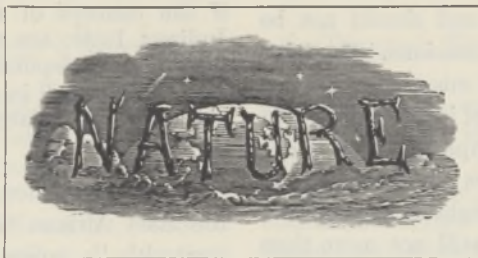


Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3549

SATURDAY, NOVEMBER 6, 1937

Vol. 140

Higher Education for African Natives

ONE of Mr. Ormsby-Gore's first acts on his return to the Colonial Office was the appointment of a representative Commission, under the chairmanship of Earl De La Warr, to make a comprehensive survey of the educational facilities provided in East Africa, to report on the development of its higher educational institutions, and to make detailed proposals for the establishment of a college of university standing for East Africans. The Commission spent from January 11 until February 19 in East Africa, and a few weeks ago presented its report.*

The outstanding features of the report are its freedom from cant, its warm sympathy with, and appreciation of, the potentialities of the Africans, its realization of the composite conditions which have been created by the impact of the European theory of progress on the African theory of traditionalism, and its desire to provide education services to enable Africans to cultivate their undeveloped powers, not for their good alone, but also for the benefit of the world. Throughout its labours the Commission had prominently before it the application of the two principles of trusteeship: the development of the peoples, and the development of the natural resources of the territories they inhabit. It rightly concludes that the better education of the African is essential to both kinds of development. As axiomatic to its report it states the two propositions that the primary need of East Africa is the improvement of health and agriculture, and that such improvement can best be achieved through the general education of Africans and by training sufficient numbers of qualified African experts.

* Higher Education in East Africa. Report of the Commission appointed by the Secretary of State for the Colonies. (Colonial No. 142). Pp. 136. (London: H.M. Stationery Office, 1937). 2s. 6d. net.

There have been several commissions on East African development. All have expressed the conviction that only from the Africans themselves can enough qualified men and women for the medical, agricultural, veterinary, forestry, railway, public works and education services be obtained at an economic cost. To this Commission belongs the distinction of being the first to give details of the requirements of these essential services for qualified African personnel. It states that within the next ten years, Uganda, Kenya, Tanganyika and Zanzibar will require at least nine hundred college-trained African men and women for these services and about the same number of Africans who have had a full course of secondary school training. Taking into consideration other avenues of employment for those who have received a secondary school training, and assuming that the average college graduate will look for a wife who has at least had that advantage, the Commission estimates that useful occupations can be found for more than four thousand secondary school pupils.

The absorption of an average of four hundred educated Africans a year for the next ten years in the service of nearly twelve million of their fellows does not appear too ambitious a project at first sight. There are, however, obstacles which cannot be surmounted without a thorough overhaul of the education services. A great and courageous effort has to be made to broaden the base of the pyramid on which the education of the African is built. The local governments must assume a much greater responsibility for the finance and guidance of education agencies, and cease to regard expenditure on education as one of those luxuries

on which to practise self-denial in times of economic depression. The task cannot and should not be left so largely to the Christian missions. The local governments must supplement missionary pioneer effort by the provision of model institutions while encouraging the missions to improve those under their care. After sixty years of education in Uganda—and Uganda is the brightest spot in East African education—there are still not more than forty schools fit to provide a full primary course of six years. The fact that upon this small basis it was possible to recruit pupils to Makerere College in Uganda for a training to enable them to take places in the government services is evidence of the keenness of the African for education, rather than a matter for complacency. Makerere and its allied institutions are still unable to deal with the requirements of the Uganda Government alone for trained unqualified assistants for the public services, and it is neither equipped nor staffed to provide the territories with university-trained, professionally qualified staffs. It is clear, therefore, that "a large expansion and improvement will be required in all stages of education, primary, secondary, and post-secondary" throughout the East African territories. The instruction in all types of schools, in spite of the advice and assistance persistently given by the Colonial Office Advisory Committee on Education, is mostly of the kind that was discarded as unsuitable in European schools years ago. It is certainly not calculated to give an African an intelligent appreciation of his own surroundings.

It was suggested in the evidence given to the Commission that the paramount need of the territories was for African assistants to work under European officers, and that plans for the establishment of university courses were therefore premature. The reality the Commission faces, however, is the demand by Africans for university training and full professional status, and that unless they find means to attain it in Africa they will seek it overseas. The governments need Africans of the highest qualifications to undertake an ever-increasing share of the responsibility in every department. To restrict Africans permanently to a low standard of employment is impossible. It would foster discontent. It would be a denial of the policy of trusteeship which, as the Commission says in a trenchant passage,

"has been proclaimed as the policy of His Majesty's Governments. It is a policy which will have to confront inconvenient problems, and which already

inspires young energies and fresh ambitions. Yet if the concept of trusteeship, if the method of Indirect Rule, are to be anything more than glib evasions of responsibility they must assert that the African shall in due course reach full maturity and take his place among the peoples of the world".

The Commission therefore recommends that the East African Governments should announce forthwith "a policy offering facilities for training Africans in due course to full university standard, and of giving them opportunities thereafter to rise in the service to the highest responsibilities commensurate with their abilities". This policy obviously implies the provision of primary and secondary education on a most liberal scale in all the East African territories, to act as feeder institutions to the higher college.

The Commission definitely recommends the establishment of a university college in the near future and of a university at no very distant date. It is aware of the "present very flimsy foundations of primary and secondary education upon which such institutions will need to be based, and realizes the possible risks of too rapid advance and of a top-heavy structure". Nevertheless, it is convinced that the risk should be taken, believing that Africa can profit by our long and painful experiments, and can advance at a pace far greater than was possible for Europe a hundred years ago.

The Commission proposes that the constitution of the higher college should be similar to that of institutions of university rank in the United Kingdom; in other words, that it should be under the control of an autonomous independent body with trustees, appointed by the Secretary of State for the Colonies, to administer an endowment fund of at least £500,000, which it is hoped will be forthcoming from the local governments, the Imperial Exchequer, and private donors. The initial capital outlay required for buildings and equipment is estimated at less than £200,000. Of the total sum required Uganda is expected to contribute £300,000 from its surplus balances, which leaves less than £400,000 to be provided from other sources. This appears a small price to pay for the provision of an institution which should, if it is properly staffed and equipped and directed by an inspiring personality, become a centre of learning and research from which East Africa should be able to draw on the intellectual resources of the world through the medium of its own people.

