, valve oscillator. In the latter case resonant 'humps' can be shown to exist at the frequencies $(p \pm q)/2\pi$; $(p \pm 2q)/2\pi$, etc. The same experiment shows that a selective receiver responds to a modulated electromotive force quite differently from an unselective receiver, and it is here perhaps that the real explanation is to be found of the width of frequency band found necessary in practice. If a sudden change of amplitude takes place an undamped receiver will continue to oscillate for many cycles before its amplitude falls correspondingly. Its response to sudden changes is therefore not strictly in accordance with the changes of the received impulse and the rendering is imperfect. The well-known effect of excessive reaction in a broadcast receiver is due to this cause. A heavily damped oscillator, however, follows quickly the changes of amplitude and gives a true rendering. But such a heavily damped oscillator cannot be limited to picking up energy from a narrow band of frequency. Or, as the wave-band theorists express it, the sudden changes involve a certain 'width of band'.

Thus, whether the side-bands exist or not is merely a matter of a choice of points of view. The final results are the same, namely, that a considerable range of frequency is necessary for each line of communication, and the higher the frequency of the changes, the wider the range of frequency on which energy must be received by the receiver. Hence, since television involves the greatest rapidity of change of amplitude, it also necessarily involves the most highly damped receiver and thus the widest band of frequency.

CECIL L. FORTESCUE.
City and Guilds (Engineering) College,
Exhibition Road,
London, S.W.7, Jan. 21.

IN NATURE of Jan. 18, Sir Ambrose Fleming presents the wave-band theory of wireless transmission as a mathematical fiction and issues a caution against being misled by the assumption of any physical reality in the so-called 'side waves'. It can be shown, however, not only that this assumption is perfectly justifiable, but also that the other mode of thought is liable to lead to false conclusions.

Adopting Sir Ambrose Fleming's notation, we may write for the modulated part of a high frequency signal

$$a = A \cos qt \sin pt,$$

in which $q/2\pi$ is the audio frequency and $p/2\pi$ is the radio frequency. This is mathematically indistinguishable from

$$\tfrac{1}{2}A(\sin \overline{p+qt} + \sin \overline{p-qt}),$$

and the question arises whether there is *any* sort of distinction. The same kind of question arises when we attempt to distinguish a force from the vector sum of its components, and either question is one of philosophy which need not concern us here.

The inference which one is invited to draw from Sir Ambrose Fleming's article is that if a signal $\Sigma A \cos qt \sin pt$ were applied to a band pass filter with a pass range of $p - q_0$ to $p + q_0$ it would emerge intact; but everybody knows that in fact all the terms corresponding to $q > q_0$ are cut down.

The possibility of filtering out side waves, and of 'single side band' transmission and the like, are the usual arguments for their physical existence, but the root of the matter and the relation between the two points of view can be more clearly exhibited thus:

The solution of any electrical network problem turns on the solution of simultaneous or possibly partial linear differential equations which may be typefied by a simple case:

$$\ddot{y} + B\dot{y} + Cy = f(t).$$

Here y is the current in a certain branch and $f(t)$ is the 'driving force', which may, for example, be $A \cos qt \sin pt$. In this form there is no generally known method of solution, but if the right-hand side is replaced by $\frac{1}{2}A$ $(\sin \overline{p-qt} + \sin \overline{p+qt})$, the equation assumes a well-known standard form and the solution is equally a solution of the original, because there is no mathematical distinction between the two forms of the right-hand side.

Occasionally it is possible to recombine the $\overline{p-qt}$ and $\overline{p+qt}$ terms occurring in the solution; in this event one might regard the introduction of the side wave terms as a mathematical fiction; but far more generally no such recombination is possible, and this is the basis of the 'real side wave' viewpoint.

Even so it may be possible to develop a calculus of the subject which does not employ the side wave concept, but it is difficult to see how it could fail to be cumbersome, and certainly less convenient than the known methods. But if it is proposed to think on such lines, an amendment does seem necessary to Sir Ambrose Fleming's statement, "The whole question at issue then is, What range of amplitude is admissible?" The question surely is not how *much* the amplitude may vary, but at what frequency.

LESLIE H. BEDFORD.

IT is evident there are strong differences of opinion as to the validity of the accepted 'wave-band' theory. Prof. Fortescue and Mr. Bedford have stated with great clearness their views. May I present the following considerations on the opposite side?

If a highly selective wireless receiver associated with a good moving coil loud speaker is used to receive vocal or instrumental music from a broadcast station, we do not find that we have any imperfect reproduction of high notes relatively to bass notes in receiving music broadcast. If we are in tune for very low frequency acoustic modulation or bass notes, we are also in tune for high frequency or shrill notes. If this was not the case, we should have to keep on adjusting our receiver as the pitch of the music varied.

Now musical pitch varies from 40 to 4000, and if the carrier wave has a frequency, say, of 193 kc/s (long wave Daventry), then the ordinary theory would assert that for each of the highest notes of the orchestra there are two simultaneous carrier waves emitted which may differ in frequency by as much as 4 per cent.

A good selective receiver cannot respond equally well to waves differing so much in frequency. If, then, these two component waves really exist, we should have to set our receiver condenser so as to pick them up in equal strength, without which the modulation would not be created. If the receiver resonance curve is sharp, this implies that on the band theory high notes in music would not be reproduced sufficiently loud relatively to low notes. Hence one would be led to the conclusion that the best results would be obtained by the use of a not-very-selective receiver. But that is contrary to experience. Makers of wireless receivers endeavour to give them the highest selectivity—not only to get the best results on one broadcast station but also to exclude that background of noise which is due to the jam of waves in the ether at present of closely adjacent frequencies.

What we require to improve broadcasting is greater constancy in emitted carrier wave-length and greater selectivity in all receivers.

If it were merely a question of formulating explanations, everyone is entitled to regard the results in whatever light he pleases or to employ what mathematical artifices enables him to solve equations. But when we come to practice and official regulations, it is a great disadvantage from the point of view of experimental progress to have these official regulations such as the 9-kilocycle wide wave-band, based upon a merely theoretical interpretation of certain facts, and moreover an interpretation which seems out of agreement with practical experience.

AMBROSE FLEMING.

Manor Road,
Sidmouth, Devon.

Light in Four Dimensional Space.

IN works on relativity little mention is made of the plane in which light travels in four dimensional space. If we assume that a small body sends out rays of light in a three dimensional plane at right angles to its world-line, the form of the equation for the interval ds :

$$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2 \quad . \quad . \quad (1)$$

can be simply explained without the use of imaginary angles and imaginary time.

Let the plane of Fig. 1 be a section of four dimensional Euclidean space containing the world-lines of the following particles or observers: AA, BB, and CC at rest relative to each other, and DD in motion relative to the other three. The sinuous lines represent the bobs of the pendulums of two clocks travelling with A and D. *Time* in the case of each observer has of course the direction of his own world-line. At P and Q rays of light are sent out from DD. They travel at right angles to DD in three dimensional planes, which cut the plane of the diagram in the lines XX and YY. An observer AA wishing to measure the interval PQ will make the two measurements, dx with a foot-rule and dt with his clock. He will then calculate the interval by the formula :

$$ds^2 = \tfrac{1}{2}c^2dt^2\left\{1 + \sqrt{1 - 4\left(\frac{dx}{cdt}\right)^2}\right\} \quad . \quad (2)$$

which follows immediately from the geometry of the figure, for $dx/\sin\theta = ds = cdt\cos\theta$

where $ds^2 = c^2dt^2\cos^2\theta = \tfrac{1}{2}c^2dt^2\{1 + \cos 2\theta\}$

$$= \tfrac{1}{2}c^2dt^2\left\{1 + \sqrt{1 - 4\left(\frac{dx}{cdt}\right)^2}\right\}.$$

In this form ds is invariant to all observers. If we write $v = dx/cdt$ and neglect high powers of v, formula (2) becomes :

$$ds^2 = c^2dt^2(1 - v^4 - \ldots) - dx^2 \quad . \quad (3)$$

which reduces to formula (1) when the relative velocity is neglected altogether.

Observer AA is very much handicapped in his choice of co-ordinates. A fictitious observer at right angles to him, or to the plane of the diagram, for example, could measure the co-ordinate dp with a foot-rule, which would give the simple formula :

$$ds^2 = dx^2 + dp^2 \quad . \quad . \quad . \quad (4)$$

In practice, however, he must be content with the indirect measurement dt and must not expect even the simplicity of formula (1). We have assumed *flat* four dimensional space. In curved space, XX and YY will become geodesics. AA must know the value of the Riemann-Christoffel tensor at every point along the path of the light and correct formula (2) accordingly.

In the case of two observers whose world-lines

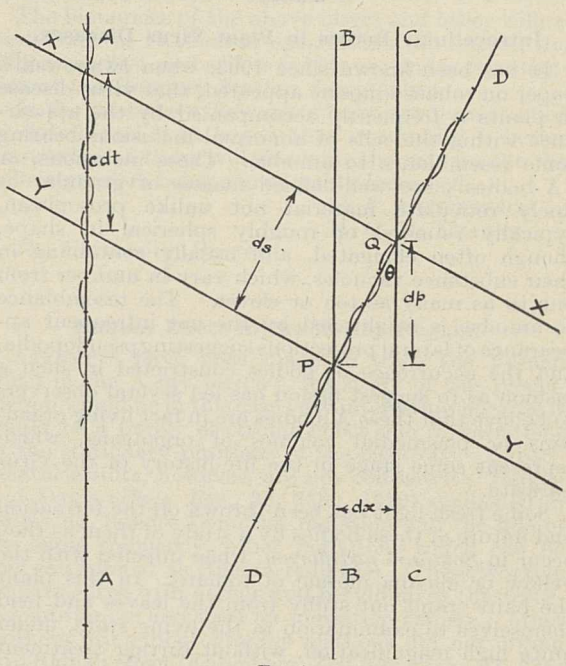

FIG. 1.

lie in the plane of the diagram and are inclined at an angle α, the transformation formulæ become :

$$dt' = \frac{dt}{\cos\alpha}\{1 + \tan\alpha\tan\theta\}^{-1} \quad . \quad . \quad (5)$$

$$dx' = dx\cos\alpha\{1 - \tan\alpha\cot\theta\} \quad . \quad . \quad (6)$$

where $$\theta = \tfrac{1}{2}\sin^{-1}\left(2\frac{dx}{cdt}\right).$$

Formulæ (5) and (6) are derived from the relations

$$cdt'\cos\theta' = ds = cdt\cos\theta,$$

$$dx'/\sin\theta' = ds = dx/\sin\theta,$$

$$\theta' = \theta - \alpha.$$

If we neglect powers of $\tan\alpha$ and of v, $= dx/cdt$, and write $u = c\tan\alpha$ the formulæ reduce to :

$$cdt' = \frac{1}{\cos\alpha}\{cdt - dx\frac{u}{c}(1 + v^2 - \ldots)\} \quad . \quad (7)$$

$$dx' = \cos\alpha\{dx - dtu(1 - v^2 - \ldots)\}. \quad . \quad (8)$$

If v^2 is neglected and β put in place of $\sec\alpha$, they correspond very closely to those of the Lorentz transformation as given in Eddington's "Mathematical Theory of Relativity".

The question naturally arises: Is the velocity of light a measure of the curvature of space and would it be infinite in flat space? Assume that the measure-

ment is made between two mirrors A and B at a fixed distance apart. In a gravitational field the world-lines of A and B will not be parallel. Light leaves A at right angles and travels in a geodesic to B. It returns starting at right angles to B and the return geodesic cuts A at A', which in general will not coincide with the starting point. The difference in time which is due to the curvature of space will be taken as a measure (inverse) of the velocity of light. Cannot the velocity of light be expressed in terms of the Riemann-Christoffel tensor? In formulæ (1) c is usually identified with the velocity of light, but AA will have to adjust the value of it if his acceleration of gravity changes and the latter is a function of the curvature of space.

J. HALCRO JOHNSTON.

P. W. D. Secretariat,
Lahore.

Intracellular Bodies in Plant Virus Diseases.

IT has been known since 1903, when Iwanowski's paper on tobacco mosaic appeared, that virus disease in plants is frequently accompanied by the appearance within the cells of abnormal inclusions bearing some resemblance to amœbæ. These inclusions, or 'X-bodies', are well-defined masses of granular or finely reticulate material not unlike protoplasm, typically rounded or roughly spherical in shape, though often elongated, and usually containing in their substance vacuoles, which vary in number from one to as many as ten or eleven. The resemblance to amœbæ is heightened by the not infrequent appearance of lateral projections suggesting pseudopodia, and the occurrence of bodies constricted in such a fashion as to suggest fission has led several observers to believe that these X-bodies are in fact living organisms or plasmodial colonies of organisms, which represent some stage in the life-history of the virus parasite.

Some fresh light has been thrown on the formation and nature of these bodies by a study of them as they occur in *Solanum nodiflorum*, when infected with the yellow or aucuba mosaic of tomato. In this plant the hairs stand out stiffly from the leaves and lend themselves to examination in the living state, under quite high magnification, without further treatment than mounting the leaf in water or other suitable medium. The bodies in the cells of infected hairs are unusually conspicuous, and ordinarily occur uncomplicated by the other abnormal structures, for example, striate material, crystal plates, etc., which are usual in the cells of mosaic tobacco, tomato or other plants, although a long crystalline spike is frequently seen lengthways in the cell. They can be readily seen in cells of other type than the hair cells, for example, in epidermal or palisade cells of the leaf, but in these situations some operative interference is necessary to show them clearly.

It was noticed by one of us (F. M. L. S.) that in the early stages of infection there appear in the streaming cytoplasm of the hair cells small particles, which are carried along in the stream and tend to aggregate together to the formation of larger masses; and it has been found possible to follow in the individual living cell the formation of the X-body from its early beginnings to its completion. A young plant is inoculated and, when the first signs of the disease appear, a suitable leaf is detached, and under the microscope the hairs projecting from its margin examined seriatim. The leaf is then placed with its petiole in water or nutrient solution, and examined again from time to time at short intervals; the appearance and development of the X-bodies can be watched in selected individual hairs for many days.

At the first examination, no bodies may be visible in any hairs. In a few hours tiny particles appear in the cytoplasmic strands and are carried round the cell in the stream. As time goes on, these particles increase in size, and at the anastomoses of the strands tend to hesitate or halt for a longer or shorter time before they move on, their further progress being facilitated by modification of the strands and by alteration in shape of the plastic particles themselves. With still further increase of size, the halts become longer: they may last for a couple of hours or more. At such a halt another particle may join the stationary one, and when the movement is resumed the two may again separate or they may go on together as one mass. By successive increments large masses are eventually formed which are readily recognisable as X-bodies. There may be several such masses in a single cell, which continue to move independently of one another, or they may coalesce to form one or more larger masses.

These composite masses may remain permanently in union, and, when they do, they seem to fuse together, as it were, into a more homogeneous whole, in which vacuolation can be observed; even in quite small masses vacuolation is sometimes observable. Sometimes, however, a composite mass may again separate, even after long contact, into its constituent parts which resume their independent movement. When this occurs, figures are seen which look quite like a process of fission; but it is not a case of division in the sense of multiplication, since the separate portions may again unite. Similarly, when a smaller mass breaks away from, or joins up with, a larger mass, appearances may be presented which simulate pseudopodia, and have been so interpreted. In leaves which have been infected for several weeks, breaking down of the bodies is comparatively common.

This mode of formation accounts for many of the appearances which have led to the belief that X-bodies are living creatures, for example, the pseudopodia, the fission-figures, the occurrence of several bodies in one cell (which has been attributed to division of a parent body). It also explains the great tendency of X-bodies to be associated in position with the nucleus, since it is round the nucleus that the protoplasmic strands cross and anastomose most freely, and it is in such situations that aggregation tends to occur. Of the nature of the small particles themselves it is too early to say anything definite. They give the impression of being foci where the protoplasm has condensed or solidified, and are of no fixed shape. There is no sign of autonomous movement and nothing to suggest that either they or the complete body is living, in the sense of being an independent organism or parasite.

The possibility that they are cytoplasmic condensations is strengthened by the fact that X-bodies are protein in nature. They give the usual protein reactions, such as Millon, Raspail, biuret, and various aldehyde tests; they are soluble in acid and alkali of sufficient strength, insoluble on boiling and in alcohol. They have a distinct tendency to crystallise out, especially in old leaves, and the crystals have all the characters of protein crystals, such as are seen in aleurone grains, including the tendency to take semi-crystalline forms with faces and angles on only part of their surface. In polarised light these crystals do not appear, nor does the uncrystallised body, though sometimes one or two small doubly-refracting crystals may be seen lying on the surface of the body or embedded in its substance.

F. M. L. SHEFFIELD.
J. HENDERSON SMITH.

Mycology Department,
Rothamsted Experimental Station,
Harpenden, Herts.

Insect Pests of Willows.

ALL plants of the genus *Salix* are attractive hosts for destructive insects. In the case of basket willows, attacks of varying degrees of intensity are of annual occurrence. A loss of 50 per cent is frequently experienced amongst willow growers, while at times insect invasion is so great as to render the crop totally worthless for basket-making purposes.

There is scope for extension of the willow-growing industry in Great Britain for the following reasons:

(1) The climate suits the willow crop; no other country being able to produce rods superior in quality to the best English-grown varieties.

(2) A considerable area of suitable land, now producing crops of little or no value, could be brought under profitable willow cultivation.

(3) The demand of the basket-making industry of the country for its raw material is not fully met from English sources, the annual value of basket-making material and of basket ware imported being £170,000 and £400,000 respectively.

(4) No willow rods are exported.

In spite of the heavy losses due to insect attacks, the willow crop under average conditions is profitable, but it is probable if destructive insects could be kept reasonably in check the financial returns from the crop would be such as to make willow growing the most profitable amongst agricultural crops, and should extend and improve our basket-making industry and ultimately result in English-grown willow rods becoming an article of export.

We are primarily concerned in this communication with an investigation on the life-history, behaviour, and methods of control of the principal willow pests. To mention one or two, such as *Phyllodecta* species and *Galerucella luteola*, these produce damage in two ways: the first and more serious by the attack on the growing terminal buds and resulting development of side-shoots which ruins the rods, and secondly the impaired vitality of the plant through the loss of foliage by the adult and larval attack, and consequently causing considerable reduction in yields and quality.

Galerucella luteola appears to be confined to *Salix triandra* varieties, and as this species of willow is grown extensively this beetle pest is frequently seen.

Phyllodecta vitellinæ will attack many species of willow, particularly *Salix purpurea* and varieties, and *Salix alba vitellina*, whilst *Salix triandra* is never attacked.

Phyllodecta vulgatissima appears to be confined to *Salix viminalis* varieties.

The above three species of Chrysomelid beetles are major pests, and it is seen that the principal species of willows grown for basket work are attacked.

Another pest, the bean gall sawfly of willows (galls are produced on the leaves by the oviposition of the sawfly *Pontania gallicola* Steph. and occur commonly in huge numbers on *Salix triandra*, *S. fragilis*, and *S. alba*), is not considered by growers a serious pest, although cases occur when the crop of rods is weighed down to the ground by the mass of galls. The damage is not always so obvious, but the gall formation when many leaves are attacked may cause a drain on the plant and probably results in reduced yields in the year of attack, and the vitality of the plant is impaired the following season.

Briefly, the life-history of this pest is as follows:

The sawfly hibernates as a full-grown larva in a waterproof cocoon under loose bark, etc., during the winter. In spring the larva pupates and the adult emerges in early May, and oviposits in the terminal unfolding leaves of the willow. The gall very quickly develops and forms food for the larva inside, and the larva is full-grown about the third week in June. The larva cuts an exit hole in the gall and in due course pupates in cracks in the bark of willow stumps near the ground. A second brood of adults appear at the end of July. Still, sunny weather greatly facilitates oviposition and a large number of galls results. It is this second crop of galls that cause the damage to the plant. In mid-September the majority of the larvæ are full-grown and these go to their hibernation quarters.

The second brood of sawfly larvæ is frequently attacked by Hymenopterous parasites, and in some seasons nearly every larva is found parasitised. However, this natural control does not help the existing crop, as the damage has been done by the sawflies at the moment of oviposition, but possibly checks injury to the crop by reducing the intensity of the attack the following season.

The bionomics of the above insect and other willow pests such as *Phyllodecta* sps., *Galerucella luteola*, the willow sawflies, and willow aphids are under investigation at the Research Station, Long Ashton.

In the past the willow pests have not been studied in detail, and it is hoped that eventually a better knowledge of them will result in the returns for the willow-growers being considerably increased.

H. P. HUTCHINSON.
H. G. H. KEARNS.

The University, Bristol,
Jan. 11.

Raman Effect in the X-Ray Region.

ATTEMPTS have been made to trace the Raman effect in the X-ray region; the study of this phenomenon would be in this case very interesting because it would be a purely electronic effect due to variations in the stationary positions of the electrons. Experimental results, however, are not consistent; Bergen and Davis (*Phys. Rev.*, **33**, 338; 1929) succeeded in obtaining, besides Compton radiation and the line of the same frequency, other radiations which can be well interpreted as Raman radiation. These workers experimented with carbon and beryllium as the diffusing substances and used an ionisation camera; other workers using photographic methods did not obtain any Raman effect (Ehrenberg, *Zeit. für Phys.*, **53**, 234; 1929). Similarly, Kast (*Zeit. für Phys.*, **58**, 519; 1929), using aluminium as diffusing substance, found nothing but the classical and Compton radiation.

It should be noted that the Raman electronic effect will appear in the X-ray region under the following conditions: the electron in one of the Röntgen levels $K, L, M \ldots$ must be able to pass from one of these levels to an X-level which is not yet filled up, or to an optical orbit at the periphery of the atom. In both cases the substance showing the effect must show the so-called semi-optical lines, that is, absorption lines in the X-ray region. Such lines show themselves as a fine structure at the limits of the continuous absorption bands. It should be noted, however, that not all the elements showing such fine structure can present this effect, because, as modern researches have proved, such fine structure is frequently due to a process of double ionisation. On the contrary, a substance suitable for the study of this effect would be argon, because, as Coster (NATURE, **117**, 586; 1926) has shown, in this element the passage of an electron from an orbit K to an orbit $2p$ has been controlled.

We have examined the question theoretically and calculated the intensity to be expected, and we give here the essential results. The problem has been treated like the problem of the Compton effect, which has been already explained with great success by Wentzel (*Phys. Zeit.*, **43**, 1 779 and;

1927) and Sommerfeld ("Atombau . . . Wellenn. Erg.", p. 251). Supposing that an electron could pass from an orbit K, L . . . to an optical orbit, we approached the problem using Schrödinger's functions ψ relative to the H, assuming that the exciting frequency is much larger than the frequency of the limits of absorption. In these conditions, we have obtained by calculations that the intensity of the Raman lines is different according as the initial state is K or L or M . . . level and the final state is the optical level $1s$, and is also different if the final state instead of $1s$ becomes the state $2p$. We have found that, indicating by E_e the kinetic energy of the electron emitted for the Compton effect in one particular direction of observation, and with one particular exciting frequency, the intensity of the Raman line for an element of atomic number Z observed along the same direction is proportional to the quantity

$$Z^{-3}\left(1+\frac{E_e}{|E_\mu|}\right)^{-4}$$

where $|E_\mu|$ is the energy of the K level if the jump is $K \longrightarrow 1s$. As the intensity of the undisplaced line is proportional to

$$\left(1+\frac{E_e}{4|E_\mu|}\right)^{-4}$$

we see that the relation of the intensity of the Raman line to the undisplaced line is practically inversely proportional to the cube of the atomic number. More complex expressions have been obtained for the jumps $L \longrightarrow 1s$, $M \longrightarrow 1s$. If the final optical orbit is a level $2p$, then the intensity is proportional to Z^{-5}.

From our theoretical investigations we conclude that to observe this effect it is necessary (1) to use substances presenting semi-optical lines, (2) to use substances of low atomic number, (3) to use exciting wave-lengths, directions of observations, and substances for which the relation $\frac{E_e}{|E_\mu|}$ is very high.

Details of calculations will be published elsewhere.

ANTONIO CARRELLI.

Istituto Fisico,
R. Università, Napoli,
20 Gennaio.

Existence of two Limits of Predissociation in the Nitrogen Peroxide Molecule and the Heat of Dissociation of Oxygen.

THE absorption spectrum of nitrogen peroxide vapour is composed of two regions: the first from the red to about 2900 A., the second from 2596 A. to about 2200 A. These two regions correspond to two different electronic activations of the molecule.

The first region is made up of a large number of bands and fine lines having a very complicated structure, which we are studying now with L. Harris. From the visible up to about 3700 A. the bands are very fine with quite definite rotation lines; there are two or three fundamental vibration frequencies. But between 3800 A. and 3700 A. the bands become broad and diffuse, the fine structure disappears. This corresponds to the first limit of predissociation.

In the second region we have obtained with L. Harris between 2596 A. and 2459 A. a series of bands with a fine structure corresponding to a very clear double rotation spectrum; at $\lambda = 2459$ A., the bands become abruptly diffuse and broad and up to 2200 A. there are nine such bands. This is the second predissociation limit.

The physical interpretation of these two predissociation limits is that they correspond to the two limits of dissociation of the nitrogen peroxide molecule into nitric oxide and a *normal* or an *activated* oxygen atom.

The corresponding energies are:

(1) $NO_2 \longrightarrow NO + 0$ – 77,000 cal.(3700 A.)
(2) $NO_2 \longrightarrow NO + 0^*$ – 116,000 cal.(2459 A.)

The first is in exact agreement with the results obtained by Norrish (*Chem. Soc.*, June 1929), who obtained a photochemical dissociation of NO_2 into NO and O_2 by light of $\lambda = 3650$ A., and no action by $\lambda = 4300$ A., the light of $\lambda = 4050$ A. giving a very slight reaction.

From these results, the heat of dissociation of the oxygen molecule can be calculated:

$$O_2 \longrightarrow 0 + 0 - 128{,}000 \text{ cal.}(5{\cdot}5 \text{ volts});$$

and the activation of oxygen atoms:

$$O \longrightarrow 0^* - 39{,}000 \text{ cal.}(1{\cdot}7 \text{ volts} = 13{,}700 \text{ cm.}^{-1}).$$

The dissociation energy of the oxygen molecule was calculated first by Birge and Sponer as 163,000 cal. (7·1 volts), then corrected by Birge (*Phys. Rev.*, **34**, 1062; Oct. 1, 1929), Bristol meeting of Faraday Soc. (Sept. 24, 1929) to 5·6 – 6·5 volts; by Kassel (*Phys. Rev.*, **34**, 817; 1929) to 5·0 – 5·5 volts, and by Mecke (*Naturwissenschaften*, Dec. 20, 1929) to 5·6 volts.

The active oxygen obtained from the second predissociation limit is probably in the metastable ^1D state.

The value $^3P_2 - {}^1D$ is not known for oxygen; R. Frerichs (*Phys. Rev.*, **34**, 1239; Nov. 1, 1929) gives a probable value of 15,500 cm.$^{-1}$; McLennan (NATURE, Dec. 7, 1929, p. 874) has calculated by analogy with selenium and tellurium spectra a value of 10,587 cm.$^{-1}$.

Our value is therefore the mean of the two.

VICTOR HENRI.

Institute of Physical Chemistry,
Zurich, Jan. 17.

Tides of the Upper Atmosphere and the Heights of Meteors.

IN NATURE of Dec. 14, 1929 (vol. 124, p. 913), the result of an examination of some data giving the heights at which the meteors disappear has been published. There seemed to be a variation of these heights with the lunar hour-angle. By kind information from Dr. G. M. B. Dobson my attention was directed to a great number of observations of the heights of meteors given by Mr. W. F. Denning in *Monthly Notices of the Roy. Astron. Soc.*, March 1912 and January 1916. These observations (556) were divided into 6 groups and treated in the same manner as the former. Using the same designations as in the former letter, the following values were found for the mean height at which the meteors disappear:

Flood-tide	.	46·9 ± 1·8 miles
+ 0	.	47·0 ± 1·1 ,,
– 0	.	49·2 ± 1·9 ,,
Ebb-tide	.	49·1 ± 0·8 ,,

The mean error is derived from the 6 group-means. Examining in the same manner the heights at which the meteors appear, the following values for the mean height are found:

Flood-tide	.	70·1 ± 2·2 miles
+ 0	.	67·5 ± 1·9 ,,
– 0	.	70·8 ± 2·6 ,,
Ebb-tide	.	71·6 ± 1·0 ,,

From the result of the former letter it would be expected that the mean height for flood-tide (and + 0) should be greater than that for (– 0 and) ebb-tide, both for the heights referring to the disappearance of the meteors and for the heights referring to the appearance. This is in no way the case; on the con-

trary, from the above tables it will be seen that the values for flood-tide (and +0) are smaller. From this it may be concluded that the result given in the former letter is due to an exceptional (but nevertheless an accidental) distribution of the heights examined. A further examination has also shown that the numbers of heights under 55 km. for flood-tide, +0, −0, and ebb-tide are 2, 3, 9, and 7, respectively. The relatively great numbers for −0 and ebb-tide have caused that an amplitude with a comparatively small mean error was found.

After this it does not seem possible to obtain any trustworthy information as to the tides of the upper atmosphere from the meteor-observations used hitherto, but it ought to be remarked that the highest meteors are not easily observed, and this circumstance might have influenced the result. In this connexion, attention may be directed to the fact that, while the mean height for disappearance was 85 km. in the former case, the mean height derived from the present data is 48 miles or 77 km., and, furthermore, that the number of observations for flood-tide and ebb-tide in the present case are 172 and 200, respectively.

In NATURE of April 27, 1929 (vol. 123, p. 642), some results are given, which are based on an examination of the two maxima of the frequency-curve of the heights of the bases of aurora. This investigation led to the result that these maxima are due to the tides of the upper atmosphere. It should be of great interest to learn whether new series of observations of the heights of the bases of the aurora confirm the existence of the peculiarity of the older series.

J. EGEDAL.

Geofysisk Afdeling,
Meteorologisk Institut,
København, Jan. 10.

Natural Control of *Lucilia sericata*.

AT the Farnham House Laboratory of the Imperial Bureau of Entomology, experiments are being carried on to determine the value of the braconid parasite *Alysia manducator* Panzer as a controlling agent of the sheep blowfly, *Lucilia sericata* Meigen. Preliminary studies of the bionomics of the host have been in progress for nearly a year.

The potential rate of reproduction of *Lucilia sericata* is very high. Eight females the oviposition of which was followed completely laid an average of 1561·5 eggs; the most prolific of them depositing 1883. The eggs are almost completely viable, and large numbers can be reared to the adult stage with the loss of only 1 or 2 per cent. In critical experiments this loss is kept below 1 per cent and in many cases can be quite eliminated. Obviously such a high rate of reproduction is by no means attained in Nature. Parasites play a part—at certain seasons of the year an important part—in the control; but the reduction seems to be principally brought about in another manner.

In laboratory experiments it is found that if increasing numbers of eggs of the same age are placed on equal portions of meat under identical conditions, the increasing rigour of starvation has three effects: (1) the size of the adults obtained becomes gradually smaller, (2) the mortality during the larval period gradually increases, (3) beyond a certain point fewer adults are obtained than the amount of food supplied is capable of supporting. The last result may be attributed to the use of food by many first and second instar larvæ that are never able to complete their development, but deplete, by feeding, the amount of food available to those that are able to mature.

During September and October 1929 this matter was studied under field conditions at Farnham Royal. It was first ascertained that exposed meat is soon overblown. In one case, 156 gm. of meat exposed in bright sunshine bore 5645 eggs, principally of *Lucilia sericata*, after only five hours; although this amount of food could support no more than 1560 normal individuals. Mice, rats, and guinea-pigs were similarly provided in a few hours with far more eggs than could develop on their tissues. Moreover, oviposition continued for at least ten days on animal remains from which thousands of half-grown, starving larvæ were already migrating. It was then determined that from pieces of beef and whole small mammals, exposed in both sunny and shady situations and known by observation to have been provided with immense numbers of eggs, comparatively few adults were obtained; fewer, in fact, than could have developed on the same food had a smaller number of eggs been laid.

It appears, then, that the high reproductive rate of *Lucilia sericata* is largely offset by its habit of laying more eggs on a carcass than the latter can support. This results, it is to be noticed, not only in the loss of the surplus eggs, but also in the death of individuals that would have survived had the additional eggs not been laid.

GEORGE SALT.

Farnham House Laboratory,
Imperial Bureau of Entomology,
Farnham Royal, Bucks.

Crossed Connexion of the Cerebral Hemispheres with the Muscles and Sense Organs.

THE crossed connexion of the mammalian cerebrum with muscles and sense organs is a condition derived from a more primitive state of the nervous system. Thus, Ferrier found [1] that stimulation of the brain in frogs and fishes caused movements of the opposite side of the body. That the crossing is a general phenomenon is shown by the crossing of nerve fibres in the nervous system and the decussation of the optic nerves in all vertebrates.[2]

The crossed relationship is suggestive of an optical effect as the image (when real) of an object is always inverted, that is, on the opposite side of the optical axis. In order that this optical inversion can be a factor in the development of the nervous system it is necessary to look for a primitive animal with a single median eye. An example of such an animal is the larva of a simple ascidian in which an unpaired optic organ is present and the region where the images would be formed is represented by the enlarged anterior extremity of the nervous system.[3]

The image of an object on the right of such an animal would be formed on the left side of the retina, and by a movement of the muscles on the right side of its tail it would move so that the image would be central. By repeated correlation between stimulation due to an object and the movement to bring the image of it on the centre of the retina a relationship would be established in the same way that a conditioned reflex is developed.

After such a relationship had been established, all those portions of the nervous system which grew out from that part of the nerve mass would show a crossed relationship. This view is frankly Lamarckian, as it implies the inheritance of a relationship developed in response to a functional association.

The cerebrum in man shows a further relation to optical projection as the upper margin of the calcarine fissure corresponds to the lower half of the visual field and the lower margin to the upper half, but the

[1] D. Ferrier, "Functions of the Brain", 2nd edition, 1886, p. 263.
[2] J. H. Parsons, "Introduction to the Theory of Perception", chap. vi. and p. 121. (Cambridge University Press, 1927.)
[3] W. A. Herdman, "Cambridge Natural History", Fishes, Ascidians, etc., p. 60.

architecture of the human cortex is too far removed from the primitive state to be used as an argument in support of the view that the contralateral connexions in vertebrates are the result of the formation of optical images in an unpaired median eye.

The above suggestion may not be new, but it is not well known, and I have never heard of it. There is no means by which it can be put to the test by experiment. Ascidians are degenerate forms, but their larvæ may not be far removed from the primitive vertebrate stem.

H. E. ROAF.

London Hospital Medical College,
Jan. 17.

The Muscular Sense.

I HAVE just seen Col. Lynch's letter in NATURE of Jan. 11, in which he criticises mine, which dealt with the muscular sense. In order to experience a sensation, surely no "analysis of a searching character" is required, else the state of the child and of the savage would be peculiarly unfortunate. In my letter in NATURE of Nov. 23, I merely wished to describe a method involving no apparatus which permitted one to experience sensations produced by the activity of muscles engaged in raising or lowering the mass of the limbs. I am aware that some psychologists have discussed the question whether these sensations in or of muscles are not rather sensations of the outgoing, cerebral, efferent impulses to the muscles. I have always thought that view extremely unlikely and akin to learned trifling. If it were true, would it not be very peculiar that we should not have any awareness of any other kinds of efferent innervations such as those of heart, blood-vessels, or glands?

I did not set out to offer any "explanation" of the muscular sensation which involved or did not involve "a minute examination of a long series of neurological phenomena".

I still think the method I have described is an interesting one, because it is, to some extent, quantitative, in that the moment the limb rests on the water the sensation is minimal, and the moment it begins to be raised or lowered the sensation is increased in intensity. I hope we may still be allowed to experience and report on sensations without being compelled to give "a valid analysis" of them "with the necessary rigour".

D. F. FRASER-HARRIS.

Chiswick, W.4, Jan. 13.

Sterilisation as a Practical Policy.

MAY I add to the admirable review by Prof. MacBride (NATURE, Jan. 11, pp. 40-42) that there is an urgent and immediate place for voluntary sterilisation in Great Britain side by side with voluntary birth control? The medical profession at present does not meet the demand of those conscious of heritable defect and with a sufficient sense of civil responsibility voluntarily to desire sterilisation. Compulsory sterilisation of the unfit would require legalisation which we may properly hope may be passed before long, but to secure the voluntary sterilisation of those ready to ask for it requires such public propaganda as was given to constructive birth control. But while it is easy to sterilise a male effectively and harmlessly, it is neither so easy nor so successful, as Prof. MacBride's article would lead one to believe, to sterilise the female, the tying of the Fallopian tubes sometimes leading to internal pregnancies which are worse than the normal. Nevertheless, as a social step it will be valuable to facilitate voluntary sterilisation even of the defective males who are conscious of their defect and willing to have vasectomy performed.

The Society for Constructive Birth Control has for some time past been considering the possibilities for facilitating this and will be pleased to hear from competent surgeons willing to undertake such cases in any part of the country.

MARIE C. STOPES
(President).

Society for Constructive Birth Control
and Racial Progress,
108 Whitfield Street, London, W.1.

Botanical Nomenclature.

MAY I request the publication of a short note which I consider a point of importance in view of the forthcoming botanical conference in Britain?

Article 57 of the Vienna rules states "the original spelling of a name must be retained except in case of a typographic or orthographic error". The use of the word "spelling" along with the word "orthographic" in this sentence appears to many to override the original meaning of the latter word, namely, "correct writing"; and to restrict it to the dictionary sense of correct spelling alone. But correct writing is equally important with correct spelling. To avoid ambiguity, I suggest Article 57 be amended to read "typographic, orthographic, or syntactic error".

Is a man to be allowed to write, say, "ein schöner Buch" in German, or "une beau fille" in French, through ignorance or temperamental whimsy, without protest from lovers of good German or French? Why, then, should we allow our 'nodding Homer' of nomenclature, even, to palm off on us an orthographic blunder such as *Polygala sanguinea* instead of *P. sanguineum*; or pass by uncorrected a recent new specific blunder like *Airosperma fusca* for *A. fuscum*?

ROBERT A. INGLIS.

Central Experimental Farm,
Ottawa, Dec. 16, 1929.

Spectrum of Trebly Ionised Krypton.

A SHORT note by me on the spectrum of doubly ionised krypton was published in NATURE of Feb. 16, 1929 (vol. 123, p. 244). Since then the observational data with regard to the spectrum of krypton have been extended up to λ1930 A. on the ultra-violet side. In the region of about 41,000 frequency units, some very strong lines, namely, 42,475·1(10) and 40,560·3(9), have been observed. Although the lines of Kr^{++} due to the transition $3N_2(O_2 \leftarrow\!- O_3)$ had been located near this region, it did not seem probable that this transition would give rise to such intense lines—lines more intense than the fundamental lines due to $3N_2(O_1 \leftarrow\!- O_2)$.

Further, by extrapolation by the method of horizontal comparison, it has been found that the fundamental lines of Kr^{+++} due to the transition $2N_2(O_1 \leftarrow\!- O_2)$ would lie in this region.