Mineral Chemistry and Crystal Structure

Atomic Structure of Minerals

By Prof. W. L. Bragg. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University). Pp. xiii + 292. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1937.) 18s. net.

THOUGH only twenty-five years have elapsed since in June 1912 the interference phenomena of X-rays on crystals were discovered by M. von Laue and his collaborators, experimentally determined atomic arrangements are to-day available in sufficient number to form the subject-matter of a notable book. This advance has to a large extent been the result of work carried out in the laboratories of Sir William Bragg and of Prof. W. L. Bragg, and mineralogists will be grateful to the latter for having given them a first-hand and illuminating account of the results achieved. Prof. Bragg's book shows clearly, as do in a more detailed fashion the "Strukturberichte" published by the *Zeitschrift für Kristallographie*, the amazing extent to which crystallography has been developed by the united researches of physicists, chemists and mineralogists. A single new method of experimental investigation has served not merely to solve—or at least to define more clearly—a multitude of old problems, but also by opening up entirely new vistas has enabled many questions not thought of hitherto to be precisely formulated.

After giving a short but instructive introduction on the fundamental principles of space lattice crystallography and on crystal analysis by X-rays, Prof. Bragg proceeds to what is the main subject of his book, the description of actual mineral structures. Aided by a large number of excellently drawn figures, he discusses in turn the elements, halides, sulphides, arsenides and related compounds, oxides, oxygen salts and silicates, thus adhering to the traditional sequence followed in mineralogical text-books. It is obvious that the description of the silicate group, comprising as it does by far the most important minerals, must occupy most space. Actually, about half the book is devoted to their structures, and the introduction to this chapter shows clearly that X-ray data have furnished quite new principles for the classification of the minerals concerned. The author makes it clear that the various types of silicon-oxygen framework in the silicates are due to a linking of the tetrahedral silicon-oxygen groups which resembles polymerization, and accordingly subdivides the silicates into the following classes: silicates containing separate SiO_4 groups, alumo-silicates, structures containing

complex silicon-oxygen groups, pyroxene and amphibol groups with silicon-oxygen chains, mica and clay groups with sheets of linked silicon-oxygen tetrahedra, a felspar group with a silicon-aluminium-oxygen framework, zeolite, and other framework structures with acid radicals or molecules of water or other compounds in the cavities. This enumeration alone suffices to show how great the changes are which have been introduced into our conceptions of silicate chemistry by the use of X-rays, and it is a remarkable fact that idealized atomic arrangements can already be given for nearly all the important rock-forming minerals such as the plagioclases, alkali-felspars, feldspatoids, micas, amphibols, pyroxenes, zeolites, and of olivine, garnet, chlorite, talc, kaolin, vesuvianite, melilite, titanite, cyanite, sillimanite, andalusite, staurolite, etc.

In some of these silicates, hydroxyl groups are present as well as the alumo-silicate anions, and an important part is played not only by the silicon-aluminium-oxygen arrangement, but also by octahedral units with Al, Mg, Fe, Ti, etc. as co-ordination centres and O, OH or F grouped around them. A somewhat more detailed consideration of these circumstances might, perhaps, have been the starting-point for a stricter systematic arrangement of silicate structures. It is clear, however, that Prof. Bragg's book can offer only the foundation for a mineral chemistry based on crystal structure. Of many problems, such as the limits of isomorphic replacement in relation to structural types, the variation in composition of many minerals, the limits of stability of various structures, their possible deformations, etc., which to the mineralogist appear of fundamental importance, he can give but brief indications. The many new problems which present themselves in these connexions can only be solved by the united efforts of analytical-chemical, paragenetic and structural investigations. The relations which exist between structure on one hand and morphology, cleavage, twinning, etc., on the other, have not been neglected by Prof. Bragg, though it was not, of course, his intention to enter very deeply into these subjects. It may be said, however, that such excursions as he does make into these side-issues are admirably adapted to remind the mineralogist that a thorough knowledge of atomic arrangements is a fundamental necessity for the solution of his major problems.

Taken as a whole, the book provides a typical example of modern trends of development in the field of natural science. The barriers which formerly existed between the various branches

have fallen, and subjects such as the nature of matter, the structure and grouping of atoms, etc., have come to be of equal interest to astronomy, physics, chemistry, mineralogy and biology. Each of these has its own part to contribute towards the

solution of common problems. Mineralogists are greatly indebted to the physicist whose book does so much to place mineral chemistry on a new foundation.

P. NIGGLI.

Lomonosov and Early Science in Russia

Trudy M. V. Lomonosova po Fiske i Chimii By B. N. Menshutkin. Pp. 537 + 5 plates. (Moscow and Leningrad: Izdatelstvo Akademii Nauk SSSR, 1936.) 13 rub. (In Russian.)

M. V. LOMONOSOV (1711-1765), the first Russian man of science, has often been described by his fellow-countrymen as a 'Samorodok', a word meaning 'nugget'. This translation, however, does not convey quite the meaning which Russians attach to 'Samorodok'. It actually conveys something "of a spontaneous nature coming to life without an external incitement".

To realize what an exceptional man Lomonosov was, one has only to refer to the history of the Russia of two centuries ago. Peter the Great was putting the finishing touches to gigantic reforms and "hacking the window" in the wall surrounding dark Russia. One of the new institutions established by the Tsar was the Academy of Sciences, in which Lomonosov was to lay the foundation stone of Russian experimental science.

Prof. Menshutkin's book on Lomonosov's achievements in physics and chemistry has been the work, with some unavoidable interruptions, of some thirty years. It presents a summary of many manuscripts found in the rich archives of the Academy of Sciences of the U.S.S.R. and of many other documents relating to this Russian man of science, discovered among the papers in various State institutions. As many of the "Discourses" and "Dissertations" of Lomonosov were originally written in Latin, Prof. Menshutkin has translated them into Russian, giving very interesting explanations and, whenever necessary, commentaries, adding to this most valuable material numerous notes on contemporary men of science with whom Lomonosov came in contact in Russia and abroad.

In his preface to the book, Prof. Menshutkin remarks that one cannot realize the full significance of Lomonosov in the history of the Russian science unless one knows something about the life of the great man.

Lomonosov was born in 1711 of peasant parents in a village, some hundred miles away from the White Sea. Already in 1723 we find his signature appended to certain village documents which he signed on behalf of his illiterate relatives. At that

time, we learn, he read psalms in the church and knew by heart a score of books available in the village. At the age of nineteen years, in 1730, he went to Moscow to study at the Academy, a school conducted by the monks of a monastery. There he distinguished himself, and in 1736 was sent with other young students to the Academy of Sciences founded by Peter the Great (1725) in St. Petersburg. It happened that the Academy was requiring "an experienced chemist with knowledge of mining" to be sent to Kamchatka. As no such man was available in Russia, it was decided to send three Russians to Germany to acquire the necessary knowledge. Among these three was young Lomonosov.

His first place of study was Marburg, where he worked under Prof. Chr. Wolfe. Lomonosov spent five years abroad, and upon his return to St. Petersburg submitted to the Academy several dissertations, among which was one on an optical instrument invented by him, as well as several other works: "On Silver and Mercury", "Elements of Mathematical Chemistry". One of the theses of the latter was "Chemistry—the Science of Substitutions taking Place in a Compound Substance". This paper, says Prof. Menshutkin, shows Lomonosov's great ability in handling a complex theory and demonstrates the vast amount of general knowledge and facts acquired by him in the University of Marburg under the guidance of Wolfe.

The learned administration of the Academy was very favourably impressed by Lomonosov's dissertations, and he was soon appointed junior professor at the Academy. His next contribution was a translation of Wolfe's experimental physics, a work done, according to Prof. Menshutkin, in a most brilliant way. No Russian scientific vocabulary existed at that time, and Lomonosov had to create new words and expressions, many of which are still being used in Russia.

In response to Lomonosov's request, funds were granted for erecting a laboratory, where he pursued researches on most varied subjects. One of them was a theory of atmospheric electricity. A machine "Thunder Machine", was built and experimented with, and one day his colleague, the academical Prof. Richman, was killed by an electrical discharge from it. However, a few months later

Lomonosov read at a meeting of the Academy, to commemorate the untimely death of Richman, a paper on "Aerial Phenomena due to Electricity".

Lomonosov was strongly under the influence of the then widely discussed corpuscular theory of matter. On his return to Russia, he devoted himself seriously to the development of this theory. All his dissertations and discourses bear witness to that, and throughout all his works we find the same familiar theme. While propounding the corpuscular theory, Lomonosov, however, submitted it to an original and constructive criticism. The *Proceedings of the Academy of Sciences* of 1744 contain an elaborately prepared dissertation "On Inanimate Physical Corpuscles forming Part of Bodies, in which Sufficient of the Peculiar Rudiments of the Whole Body is Enclosed".

Heat as a complex molecular motion was the next theory Lomonosov brought to the notice of his learned colleagues. It had an indifferent reception, and he was criticized for his irreverent treatment of Boyle. The study of the elasticity of the air, of its composition, hydrodynamics, etc., followed as a logical sequence to Lomonosov's work on the corpuscular theory. A dissertation "On the Origin of Light and a New Theory of Colours" was presented to the Academy in 1756. His work "On the Ratio between the Quantity of Matter and Weight" was discussed at the Academy the same year. After these followed:

"On Solid and Liquid Bodies", "On the Action of Chemical Solvents", "The Nitre", etc.

The profoundly scientific treatment of any subject under discussion, Prof. Menshutkin says, is the main characteristic of all Lomonosov's works; for Lomonosov, chemistry was a pure science and not an art. "It is curious to note", remarks Lomonosov himself in his preface to the translation of Wolfe's "Physics", "how little attention learned men pay nowadays to the ideas born in their own heads, and strive more and more to make deductions from the results of experiments".

Lomonosov was a great experimenter and brilliant theorist. His work on physical chemistry, envisaged in the light of the history of science and of the contemporary achievements in this domain loses none of its interest and originality. A comparison of Lomonosov with Mendeléeff at once suggests itself, says Prof. Menshutkin. They both show a remarkable similarity of their genius. Both were physical chemists, whose interest centred chiefly in a particular class of research—that of solvents. Both adopted a serene philosophical attitude in their teaching, and yet both remained practical workers; throughout their lives Lomonosov and Mendeléeff remained great Russian patriots endeavouring to bring scientific conquests within the reach of their Fatherland. "Lomonosov was the Mendeléeff of the eighteenth century, and they were both Titans of Science". — S. S. IVANOFF.

Scientific Study of Folk-Lore

Volkstumsatlas von Niedersachsen

Von Wilhelm Pessler. (Veröffentlichungen der Historischen Kommission für Hannover, Braunschweig, Schaumburg-Lippe und Bremen, 14). Lief. 1. Pp. 20 + 8 maps. Lief. 2. Pp. 12 + 5 maps. (Braunschweig: Georg Westermann, 1933, 1936).

FOLK-history is beginning to supplement the accounts of Church and State which have hitherto been our guide to the past. The thoughts, customs and actions of a people are, indeed, the most reliable index to their state of culture, and a true understanding of any race can scarcely be obtained without a knowledge of its folk-lore. Dr. Wilhelm Pessler is writing the folk-history of Lower Saxony, the province of Germany between the lower parts of the Rivers Ems and Elbe, with Hanover as its principal city, and the publications under notice represent a contribution to the personal and agricultural customs of the province. A series of large, detailed maps shows the distribution of methods of yoking draught oxen, the

stooking of rye, the use of children's cradles, and even of less tangible affairs, such as the charming (*Besprechen*) of ailments, the most suitable days for marriage, and belief in luck. An explanatory text accompanies each map, and provides illuminating information. Charming of ailments, for example, thereby appears as a practical psychology of medicine rather than a survival of archaic custom. The information has been gathered together as the result of a large number of questionnaires sent to about 1,800 people in all parts of the province, and is part of a more comprehensive scheme fostered by the Notgemeinschaft der deutschen Wissenschaft. The "Volkstumsatlas von Niedersachsen" is published under the aegis of the Historische Kommission zu Hannover.