An attempt to find out these lines of Kr^{+++} has revealed a number of multiplets. The lines 42,475·1(10) and 40,560·3(9) have been found to be the $^4P_3 - {}^4D_4$ and $^4P_2 - {}^4D_3$ lines.

A complete analysis of this spectrum is in progress and will be published shortly.

D. P. ACHARYA.

B.N. College, Patna,
Dec. 3, 1929.

The Raman Effect.

By Dr. A. C. MENZIES.

INTRODUCTORY.

IT is now just two years since the effect known by his name was discovered by Sir Chandrasakara Raman,[1] but the phenomenon has aroused so much interest that even in this short time a tremendous amount of work has been done. A summary, therefore, at this stage may serve a useful purpose.

In brief, the effect may be thus described: When a beam of monochromatic light is directed into some transparent substance, some of the light is scattered, and this light has the same frequency as the incident light (unmodified scattering). In addition, a much smaller quantity of the light suffers a change of frequency, usually a diminution (modified scattering), and it is this which constitutes the Raman effect. The magnitude of the change is found to depend upon the nature of the scattering material and is independent of the frequency of the incident light. In general each exciting line evokes several modified lines, some of which may be plane polarised.

On account of their superficial resemblance, it would be well to make clear the respects in which this effect differs from fluorescence.

(*a*) In fluorescence, the frequencies of the fluorescent spectrum are independent of those of the exciting radiation, provided the latter are able to excite fluorescence at all. On the other hand, the frequencies of the radiations modified by Raman scattering are directly related to the incident frequencies ν_i, being $(\nu_i \pm \nu_R)$. These shifts, ν_R, are either actual infra-red frequencies in the absorption spectrum of the scattering material, or differences in such frequencies.[2, 3] For example, measuring wave numbers in cm.$^{-1}$, the frequencies 27354, 27290, 24704, and 22939 emitted by a mercury vapour lamp are scattered by benzene molecules and give rise to the Raman lines (among others) 24294, 24231, 21646, and 19877 respectively. These, it will be seen, are lines shifted to the red by an amount 3060 cm.$^{-1}$ approximately, and correspond to an infra-red wave-length 3·27 μ, while the infra-red absorption spectrum of benzene includes a a strong band at 3·25 μ.

(*b*) The intensities of the Raman lines are of a different order of magnitude.

(*c*) Many of the Raman lines are strongly polarised.

TECHNIQUE.

The first observations were made with complementary light filters, but this was abandoned in favour of spectroscopic methods. The light from a mercury vapour lamp is directed by a large condensing lens into a flask and the light scattered at right-angles is focused on to the slit of a spectrograph (flask method). This has been modified by R. W. Wood,[4] who uses a long tube, water-cooled, placed parallel to a long tubular mercury arc and almost touching it. Observation is made axially along the tube, and portions of the spectrum of the incident light may be filtered out by the addition of suitable colouring matter to the cooling water (tube method).

As a source for Raman scattering experiments, the mercury vapour lamp has the disadvantage that it cannot be arranged to give really monochromatic radiation. For this reason, helium excitation is sometimes used,[5] since the strong line λ3888 A.U. can be isolated by ultra-violet glass and the results are then unambiguous.

Although most observations have been made in the visible region, the ultra-violet region has been used as well, entailing the use of quartz throughout. This region has the advantage that the Raman lines are considerably stronger. It must be borne in mind, however, that chemical action may easily be induced by the use of such short-wave exciting light, and the experiment thereby vitiated.

When gases are to be investigated, the tube method is used, and the exposure may be shortened by having the gas under pressure.

In the case of solids, a block is treated as in the flask method. Recently, it has been shown by me [6] and independently by Bär [7] that the Raman spectra of solids in powder form may be obtained, since the incident radiation is much weakened by repeated reflections. Thus the field for investigation is considerably greater, since only a few solids are obtainable in large pieces.

WIDTH OF LINES.

The scattered lines differ greatly in respect of width.[8, 9] When scattered by crystals, the lines are particularly sharp, less sharp for amorphous solids, and some lines scattered from liquids are more diffuse still. The change in sharpness in the transition from solid to liquid is well shown in the liquefaction of ice.[10] In this case the lines become much broader when the ice melts, but with little alteration of frequency. This, as pointed out by C. P. Snow (private communication), means that ice is a molecular lattice and not an ionic one. In some liquids the lines are very sharp indeed, but quite frequently a continuous spectrum [11] is obtained, especially in very viscous liquids. The unmodified lines are often diffusely broadened; this is perhaps to be accounted for as a Raman scattering where the incident radiation has been modified by the abstraction of energy required to produce changes in the rotational frequencies of the molecules.[12]

INTENSITIES.

If corresponding Raman lines (that is, lines having the same frequency shift from the different exciting lines) be considered, the intensity is augmented considerably as the frequency of the exciting line is increased. It does not, however, follow the fourth power law.[13] The Stokes lines (shifts to the red) are very much more intense than the corresponding anti-Stokes lines.[14, 15] The ratio of the intensities of corresponding Stokes and

anti-Stokes lines has provided an interesting criterion for the quantum theory of dispersion. Schrödinger's original dispersion theory implies an intensity-ratio equal to one.[16] Statistical mechanics, however, yields intensity-ratios in accordance with those observed.[17, 18]

Effect of Temperature.

Intimately connected with the consideration of the intensity-ratio just mentioned is the effect of change of temperature. Whatever the true explanation of the Raman effect may be, jumps between quantised states must be involved and intensities will be affected by the molecular populations of these states. So increase of temperature, which favours an increase in population in the higher states, is bound to augment the intensities of the anti-Stokes lines, and this is found to occur.[19] In quartz, for example, a particular Stokes line has an intensity about two-fifths of that of the corresponding unmodified line. As the temperature is increased, the unmodified line increases in intensity, the anti-Stokes line increases more rapidly and the Stokes line decreases slightly in intensity.[20, 21] At the same time, the lines become more diffuse; this has been attributed to an increase in the molecular rotation.[22]

Critical State.

Ordinary unmodified scattering increases very considerably in intensity as the critical state is approached, but there is little corresponding increase in the intensity of the modified radiations. This is taken as a proof that the modified radiations are incoherent.[23, 24]

Polarisation.

In scattering by liquids, the modified lines may be plane polarised parallel to the direction of polarisation of the unmodified lines, partially polarised in this direction, or unpolarised.[1, 25] In scattering by solids, it is possible in addition for modified lines to be plane polarised in a direction perpendicular to that of the unmodified lines. This has been shown to occur in quartz, and is related to the direction of the optic axis with regard to the directions of the incident and scattered beams. A new orientation of the crystal produces a change in the direction of the plane of polarisation for some of the lines, but not for others.[26, 27]

Scattering in Gases.

It has been suggested that many of the weak lines listed in spectrum tables may be Raman lines excited by strong lines of the element involved. For example, H. S. Allen suggests that some of the secondary lines of hydrogen may be Raman lines excited in the molecules by Balmer lines.[28]

Hydrogen chloride gas gives a sharp Raman line corresponding to the 'missing' line in its absorption spectrum, together with some lines corresponding to molecular rotations.[29] It is interesting that the changes in the rotational quantum number m for the Raman spectrum of HCl gas are given by

$$\Delta m = 0 \text{ or } \pm 2,$$

while in the infra-red absorption spectrum they are given by

$$\Delta m = \pm 1.$$

This fits in with the 'three-level' theory discussed later.

Carbon monoxide gives a line corresponding to the infra-red absorption band, while carbon dioxide gives two lines which correspond to the *differences* in frequency of the components of the doublet infra-red absorption bands.[2]

Oxygen, hydrogen, and nitrogen scatter the exciting line with several equally spaced lines on either side; these are found to be due to changes in molecular rotational energy, with alternate rotational levels missing or relatively weak. In oxygen the lines are due to transitions between odd levels only; in hydrogen the lines due to transitions between odd levels are strong, while those between even levels are weak; and in nitrogen the intensities are reversed.[30] The difference between the three gases in this respect may be made clearer by the use of heavier type to indicate larger intensities:

Oxygen	**odd**	
Hydrogen	**odd**	even
Nitrogen	odd	**even**

It is remarkable that in this respect nitrogen should be unlike hydrogen, for from the point of view of nuclear states one would expect them to be similar.

In nitrogen monoxide a Raman line has been photographed corresponding to a change in the direction of electronic spin.[31]

Oxygen, hydrogen, and nitrogen were first examined in the liquid state,[32] and in the case of hydrogen two-quantum transitions in the molecular rotation were observed, and a one-quantum vibrational transition. The rotational transitions are $0 \rightarrow 2$ and $1 \rightarrow 3$, the molecules being in the zero vibrational state. This is evidence of the existence of both the α- and β-forms in liquid hydrogen.

Scattering in Liquids.

The effect was first discovered with liquids, and it is with the scattering material in this state that most of the work has been done. With the exception of the work on liquefied gases just mentioned, the results obtained with liquids have been important more with regard to the infra-red spectra and chemical constitution of the material than to the elucidation of the effect itself. It would be impossible here to refer to many of the papers dealing with liquids; a comprehensive memoir has lately been published by Ganesan and Venkateswaran.[33]

As an example of the use of the effect for the study of chemical constitution we may consider the C-H bond. This bond is found to involve a Raman shift corresponding to $3{\cdot}35\,\mu$ in tetrachlorethane for example, but when the carbon has a double bond, the C-H line is displaced towards the shorter wave-lengths, for example, $3{\cdot}25\,\mu$ in trichlorethylene.[34, 35] In a similar way other Raman shifts are connected with chemical linkages. In

the instance just quoted, Raman effect measurements are supported by infra-red observations; unsupported evidence should be treated with caution, since Raman shifts correspond so frequently to the difference between frequencies rather than to the frequencies themselves.

Solutions of salts in water show Raman lines characteristic of the salts in addition to those due to the water. As an example of work on solutions may be quoted the recent interesting experiments of I. R. Rao with nitric acid at different concentrations.[36] Lines were found with the concentrated acid, due to the NO_3 ion, as well as lines attributed to HNO_3. On dilution, the NO_3 lines intensified up to a maximum and thereafter diminished in intensity, while the HNO_3 lines progressively grew weaker and faded out altogether. The dilution at which the HNO_3 lines disappeared was the same as that at which the intensity of the NO_3 lines was a maximum. Thus, literally an ocular demonstration is provided of the increase of ionisation in a solution when it is made more dilute.

Scattering in Solids.

Quartz and iceland spar were investigated by Landsberg and Mandelstam,[37] who claim to have discovered the effect independently of Raman; one of the shifts found by them in Iceland spar corresponds to the optically inactive fundamental frequency of the CO_3 ion. Such inactive frequencies occur with great strength in the Raman effect in crystals; they may be observed easily using the crystals as a coarse powder, or in solution.

When water of crystallisation is present, the water Raman lines are found, and are considerably sharper than in water itself.

Raman lines corresponding to the residual ray frequency of rock-salt are *not* found, nor do the residual ray frequencies appear in the Raman effect investigation of lithium or sodium fluoride. Schaefer [38] suggests that the Raman effect implies an asymmetrical vibration, while the lattice vibration of NaCl is essentially a symmetrical vibration.

Theory.

The original theory as put forward by Raman was that the modified lines were displaced by an energy amount equal to that required to raise a molecule from the normal state to some higher energy state. If this were so, all Raman lines would correspond to infra-red absorption lines, and this is certainly not the case. The modified lines are implicit in the Kramers-Heisenberg [39] dispersion formula, which was developed from the theory of Smekal.[40] The existence of the effect was nevertheless not sought for, and remained to be discovered quite independently.

The modified lines differ in frequency from the exciting lines by an amount equal to a difference in frequency between infra-red absorption lines. The absorption lines themselves may appear, but they are usually very weak. Three levels are involved in the production of a single Raman line, say k, l, and n. If transitions may take place between k and n, and between l and n, then a Raman line may be expected corresponding to the transition between k and l, even though this may be a forbidden transition in the infra-red.[3, 41] Thus it is at once explained why Raman lines exist having no counterpart in the infra-red, and vice versa. As the energy of the exciting quantum approaches the value $(E_n - E_k)$, the Raman scattering becomes increasingly intense, and when it reaches it, fluorescence occurs.[42]

The theoretical explanation of the polarisation of the lines is not yet fully understood. Raman has sought to explain it in terms of the optical anisotropy of the molecule,[12] while I have endeavoured to picture it in terms of the energy transitions between directions of vibration which have different orientations in the molecule.[27]

Future Progress.

Although a great deal has been done, much remains for investigation. The polarisations of the lines, the relative intensities of the Stokes and anti-Stokes lines, and the energy-levels of molecules deduced from the Raman effect observations combined with infra-red work, are a few of the lines of investigation which will provide work for many investigators. There is little doubt that when its usefulness is appreciated, it will be constantly employed by the research chemist.

References.

1. Sir C. V. Raman, *Ind. J. Phys.*, **2**, p. 387; 1928.
2. F. Rasetti, NATURE, **123**, p. 205; 1929.
3. R. M. Langer, NATURE, **123**, p. 345; 1929.
4. R. W. Wood, *Phil. Mag.*, **6**, p. 729; 1928.
5. R. W. Wood, *Phys. Rev.*, **33**, p. 294; 1929.
6. A. C. Menzies, NATURE, **124**, p. 511; 1929.
7. R. Bär, NATURE, **124**, p. 692; 1929.
8. R. M. Langer and W. F. Meggers, *Bull. Am. Phys. Soc.*, **124**; 1928.
9. R. W. Wood, *Phil. Mag.*, **6**, p. 1282; 1928.
10. I. R. Rao, *Ind. J. Phys.*, **3**, p. 123; 1928.
11. S. Venkateswaran, *Ind. J. Phys.*, **3**, p. 105; 1928.
12. Sir C. V. Raman and K. S. Krishnan, *Proc. Roy. Soc.*, **122**, p. 23; 1929.
13. P. Daure, *Comptes rendus*, **187**, p. 826; 1928.
14. Sir C. V. Raman and K. S. Krishnan, NATURE, **122**, p. 12; 1928.
15. P. Daure, *Comptes rendus*, **188**, p. 1605; 1929.
16. P. Pringsheim, *Naturwiss.*, **16**, p. 597; 1928.
17. M. Born, *Naturwiss.*, **16**, p. 673; 1928.
18. J. H. van Vleck, *Proc. Nat. Acad. Sci.*, **15**, No. 9, p. 754; 1929.
19. K. S. Krishnan, NATURE, **122**, p. 650; 1928.
20. F. G. Brickwedde and M. F. Peters, *Bull. Am. Phys. Soc.*, **3**; 1928.
21. Gr. Landsberg and M. Leontowitsch, *Zeits. f. Phys.*, **53**, p. 439 1929.
22. Y. Fujioka, NATURE, **124**, p. 11; 1929.
23. W. H. Martin, NATURE, **122**, p. 506; 1928.
24. S. L. Ziemecki and K. Narkiewicz-Jodko, *Naturwiss.*, **17**, p. 876 1929.
25. P. Daure, *Comptes rendus*, **186**, p. 1833; 1928.
26. J. Cabannes, *Comptes rendus*, **188**, p. 249; 1929.
27. A. C. Menzies, *Phil. Mag.*, **8**, p. 504; 1929.
28. H. S. Allen, NATURE, **123**, p. 127; 1929.
29. R. W. Wood, NATURE, **123**, p. 279; 1929.
30. F. Rasetti, *Proc. Nat. Acad. Sci.*, **15**, p. 515; 1929.
31. F. Rasetti, NATURE, **124**, p. 93; 1929.
32. J. C. McLennan and J. H. McLeod, NATURE, **123**, p. 160; 1929.
33. A. S. Ganesan and S. Venkateswaran, *Ind. J. Phys.*, **4**, p. 195; 1929.
34. G. B. Bonino, *Trans. Faraday Soc.*, Sept. 1929.
35. A. Petrikaln, *Zeits. f. Phys. Chem.*, B, **3**, p. 360; 1929.
36. I. R. Rao, NATURE, **124**, p. 762; 1929.
37. Gr. Landsberg and L. Mandelstam, *Comptes rendus*, **187**, p. 109; 1928.
38. C. Schaefer, *Zeits. f. Phys.*, **54**, p. 153; 1929.
39. H. A. Kramers and W. Heisenberg, *Zeits. f. Phys.*, **31**, p. 681; 1925.
40. A. Smekal, *Naturwiss.*, **11**, p. 873; 1923.
41. G. H. Dieke, NATURE, **123**, p. 564; 1929.
42. F. Rasetti, NATURE, **123**, p. 757; 1929.

A bibliography of 160 papers has been published by A. S. Ganesan (*Ind. J. Phys.*, **4**, p. 281; 1929), and in most cases an abstract of the paper is given. This bibliography deals with papers published up to July 1929.

The *Transactions* of the Faraday Society dealing with the conference on molecular spectra, just published, contains several papers dealing with different aspects of the Raman effect.

Malaria Prophylaxis in Kenya.[1]

IN the years 1925, 1926, 1927 there were in Kenya at least 10, 10, and 5 deaths, and in Uganda at least 19, 48, and 22 deaths from blackwater fever in the respective years. This is a deplorable waste of life, for it may be regarded as axiomatic that malaria and blackwater fever are so closely connected that freedom from the former means absolute freedom from the latter. Blackwater fever to-day in Africa, as it did nearly a century ago, kills twenty-five in every hundred of those attacked, and yet, says Col. S. P. James in the report before us, "Several people told me, with obvious pride, that they had had two or more attacks of the latter disease" [blackwater] (p. 24). This century-long waste of life, in spite of the "obvious pride" of the ignorant, is a totally unnecessary sacrifice. It is unnecessary because malaria (and so blackwater) is a preventable disease, but now we are rejoiced to hear that this slaughter will cease in Kenya, for "the Governor had announced that it was his Government's intention to stamp out the disease" (malaria). With it will also disappear blackwater not only from among Europeans but also from among the Indians, of whom there are three times as many in Kenya as there are Europeans, and among whom the incidence and fatality of blackwater is surprisingly high (p. 29).

Now "although the Kenya Government had taken various measures within the limits imposed by financial considerations and available staff, the disease [malaria] was still a serious menace" (p. 5). Col. James points out that the campaign (now to be undertaken) will be long and difficult; it must, in the words of H.R.H. the Prince of Wales, be "intensive and scientifically conducted". How far these conditions are compatible with financial considerations remain to be seen. So recently as 1926, Mr. Ormsby-Gore [2] stated "that malaria can be controlled is well known, but the difficulty and expense of such control, in view of the extent of the West African colonies and the conditions which prevail in those territories, are almost insuperable" (p. 67).

Whether or no we can stamp out malaria remains to be seen, but if we try to do so, we should at least use the best methods available. It is true that malaria has been 'stamped out' (we ourselves prefer a less ambitious word, 'moderated') here and there in various parts of the world, but it is unfortunately also true that no general widespread success has attended the efforts of sanitarians. Perhaps a clue to the whole situation is afforded by the example of malaria in Great Britain itself. Ague has disappeared from the country. Perhaps the most satisfactory explanation is that it has disappeared as the result of improved social hygiene. Poverty, dirt, malnutrition, ignorance, have been replaced by wealth, cleanliness, well-being, and education to such an extent as to mitigate completely its ill-effects. Drainage and agriculture and improved housing also play their part. Whatever be the exact cause, malaria for all practical purposes disappeared long before anti-malarial campaigns were heard of, nor is this an entirely exceptional occurrence.

Col. James in this report lays great stress again on the view, so ably defended by him, that the methods of malaria prophylaxis are not simply those of the 'Aquatic school' (pouring paraffin on pools), or of the 'Mithridatic school' (poisoning the parasite with potions), if we may use these terms without disrespect, but that while both these methods have their (limited) usefulness there is something more, namely, the great malaria problem is one of social hygiene in its widest application and that mere prophylaxis as usually carried out is not likely to succeed until this is realised. Poverty then must be stamped out by wealth, and ignorance by knowledge; malaria also will be stamped out in the process. The practical advice given in this report will be of great value to those directly concerned with the actual administrative problems that arise in such a vast undertaking and high aim as the Kenya authorities have in view.