Results portrayed on the maps sometimes show well-marked divisions of ideas and interests in various parts of the province. Methods of stooking rye, for example, exhibit sharp variation by districts. There is, however, strong support to be gained for the view that man is not largely

dominated by his environment. Given a set of ideas which satisfy his reason, he will hold them and put them into practice, without undue reference to geographical surroundings. This is seen more on the maps relating to folk customs than on those which refer to agricultural practice, though the latter sometimes exhibit the same phenomenon.

Dr. Pessler is to be congratulated upon the artistry of his maps, the scholarly nature of the text, and the completeness of his investigation. The human appeal of such studies in folk-lore finds a strong expression in the Niedersächsisches Volkstumsmuseum at Hanover, of which Dr. Pessler is director. A number of exhibits, particularly of houses, are presented there with a

reality which commends itself to remembrance. Some re-erected houses and rooms are quite open to the visitor, who can thus make a quiet excursion into a different historical environment, whilst an extensive series of models interprets the development of farm-houses in Lower Saxony. Dr. Pessler has also written many papers upon this aspect of folk-lore. Mention may be made of "Harzer Häuser" (*Monatsschrift für Kultur- und Heimatpflege Niedersachsen*, Jan. 1937), which is a study of house architecture and types of dwellings in the Harz mountains, and "Das Niedersächsische Bauernhaus", a study of the development of farm-houses in Lower Saxony (from the Niedersächsisches Volkstumsmuseum, Hannover, 1936).

J. G.

A Census of Periodicals

Union Catalogue of the Periodical Publications in the University Libraries of the British Isles, with their respective Holdings, excluding Titles in the World List of Scientific Periodicals, 1934. Compiled on behalf of the Joint Standing Committee on Library Co-operation by Marion G. Roupell. Pp. xii + 712. (London: National Central Library, 1937.) 52s. 6d.

THIS publication provides for the first time a list of periodicals both humanistic and scientific, English and foreign, whether still appearing or not, so far as they were possessed by the library of any university or university institution in the British Isles at the end of December 1935, but excluding those published in the years 1900-33, and referred to in the "World List of Scientific Periodicals".

The term 'university institution' has been interpreted broadly, since the libraries of the Lister Institute, the Rothamsted Experimental Station and the Pharmaceutical Society are among those included.

23,115 different periodicals are listed with full particulars of the original title and all subsequent changes, volume numbers, dates and places of publication. In addition, the same alphabetical sequence includes some 32,000 cross-references from all changes of title, and from the various bodies responsible for publication. With the help of these informative cross-references, research workers faced with an unknown abbreviation, or knowing only the name of the publishing body, will rapidly find the necessary clue.

To test the accuracy of the work, a number of publications were looked for which were known to be obscure and difficult to trace, and in every instance the quarry was tracked with extreme ease.

Whilst the work will be of particular value to workers in fields other than scientific, it will also be of considerable use to scientific investigators, containing as it does those periodicals which lived and died prior to 1900, or came into being after 1933, and thus do not come within the scope of the "World List".

Of a necessity the editors have had to exclude certain weekly periodicals, if only to prevent the work becoming unwieldy, but the method of discrimination is not very obvious in cases such as the *Athenæum*, which is omitted, whilst the *Academy* is retained. This, however, is a minor detail, and does not detract from the extreme usefulness of the work.

The preface contains an expression of belief that the volume will be of service to libraries in revising their own buying of periodicals, etc., but it is much to be hoped that should any process of 'weeding' be indulged in, those responsible will consult the Joint Standing Committee before taking definite action. Otherwise two libraries may each dispose of a rare set on the grounds that it is possessed by the other, as has already occurred since the publication of the "World List".

The Catalogue has been compiled under the direction of a distinguished editorial board, while the trustees of the Carnegie United Kingdom Trust have generously rendered financial assistance both in compilation and in publication. All concerned are to be heartily congratulated upon having produced a great census and directory of the wealth of periodicals contained in the university libraries of the British Isles, which at the same time constitutes a bibliographical list of permanent value.

F. W. CLIFFORD.

Rapports sur la photoluminescence présentés à la réunion Internationale de Photoluminescence, Varsovie, 20-25 Mai 1936

Publiés par la Société Polonaise de Physique sous la rédaction de Prof. Dr. S. Pieńkowski et Dr. W. Kapuściński. (Vol. 5 des *Acta Physica Polonica*.) Pp. ix + 431. (Wilno : *Acta Physica Polonica*, 1936.)

THE first International Conference on Photoluminescence, which was held at Warsaw in May last year, was presided over by Prof. P. Pringsheim and attended by many eminent European physicists. It served to bring to the forefront the important scientific results which the subject is at present yielding. Some twenty-seven papers on the various aspects of phosphorescence and fluorescence were presented. They have now been published by the Polish Physical Society in the volume under notice.

It is only possible to mention here a few of the interesting topics which came up for discussion. Among the papers dealing with the line fluorescence of atoms, that by W. Hanle is of considerable importance as it deals with the influence of electric and magnetic fields on the polarization of resonance fluorescence. This constitutes one of the main methods of measuring the lifetime of an excited atomic state. The continuous absorption and fluorescence of van der Waals' molecules (as formed, for example, from an excited mercury atom with a rare gas atom) is treated by W. Finkelnburg. The interesting paper by V. Kondratjew on the luminescent emission of flames discusses very clearly the difference between thermoluminescence and chemiluminescence as revealed in their respective behaviour towards quenching by foreign molecules. A number of papers are devoted to fluorescent, phosphorescent and predissociation phenomena in the gaseous state. Another section deals with these phenomena in solution and in the adsorbed state. Finally coming to solids, R. Tomaschek discusses the line emission of the rare earth phosphors and R. W. Pohl the absorption spectra of the alkali halide crystals.

While most of the papers are in the nature of reports summarizing the work of the different authors in their respective fields, they also contain original material, and the discussions following each paper contain valuable contributions to the subject.

W. C. PRICE.

The Biochemistry of the Lipids

By Dr. Henry B. Bull. Pp. ix + 169. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1937.) 13s. 6d. net.

WHEN an author apologizes so profusely as does Dr. Bull for writing a book on a particular subject, the reviewer is to a great extent disarmed. There are, however, several comments which may be made for the purpose of general information.