J. W. W. S.

[1] Report on a visit to Kenya and Uganda to Advise on Antimalarial Measures. By Col. S. P. James. Pp. 48. (London: Crown Agents for the Colonies, 1929.) 1s.

[2] Report by the Hon. W. G. A. Ormsby-Gore (Parliamentary Under-Secretary of State for the Colonies), on his visit to West Africa during the year 1926. (London: H.M. Stationery Office.)

Obituary.

PROF. KARL VON DEN STEINEN.

BY the death of Karl von den Steinen on Nov. 4 last, ethnological studies in Germany have lost one of their most distinguished and widely known representatives. Born at Muhlheim a. Ruhr in 1855, he graduated at Düsseldorf in 1871 and studied medicine at Zurich, Bonn, and Strasbourg. While travelling round the world from 1879 to 1881, he met Adolf Bastian in Hawaii. Association with that distinguished and enthusiastic ethnologist turned his attention to the study of primitive cultures, especially those of Polynesia.

It was not, however, until 1884, after his return from South Georgia, where he had been attached to the German party in charge of the meteorological station, that von den Steinen definitely turned to anthropological exploration. He then organised an expedition through Central Brazil and explored the then unknown region of the Xingú, one of the southern tributaries of the Amazon. The results of this expedition were embodied in his book "Durch Zentral Brasilien". He returned to the Xingú in 1887, publishing the results of his intensive studies of the natives of the area in his grammar of the Bakairi language in 1892, and in his "Unter den Naturvölkern Zentral Brasiliens" in 1894.

For long von den Steinen was best known to the

outer world for his work in South America, but his interest in the culture of Polynesia never flagged. In 1897 he visited the Marquesas and in 1898 the tribes of north-western Canada. His studies in Brazil had interested him in the problems of primitive art, and this interest was intensified by the curious art forms of the Marquesas. From this time forward he devoted himself to the accumulation of material for the study of the history of Marquesan art. The result was his monumental work on Marquesan art, of which the first volume appeared in 1925 and the second in 1928—a work which cannot but have a profound effect on method in all future studies of primitive art.

Von den Steinen's life was devoted to research, but he held a chair in the University of Marburg from 1891 to 1892, was president of the German Geographical Society in 1896, director of the South American department of the Ethnographical Museum in Berlin from 1902 to 1906, and president of the Anthropological Society of Berlin from 1908 to 1910. He was elected an honorary fellow of the Royal Anthropological Institute so long ago as 1905.

Prof. Auguste Rateau.

WITH De Laval, Sir Charles Parsons, Curtis, and Ljungström, the late Prof. Rateau, who died in Paris on Jan. 13, will be remembered as one of the successful pioneers of the steam turbine. So long ago as 1890 he published his "Études sur les turbines à vapeur"; in 1896 he patented his well-known form of multi-stage impulse turbine; in 1900 at the Paris Exhibition he exhibited complete designs for a turbine installation of a torpedo boat, and in 1903 he founded the Société Rateau, which from small beginnings rapidly grew into a large undertaking employing some three thousand workmen, with branches in all European countries. Though the turbine claimed the greater share of his attention, he did most successful work on the compound centrifugal air compressor, while his turbine super-charger has been fitted to aero engines and to marine Diesel engines.

Born at the small town of Royan, near the mouth of the Gironde, on Oct. 13, 1863, Rateau attended the grammar school at Cognac and then spent some years as a student, first at the École Polytechnique and then at the École Supérieure des Mines in Paris, gaining the rank of Inspector of Mines in 1886. He was already distinguished by his high attainments, and in 1888 was appointed a professor at the Mining School at St. Étienne; about ten years later he returned to Paris as a professor of electrical engineering in the École Supérieure des Mines.

It was Rateau's early work on mine ventilation which laid the foundation of his work on turbines and turbo-blowers. Of world-wide reputation, he read papers in England to the Institution of Mining Engineers, the Institution of Naval Architects, and the Institution of Mechanical Engineers, and during the James Watt centenary celebrations in 1919, with other distinguished engineers, received the honorary degree of LL.D. from the University of Birmingham. He was likewise honoured by places so far apart as Charlottenburg, Wisconsin, and Louvain, while he was one of the few engineers to be elected a member of the Institut de France.

WE regret to announce the following deaths:

M. Maturin L. Delafield, originally of New York, who for the last twenty-five years has resided in Lausanne, known for his work on the taxonomy of vascular plants and on phytogeography, on Dec. 18, aged sixty years.

Mr. E. T. Newton, F.R.S., formerly palæontologist to the Geological Survey of Great Britain, on Jan. 28, aged eighty-nine years.

Dr. J. M. D. Scott, professor of physiology in the University of Saskatoon and formerly lecturer and senior demonstrator at St. Bartholomew's Hospital Medical School, London, on Jan. 28.

News and Views.

THE centenary of the birth of Lord Salisbury, who delivered a noteworthy address as president of the British Association at the meeting at Oxford in 1894, fell on Feb. 3 last. It is interesting to recall that, for a great part of his life, scientific experiment was the favourite occupation of his leisure hours. In the earlier phases of this hobby, his interest lay in the direction of chemistry, especially as applied to photography, in that stage of its development when the amateur had to be a good deal more independent of expert assistance than he is to-day. In the biography written by his daughter we are told that, in addition to the camera and tripod, "the paraphernalia of bottles and trays and red lamps and sheets of unsavoury velvet were, at this time of his life, a constant accompaniment in holiday travelling". We are also told that "his wife shared in the painful experiences familiar to relatives of self-educating chemists", and that on one occasion he staggered into her presence and fell fainting at her feet, as the result of a too successful manufacture—and inhalation—of chlorine. At a later period, when increased means brought more expensive apparatus within his reach, he turned from chemistry to electricity, and in his laboratory at Hatfield spent his leisure on prolonged and minute experiments, at first on problems of polarisation and magnetism, and later on certain spectroscopic phenomena. On the latter he published a paper in the *Philosophical Magazine*, and in a German handbook on the subject they are mentioned as the first in point of time in which the conclusion was drawn that a gas at low temperature could emit a bright spectrum.

OF Lord Salisbury's work at Hatfield an account written by his friend and helper, Prof. H. M'Leod, shows him "repeating, checking, analysing, with as much patience and enthusiasm as if such work had been the occupation of his life". There is no disposition on the part of his biographers to claim or to suggest that he would have attained high eminence as a

scientific worker had he adopted science rather than politics as his life-work; on the contrary, he was so deficient in the instinct for external observation—to the extent of being on one occasion unable to recognise a colleague in the Cabinet when he saw him—that, as his daughter puts it, "it is difficult to believe that he could ever have acquired that power of recognising unlooked-for phenomena among the accidental by-products of an experiment to which so many discoveries have been due". But it is easy to understand his addiction to scientific experiment, with its promise of some definite result, as a restful contrast to the inconclusiveness and lack of finality in politics.

A BILL for the Protection of Wild Birds in Scotland was introduced in the House of Commons on Jan. 23, and obtained a first reading. The bill repeals the present laws relating to wild birds, other than game birds, and substitutes a simplified code the essence of which is that all birds and their eggs are to be protected at all times, with a few exceptions. The apparent simplicity of such a measure is sure to appeal to unthinking minds, but the principle of the bill is unscientific. Equally to protect all birds is in reality to favour the stronger and more successful as against the weaker. It has been forgotten that man, with his cultivation and industries, has irretrievably upset the balance of wild Nature. The best he can now do is not to perpetuate this upset balance, but so to regulate numbers and species that so far as possible none should suffer unduly from his original interference. It would be easy to cite cases where already overmuch protection has resulted in the increase of certain species at the expense of equally or more desirable birds. The bill has other defects. In some respects it is unnecessary legislation, for it protects many birds which require no protection. It would make the schoolboy who takes a blackbird's egg a criminal. Even more curious, while preserving intact all the laws which conserve game birds for the wealthy, it makes serious inroads against the old-established right of the ordinary man to obtain, if he can, an occasional meal on the seashore. It is unlikely that such a bill will pass unchallenged at its second reading, which is put down for Feb. 10.

So little notice is taken by the public Press of Great Britain of the award of Nobel prizes, except the prizes for literature and peace, that the banquet given on Feb. 3 by the Biochemical Society in honour of the Nobel Laureates in medicine and chemistry last year is of particular interest. In Sweden the prizes are rightly regarded as of outstanding and world-wide importance, and when they are presented on the anniversary of Alfred Nobel's death, the head of the State is present, and the ceremony is conducted with impressive solemnity and dignity. The Swedish people show that they are proud of the great foundation with which Nobel entrusted them, and the nation delights to associate itself with the progressive thought and work of the recipients of the prizes. British Laureates find a very different atmosphere prevailing when they return to their own shores; and it is not surprising to know that this public indifference is not understood in Sweden. The banquet on Monday will, we hope, show that scientific people, at any rate, realise the high distinction conferred by the Nobel awards. The three Laureates in medicine and chemistry who were present were Sir Frederick Gowland Hopkins, Prof. Hans von Euler, and Prof. Arthur Harden. Prof. C. Eijkman was unfortunately unable to attend, owing to ill-health.

SIR CHARLES MARTIN presided at the banquet, which was largely attended, among the company being the Swedish Minister and Sir Ernest Rutherford, president of the Royal Society. In proposing the toast of "The Nobel Laureates", Sir Charles Martin gave a very interesting survey of the growth of knowledge of accessory food factors from the time when Eijkman became director of the pathological laboratory at Weltevreden to the present period of marvellous activity. Beri-beri was then regarded as an infection, and it was Eijkman's experiments which showed that the disease was similar to a disease in fowls and due to a dietetic deficiency. Turning to Sir Frederick Hopkins, the chairman hailed him as a prince of biochemists who has enriched physiology for forty years by his discoveries. From his experiments with synthetic diets he was led to conclude that for nutrition certain minute quantities of hitherto unknown substances were essential; and so began our knowledge of vitamins. Prof. Harden's researches began with the fermentations of bacteria by accurate quantitative methods, and developed into his brilliant work on alcoholic fermentation. His discoveries have brought about completely new conceptions of the chemistry of these changes. Prof. von Euler's explorations in the same field have been most extensive, and there is scarcely any aspect of the subject that he has not illuminated by his researches.

MANY British botanists realised anew, during the British Association meeting in South Africa last year, the very interesting nature of the vegetation of South and East Africa and of Rhodesia. Between November 1928 and March 1929, Dr. T. F. Chipp, assistant director of the Royal Botanic Gardens, Kew, was travelling in the Anglo-Egyptian Sudan and, as a result, presented to the Royal Geographical Society on Jan. 13 an interesting account of the vegetation features of this West African botanical region. Vegetation belts of very different character are found, lying at varying distances from the Gulf of Guinea and ranging from the luxuriant development of vegetation in the south-west area, favoured by the monsoon from the Gulf, to the desert vegetation to the north-east in an area desiccated by the north-east Trades from the continent of Asia. Whilst climate, therefore, plays an all-important rôle in determining the distribution of vegetation, biotic factors, as exemplified by man, may play a very important part in two ways, which seem of fundamental importance from the Cape to Cairo, namely, shifting native cultivation and the burning of the dry grass and bush lands.

MAJOR CHIPP, with his experience both of vegetation and of problems of agricultural and horticultural significance, discussed one administrative problem

that deserves examination. He pointed out that the political units in Africa are by no means natural vegetation units. Each big British territorial unit cuts across a number of the natural belts of vegetation, and so independently, in each territory, as scientific investigation begins to precede further agricultural exploitation, the same problems are taken up afresh by different investigators at different, and very isolated, centres. This would not matter if the men and money available were unlimited, but this is very far from being the case. As Dr. Chipp said . . . "no one country can afford to maintain a staff of specialists sufficient to deal with all the food crops and crops of commercial importance which occur within its boundaries, and the inevitable tendency is for a few individuals in each country to attempt research into vastly different problems". Such a dissipation of our very limited available scientific resources will certainly prove wasteful. Possibly, as the new tropical research centre at Amani, in Tanganyika Territory, gets into its stride, we shall see a better co-ordination and utilisation of the efforts of a widely scattered body of scientific workers, whose labours should certainly be utilised to best advantage if the tropical resources of the Empire are to be tapped at a pace in any measure commensurate with our needs.

THE esteem in which the late Ernst Abbe was held by his countrymen is well illustrated by the fact that, twenty-five years after his death, *Die Naturwissenschaften* devotes more than half its issue of Jan. 17 to an account of his connexion with the firm of Zeiss, written by Dr. H. Hartinger. Most of the facts are already known from the "History" by Prof. von Rohr, but they furnish a romance of science which still bears repetition. Carl Zeiss, after learning his trade as an instrument maker at Weimar and working in Vienna, Berlin, and other towns, established himself in 1846, at the age of thirty, as instrument maker to the University of Jena. His experience convinced him that great improvements in the microscope were possible, and in 1866 he took into his works Ernst Abbe, a mathematician of twenty-six years of age, trained at the University and clever with his hands, and the firm began to construct instruments with Abbe's improvements. When, in 1870, their progress was stopped by the want of glass with new properties, they called in Otto Schott, and with the aid of a grant of £3000 from the Government, established the Jena glass works in 1884, proceeded to make the glass required, and in this way produced their apochromatic objective in 1886. Carl Zeiss died in 1888, and his son retired in 1889, leaving Abbe the sole head of the firm. Much of the work now fell on the shoulders of Abbe's assistants, Rudolph, Czapski, and von Rohr, and in 1903 he gave up scientific work. He died two years later. A statue of him by Hildebrandt stands in the hall of the University of Jena, and views of this and a smaller one by Hischen are reproduced in the article. An indifferent photograph of Abbe in 1886, a good one of Zeiss in 1883, and a drawing of the house in which he lived in 1834–38 are also reproduced.

THE regulations of the Post Office with regard to broadcast licences in Great Britain have been subjected to criticism, some of which is discussed in the *Wireless World* for Jan. 29. In particular, a Post Office regulation states that: "The Licensee shall not use or allow the station . . . to be used for the receipt of messages other than messages intended for receipt thereby or sent for general reception". Listeners, therefore, who take pleasure in picking up the messages sent out from Croydon air-port to aeroplanes flying between England and the Continent have a guilty feeling that they are breaking the law. One of them, Mr. Cyril E. Baron, during the recent gales, picked up SOS calls from a ship in distress in the Channel. Finding that the calls were not being answered, he communicated the information by telephone to the North Foreland Radio Station, and by this action was probably the means of saving the ship and the lives of those on board. For this action, presumably illegal, he was duly thanked by the Post Office instead of having his licence cancelled. The Post Office cannot hope to prevent listeners on radio receiving sets overhearing messages which it is desired to keep secret. Those who are expert at the Morse code occasionally are interested in the messages they hear from ships at sea. As a general principle, it is not advisable to publish regulations which cannot be enforced.

LORD RAYLEIGH discussed, in his Friday evening discourse delivered at the Royal Institution on Jan. 31, "Iridescent Colours in Nature". The colours of insects, said Lord Rayleigh, are of two distinct classes. Some of them are due to pigmentary substances; for example, the tortoiseshell butterfly owes its red colour to pigments, and accordingly the red colour is seen by transmitted light. On the other hand, blue butterflies apparently never owe their colour to a pigment; for example, in *Morpho Rhetenor*, the blue colour seen so brilliantly by reflection disappears entirely by transmitted light, a nondescript brownish colour being alone perceptible. The experimental evidence leads to the view that the blue butterfly owes its colour to interference of light; the reflection at the front and back surfaces combining to give this interference for the less refrangible parts of the spectrum, and leaving the blue as a residuum. The colours of metallic beetles are of special interest and have excited considerable controversy. Some authorities attribute them to the surface reflection of intensely absorbing matter assumed to be present in the wing case, and in fact to be analogous to the surface reflection of aniline colour. Lord Rayleigh held that this view presents insuperable difficulties. First, the colour by absorption is not saturated, as it always is in the case of substances known to give surface reflection. Secondly, the colour of the reflection changes greatly with the angle of incidence, while surface reflection colours do not. Lastly, when the spectrum is examined by absorption, it is found that bands are present which can be identified as essentially the same over different parts of the specimen, but vary slightly in position. The colour seems to be due to interference in this case also, the peculiarities of the

reflection and also of the absorption being due to the presence of a large number of reflecting layers suitably spaced.

PROF. J. L. MYRES'S presidential address to the Royal Anthropological Institute on "Anthropology, National and International", which was delivered at the anniversary meeting on Jan. 28, was a valuable survey of the movements during the last century to promote intercourse between men of science within their own country and internationally. Of these the British Association, which will celebrate its centenary next year, is a noteworthy example. In the international field, anthropology appeared early with the International Congress of Archæology and Prehistoric Anthropology, which first met in 1864 and continued to meet at more or less regular intervals up to 1912. At Geneva in that year it was decided that the next session should be held in Spain in 1915. The War intervened and the meetings have never been resumed, although an attempt was made to hold a congress at Madrid in 1927, which fell through after the preliminary arrangements had been made.

THE present position in regard to an international congress of anthropology is one of considerable difficulty, of which the facts are admirably summarised by Prof. Myres's address. At the close of the War, our French allies, among their praiseworthy efforts to reinstate international co-operation in intellectual affairs in accordance with the intention of the treaty of Versailles, founded an Institute of Archæology in Paris to which the title of 'International' was given. One of the objects of this Institute was the promotion of international congresses in archæology and anthropology. Several such congresses have been held at triennial intervals, beginning with that at Liège in 1921. But, as Prof. Myres showed, whatever may have been the case in the period immediately after the War, a congress organised in conditions at present inseparable from the constitution of the French institute can no longer comply with the requirements of a congress which is truly to be regarded as international. The problem, though difficult, should not be insoluble. It appears essentially one for which a solution might be found through the International Research Council.

THE relationship between the engineer concerned with petroleum and the industry itself is not easy to define. It is usually clouded by argument as to whether the engineer made the oil industry or the industry the oil engineer. It is further complicated by lack of agreement as to what really constitutes the engineer in the oil industry, since according to circumstances and national custom the designation may imply anything from a raw driller's assistant to the highly trained and technically qualified consultant. This would seem *prima facie* a case for a formula, but Mr. John Gillespie's discursive paper on the subject at the Institution of Petroleum Technologists on Dec. 10 cannot be said to have supplied one. If one takes the stand at the outset that "the engineer *is* in the forefront, and forms, and will always form, the spearpoint in this line of attack upon the . . . resources which Nature has hidden . . .", then obviously the engineer made the oil industry and the relationship becomes practically parental.

WE would remind Mr. Gillespie, however, that in many instances the geologist might legitimately claim to be in the forefront of the attack on oil resources: that it is due to his initial efforts that the engineer is led to the scene where his "spearpoint" will prove most effective. On the other hand, there are equally cases where the engineer, either because he has no use for the geologist or because he believes more fervently in his own judgment, occupies the front line from the start. The early history of development of the industry is full of examples of the triumphs of pioneers of this kind, and to them all honour is due. But in latter days, oilfields are not so easily located; those that formerly were 'there for the asking', so to speak, are now worked out, and new discoveries are more and more determined by intensive technical effort, to the inevitable displacement of the old-time oil engineer. The vocation of the petroleum engineer to-day is entirely professional and specialised; in some countries he is both geologist and civil engineer; in others, he is fundamentally the engineer responsible for winning the oil successfully from the pool, and his geology is second-hand. The driller is the mechanical engineer on the field: he is not a geologist and never will be. The matter will for long continue to be contentious, but it will scarcely be helped to settlement by exaggerated claims for one individual or the other.

SIR DOUGLAS MAWSON announces further discoveries in the Enderby Land region of Antarctica in messages to the *Times*. After finding that Enderby Land extends to the south-west in long. 46° E., he turned eastward and passed in lat. 66° 22′ S., long. 48° 30′ E., the tip of a great ice-shelf walled by 200 feet ice cliffs. This ice-shelf extends south-east to join the land. It is evidently comparable with the Termination and other floating ice shelves already known and is responsible for many of the large tabular bergs already reported in the neighbourhood. About three degrees farther east the land faces the sea in a rocky height of 1500 feet on which antarctic petrels and other birds were nesting. Several aeroplane flights have facilitated exploration. The ice plateau of Enderby Land seems to rise in the interior to about 4000 feet and there are many nunataks protruding through the ice. On one flight no less than 73 were visible at one time, one of them being 7000 feet in height. The *Discovery* is now short of coal. The Norwegian expedition in the *Norvegia* was last reported to be moving westward from Enderby Land carrying out oceanographical researches. An aeroplane is being used for coast exploration and reconnaissance of ice conditions.

PSITTACOSIS or parrot fever has lately been much before the public. The disease is primarily one attacking parrots and some other birds, and is contracted by close association with sick birds. In man it causes a fever of a septic or typhoid-like type with bronchitic or pneumonic complications, and severe cases are rare,

though milder forms may be more frequent and be mistaken for other maladies. A considerable epidemic was reported in Argentina last July, and according to a *Daily Science News Bulletin* issued by Science Service, Washington, D.C., 38 cases have recently occurred in the United States. The disease has been attributed to infection with *Bacillus psittacosis*, a micro-organism first isolated from Parisian cases by Nocard in 1893 and very similar to, or identical with, *B. aertrycke* of food-poisoning. This organism does not appear to have been found in the recent cases investigated, and Bedson, Western, and Simpson, in the *Lancet* of Feb. 1, p. 235, suggest that it may prove to be a secondary infecting agent, and that the disease may be caused by a filter-passing virus.

MR. F. TWYMAN will deliver his presidential address to the Optical Society at the meeting to be held at the Imperial College of Science and Technology, South Kensington, on Thursday, Feb. 13, at 7.30 P.M. The subject of the address is "Optics in Radio Transmission and other Fresh Fields".

SIR HAROLD HARTLEY, fellow and tutor of Balliol College, Oxford, and distinguished for his work in physical chemistry, has been appointed a vice-president of the London, Midland and Scottish Railway Co. in succession to the late Mr. R. W. Reid, and also director of scientific research to the Company.

LIEUT.-COLONEL THE RIGHT HON. WALTER E. GUINNESS, M.P., has been elected president of the Marine Biological Association of the United Kingdom in succession to the late Sir E. Ray Lankester. Colonel Guinness was Minister of Agriculture and Fisheries in the recent Conservative Government.

MR. A. H. G. ALSTON has been appointed Assistant-Keeper in the Department of Botany, British Museum (Natural History), where he will be in charge of Pteridophytes. Mr. Alston was formerly systematic botanist to the Department of Agriculture, Royal Botanic Gardens, Peradeniya, Ceylon.

MR. G. S. GORDON, president of Magdalen College, Oxford; Prof. O. W. Richardson, director of research in physics, King's College, London; and Mr. H. T. Tizard, Rector of the Imperial College of Science and Technology, have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

IT is announced in *Science* that the Edison medal, awarded by the American Institute of Electrical Engineers for "meritorious achievement in electrical science, electrical engineering, or the electrical arts", has been conferred on Dr. Charles F. Scott, professor of electrical engineering at Yale University, who was president of the Institute so long ago as 1902, for "his contributions to the science and art of polyphase transmission of electrical energy".

THE council of the Institution of Naval Architects has awarded the Gold Medal for the year 1929 to Mr. John Johnson, chief superintendent engineer of the Canadian Pacific Steamship Line, for his paper "The Propulsion of Ships by Modern Steam Machinery", and the Premium to Lieut.-Col. F. Dondona, for his paper "Sea Trials of Italian Destroyers". The medal and the premium will be presented at the opening of the annual general meeting, which will be held on April 9 at the Royal Society of Arts, John Street, W.C.2.

APPLICATIONS for the Government grant for scientific investigations must be made upon forms obtainable from the Clerk to the Government Grant Committee, Royal Society, Burlington House, W.1, and returned not later than Mar. 31.

THE annual general meeting of the Institute of Metals will be held in the Hall of the Institution of Mechanical Engineers on Mar. 12 and 13. The president is Dr. W. Rosenhain, and the president-designate, Dr. R. Seligman. In addition to the reading and discussion of papers, members will be given facilities for visiting the Birmingham section of the British Industries Fair. The May lecture of the Institute will be delivered on May 7 by Dr. F. A. Freeth, joint research manager of Imperial Chemical Industries, Ltd.

THE annual meeting of the Iron and Steel Institute will be held at the house of the Institution of Civil Engineers, Great George Street, London, S.W.1, on May 1 and 2, under the presidency of Prof. H. Louis. The autumn meeting this year is to be at Prague during the week beginning Sept. 15, in response to an invitation from the Society of Czechoslovakian Engineers, in the house of which the meeting will be held. As arranged in 1928, the autumn meeting for 1932 will be held in the United States, at the invitation of the American Iron and Steel Institute and the American Institute of Mining and Metallurgical Engineers.

THE provisional figures of the birth- and death-rates and infant mortality for England and Wales during 1929 have been issued by the Registrar-General. The birth-rate, 16·3 per 1000 population, is the lowest recorded, and is 0·4 below that of 1928. The death-rate is 13·4 per 1000 population, which is 1·7 above that of 1928. The rise is practically confined to the first quarter of the year, and is due to the prevalence of epidemic influenza and to the severe weather in that period. The same causes probably account for a rise in the infant mortality rate (deaths of infants less than 1 year of age per 1000 live births) from 65 in 1928 to 74 in 1929.

THURSDAY last, Feb. 6, was the centenary of Daniel Oliver, for many years Keeper of the Herbarium at Kew, and also professor of botany at University College, London. He was born on Feb. 6, 1830, at Newcastle-on-Tyne. His work at Kew began in 1858: he retired from the Herbarium in 1890 and died in 1916 at Kew. His official life was entirely devoted to his botanical work, and he was gifted with remarkable insight and a great habit of accuracy. Oliver's unofficial life was largely given to art. He worked in sepia, chalk, oil, and water-colour. It is proposed to hold an exhibition of his drawings at Kew this summer; the Director of the Royal Botanic Gardens has arranged for the show to be held in one of the

museums at Kew. It is thought that this by-product of the life of a serious botanist may be of interest to both artists and scientific workers. The works are of varied character and many are of great delicacy.

THE recently issued catalogue (No. 448) of Messrs. Bowes and Bowes, Cambridge, contains the titles of upwards of 3000 works relating mainly to mathematics, astronomy, and physics. It is of special interest because most of the volumes belonged to such distinguished men as the late Dr. J. W. L. Glaisher, James Glaisher, Prof. G. H. Bryan, and Dr. R. A. Herman. The prices asked appear to be reasonable. The catalogue can be obtained upon request.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in biology in the Department of Education of the University College of the South-West, Exeter—The Registrar, University College, Exeter (Feb. 15). An instructor in commercial fruit growing and an assistant agriculturist under the Kent Education Committee—The Agricultural Organiser, Springfield, Maidstone (Feb. 20). A part-time master for mathematics at Willesden Polytechnic School of Building—The Principal, Willesden Polytechnic, Kilburn, N.W.6 (Feb. 22). Two appointments in the Forest Service of Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Feb. 24). A demonstrator in the Division of Bacteriology and Immunology of the London School of Hygiene and Tropical Medicine—The Secretary of the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1 (Feb. 24). Three research assistants in the Department of Coal Gas and Fuel Industries of the University of Leeds—The Registrar, The University, Leeds (Feb. 24). A lecturer in chemistry and a lecturer in mathematics at Raffles College, Singapore—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Feb. 28). A histological assistant under the Joint Board of Research for Mental Disease, Birmingham—The Director, Joint Board of Research for Mental Disease, City and University of Birmingham, Hollymoor, Northfield, Birmingham (Mar. 1). An advisory veterinary officer at the Seale-Hayne Agricultural College—The Principal, Seale-Hayne Agricultural College, Newton Abbot, Devon (Mar. 1). A professor of pathology and bacteriology in the Veterinary College, Patna—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Mar. 15). An experimental assistant at the Air Defence Experimental Establishment—The Superintendent, Air Defence Experimental Establishment, Biggin Hill, near Westerham, Kent. A technical officer in the Admiralty Technical Pool for service in an Admiralty Establishment at Portsmouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. Three research assistants under the British Cotton Research Association—Dr. R. H. Pickard, Shirley Institute, Didsbury, Manchester. A veterinary advisory officer in the Department of Agriculture and Horticulture of the University of Bristol—The Secretary, The University, Bristol.

Our Astronomical Column.

Comets.—*Popular Astronomy* for January contains an enlargement (six times) of a photograph of Wilk's comet taken by Prof. G. van Biesbroeck at Yerkes Observatory on Dec. 22. The exposure was for 20 minutes; the coma appears exactly circular, 20′ in diameter; its brightness is nearly uniform, but there is a slight fading at the edges. A central condensation could be seen visually, but does not appear in the reproduction. It is noted that a slender tail, pointing almost exactly opposite to the direction of the sun, can be traced through 20′ on the negative. Prof. van Biesbroeck also gives reproductions of the two plates taken by M. Quénisset in Switzerland of Forbes's first comet on Oct. 25, 1928, nearly a month before its discovery. Prof. van Biesbroeck has measured the enlargement of the first plate, and gives the following position of the comet, which he estimates to be trustworthy within 5″. 1928 Oct. 25. 1542 U.T., R.A. $10^h\ 56^m\ 54{\cdot}5^s$, N. Decl. 11° 32′ 3″ (equinox 1928·0).

The Central Solar Eclipse of April 28 next.—This eclipse will be total for about 1½ seconds in the western parts of the United States of America. It passes a little north of San Francisco and runs from there in a north-easterly direction. *Popular Astronomy* for January states that the Lick Observatory is sending an expedition to Camptonville, California, under Dr. Moore: its work will be mainly spectrographic, and Dr. Menzel will try to photograph the flash spectrum. Dr. Aitken states that an attempt will also be made to obtain at least one photograph of the corona: three observers with cameras will be stationed at intervals of ⅓ of a mile along a line at right angles to the central line, as there is inevitable uncertainty of at least this amount in the prediction of that line. This is one of the eclipses that, though 'invisible at Greenwich', is visible in portions of the British Isles. A small partial eclipse will be visible before sunset over the whole of Ireland and the northern part of Scotland.

The Grootfontein Meteor.—*Popular Astronomy* for January contains an account of this enormous meteor by Dr. W. J. Luyten, who made the long journey (1550 miles) from Bloemfontein to Grootfontein in order to study it. Several photographs of the meteor are reproduced. It is roughly rectangular in shape, about 10 ft. by 9 ft., and the thickness at the sides varies from 2½ ft. to 4 ft. Analysis of portions of it indicates that it is about one-sixth nickel, the rest nearly pure iron. Its specific gravity may be estimated as 7·3, and its mean thickness as 3·2 ft: its mass in tons would then be roughly 58·7 tons: it cannot be much less than this, but may be more if there is a 'nose' in the middle of the base. It is probably the most massive meteor known; that brought by Peary from Greenland weighed 36·5 tons. Dr. Luyten, who removed a small fragment, noted that it was as hard as the hardest steel. He states that the existence of the meteor has been known in the neighbourhood for "a considerable length of time", but no record of the date of fall is mentioned. He also mentions a valley "east of Gibeon" that contains a number of smaller meteors, weighing about 500 lb. each; but these have been known for a long time. They contain less nickel than the great meteor—only 7 or 8 per cent.

Research Items.

Plant Remains in Sun-dried Bricks.—Prof. George W. Hendry, of the University of California, looking for the source of the black oats grown in Sonoma County, California, noticed that adobe bricks contain well-preserved specimens of vegetation. Since that time, 14 sun-dried brick buildings in different parts of California have been examined, and whilst not one sprig of black oats has been found, many interesting data have been obtained as to plant introductions and were reported by Prof. Hendry at the meeting of the American Association for the Advancement of Science at Des Moines in December last (*Daily Science News Bulletin*, Science Service). The approximate dates of introduction and sources of many plants and weeds, however, have been accurately determined from a careful study of the ages of the buildings in which they occur. In spite of the fact that much of this vegetation has been embedded in the clay for more than a century and a half, it is still preserved well enough for identification. Contrary to popular belief, it has been definitely established from these finds that wheat was introduced into California during the Spanish period. Barley has been found in 12 of the 14 missions examined, which shows that its culture lasted from 1701 to 1837. Only one kernel of wild oats has been discovered, and that was taken from the pulpit stair of the old church of the Mission of San Juan Bautista. It is thought that the present wide dissemination of wild oats in California has occurred since 1837. Remains of garden crops, ornamental plants, fruits and fibre plants taken from the sun-made bricks have also been identified.

The Gaits of Quadrupeds.—Having already analysed in a lengthy and detailed monograph the motions and limb stances of galloping animals, P. Mayne de la Croix has now turned his attention to the elucidation of the laws which he thinks rule the evolution of locomotion in the vertebrates (*Anal. Soc. Cient. Argentina*, t. 108, p. 383; 1929). A long series of observations leads him to postulate the great law of the evolution of quadrupedal locomotion as follows: Progression takes place from the alternate use of quadrupedal and tripedal stances to the sole use of unipedal stances, and this evolution is made possible by means of a discord, always increasing, between the period of the swing of the anterior and that of the posterior. Further, he finds that, just as in rapid gaits times of suspension are intercalated, when the animal is entirely free from the ground, so in slow gaits there are intercalated times of 'arrest' when the animal reposes upon all fours. By this means are distinguished four great groups of gaits—reptilian creeping gaits, reptilian leaping gaits, walking gaits, and leaping gaits—and the author proceeds, aided by a series of figures of the successive poses in these types of movement, to trace what he calls the phylogeny of locomotion.

Habits of the Manx Shearwater.—Much acute field observation makes R. M. Lockley's account of the breeding habits of the Manx shearwater (*Puffinus puffinus*) of special interest (*British Birds*, vol. 23, 202; 1930). The birds were studied upon Skokholm, a rock-bound isle off the coast of Pembrokeshire, where some five thousand pairs breed. Nesting burrows having been marked and traced to their end, a large sod was very carefully cut immediately over the nest, so that, when need be, this improvised window could be opened for observation. Although shearwaters are nocturnal birds, spending the day in the farthest recesses of their burrows, it was found that while the nesting holes were visited nightly with great regularity, during the day one or both of the paired birds might be absent. Both parents incubate the eggs, but one bird may sit for several days at a stretch, its only exercise being the turning of the solitary egg. Probably during this period it is fed by its mate. The passage of the young birds from the nest to the sea is attended by considerable mortality. Most of the young at this stage still bear some of the down plumage, and since they are unable to rise on the wing except in face of a stiff breeze, they make an awkward and exhausting journey on foot across country if the weather be calm. Should daylight find them still in the open, gulls and other marauders almost certainly destroy them. The young which reach the cliff edge launch themselves straightway into the air, and flap downwards to the dark sea.

Evolution of the Pelvis of Primates.—Miss H. C. Waterman (*Bull. Amer. Mus. Nat. Hist.*, vol. 58, pp. 585-642; 1929) has made a detailed study of the pelvic region of thirteen genera of Primates, with the purpose of determining the relation between the locomotor habits of the animal and the external form of the pelvis. It was hoped thus to provide material of value in the attempt to separate habitus from heritage characters in these forms and to obtain some light on the evolution of the pelvis within the group. The results of her studies lead Miss Waterman to support Gregory's views as to the main stages in the evolution of the pelvis from primitive arboreal quadrupeds to man. These stages are: (1) a primitive lemuroid stage; (2) the stage of the primitive monkey in which there are incipient adaptations for upright sitting; (3) the stage of the quadrupedal monkey in which adaptations for upright sitting are perfected; (4) the brachiating stage; and (5) the stage of bipedal man.

Solution of Coral Reef Limestone.—In the *Geographical Journal* for January, Mr. W. A. Macfadyen describes the result of some of his observations on coral islands in the Red Sea. His work was done on the Ashrafi and Jubal Islands at the mouth of the Gulf of Suez and on the Farsan Islands and Kamaran Island in the south-east of the Red Sea. These are practically all islands of reef limestone fringed with growing corals. They project above a submerged platform and are fringed with shallow water which largely protects the coast from erosion by wave action. The coasts are usually fringed by undercut cliffs. The undercut may reach a depth of three or four feet. The sharpened and roughened surface of the undercut suggests solution rather than wave action, which would give a smooth surface. The presence of barnacles on miniature pedestals also suggests solution. At the same time, Mr. Macfadyen admits that boring and other organisms probably play some part in the formation of the undercut cliffs. The small range of the tide confines action to a narrow depth and makes it more conspicuous.

Physico-Chemical Phenomena in the Silkworm's Egg.—The results of an investigation of the various chemical and physico-chemical phenomena observed in the egg of *Bombyx mori* are described by Dr. Mario Tirelli in the *Atti della Pontificia Accademia delle Scienze* (*Nuovi Lincei*) for 1929. It appears that the silkworm's egg is the seat not only of a morphological, but also of chemical and physico-chemical ontogenesis, which is to some extent independent of the first. Embryonal development is accompanied by characteristic variations in the viscosity, cryoscopic

point, and amino-acid content of the egg, which contains a proteolytic enzyme. The liquid of the egg exhibits the power of undergoing stratification, which takes place in different manner with different strains and may be easily reproduced by adding toluene to the liquid and drawing the latter up into tubes. The viscosity of the egg is characteristic of the race and, in the case of crosses, is sometimes intermediate to the values for the parental races, so that the male element also exerts an influence in modifying the physico-chemical characters, and hence the chemism, of the egg.

Studies on Tetrarhynchids.—Descriptions of larvæ of *Tetrarhynchus* deal for the most part with external features and systematic characters. The late Dr. H. Cammerloher (*Sitzungsber. Akad. Wiss. Wien*, Mat.-nat. Kl., 138 Bd., pp. 125-143, 1929) describes the structure of the larva of *Anthocephalus elongatus* from cysts on the liver of *Orthagoriscus mola*. All the specimens, which were obtained at Trieste, Naples, and Messina, had completely formed proboscides; younger stages were not found. In the fresh liver the worms lie motionless in their cysts, but when the cyst is dissected in sea-water, active rhythmic movements of the larva are observed which are also seen in specimens in the liver when the latter begins to decompose. Larvæ preserved in extended condition are about 25 mm. long. After a brief account of the larva as seen in a whole mount, the author describes transverse sections through three different regions of the body and one through the tail appendage. One of the most interesting points in the histology is that giant-fibres are present in two of the nerves, seen in transverse section of the bothridial region, which innervate the muscle bases of the proboscides. The muscle in the parenchyma in relation to the proboscides exhibits a spiral striation. In the following paper Dr. T. Pintner describes the original example of *Diesingium* (*Rhynchobothrium*) *lomentaceum* Diesing, 1850, preserved in the State Museum in Vienna, from *Mustelus* taken at Palermo.