As usual in a text-book on a specialized part of biochemistry, terminology is discussed, since the leading workers in this field are still not agreed among themselves. British workers have generally adopted the classification proposed by Dr. Smedley-Maclean, who has herself made so many notable contributions in this field. "Lipides" may be confused with "lipins",

and both these words together with "lipoids" generally signify substances of a fat-like nature yielding on hydrolysis fatty acids or derivatives of fatty acids, and containing in their molecule either nitrogen or nitrogen and phosphorus. This is the well-known and generally accepted definition given by Maclean and Maclean. Some confusion may therefore arise since "lipids" as used by the author signifies not only the above substances but also the simple fats and waxes and even the sterols.

The author has therefore aimed at comprehensiveness rather than completeness and has supplemented his description of individual substances by a detailed bibliography. The treatment of the fatty acids and the soaps is especially good and up to date, but the treatment of other classes of the "lipids" suffers considerably by the severe condensation.

An unusual formula is given, without comment, for sphingosine and consequently for sphingomyelin, but, apart from this, the book forms a good if rather hurried introduction to an important class of biochemical substances on which much investigation is being made.

C. S. G.

Les plantes alimentaires chez tous les peuples et à travers les ages :

histoire, utilisation, culture. Vol. 4 : Les plantes à boissons. Par Prof. D. Bois. (*Encyclopédie biologique*, Vol. 17.) Pp. iv + 601. (Paris : Paul Lechevalier, 1937.) 120 francs.

THIS volume of the "Encyclopédie Biologique" deals entirely with those plants that are used by man in various parts of the world for preparing beverages. All the more important species are dealt with, but those regarded as purely medicinal are omitted. They are arranged in three main categories—plants yielding alcoholic beverages such as wine, beer, cider, perry and distilled spirits; non-alcoholic drinks such as fruit syrups obtained by expression, and aromatic, non-alcoholic beverages, made by infusion or decoction, such as tea, coffee and cocoa. As might be expected in a work of this sort emanating from France, the grape and its numerous beverages receive detailed attention. Brief descriptions of all the leading varieties of wine grape, including synonyms, are given. Among the beverages of the tropics are the various palm wines or toddy and the spirits they yield (arack), also the spirits and native beers prepared from millets and other cereals. Maté or Paraguay tea and guarana, so well known in South America, are fully discussed. No fewer than eighty substitutes for ordinary tea are given and twenty for coffee.

A good deal of useful historical information and facts not usually recorded appear within the pages of the book. It is interesting to read, for example, that the flowers of the Indian 'mahua' tree, *Madhuca latifolia* (syn. *Bassia latifolia*), used in India for sweetening and making fermented liquors, were imported into France in 1880 to the extent of 400,000 kilogrammes for the manufacture of alcohol. Their importation and use in this manner, however, was afterwards banned by the French Government.

Indiana

By Prof. Dr. Leonhard Schultze Jena. 1: *Leben, Glaube und Sprache der Quiché von Guatemala*. Pp. xii+394+24 plates. 34 gold marks. 2: *Mythen in der Muttersprache der Pipil von Izalco in El Salvador*. Pp. xii+364+12 plates. 32 gold marks. (Jena: Gustav Fischer, 1933 and 1935.)

THESE two volumes give a detailed and comprehensive account of the social and religious life of the natives of the Quiché tribe of Guatemala and the Pipil of Salvador. Though collected in modern times, the legends and observances are obviously survivals from the early days when the great cultural development of the Maya peoples gave rise to the most spectacular architectural achievements of the aboriginal American.

The author collected his information in the native idiom, which is given in full, with a translation into German on the opposite pages. Chapters dealing with the languages, and grammatical notes and full vocabularies complete a work which will be essential not only to all students of early American culture but also to those who specialize in sociology or linguistics. The account of the Maya peoples recorded by the early Spanish chroniclers, notably Landa and Cogolludo, and the native traditions preserved in the Popol Vuh and the books of Chilán Balam will probably be easier of interpretation when re-read in the light of Dr. Schultze Jena's detailed account of surviving belief and practice.

The author has put forward no far-reaching theories, but has simply placed a vast material in the most admirable form, at the disposal of anthropological students. From this point of view, his two volumes constitute one of the most notable contributions to American sociology, and also archæology, produced in recent years. The volumes are admirably illustrated with photographs of native physical types, scenery and archæological sites. A short bibliography is appended to each volume.

T. A. J.

Exposés de génétique

2: *L'Effet de position et la théorie de l'hérédité*. Par Prof. Th. Dobzhansky. (*Actualités scientifiques et industrielles*, 410.) Pp. 38. (Paris: Hermann et Cie., 1936.) 12 francs.

BEGINNING with a short statement of corpuscular theories of the germ-plasm, the author classifies chromosomal aberrations into changes of (a) the number of chromosomes, (b) the number of genes in a chromosome, (c) the linear order of the genes. The bar-eye gene of *Drosophila* is then discussed on the basis of gene duplication. Other topics considered are (1) the relation between a chromosome break and the dominance of the neighbouring genes, (2) visible mutations appearing at the point of breakage, and (3) reversibility of the position effect. It is concluded that the existence of a position effect is proved. The functioning of a gene is therefore determined not only by its own structure but also by that of neighbouring genes. A gene can therefore be modified by its transfer to a new position, and the position effect can be used in order to investigate the first stages of the action of a gene in development.

What is Osteopathy?

By Drs. Charles Hill and H. A. Clegg. Pp. xix+217+8 plates. (London: J. M. Dent and Sons, Ltd., 1937.) 7s. 6d. net.

THIS is a searching and pitiless exposure of the claims of osteopathy. The first five chapters deal with the life, theories and practice of Andrew Taylor Still (1828-1917), the founder of osteopathy. His inventive power, we are told, far outstripped any scientific discretion he may have possessed, while the evidence that he possessed any at all is scanty. Modern osteopaths, whose theory and practice are examined in the rest of the work, have done nothing to justify their claim for State registration. Their advanced text-books show, it is said, lack of knowledge of the facts of anatomy and physiology as well as a complete absence of scientific evidence in support of their contentions.