Hyperfine Structure in Line Spectra.—It is by now well established that there is a hyperfine structure to certain spectral lines which requires for its description an additional quantum number, and that the effect has its origin in the rotation of the nucleus. The nature of the information which can be obtained from a study of this effect is well illustrated by two papers by H. E. White in the first December issue of the *Physical Review*. The first of these deals with the spectrum of singly ionised praseodymium, data being given for the structure of 173 lines, all of which have six components spread over an interval of only about a quarter of an Ångström unit. High spectral resolution is naturally needed to bring out such detail, and has been obtained in this instance by working in the fourth order of the 75-ft. grating spectrograph at Mt. Wilson; reproductions of the photographs obtained for ten typical lines are shown. The praseodymium nucleus has been shown to possess an angular momentum of $\frac{5}{2}$ Bohr units, which compounds with the angular momentum of the outer electrons of the ion according to the usual rules of the quantum theory. The second paper treats of the theory of the effect at greater length, with particular reference to the spectra of cadmium, bismuth, and lanthanum, and it is stated in a note that the theories advanced also fit in well with the structure reported by Prof. McLennan and his collaborators for the spectrum of ionised thallium (Tl II), and with the author's own preliminary observations with manganese. The same issue of the *Physical Review* contains a letter from S. Goudsmit and R. F. Bacher on the subject of the Paschen-Bach magnetic effect with hyperfine structure.

Quenched Arc Switches.—The large currents and the very high voltages now used in the networks distributing electrical energy have greatly increased the difficulty of breaking the supply in the event of a fault developing in a section of the network. The problem of constructing an oil switch which breaks the current under oil has been solved up to a rupturing capacity (the product of the open circuit volts at the break and the short circuit current) of 800,000 kilovolt amperes. When the switch contacts separate under the oil a high temperature arc ensues and a gas bubble is formed which rapidly increases in size even after the arc is extinguished. In a medium sized switch the bubble may grow to be a foot in diameter and the gaseous pressure even when a large air chamber is provided may rise to 200 lb. per square inch. The energy evolved in a break depends on so many variables that it is impossible to predict accurately what will happen. In a paper read to the Institution of Electrical Engineers on Jan. 23 by L. C. Grant, the breaking performance of high power switchgear is discussed and a new form of quenched arc switch is described. He quotes interesting results on the effects produced by oil switches which have one, two, or four breaks within them. He concludes that the average 'distress' produced by the three kinds of switches are in the ratio of 100 : 62 : 50. With six breaks there seems to be only a slight improvement on the four break. The size of the contact pieces and the speed with which they separate have a great influence on the performance of the switch. The author insists on the necessity of manufacturers having high power available to test their switches. A new quenched-arc circuit-breaker which he described measures six inches in diameter and six inches long and weighs only 28 lb., and yet it easily broke 50,000 kilovolt amperes at 6000 volts. He stated that a device of this type could be constructed to break three million kilovolt amperes.

Promoter Action.—It is well known that the activities of many catalysts are enhanced by the addition of small amounts of other substances, called promoters. In a study of the catalytic oxidation of methane with steam (*Bulletin of the Chemical Society of Japan*, October), Kuboto and Yamanaka have observed a relation between the type of reaction and the properties of the promoters. They suppose that the reaction takes place successively in the following manner:

$$CH_4 \xrightarrow{H_2O} CO + 3H_2 \xrightarrow{H_2O} CO_2 + 4H_2.$$

The catalyst was nickel, and it was found that the largest quantity of carbon dioxide was obtained by using a catalyst promoted by Al_2O_3, whilst when water vapour was regulated the catalyst promoted with MgO gave the largest yield of carbon monoxide. The effect of the promoters may be to transfer water molecules to the reaction centres of the catalyst where the action of water on methane is occurring, and the products will then be determined according to the capacity of the promoter to adsorb water molecules and also to the size of the promoter molecules. The results are in good agreement with this hypothesis in the special form given to it by Balandin in a recent communication. The reactions are assumed to occur in associations of reacting molecules called multiplets, and the two factors mentioned then come into consideration.

Electrical Breakdown in a Solid Dielectric.

IT is now well known that if we have two spherical electrodes in a gas, then in certain cases, over a very wide range of the distance between them, the disruptive voltage can be determined with great accuracy. In computing this voltage, it is necessary to know first the nature of the gas and its temperature and pressure; secondly, the radii of the electrodes and the distance between them; and thirdly, the electric strength of the gas.

The only problem that is laborious and difficult is the computation of the maximum electric stress between the electrodes. When the electrodes are equal, these values can be found from tables well known to electrical engineers. For example, when the electrodes are each one inch in diameter, the disruptive voltage in air can be computed with at least a one per cent accuracy at distances varying from one-tenth of an inch to three inches, the corresponding voltages varying from about 10,000 volts to 50,000 volts. When the spheres are closer together than a tenth of an inch, other physical factors have to be taken into account. Everyday experience seems to show that there is a minimum sparking potential which is about 350 volts in air at ordinary atmospheric pressure and temperature.

The early experimenters, only having a few thousand volts available, were naturally unable to find any simple law connecting sparking voltage and distance. Kelvin, however, in his Reprint of Papers, pointed out so far back as 1860 that if we regarded the maximum electric stress as the determining factor, then it was 'most probable' that the numbers obtained in this way at higher voltages would be found to be sensibly constant, a surmise which has been rigorously proved in recent years by electricians.

With electrodes in a gas, there are three cases which need to be considered separately. First, when they are very close together; secondly, for distances apart up to about three diameters of either electrode; and thirdly, for greater distances when coronæ form before the breakdown discharge occurs. It is very easy to calculate in the last case when the corona appears.

In the *Journal of the Franklin Institute* for December, P. H. Moon and A. S. Norcross prove that in a solid dielectric there seem to be three different physical causes that lead to its disruption by electric stress. The experiments were made on the lead glass of the approximately spherical bulbs of flasks. Mercury inside the flask formed one electrode, and it was immersed in a bath of mercury which forms the other electrode. This arrangement gets rid of the edge effect. All the tests were made with direct-current voltage obtained either from a hundred kilovolt kenotron set or a 4000 volt motor generator set.

It was found, first, that for low temperatures and for low values of the thickness, the relation connecting the breakdown voltage with the thickness of the glass is a linear one. Secondly, for higher temperatures and greater thicknesses, the breakdown voltage is no longer independent of the temperature but decreases as the temperature is raised. Finally, when the temperature is raised above 150° C., the effect of temperature becomes much more pronounced and we reach the region of thermal instability which has been much studied by electricians. Tests with sodium-lime glass give similar results. Apparently there is no connexion between resistivity and breakdown in the disruptive region. Messrs. Moon and Norcross consider that there are three distinct mechanisms of breakdown, the one that actually takes place depending on the temperature, thickness, and constants of the material.

Transport of Stones by Attached Seaweed.

MR. SYMINGTON GRIEVE directed attention to the ocean transport of stones through the buoyancy of attached seaweed, with their consequent piling up as a stony beach where obstacles intercepted the ocean currents, in a paper in the *Transactions of the Botanical Society of Edinburgh*, vol. 14, pt. 2 (1882). This paper is reprinted in the *Trans. and Proc. Bot. Soc.*, vol. 30, Part 2, 1929, together with further papers which give results of additional observations by the author since that time. Charles Darwin discusses in "The Voyage of the *Beagle*" the transport of stones to Keeling Island and other atolls, through their attachment in the roots of floating trees, and it is interesting to learn that shortly before his death (Mar. 22, 1882) he wrote to Mr. Symington Grieve from Down a brief note that indicated his interest in the subject, in which he states that he had "long known that stones were transported by floating Fuci".

Probably almost every naturalist who reads these interesting papers will recall some observation from his own experience which might have enlightened him as to the buoyancy added to stones by the canopy of attached seaweed, but it has been left to the author to realise the significance such an apparently incidental occurrence may have, both in building up beaches of water-worn rocks, in contributing to the erosion of the cliff surface by its bombardment by *Fucus*-transported missiles in the waves, and even in contributing to the dislodging of massive masonry exposed to the waves and which, in time, has become covered with a canopy of seaweed. Around the British Isles the seaweeds that contribute most in giving buoyancy to the stones on which they grow are *Fucus vesiculosus* and *Fucus* (*Ascophyllum*) *nodosus*; to a lesser extent *Fucus serratus* and *Chorda filum*.

The author points out that the shape of the stone and the extent of the surface it exposes for the growth of the seaweed will be factors of importance in determining whether it is lifted from its bed by the tide, as also will be the amount of growth of the seaweed and the height of the water above it when under the influence of this tidal scour. He has noted stones with seaweed attachment drifting along the bottom of the tide, so that the stones left a grooved trail on the bottom. In the earlier paper it was pointed out how such a trail may be left on the sand or mud as the tide recedes, an alternative suggestion thus arising for some of the 'reptilian marks' or 'ripple marks' described for ancient or modern beaches.

The author also raises the question as to whether the sargasso seaweed, composed of the two species *Sargassum vulgare* and *S. bacciferum*, as it floats away from its breeding places upon the shores of the islands of Martinique, Guadeloupe, and Dominica, may not carry with it stones on its journey in the Caribbean Sea or the Atlantic or Pacific Oceans. The late Prof. James Chilton directed attention, in the *Transactions of the New Zealand Institute* (vol. 56, pp. 523-524), to the habit of the free-swimming larvæ of an ascidian of attaching themselves to pebbles, which are thus lifted from gravel beds so that, in stormy weather, they are thrown up on the beach.

Developments of Electrodeposition.

THE Electroplaters' and Depositors' Technical Society held its annual convention on Jan. 31 at the Northampton Polytechnic Institute, St. John Street, Clerkenwell, one of the features of the meeting being an exhibition representative of modern scientific and practical advances in electrodeposition. This may be claimed to be the first exhibition devoted purely to the interests of the many phases of electrodeposition ever held in Great Britain and is indicative of the big strides which have occurred in the technical development and the resultant commercial applications of the deposition of metals since the War. The exhibition aroused great interest, and the subsequent meetings were attended by members and visitors from all parts of the country.

The afternoon meeting was addressed by Dr. W. Rosenhain, of the National Physical Laboratory, Teddington, who discoursed upon "Research and Practice". In the evening, a discussion was held on the "Present Position of Chromium Plating", at which more than two hundred people were present; Dr. R. S. Hutton, director of the British Non-Ferrous Metals Research Association and president of the Electroplaters' and Depositors' Technical Society, being in the chair. The discussion dealt with the practical aspects of chromium deposition.

The exhibition was fully representative of practically every phase of the science and art of electrodeposition. Exhibits illustrated the application of electroplating for decorative (as in nickel and chromium deposition) and protective effect (as in the deposition of cadmium and zinc on ferrous metals); the 'building up' of worn parts by depositing iron or nickel and grinding afterwards to the required size; electrotyping and galvanoplasty, deposits being shown upon such non-conductors as glass, porcelain, plaster, vulcanite, and cellulose acetate.

One of the most remarkable exhibits consisted of very thin gold and nickel films, prepared by Dr. Carl Müller of the Physikalisch-Technisches Reichsanstalt, Charlottenburg, Berlin. These gold films are 60 mm. in diameter, and, although transparent, quite non-porous. The thickness of the films is no more than 0·00002 mm. One of the applications of these films is for use as windows for cathode ray tubes, for which purpose they are supported on grids. It is interesting to add that Dr. Müller has exhibited elsewhere similar electrolytic films, ranging from 0·00002 mm. up to 0·001 mm. in thickness, in both a polished and matt condition. In one of these exhibits the transparency of these films was illustrated in a striking way, printed type being distinctly read through six foils placed one behind the other. The Royal Aircraft Establishment, Farnborough, at the same time exhibited films of aluminium oxide obtained in the anodic oxidation process which are of the order of one eighty thousandth of an inch in thickness.

Among the comprehensive exhibits of the Research Department of the Woolwich Arsenal, X-ray spectra of deposited nickel were shown, indicating in striking fashion the difference between hard and soft nickel deposits. The soft deposit is build up of nickel crystals, nearly all of which have their cube faces nearly parallel to the plane of the deposit, but have a random orientation about the direction of the current. The hard deposit is built up mainly of a random arrangement of nickel crystals, but there is an appreciable number of crystals with their dodecahedral planes parallel to the plane of the deposit, thus giving a weak symmetrical pattern in the perpendicular spectrum.

Native Fish-Poisons as Insecticides.

THE use of certain orders of plants for purposes of stupefying and catching fish is almost world-wide; this practice in countries under British control is now deprecated and in many cases prohibited. There are references to this custom scattered throughout the literature of exploration, and in the course of time a considerable list of the plants used has been compiled.

Derris or tuba root (*Deguelia elliptica*) of the East Indies is the most widely known of these plants owing to its increasing use as an insecticide. An examination at the Rothamsted Experimental Station of derris and many other tropical fish poisons, collected by Empire officers, indicated that for insecticidal purposes those of the order Leguminosæ were, in general, the most potent. Among those of a high order of toxicity are two plants used by the Indians of British Guiana and known to them as white and black haiari (*Lonchocarpus* spp.), which contain the characteristic principle of derris root—now known as rotenone—a most potent insecticide. These plants, which are lianes, have been collected in the forests of British Guiana by Mr. R. A. Altson, but such is their habit of growth that the definite species has not been so far recognised. An attempt is now being made to cultivate the haiari plants for commercial use as insect sprays and animal dips, and the Empire Marketing Board has made a grant for an investigation at an agricultural experimental station in British Guiana. In the meanwhile, it is hoped that the woods and forests of British Guiana will not be denuded of plants of such prospective value.

Other Leguminosæ of interest, from the fact that they possess both fish-poisoning and insecticidal properties, are yarraconalli (*Tephrosia toxicaria*) of British Guiana and iLozane (*Tephrosia macropoda*) from South Africa. The fact, however, that *Cocculus Indicus* (*Menispermaceæ*) possesses the same dual properties would indicate that they are not entirely limited to leguminous plants. The constitution of the active principles, which are neither alkaloids nor glucosides, is unknown, although much useful research on rotenone has been in progress for several years. They are possibly closely related compounds, and should well repay investigation. In addition, there is much to be done to clear up the confusion of the identification of the plants arising out of the use of native names. The encouragement of the Empire Marketing Board may well lead to a wider use and more extended knowledge of these interesting plants.

Sea Trout from the Moray Firth.

THE Scottish sea-trout is a creature of much more variable habit than the Scottish salmon. Mr. G. Herbert Nall has shown that it is a plastic species capable of adapting itself readily to its environment and reflecting in a marked degree the feeding possibilities of the area which it inhabits (*Fisheries, Scotland, Salmon Fish.*, 1929, No. 111).

The south-westerly area of the Moray Firth, comprising the Inverness Firth and the Beauly Firth, is an extensive sheet of somewhat shallow water. It forms a rich feeding ground for the sea trout of the Ness and Beauly and a few minor streams. Many of the fish feed most actively and grow most rapidly in summer. But in mid-winter, shoals of sprats and small herrings enter the firths and a large portion of the trout feed heavily upon them, and in spite of lower temperature have a period of maximum growth and fatness between

November and February. Moreover, the scales of certain fish reveal on examination strong evidence that individuals may be winter feeders one year and summer feeders the next. Thus, the trout of the district seem to be in a transitional stage of partial adaptation to their special environment.

Between January 1921 and January 1924, nearly sixteen hundred sea trout, brown trout, and parr were marked in the Beauly Firth and in the lower reaches of the Beauly and Ness Rivers in order to glean information regarding their migratory movements. About 16 per cent of these have been recaptured, the recaptures proving that there is a constant movement and interchange of fish through the firth between the tidal reaches of the two rivers. As only three marked fish have been recaptured outside the firths, there is little direct evidence that the Beauly-Ness fish travel far from their rivers. It is scarcely likely, however, that their movements are confined to this area, since from other districts there is abundant evidence that both finnock and adult trout undertake extensive coastal migrations, and that adult trout are caught at times far out at sea.

Careful study of the scales of these sixteen hundred fish has also been carried out. The reversal of the ordinary seasons of growth and rest render inadequate the usual methods of scale interpretation, and special methods had to be adopted to overcome this difficulty. Like most sea-coast trout, the Beauly-Ness fish have short lives, and few survive to spawn more than two or three times. One exceptional fish, however, was in its eleventh winter and had spawned seven times.

University and Educational Intelligence.

CAMBRIDGE.—Dr. A. B. Appleton, University lecturer in anatomy, has been elected to a fellowship at Downing College.

Mr. J. C. Dobbie, of Trinity College, has been appointed first junior observer at the Solar Physics Observatory.

Dr. H. McCombie and Mr. H. Thirkill have been appointed members of the council of the School of Physical Sciences, and Dr. E. K. Rideal and Prof. Engledow members of the council of the School of Biological Sciences.

EDINBURGH.—On the recommendation of the University Athletics Committee, the University Court has appointed Colonel Ronald B. Campbell as director under the scheme for the promotion of the physical welfare of students and the development of University athletics, the appointment to date as from May 1.

LONDON.—The following doctorates have been conferred: D.Sc. in chemistry on Mr. R. P. Linstead (Imperial College—Royal College of Science), for a thesis entitled "Three-Carbon Tautomerism"; D.Sc. in the history, methods, and principles of Science on Mr. J. H. Woodger, University reader in biology, for a thesis entitled "Biological Principles"; D.Sc. in zoology on Mr. E. A. Spaul (Birkbeck College), for a thesis entitled "On the Activity of the Anterior Lobe Pituitary".

THE examinations for the award of scholarships in engineering, science, domestic science, and hygiene at the Battersea Polytechnic will be held on Wednesday, June 11, and succeeding days. The scholarships vary in value from £20 to £30 per annum with free tuition, and are tenable for two or three years. The latest day for applications is April 19. Full particulars may be obtained from the Principal.

Two Theresa Seessel research fellowships for the promotion of original research in biological studies are being offered by Yale University. The value of each is 1500 dollars. Applications, accompanied by reprints of scientific publications, letters of recommendation, and a statement of the particular problem which the candidate expects to investigate, should be made to the Dean of the Graduate School, New Haven, Conn., U.S.A., before Mar. 1 next.

THE Board of Education is again prepared to receive applications for full-time studentships from teachers of five years' standing who desire financial assistance in order to attend approved full-time courses of advanced study at universities or other institutions at home or abroad. The amount of grant will not exceed £100 for an academic year. The course proposed, if academic, should be of at least post-graduate type, but the Board is prepared to consider also proposals involving travel or the practical study of industrial conditions connected with the teaching of technical subjects. Further information and application forms, to be returned by May 31, can be obtained from the Board of Education, Whitehall, London, S.W.1.

THE Cecil Peace Prize, of the value of £100, is offered yearly for an essay on some subject connected with the maintenance of international peace, and having some bearing on the principles or work of the League of Nations. It is open to students of any university or university college in Great Britain or Northern Ireland who have not attained the age of twenty-five years on the last day for submitting essays. The subject for the year 1930 is "Possible Developments of the Economic Activities of the League of Nations". The essay must be sent in to the Secretary, Universities Bureau of the British Empire, 50 Russell Square, London, W.C.1, so as to arrive on or before Nov. 1 next.

FELLOWSHIPS and scholarships for advanced work in science and technology are listed in a bulletin (154 pages) recently published by the National Research Council of the National Academy of Sciences, Washington. The number, variety, and value of these aids and encouragements are impressive. A significant feature of the situation is the important part played by industrial firms and trade associations. Eighty-five such bodies support fellowships or scholarships. Conspicuous among these is the E. I. du Pont de Nemours of Wilmington, which maintains 24 fellowships, each worth 750-1000 dollars, and four scholarships of 300-400 dollars. The company selects each year the institutions in which the work is to be carried on. The National Canners Association, on the other hand, which grants annually 19,000 dollars for research work in connexion with the wholesomeness and nutritive value of food, leaves the disposal of the grant entirely to the University of California, which uses it in large part for the payment of salaries of assistants and fellows who conduct the work under the direction of members of the faculty. Among the methods employed by the Mellon Institute of Industrial Research, Pittsburgh, is a system of 'multiple fellowships', in which the services of one or more researchers are utilised under the direction of a senior fellow who, in turn, is responsible to the executive staff of the Institute. These twenty-one fellowships are financed from foundation sums covering all expenses of the specific researches for which they are given, including salaries, and ranging from 8000 dollars to 80,000 dollars. While the activity of industrial firms in fostering research tends to the exaltation of applied science at the expense of pure science, the latter is of course not neglected in the allocation of funds in universities. Under the head of astronomy, for example, twelve fellowships are mentioned; under mathematics, twenty-six.