The fundamental doctrine of osteopathy, that the predisposing cause of 90 per cent of disease is nothing more or less than a strained joint, is in no department of medicine more obviously false than in that of infectious disease, nor is there any support for such a view in the case of other disorders. While the authors do not deny that osteopathic manipulations may do good in certain conditions which respond to manipulative treatment in the skilled hands of manipulative surgeons, they maintain that no patient should have such treatment until his condition has been correctly diagnosed, and that a correct diagnosis is not likely to be made by one who has not had a thorough medical training.

The Road to Oxiana

By Robert Byron. Pp. ix+341+16 plates. London: Macmillan and Co., Ltd., 1937.) 10s. 6d. net.

SUPERFICIALLY, telephone and motor-car may seem to have transformed travel in inner Asia, but all they have done is to speed it up—in some ways only. Fundamentally it remains the same, especially where the human factor acts as grit in the machinery. Hence Mr. Byron failed to reach the Oxus—the objective of his journey. In this journal of travel in the Middle East, the villain of the piece, though not in the final obstruction, is "Mr. Marjoribanks", a synonym for the ruler of Persia, though perhaps this name ought to be interpreted as a generic term for all the many incongruities, restrictions and uncongenial elements which the author encountered in the 'modernized' life of the country. In Afghanistan and among its people Mr. Byron was much more at home, even though political exigencies were invoked to debar him from the riverine frontier of Turkestan. International policy and the British Foreign Office receive treatment which the author considers their due.

This lively and entertaining record of personal experiences—in Palestine and Syria as well as in Persia and Afghanistan—is varied by excellent appreciative notes on the architectural features of the more important historical monuments. These are illustrated by a number of photographs which are both beautiful and informative.

The Seventeenth International Geological Congress

"Science is called Science just because it recognises no fetishes, and does not fear to raise its hand against everything that is obsolete and dying, and attentively listens to the voice of Experience, of Practice."—STALIN.

THE decision made at Washington, D.C., in 1933, accepting the invitation of the Government of the U.S.S.R. to hold the seventeenth International Geological Congress in Russia, was received with pleasure by geologists all over the world; and, as a consequence, the meetings at Moscow and Leningrad, which began on July 21 last, were well attended from abroad. The preparations were on a scale that has rarely, if ever, been exceeded, and every opportunity was given to foreign geologists to appreciate the resources of the Union, and the work that had been accomplished by Russian research workers.

The general attitude towards science, in Russia, is clearly exemplified in the quotation from Stalin that heads this article—a quotation that was translated into all the official languages of the Congress, and displayed on each side of the rostrum in the general meeting room. But the attitude towards, and intense interest in, geology, in particular, had to be experienced to be believed; and contrasted most strikingly with the general lack of knowledge in Great Britain of what that science is doing, and has done, for the nation. Geology, to the Russian, stands not merely for the means by which the natural mineral resources of his country may be explored, but also for the means by which his mind can be enlarged beyond the possibilities offered by other sciences. It was not surprising, therefore, to learn that there were about eight hundred Russian members of the Congress.

The language difficulties were overcome in a most excellent manner; for the general meeting room—the Moscow State Conservatory—was fitted up with head-phones, so that the delegates could receive a running translation of the speech of the particular delegate at the rostrum in any of the official languages of the Congress. Some difficulties certainly arose, for the interpreters were not all technical experts, but the ease with which the great bulk of the communications could be followed was remarkable. In the several sectional meeting rooms, official interpreters gave similar services, though the results were not usually so effective. Nevertheless, these services made the Congress a memorable one by relieving the strain

of following papers in foreign languages, and so rendering the meeting more interesting and enjoyable.

The programme for the Congress consisted of some ten major topics; and, of these, the opening meeting considered the problems of petroleum and the world resources of this material. A paper by the president, Dr. I. M. Goubkin, on the estimation of the oil resources of the U.S.S.R., opened the discussions. Subsequent papers covered the several suggested modes of origin of petroleum in the oil-fields of the world; and estimates of oil resources in many areas were presented. Criticism of the figures given for potential supplies was not wanting, but the consensus of opinion tended to a less pessimistic view of the world situation, though quite recognizing that the resources were being rapidly dissipated. Theories of oil production from vegetable and animal matter by bacterial action, from methane by ionization produced by radioactive elements, from coal and oil shale by destructive distillation due to volcanic action, were all advocated as possible modes of origin of petroleum; but the bulk of the communications centred round the tectonics of the several fields described.

The geology of coalfields introduced fewer speculative topics. Again, however, the geological surveying of fields, and the determination of hidden fields in the U.S.S.R., constituted the main themes of the communications; in addition, coalfields in Japan, French Morocco and other regions were described. Methods of correlation of coal seams, and especially the most recent that depend on the examination of the spores and pollen in the individual coal beds, were illustrated by several papers. A particularly interesting communication discussed the structures of anthracites as shown in polarized light. The method had been first proposed by the Chinese geologist Si.

The mineral resources of the U.S.S.R. were still further delineated in the communications relating to Pre-Cambrian rocks, and ore deposits in other formations. These ranged throughout the whole territory of the State, from the Kola peninsula to farthest Siberia, from the Caucasus to the Arctic. While some of these resources have been known for many years, new deposits have come to light during the past two decades, and some of these were very striking. Of special interest to the microscopist was the discovery, in Siberia, of large crystals of optically clear fluor spar. Some of the crystals were cubes with an edge length of

from 4 to 6 inches. They are the largest crystals of colourless fluor spar which have ever been found.

Historically, the geological formation most closely associated with Russia is the Permian System. It is little wonder that problems relating to these rocks should have constituted a considerable part of the proceedings; and, among the most striking of the exhibits arranged for the Congress was a gallery in the Palæozoological Institute of the Academy of Sciences, Moscow, containing the mounted skeletons of herbivorous and carnivorous Pareiasaurians from Permian strata. In *Inostrancevia*, the Pareiasaurian equivalent of *Smilodon* (the sabre-toothed tiger from Pleistocene deposits), there is an example of parallel development that could scarcely be bettered in the whole palæontological record. The teeth of this carnivore attained a length of 10 inches in the specimens on exhibit. This whole exhibit rivals that of the *Smilodon* Gallery in the Museum at Los Angeles, California.