Historic Natural Events.

Feb. 9, 1913. Group of Meteors.—A remarkable group of meteors was observed over Saskatchewan in Canada at 9.5 P.M. and was last seen from ships beyond Bermuda. It travelled across Canada in seven minutes and probably struck the sea after a total path of 6000 miles, traversed at from 5 to 10 miles per second. The whole group consisted of at least ten smaller groups, each containing 20 to 40 meteors, which kept perfect formation while the groups followed one after another along the same path, the whole taking more than three minutes to pass a given place. The groups left long trails and were accompanied by a noise like distant thunder, and in some localities the earth vibrated, but only the leading meteor of the procession burst.

Feb. 10, 1236. Floods.—Rain continued all through January, February, and a great part of March, and for eight days it rained almost without ceasing. On Feb. 10, immediately after the change of the moon, there was such a high tide in the Thames that boats might have been rowed up and down in Westminster Hall.

Feb. 11, 1895. Great Frost.—The frost of 1895 lasted from Dec. 30, 1894, to Mar. 5, 1895, except for a week of mild weather on Jan. 14–21. During almost the whole of this period easterly winds prevailed, which were especially strong in February. The greatest intensity of cold occurred from Jan. 26 to Feb. 19, for which period the average temperature at Greenwich was below 26° F. Minimum readings below 0° F. were recorded somewhere in the British Isles every day from Jan. 8 to 10 and 28, Feb. 6 to 14 and 16 to 20, the coldest day being Feb. 11 with −17° F. at Braemar and −11° F. at Buxton. At Greenwich the lowest temperature was 7° F. on the same day. From Feb. 9 to 17 the whole of the Thames was more or less blocked by ice, and it was impossible for full-powered steamers to force their way up and down except with the tide. Some of the ice-floes were six or seven feet thick. On Feb. 18 the ice on the lake in Regent's Park was ten inches thick; in the Fens it was two feet; and at Oxford a coach and six were driven over the Cherwell. Water-mains were frozen at depths of three feet. The frost was the most severe in Great Britain since that of 1813–14, but in Europe the winter, though severe, was not so rigorous as in 1879–80. 7° F. was recorded at Paris, and the Seine froze on Feb. 10. There was heavy snow in France.

Feb. 12, 1493. Storm.—On returning to Spain from his discovery of America, Columbus and his fleet were overtaken by a severe storm, which lasted three days and threatened them with destruction, so much so that Columbus wrote an account of his discoveries and threw it overboard.

Feb. 12, 1920. Snowstorm in Jerusalem.—Twenty-nine inches of snow fell during the six days Feb. 8–13 in Jerusalem. This was the greatest fall of snow ever recorded there. It began with heavy rain and sleet on Feb. 8 and 9; a blizzard with wind of gale force blew on the Mount of Olives on Feb. 9, but the snow did not lie until that night. After that it snowed continually until Feb. 12. The total depth of rain and melted snow was equivalent to 10 inches of water. The minimum temperature recorded on the Mount of Olives during that time was 25° F. Snow fell over a wide area and not only on the hills.

Feb. 12–14, 1899. Cold Wave.—On the morning of Feb. 11 pressure over northern Montana rose to 31·42 inches (1064 mb.), and temperatures of −20° F. were recorded so far south as central Kansas, the lowest being −61° F. at Fort Logan, Montana. During Feb. 12 and 13 the 'high' passed southward over the Great Plains region to the Gulf of Mexico, and temperatures 8° and 13° F. lower than previous records were registered at New Orleans and Mobile, Ala., respectively. At Tallahassee, Fla., −2° was recorded. Snow began to fall in the Ohio Valley on the morning of Feb. 11, and spread southward over the east Gulf and Atlantic States. By 8 P.M. of Feb. 13 the storm had become a raging blizzard centred over Cape Cod, with winds of 40-70 miles per hour. Many people were frozen to death in the central and northern States, damage valued at millions of dollars was done to fruit orchards, game birds perished by the thousand, and poultry froze in their roosts. Swiftly flowing streams froze over and fish were killed; even the Mississippi had one inch of ice at its mouth.

Feb. 13–14, 1892. Magnetic Storm.—A violent magnetic storm accompanied by a magnificent display of the aurora which was visible, in spite of full moon, from Europe (so far south as Rome), Canada, and the United States above lat. 36°. Telegraphic systems in general suffered dislocation for a few hours. The range in declination at Kew and Greenwich exceeded 2° and $1\frac{1}{4}$° respectively; the range at Washington was $1\frac{1}{2}$°. At the time a very large sunspot, covering $\frac{1}{400}$ of the sun's visible hemisphere, was one day past the central meridian. The region of the spot, which showed abnormal developments on Feb. 11 and 12, was one of the first to be explored by Hale with his recently devised 'spectroheliograph'. On Mar. 11, that is, one solar rotation later as timed from the earth, another magnetic storm of somewhat lesser intensity took place, also accompanied by an aurora.

Feb. 13–14, 1923. Blizzard.—The wind over the plains of North Dakota and Minnesota reached a velocity of more than 50 miles per hour with a temperature below freezing. In spite of warnings by the Weather Bureau, more than twenty people froze to death and many cattle died, some of them suffocated beneath the snow. The train services on branch lines were interrupted for more than a week, and on Feb. 13 no trains ran even on main lines.

Societies and Academies.

LONDON.

Royal Society, Jan. 30.—R. N. Salaman: Crinkle 'A', an infectious disease of the potato. Infection by grafting reproduces the disease in various varieties with certain modifications. In one group the clinical picture is still that of crinkle, in another it is mosaic, and in a third, streak. Infection by needle inoculation produces a reduced set of symptoms in all cases. Crinkle 'A' is a complex of two or more viruses. Infection of *Datura* gives characteristic reactions, but the leaves modify the virus, lessening the virulence. Passage through tobacco does not increase its virulence. —R. N. Salaman and R. H. Le Pelley: Para-crinkle, a potato disease of the virus group. Para-crinkle is distinguished from crinkle 'A' by the fact that certain varieties highly susceptible to it are perfect carriers of para-crinkle, while others, which suffer relatively mildly from crinkle 'A', are seriously affected by para-crinkle. Para-crinkle is due to a single virus; its action can be completely destroyed by the products of metabolism of the leaves of *Datura*. Its virulence is increased in those plants which are themselves raised from diseased tubers.—E. C. Smith and T. Moran: The formation of lactic acid in desiccated amphibian muscles. Formation of lactic acid in the

frozen state is due to the removal of water alone. The peak in the production curve at −2·2° to −2·5° C. (79 per cent water removal) is apparently coincident with the point at which death occurs instantaneously in the muscle. No sudden change in concentration of any plasma constituent seems to be associated with these events.—**H. G. Thornton**: The influence of the host plant in inducing parasitism in lucerne and clover nodules. When inoculated lucerne seedlings are placed in the dark, formation of fresh nodules soon ceases, and those already formed cease to grow. This is associated with, and probably due to, cessation of cell division. The bacteria become parasitic upon the host tissues. In old nodules in lucerne and clover, growing in the light, bacteria behave similarly. Lack of carbohydrate is the cause of change of behaviour of the bacteria, which then derive their energy from the host tissue.—**F. Kidd** and **C. West**: Physiology of fruit. (1) Changes in the respiratory activity of apples during their senescence at different temperatures. Carbon dioxide production by apple fruit rises for a period and then falls off continually, until the fruit dies as the result of invasion of the tissues by fungal organisms. The acceleration and deceleration of respiration rate have high temperature coefficients. Change of respiratory activity is not due to changes in substrate concentration related to hydrolysis of sugars, starch, or cell-wall materials, but to a change in state of the protoplasm.

Geological Society, Jan. 8.—**Stanley Smith**: (1) Some Valentian corals from Shropshire and Montgomeryshire; with a note on a new stromatoporoid. The Valentian coral fauna is not primitive, and is more closely allied to Salopian than to Caradocian assemblages; nevertheless, the important place occupied by the species of *Streptelasma* in the *Pentamerus* Beds links these up with the Ordovician. The Purple Shales, on the other hand, have yielded several species of Rugose corals which are typically Salopian. The Tabulate corals are of little interest, except in so far that they prove the very long range of the Lower Palæozoic species; there seems to be little, if any, difference between the Caradocian, the Valentian, and the Salopian forms.—(2) The Carboniferous inliers at Codrington and Wick (Gloucestershire). The largest and most interesting is the Wick Rocks Inlier, on the same line of latitude as the Avon Gorge and some 9 miles to the west. The several outcrops expose, although not quite completely, a succession of beds ranging from the Tournaisian (Z_2) to Coal Measures. The arenaceous beds which succeed the limestone sequence are better exposed in the Wick Inlier than anywhere else in the Bristol district. These belong in part to the Lower Carboniferous, in part to the Upper, and within the series (formerly mapped as 'Millstone Grit') a considerable break in the Carboniferous succession must occur. The general succession of the Carboniferous in the area under discussion is given. The gap between the Lower and the Upper Carboniferous is placed tentatively at the top of the massive grits which contain the 'Mollusca Band'.

Linnean Society, Jan. 9.—**W. H. Thorpe**: Further notes on biological races in *Hyponomeuta padella* (Linn.). It has been shown previously that the small ermine moth, *Hyponomeuta padella* (Linn.) [*H. variabilis* Zell., *H. malinella* Zell.] is split into two well-marked biological races, one attached to apple, the other to hawthorn, blackthorn etc. Further evidence suggests that the latter form is itself split into two less strongly marked biological races, one attached to blackthorn (*Prunus spinosa*) and the other to hawthorn (*Cratægus Oxyacantha*).—**J. T. Cunningham**: The origin of adaptations. Two recent general reviews of the subject of adaptation in animals entirely omit consideration of (1) metamorphosis and recapitulation, (2) sexual dimorphism, especially the relation of these phenomena to internal secretions or hormones. Consideration of these subjects is essential to the discussion of animal adaptation. The chief general conclusion is that evolutionary changes are of two kinds, namely, those which consist of mutations of internal origin, with no relation to external conditions, and those which have such a relation and can be ascribed to the action of external stimuli.

EDINBURGH.

Royal Society, Jan. 13.—**George Bond**: Occurrence of cell division in the endodermis. Endodermal cells frequently show a considerable increase in tangential dimension at a comparatively late stage in their existence. This increase in size is often accompanied by their division, the new walls being radially orientated in the main. The divisions may actually cause the increase in size of the original cells, or they may follow passive stretching. Two types of division are distinguishable: (*a*) Those occurring in primary endodermal cells; (*b*) divisions in tertiary endodermal cells. The second type is the more common, and as many as twenty-five successive divisions of this type may occur in one original cell. The condition of the endodermal cell at the time of stretching and division determines which type of division appears. In neither case does the development of new walls interfere with the efficiency of the endodermis as a physiological barrier. — **David G. Catcheside**: Chromosome linkage and syndesis in *Œnothera*. Cytological studies were made upon pollen mother-cells of two close-pollinated, small-flowered species of *Œnothera*, *Œ. pycnocarpa* Atk. & Bartl. and *Œ. nutans* Atk. & Bartl. A single, continuous spireme is formed; the whole diploid complement of fourteen chromosomes is arranged in a ring at diakinesis, the chromosomes being attached end to end. A triploid plant of *Œ. pycnocarpa* had the twenty-one chromosomes arranged end to end in a closed circle. The telosynaptic view of chromosome conjugation is supported for the genus, the recent parasynaptic hypotheses being examined critically. Darlington's theory, that ring formation in *Œnothera* is due to segmental interchange between non-homologous chromosomes of the same complex, fails to account for the formation of a ring in the triploid form. Support is given to Sheffield's theory that ring formation is an heritable phenomenon controlled by genes in the chromosomes.—**D. R. R. Burt**: On a case of intersexuality in *Bos indicus*, with a theory of the significance of the genetic male intersex. An abnormality is described in which there is a functional ovary on the right side associated with a complete Müllerian duct, and a cryptorchid but small testis on the left associated with a complete Wolffian duct. The animal is a genetic male intersex. A hypothesis is suggested which postulates the action of a maternal sex-hormone in initiating and controlling sex reversal during intra-uterine development, the difference between the left and right sides being attributed to earlier differentiation of the left gonad in cattle. Actual confluence of the blood vessels of the crypts and villi during development may be responsible for the abnormality. This hypothesis reduces the two classes, the free-martin and the genetic male intersex, to the same order.

PARIS.

Academy of Sciences, Dec. 30.—**A. Cotton**: Asymmetric synthesis and the existence of racemic compounds in solution. Some remarks on a recent paper

by Werner Kuhn and E. Braun. It has been generally held that racemic compounds cannot exist in solution: an experiment with a mixture of solutions of lævorotatory and dextrorotatory copper tartrates is described which is regarded as furnishing evidence of the contrary view.—Jean Perrin and Mlle. Choucroun: Fluorescence sensibilised in liquid medium (transfer of activation by molecular induction).—Marcel Brillouin: The dynamical tides of an ocean comprised between two parallels. Simultaneous normalisation.—Charles Nicolle, Charles Anderson, and Jacques Colas-Belcour: The rôle of *Ornithodorus crraticus* in the natural transmission of two recurrent spirochætes. The danger of the propagation of recurrent Hispano-Moroccan fever in Algiers and Tunis.—A. Gelfond: Transcendental numbers.—Mme. M. Piazzolla Beloch: The number of odd branches of curves belonging to a surface of the third order.—G. Pfeiffer: The integrals of partial differential equations and of systems of equations of the first order of an unknown function, which possess S. Lie integrals.—Marcel Brelot: The problem of Dirichlet external in the plane relatively to the equation $\Delta u = c(x, y)\, u$.—Léonidas Kantorovitch: Projective ensembles of the second class.—J. A. Lappo-Danilevski: Analytical functions of a single variable substitution.—Oystein Ore: Hypergeometric functions of several variables.—Miloch Radoitchitch: Inverse functions of meromorph functions.—J. Petrovsky: Functions primitive with respect to a continuous arbitrary function.—J. Haag: The general theory of synchronisation.—Joseph Pérès: A formula for the calculation of the resistance of a solid in an incompressible perfect fluid.—Alex. Véronnet: The theory of the formation of large ions and droplets.—L. Décombe: Melde's experiment and the conditions of Sommerfeld.—Th. Vautier: The dissipation of the energy transported by an aerial wave.—G. Reboul: A method of activation of matter.—Michel: The calculation of a galvanometer.—Emmanuel Dubois: The Volta effect. The influence of the oxidation of the electrodes. For the various metals examined, the presence of oxygen, either adsorbed by the metal, or combined with it, makes the metal electronegative.—Trajan D. Gheorghiu: The absorption of dextro- and lævorotatory copper tartrates and of their mixture. The measurements were made with a photoelectric photometer. The absorption of the two tartrates is the same, but the absorption shown by the mixture is clearly greater.—J. Dufay and Mlle. R. Schwégler: The visual measurement of very small luminosities. The object of the experiments was to determine the accuracy with which measurements of faint luminosities of less than 10^{-6} candles could be made.—H. Volkringer: The band spectra of zinc vapour. Zinc vapour, heated to a red heat in a silica tube, gives a band spectrum when excited by discharge without electrodes. Measurements are given of lines between the wave-lengths 2983 A. and 3282 A. From the large distances separating the lines it is concluded that the molecule has a very small moment of inertia. The possibility of the spectra being due to zinc hydride is discussed.—René Audubert: The photolysis of water and the photovoltaic effect of electrodes of gold and platinum.—Mlle. Marguerite Quintin: The influence of the medium on the photovoltaic effect of iodide of copper. The results given show that the phenomenon depends upon the action of light both on the liquid and on the photosensitised substance.—Mlle. Iréne Curie and Frédéric Joliot: The nature of the absorbable radiation which accompanies the α-rays of radium. Strong preparations of polonium produce in air an heterogeneous H-radiation (maximum path about 16 cm. of air) and these probably result from a transmutation of nitrogen. It is this radiation which was taken for a γ-radiation of polonium in the experiments of Russell and Chadwick.—E. Rinck: The equilibrium in the fused state between potassium, sodium, and their iodides. In this reaction the law of mass action $(Na)(KI)/(K)(NaI) = c$ has been verified, the mean value of the constant c being 56.—Néda Marinesco: Dielectric polarisation and structure of absorbent colloids.—J. Séailles: A new method for the preparation of alumina in the wet way.—L. Andrieux: The preparation and properties of the borides of tantalum and colombium. The general method is the electrolysis of fused baths of mixtures of the oxide of tantalum (or columbium), magnesium (or calcium, lithium, sodium), borate and a fluoride. The borides obtained proved on analysis to be TaB_2, CbB_2. They are very hard and easily scratch quartz.—E. Carrière and Rouanet: The estimation of fluorine as calcium fluoride.—P. Fleury and P. Ambert: The precipitation of sugars and of polyols as a cuprobaryta complex.—Raymond Charonnat and Raymond Delaby: The constitution of dioxypyramidon. By total and partial alkaline hydrolysis the constitution of this substance is proved to be $CH_3.CO.N(CH_3)N(C_6H_5)CO.CO.N(CH_3)_2$.—Georges Darzens and André Lévy: The primary phenyl-dimethyl-ethyl alcohol and some of its derivatives.—C. Gaudefroy: Half wave and quarter wave achromatics by the superposition of several crystalline plates.—P. L. Mercanton: Observations made on board the *Pourquoi Pas?* with the pycnosonde of La Cour and Schou (summer 1929). Proofs of the value of this new instrument.—R. Bureau: The daily variation of atmospherics: monthly means, annual variation, meteorological influences.—J. J. Thomasset: The calcospherites of fossil tissues.—Mlle. Germaine Py: Cytological researches on the nutritive layer of the pollen grains of *Helleborus fœtidus*, *Euphorbia Sauliana* and *E. Peplus*.—B. P. C. Hochreutiner: A new genus modifying slightly our conception of the family of the Malvaceæ.—N. Wagner: The chondriome of the embryo in *Cucurbita Pepo* in the dry seed and during germination.—M. Bridel and J. Rabaté: The distribution of piceoside (Ch. Tanret's piceine) in the vegetable kingdom. Piceoside, the glucoside of *Picea excelsa*, salinigrine, glucoside from the bark of the black willow and ameliaroside, glucoside from *Amelanchier vulgaris*, are all the same substance, the β-glucoside of *p*-hydroxy-acetophenone.—E. Michel-Durand: The influence of treatment with alcohol on the extraction of tannin from plants. A preliminary treatment of the acorns of *R. robur* with boiling alcohol renders the tannins insoluble in acetone.—Aug. Chevalier: *Striga hermonthica*, a Scrophularia parasite on cereals in tropical Africa.—A. Demolon and G. Barbier: The fixation and mobilisation of phosphorus pentoxide in muds.—Pierre Lesne: The distribution of *Glossina* in the region of the Zambeze de Chemba (Portugese Eastern Africa).—C. N. Dawydoff: The presence of the genus *Ctenoplana* in the waters of French Indo-China.—Jacques Colas-Belcour: The identity of *Ornithodorus erraticus* and *Ornithodorus marocanus*.—N. K. Koltzoff: The element of time in physico-chemical excitability.—Jean Régnier and Fernand Mercier: Dextrorotatory pseudococaine and lævorotatory cocaine; comparative trials of rachianæsthesia in the dog.—J. Lemarchands: The proportions and the localisation of the carbohydrates in the seed of *Helianthus annuus* and their variations in the course of germination.—Léon Velluz: The action of soaps on the toxicity of certain alkaloids (cryptoalkaloids). The toxic action of strychnine and veratrine is reduced by solutions of soaps (sodium palmitate, sodium ricineolate).—Ch. Champy and M. Heitz-Boyer: The mechanism of the action of the high frequency electric cautery. Study of the me-

chanical effects of high frequency currents: their hæmostatic action on the vessels.—**Léon Binet** and **Charles Mayer**: A new technique of blood perfusion.—**C. Levaditi** and **F. R. Selbie**: The mode of transmission of acute epidemic polymorphous erythema. The mouse is subject to a spontaneous generalised infectious polyarthritis, caused by *Streptobacillus moniliformis*, the pathological agent of certain infectious polymorphous erythemas. It appears to play an important part as the reservoir of the virus and agent of transmission of the disease.