No less striking and fascinating was the exhibit of the Pleistocene mammoth and the woolly rhinoceros in the Zoological Museum at Leningrad. It was common knowledge to geologists that this unique exhibit was to be seen at Leningrad; but it was not known to the majority of the excellent guide-lecturers provided by the Intourist agency at Leningrad. There was some amusing consternation when the suggestions of trips to the Hermitage, the Winter Palace, Peter and Paul Fortress, etc., were emphatically rejected by the visiting geologists, and equally emphatic demands to see 'The Mammoth' were made in every language available to the delegates. The guides were distinctly nonplussed for the moment; but the position was soon straightened out and the pilgrimage to 'The Mammoth' organized.

University departments in geology, in Leningrad and Moscow, were also made available for visits, and among these the Fedorovsky Institute of Economic Mineralogy at Moscow afforded an excellent example of the teaching facilities, and apparatus, available for the Russian mineralogist. The Institute contains probably the most complete and up-to-date range of instruments for mineral research in the world. Prof. Fedorovsky and his assistants demonstrated the methods and technique to parties of those interested. In making mention of this Institute it must not be forgotten that all the other museums were equally generous in affording facilities for the visiting geologists; but it happens that Prof. Fedorovsky was a personal friend of the author of this article, and hence the latter was specially interested in that department. Indeed, it is no exaggeration to say that the preparations made at these several

museums and institutes far exceeded those made for any former International Geological Congress. The preparations were nation-wide, and specimens brought from practically every district of the U.S.S.R.; certainly from every part where specimens of geological interest could be obtained.

Mention must be made of the many social entertainments organized for the Congress. The banquet in the Kremlin, given by the Government, and attended by many of the chief officers of the State, will always remain the central social event of the Congress: but no less memorable were those given by the Academy of Sciences; the Soviet Committees of Moscow and Leningrad; and the Society of Cultural Relations with Foreign Countries. Nor must the numerous banquets organized for the entertainment of the participants on the several excursions be omitted. Wherever these excursions were held, unstinted kindness was lavished on the members of the Congress. Banners of welcome were made ready and displayed; and invitations freely given to visit local places likely to be of interest. A banquet generally terminated the proceedings.

On the excursion to Novaya Zemlya the Soviet Committees of Archangel and Tuloma (near Murmansk) arranged visits and banquets at which the writer was present; even at the wireless stations and settlements in Novaya Zemlya, that far-flung outpost of the U.S.S.R., such entertainments as were possible were arranged.

When one considers the enormous strides that Russian geological science has made during the present regime, it is little wonder if a note of laudation of that regime was evident; and, while political fervour sometimes became prominent, and a little disconcerting to people unaccustomed to such, the reasons for the enthusiasm could easily be understood.

Among the most important of the activities of the International Geological Congress are the excursions. Five were arranged before the Congress and five took place at the close. It was, of course, impossible to attend more than two of these; but for many members only one could be managed in the time available. The writer selected the excursion to Novaya Zemlya, and has had no reason to regret his choice. The party was accommodated on the Soviet steamship *Vologda*; and the navigation around these two islands without adequate charts—for we put into uncharted inlets where places of geological interest occurred—was a tremendous triumph of seamanship on the part of the captain and crew of the vessel. Fortunately, the weather was unusually propitious, and a most ambitious programme completed with practically no alteration, despite the preliminary notice that

the excursion might have to be curtailed. Far from that being the case, it was actually augmented by visits to additional places. The leader, Prof. S. V. Obruchev, was ably assisted by several other members of the Arctic Institute, Leningrad, and by official interpreters. The Lower Palæozoic rocks of this Arctic province were examined, and collections of the most common rocks and fossils were made. The glaciers of the region furnished opportunities of studying many problems of ice-action; while intrusions of acid and basic igneous magma gave scope to those more interested in petrology.

The other excursions were doubtless as interesting, but the writer can only touch on the one he attended.

In conclusion, a word of congratulation must be accorded to the authors and editors of the twenty-five guide books for the excursions, and

the beautiful geological map of the U.S.S.R. on the scale 1 : 5,000,000. The former were published in Russian, French and English, and represent an amount of organization, preparation and editing never before attempted for a geological congress. The map, also, is an achievement that cannot be too highly praised.

Taken all in all, the Congress will be a memorable one for those who took part in it, and the *Comptes rendus*, and other publications, will show those unable to attend the enormous amount of work that has been done, in recent years, in every branch of geology by our Russian colleagues.

It was agreed at the close of the Congress to accept the invitation to hold the Eighteenth Congress in Great Britain; and already steps have been made by the Geological Society for the meetings to be held in London in 1940. W. T. GORDON.

Planning the Land of Britain

APPARENTLY for the first time in the course of its hundred and six years of existence, no fewer than seven sections of the British Association united in a joint discussion on the last evening of the recent Nottingham meeting. The subject was "Planning the Land of Britain" and the chairman was Lord Trent. Symposium would be a more apt description than discussion, for there was no time for any discussion after the seven sectional representatives had each delivered his contribution. The result, however, was instructive; it became very clear that each of the sciences has a definite contribution to make to the general problem, but that there is a considerable divergence both in point of view and objective—differences which point the need for further discussion.

Dr. L. Dudley Stamp, director of the Land Utilization Survey of Britain, in his opening paper, attempted to stress some of the fundamental considerations underlying planning. In the first place, any planning must start from the present position, for the present utilization of the surface of Britain is the result of two or three thousand years of settlement, of a long-continued process of discovery by trial and error and of the play and interplay of a variety of factors. The isolation and intensive study of those factors must surely be the first requirement, for any planning contrary to the dictates of long-term trends and natural controls must surely end in failure. In the first place, there are the *natural* or *geographical factors* of position and accessibility, physical build and geological structure, soil and climate, all of

which impose strict limitations on land use. They emphasize the essential contrasts between the predominantly moor-covered highland Britain of the north and west with pastoral, agricultural and industrial Britain of the south and east. Insufficient is known of Britain's soils, but the limited resources of first-class soil are certain. With the improvement of transport and communications, it is easy to supply even the remoter settlements with the needs of everyday life, so that there is no longer any necessity for the semi-subsistence type of agriculture so prevalent in the past—as with the Scottish crofter. Consequently the incidence of the natural factors in determining land use is greater than ever before. In the second place, the *historical factors* often result in a stabilizing of land use—many of the parks, forests and common lands so valued to-day for amenity reasons are legacies from days when the reasons for their creation were entirely different. In the third place, the *economic factors* are clearly the most important in determining changes within the limits permitted by natural factors. A study of a large number of parishes in different parts of Britain over a hundred years or more shows a remarkable stability of land use on the best land (arable farming) and on the poorest land (heathland or woodland), and a maximum change on land of intermediate quality.