Official Publications Received.

BRITISH.

Royal Commission on National Museums and Galleries. Final Report, Part 2: Conclusions and Recommendations relating to Individual Institutions, dated 1st January 1930. (Cmd. 3463.) Pp. 104. (London: H.M. Stationery Office.) 2*s*. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 397, January. Pp. 97-204+xxxviii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twenty-second Annual Report, 1928-29, presented by the Council to the Court of Governors on the 25th October 1929. Pp. 39+6 plates. (Cardiff.)

Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending June 30th, 1929. Edited by Prof. Alexander Meek. (New Series 18.) Pp. 52. (Newcastle-on-Tyne: Armstrong College.) 5*s*.

Report on the Second Imperial Mycological Conference 1929. (Issued by the Colonial Office.) Pp. 42. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Report of the Haffkine Institute for the Year 1928. By Major S. S. Sokhey. Pp. 44. (Bombay: Government Printing and Stationery Office.) 2 annas; 3*d*.

Memoirs of the Indian Meteorological Department. Vol. 25, Part 4: Correlation between Weather and Crops with Special Reference to Punjab Wheat. By Rao Saheb Mukund V. Unakar. Pp. 145-161+2 plates. (Calcutta: Government of India Central Publication Branch.) 1 rupee; 1*s*. 9*d*.

Proceedings of the Edinburgh Mathematical Society. Series 2, Vol. 2, Part 1, January. Edited by Prof. H. W. Turnbull and Dr. W. Saddler. Pp. 60. (Edinburgh.)

Mathematical Notes: a Review of Elementary Mathematics and Science. Edited by William Arthur. No. 25, January. Pp. xx. (Edinburgh: Edinburgh Mathematical Society.)

Report on Smoke Abatement. Prepared by a Sub-Committee of the Science Standing Committee of the Royal Institute of British Architects. Pp. 7. (London: Royal Institute of British Architects.) 1*s*.

FOREIGN.

Anuario del Observatorio Astrónomico de Madrid para 1930. Pp. 592. (Madrid: Instituto Geográfico y Catastral.)

Proceedings of the American Academy of Arts and Sciences. Vol. 64, No. 1: Alternating-Current Nets. By Arthur E. Kennelly. Pp. 18. 45 cents. Vol. 64, No. 2: The Elastic Moduli of Five Alkali Halides. By P. W. Bridgman. Pp. 19-38. 45 cents. Vol. 64, No. 3: The Effect of Pressure on the Rigidity of Several Metals. By P. W. Bridgman. Pp. 39-49. 45 cents. Vol. 64, No. 4: The Compressibility and Pressure Coefficient of Resistance of Several Elements and Single Crystals. By P. W. Bridgman. Pp. 51-73. 60 cents. (Boston, Mass.)

Sitzungsberichte der physikalisch-medizinischen Sozietät zu Erlangen. Herausgegeben im Auftrag der Sozietät von Oskar Schulz. Band 60, 1928. Pp. xix+389+4 Tafeln. (Erlangen: Max Mencke.)

The Carnegie Foundation for the Advancement of Teaching. Bulletin No. 24: The Literature of American School and College Athletics. By W. Carson Ryan, Jr. Pp. xlv+305. (New York City.) Free.

Proceedings of the Imperial Academy. Vol. 5, No. 9, November 1929. Pp. xxi-xxii+403-441. (Tokyo.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 4, No. 4, December 1929. Pp. 577-673+plates 26-29. (Tokyo and Sendai: Maruzen Co. Ltd.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 219: The Influence of Autoclave Treatment on the Form of Hydroxides and on the Nature of Colloidal Suspension. By Tominosuke Katsurai. Pp. 161-166. (Tōkyō: Iwanami Shoten.) 15 sen.

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 3, No. 4, November 1929. Pp. 167-186+6 plates. (Kobe.)

Palæontologia Sinica. Series D, Vol. 6, Fascicule 1: A Study of Kansu and Honan Æneolithic Skulls and Specimens from Later Kansu Prehistoric Sites in comparison with North China and other recent Crania. Part 1: On Measurement and Identification. By Prof. Davidson Black. Pp. iii+83. (Peking: Geological Survey of China; London: Edward Goldston.)

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 5, No. 3: Den Kemiska Denudationen i Sverige (La Dénudation chimique en Suède). Av J. V. Eriksson. Pp. 96. (Stockholm.) 5.00 kr.

Statens Meteorologisk-Hydrografiska Anstalt. No. 276: Organisation Météorologique Internationale. Commission de Météorologie agricole: Procès-verbaux de la 3ème réunion, Copenhague, 1929. Pp. 101. (Stockholm.) 2.50 kr.

The Peking Society of Natural History. Bulletin, Vol. 4, Part 1: Society Proceedings and Membership List. Pp. iii+115. (Peking.) 1 dollar.

Proceedings of the American Philosophical Society. Vol. 58, No. 3. Pp. 163-274+2 plates. (Philadelphia.)

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1928. (Publication 2981.) Pp. xii+763+145 plates. (Washington, D.C.: Government Printing Office.) 2 dollars.

Department of Commerce: U.S. Coast and Geodetic Survey. Special Publication No. 140: Manual of First-Order Levelling. By Henry G. Avers. Pp. iii+93+9 plates. (Washington, D.C.: Government Printing Office.) 30 cents.

Diary of Societies.

FRIDAY, FEBRUARY 7.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Prof. Neumann, E. M. Atkinson, and H. W. B. Cairns: Discussion on Brain Abscess.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—G. H. Tipper: Recent Mineral Developments in India.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir John Rose Bradford: Massive Collapse of the Lung.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—S. S. Cook: High-Pressure Steam for Marine Work.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.30.—A. G. Lobley: Electric Furnaces for Heat Treatment.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Fuel) (at Engineers' Club, Manchester), at 7.—Prof. M. W. Travers: The Fundamental Problems of Flue Gas Purification.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—G. F. Shotter: A New Null Method of Testing Instrument Transformers and its Applications.—R. J. S. Spilsbury and Dr. A. H. M. Arnold: Some Accessory Apparatus for Precise Measurements of Alternating Current.—Dr. A. H. M. Arnold: Precision Testing of Current Transformers.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Practical Evening.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—W. G. Thompson: The Electrical Propulsion of Ships.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Royal Metal Exchange, Swansea), at 7.30.—W. R. Barclay: Nickel Alloys in Modern Engineering.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. F. O'Riordan: Co-operation between Technical Institutions and Industry.

GEOLOGISTS' ASSOCIATION (Annual General Meeting) (at University College), at 7.30.—Prof. A. Morley Davies: The Geological Life-Work of Sydney Savory Buckman (Presidential Address).

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—A. Welch: Celanese Yarns and Fabrics and their General Characteristics.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. V. G. Childe: Philology and Archæology.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—C. L. Hewer and I. W. Magill: Discussion on Anæsthesia in Thoracic Surgery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. L. Hill: Diving.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Dr. R. G. Canti: The Canti Cancer Film, showing the Effect of Radium on Cancer.

SATURDAY, FEBRUARY 8.

MINING INSTITUTE OF SCOTLAND (at 79 Grassmarket, Edinburgh), at 3.—Sir Thomas H. Holland: Address.—Discussion on J. E. Lambert's paper on Some Notes on Colliery Blasting Practice, B. A. Peach's paper on The Lochaber Water-Power Scheme and its Geological Aspect.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. G. Cooke: Tonality and Form.

PHYSIOLOGICAL SOCIETY (at St. Bartholomew's Hospital Medical College), at 3.30.—Demonstrations:—Prof. F. L. Hopwood: Some Physiological Effects of Ultrasonic Sound Waves.—Prof. H. Hartridge: (*a*) Vacuum Reaction Velocity Apparatus; (*b*) Reversion Eriometer.—E. M. Landis and T. Lewis: A Case of Raynaud's Disease treated by Cervical Sympathectomy.—A. W. Spence: On the Effect of a Vitamin Deficient Diet on the Thyroid Gland of Rats.—R. Hilton: (*a*) A Nose Piece for Administering Oxygen; (*b*) A Simple Mouthpiece of Low Resistance for Collecting Expired Air during Dyspnœa.—M. Landis: Micro-injection Method for Direct Determination of Blood Pressure in Single Capillaries of Human Skin.—M. O. P. Wiltshire: Effect of Liver Tissue on the Rate of Destruction of Adrenaline.—E. A. Carmichael and A. Q. Wells: The Tissue Culture and Vital Staining of Microglia.—Prof. H. Hartridge and R. G. R. West: Apparatus for Testing Electrical Reactions.—At 4.45.—Cinema Films Demonstrated by A. C. Denny and J. F. Rogers.—Movements of Alimentary Tract in Experimental Animals, by Drs. Carlson and Luckhardt.—Drugs on Gastric Intestinal Motility, by Drs. Kellogg and Dowd.—At 5.30.—Communications:—F. Haynes: Physiological Aspects of the Reaction of the Lungs to Inhaled Dusts.—H. G. Reeves: Dihydroxy-acetone on Smooth Muscle.—Prof. H. Hartridge and R. G. R. West: Chronaxie and Rheobase.—Prof. A. V. Hill: The Change of Water Vapour Pressure caused by Substances added to Blood.—F. R. Winton: Tonus in Mammalian Plain Muscle.—M. O. P. Wiltshire: On the Rate of Oxidation of Adrenaline and the Assumed Sensitisation of Intestinal Muscle by Blood, Serum and Tissue Cells.—Mary Pickford and Dr. E. B. Verney: A Method of producing and studying the Effects of Acute Arrest of the Renal Circulation in the Unanæsthetised Dog.

MONDAY, FEBRUARY 10.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Comparative Anatomy Lecture Room), at 4.30.—Prof. J. Barcroft: Blood Storage.—Dr. J. Needham: Nuclein Synthesis in Developing Eggs.—J. T. Saunders: Water Movements in Lakes.—Dr. A. Bishop: The Culture of Trichomonas.

BIOCHEMICAL SOCIETY (at Lister Institute), at 5.—R. Robison, M. MacLeod, and A. M. Rosenheim: Calcification *in vitro*.—C. R. Harington and W. T. Salter: Enzymic Hydrolysis of the Thyroid Gland.—P. J. G. Mann and B. Woolf: The Action of Salts on Fumarase. I.—V. B. Wigglesworth: A Theory of Tracheal Respiration in Insects.—E. Boyland: Pyrophosphate in Yeast Preparations.—R. H. Marriott: The Action of Alkalis on Collagen.—F. Wokes: Note on the Specificity of the Colour Tests for Vitamin A.

ROYAL SOCIETY OF MEDICINE (United Services Section), at 5.—Wing-Comm. H. A. Treadgold: Cardiac Functional Efficiency in the Young Male Adult.

INSTITUTION OF AUTOMOBILE ENGINEERS (joint meeting of Birmingham Centre and Graduates' Branch) (at Queen's Hotel, Birmingham), at 7.—L. H. Dawtrey: Automobile Brakes.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—T. W. Ross and H. G. Bell: Recent Developments in the Protection of Three-phase Transmission Lines and Feeders.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.—B. T. Wingfield: Automatic Control in Heating and Air Conditioning Installations.

MANCHESTER ATHENÆUM TEXTILE SOCIETY (at Manchester), at 7.—W. Wilkinson: The Weaving of Fancy Cloths.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—S. H. Hawkins: Pyrometry.

MEDICAL SOCIETY OF LONDON, at 8.—Dr. Maurer, M. Davies, and others: Discussion on The Surgical Treatment of Pulmonary Tuberculosis.

SURVEYORS' INSTITUTION, at 8.—J. L. Milne: The Rating and Valuation (Apportionment) Act, 1928.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Col. F. L. Giles: Boundary Work in the Balkans.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Cardiff).

ROYAL IRISH ACADEMY (Dublin).

TUESDAY, FEBRUARY 11.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: X-Ray Determination of the Structure of Cellulose and Similar Substances (1).

INSTITUTION OF CIVIL ENGINEERS, at 6.—R. W. S. Thompson: The Diversion of the River Ashop.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—C. H. Faris: The Applications of Electro-deposited Metals to Marine Engineering.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Loughborough College), at 6.45.—G. R. J. Parkinson: Electrical Development.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Dr. J. Hartmann: The Jet-Wave Rectifier: The Experimental and Theoretical Basis of its Design.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Dr. L. C. Martin: Studies in Colour Vision.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—W. B. Hird: The Visit of the Institution to France.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—W. Richardson: Electric Heating.

QUEKETT MICROSCOPICAL CLUB (Annual Meeting) (at 11 Chandos Street, W.1), at 7.30.—J. Ramsbottom: Presidential Address.

EUGENICS SOCIETY (at Linnean Society), at 8.—E. J. Lidbetter and others: Discussion on Poor Law.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester University College Biological Society) (at University College, Leicester), at 8.—Prof. R. H. A. Plimmer: Proteins in Nutrition.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Miss G. Caton-Thompson: Recent Excavations at Zimbabwe and other Ruins in Southern Rhodesia.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. T. G. Hill: The Biologic Factor in Plant Anatomy.

WEDNESDAY, FEBRUARY 12.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Holborn Restaurant), at 2.30.—S. Fox: Half a Century of Boiler Making.

INSTITUTE OF METALS (Swansea Local Section) (at Thomas's Café, Swansea), at 7.—Dr. A. G. Ramsay: The Corrosion of Non-ferrous Metals.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. E. G. Ritchie: Steam Storage in the Manufacturing Industries.

INSTITUTION OF ENGINEERS-IN-CHARGE (at St. Bride Institute), at 7.30.—H. E. Stilgoe: The Water Supply of the Metropolis.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—C. R. Spedding: Rags—their Origin and Uses.

ROYAL SOCIETY OF ARTS, at 8.—H. Jackson: Colour Determination in the Fashion Trades.

THURSDAY, FEBRUARY 13.

ROYAL SOCIETY, at 4.30.—Probable Papers:—G. Slater: Studies on the Rhone Glacier, 1927. The Structure of the Ice in a Compressed Zone on the South-Eastern Part of the Rhone Glacier.—T. Goodey: On a Remarkable New Nematode *Tylenchinema oscinellas* gen. et sp. n. parasitic in the Frit-fly, *Oscinella frit* L., attacking Oats.—D. E. Sladden: Distortion of Development in Amphibia caused by Lack of Oxygen in very Early Stages in Development.—*To be read in title only*:—Sir Frederick Keeble, M. G. Nelson, and R. Snow: The Integration of Plant Behaviour. Part II. The Influence of the Shoot on the Growth of Roots in Seedlings.—A. W. Greenwood and J. S. S. Blyth: The Results of Testicular Transplantation in Brown Leghorn Hens.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—T. A. Joyce: Architecture and the Industrial Arts of Pre-Spanish America (1).

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—L. A. Legros: The Influence of the Progress of Aeronautical Engineering on other Branches of Engineering Work.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. J. Hartmann: The Jet-Wave Rectifier: The Experimental and Theoretical Basis of its Design.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30—J. de la Cierva: Recent Progress with the Autogiro.

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 6.30—S. N. Kent: Discipline as applied to the Engine Room, etc.

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

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Section) (at University College, Dundee), at 7.30.—G. H. Chalmers: Lubrication.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—H. H. Smith: Temperature Measurement and Control in Works.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (Informal Meeting) (at Cleveland Institution, Middlesbrough), at 7.30.—W. T. Butterwick and others: Discussion on Are Government Regulations Effective in Preventing Marine Casualties?

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—F. Twyman: Optics in Radio Transmission and other Fresh Fields (Presidential Address).

FRIDAY, FEBRUARY 14.

GENETICAL SOCIETY (at John Innes Horticultural Institution, Merton), at 2.30.—Experiments on *Primula Sinensis*:—Miss de Winton and J. B. S. Haldane: Demonstration of the Genetics of Diploid and Tetraploid Forms.—Dr. C. D. Darlington: Exhibition of Cytological Preparations of the Tetraploid.—Dr. F. W. Sansome: Exhibition of Slides Illustrating Pollen Behaviour in the Tetraploid.—J. B. S. Haldane: The Genetics of the Tetraploid.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4.—E. W. Hey Groves: The Hunterian Oration.

ROYAL ASTRONOMICAL SOCIETY (Annual General Meeting), at 5.—President's Address on the Award of the Gold Medal to Dr. J. S. Plaskett, for his Valuable Observations of Stellar Radial Velocities and the Important Conclusions derived from them.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—W. E. Summerhays: The Diffusion Constant of Water Vapour.—M. C. Johnson: A Method of Calculating the Numerical Equation of State for Helium below 6° Absolute, and of Estimating the Relative Importance of Gas Degeneracy and Interatomic Forces.—F. D. Smith: The Magneto-striction Constant for Alternating Magnetic Fields.—Demonstration by D. Kempson of A Working Model Illustrating the Mosaic Theory of the Compound Eye, due to Altenburg.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society of London), at 6.—Annual Meeting.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—G. S. Taylor: Lantern Lecture.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—R. G. Daniels: Common Sense and Nitrocellulose Lacquer.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—L. H. Pomeroy: The Double-six Engine.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—Technical Film—The Manufacture of Staybrite and Stainless Steels.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—S. Matthews: Recent Developments in Measuring Instruments

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.—F. Moore: Unusual Coloration of Sclerotics.—R. Pickard: The Red Field and Optic Disc Resistance in Glaucoma and Allied Conditions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. A. F. Pollard: History *à la Mode*.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Cardiff).—W. G. Davies: Clinker and Ash Fusion.

SATURDAY, FEBRUARY 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. G. Cooke: Tonality and Expression in Song-Writing.

PUBLIC LECTURES.

FRIDAY, FEBRUARY 7.

UNIVERSITY OF LEEDS, at 8.—Prof. Blanchard: Human Geography and the Methods of teaching Geography.

SATURDAY, FEBRUARY 8.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Jewellery.

MONDAY, FEBRUARY 10.

UNIVERSITY OF LEEDS, at 5.15.—Dr. F. A. Bather: Fossils and Fate.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Prof. J. A. S. Watson: Recent Developments in the Feeding of Livestock.

TUESDAY, FEBRUARY 11.

KING'S COLLEGE, at 5.30.—C. W. Marshall: Electrical Transmission by Overhead Lines. (Succeeding Lectures on Feb. 18 and 25.)

WEDNESDAY, FEBRUARY 12.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street Extension of Regent Street Polytechnic), at 5.30.—H. J. C. Peake: The Beginning of Agriculture.

UNIVERSITY COLLEGE, at 5.30.—A. F. Ridley: Librarianship as an Aid to Industry and Commerce.

BELFAST MUSEUM, at 8.—Dr. R. H. Hunter: The Problem of Life.

THURSDAY, FEBRUARY 13.

MEDICAL SOCIETY OF LONDON, at 5.15.—Prof. B. Blacklock: Health in West Africa (Chadwick Lecture).

SATURDAY, FEBRUARY 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Tell-tale Inks.