The incidence of geological factors in planning is both direct and indirect. The direct influence of coalfields and ore deposits on industry and land use is obvious; so also is the negative influence of

great areas of hard ancient rock, but Prof. P. G. H. Boswell (Section C) was concerned to stress the important indirect influences, especially through water supply. If the geologist is concerned with factors which are omnipresent but static, the zoologist and botanist deal with factors which are essentially both ubiquitous and dynamic. It is quite impossible to preserve 'typical' tracts of Britain by isolating them as national parks. The vegetation which is the chief attraction of our chalk downland or our scrubby heathland is essentially ephemeral—all these seral communities will change rapidly to woodland unless deliberately preserved in their present form. On the other hand, the 'management' of woodland of necessity destroys the decaying timber, which is the home of a characteristic fauna and flora. Each case must be decided on its individual merits, and the detailed knowledge of the scientific worker is needed. There is a real danger in the preservation of small beauty spots in that the concentrated pressure of human population quickly destroys both flora and fauna. Prof. E. J. Salisbury and Dr. Julian Huxley were in obvious accord on these points, though the latter was also concerned with the provision of Nature reserves in remoter areas in which wild life could adapt itself to present or changing vegetation.

We are accustomed to associate the charm of rural England with its old and picturesque cottages, perhaps forgetting that the cottages would lose most of their charm if removed from the setting of the old cottage garden. Although gardens in aggregate only occupy some two per cent of the surface of Britain, their influence on the scenery and indeed on the whole life of the country is out of all proportion to this area. The 'standardization' of gardens may be more fatal than the standardization of rows of houses all alike, since it should be the function of the garden to provide both individuality and variety. Since most houses are on roads, this is the more important in that the traveller sees more of England's gardens than of any other aspect of land use for amenity purposes.

Sir Daniel Hall spoke as the protagonist of a depressed industry and he claimed that his 'depressed area'—the farming lands of Britain—occupied the bulk of the country. He clearly considered the modern trend to be to think too much of recreation and too little of the serious work of the countryside, though the hiker might have an important economic importance to the small farmer by his requests for accommodation and food. As he was leaving the platform, Sir Daniel threw the bomb of the evening amongst the audience when he claimed that the reorganization needed by agriculture could only be accomplished

with the State ownership of land. In a later letter to *The Times* (Sept. 24) he urges that although the farmer may know what best suits his land, it does not follow that he knows what best suits the national interest. The conditions in Fenland are such as to make this the area which, above all others in Britain, should be devoted to fruit and vegetables. Is it to the national interest that a quarter of the land should be, as it is at present, devoted to wheat, simply because the local farmer is encouraged by the wheat quota? Our leading agriculturists are clearly divided on the question of land ownership. Prof. R. G. Stapledon would agree with Sir Daniel, but many doubt whether there are sufficient numbers of experts of their calibre to direct a State-owned Britain. G. M. Young visualizes "Some Board of Experts, all fighting like cats, staffed by tired examinees aspiring to become successful officials".

Unfortunately for Britain, agriculture seems to have few contacts with forestry, nor has the forester been conspicuous in his regard for agriculture. Sir Roy Robinson expressed pride at the achievements of the Forestry Commission—the sole post-War plan to move steadily to its appointed goal. Sir Roy spoke rather as a dictator, and it may be that the widespread opposition to the work of the Commission from landowners, sportsmen and those who seek so conservatively to preserve the countryside as it is at present, is based on a hatred of a relentless prosecution of a most desirable and nationally important objective. But it bodes ill for the success of a national plan for agriculture or indeed for any single demand on the land. Surely it is co-operation which should be the keynote of any land planning.

No family has done more to develop and beautify the local city than has the family of Boot in Nottingham, and it was accordingly of interest to hear Lord Trent say that individual efforts have already done as much as possible, and that the next move is with the State. He was alive to the practical difficulties of planning, just as Prof. J. H. Jones as an economist was concerned to stress the wider and deeper aspects of planning and the difficulties involved. What is the object of planning? We cannot plan without being sure of our objective, and it must be decided whether the object of planning is social, economic or strategic. The planning of industry is identical with the planning of land, and this is a truth which it is hoped the Royal Commission on the Siting of Industry will not overlook. It is surely the duty of the scientific community to maintain a permanent committee amongst themselves and to present a considered, if not unanimous, opinion on all aspects of the land and its future. L. D. S.

A New Conception of Superconductivity

By F. London, Institut Henri Poincaré, Paris

IN the past few years, physicists have been much engaged by the phenomenon of superconductivity. It is well known that various metals, when cooled below a certain very low temperature, characteristic of the metal in question, show the strange property of conducting electricity apparently without offering any resistance to the current. This curious phenomenon seems to contradict all our customary conceptions in physics. Particularly striking was the experiment of Kamerlingh Onnes and Tuyn, in which a current was induced in a superconducting ring of lead and was found to persist there without any measurable decrease for many hours—so long as the low temperature could be maintained. This experiment seems to present a unique case of motion without any friction, whilst we have been accustomed to see in every mechanism an occasion for dissipation of kinetic energy into heat.

1. Attempts have been made to explain this phenomenon by various mechanisms. But in all of them the same type of difficulty is always encountered. As in an ordinary conductor, so in a superconductor, it seems necessary to imagine an enormous number of different electronic states corresponding to the infinite number of different currents possible in it, different as regards direction and intensity. But on the other hand, it seems very difficult to comprehend why in these states the motion of the electrons should not be damped, that is, why the electronic waves should not be dispersed. One would imagine that in any event the interaction with the ionic lattice would cause transitions between these numerous electronic states favouring the passage to states of less energy and less intensity of current. In a short time the irregularity of the thermal vibrations of the lattice should effect a complete dissipation of the initial current.

This difficulty still appeared aggravated when Bloch adduced a very general argument according to which the most stable state of a mechanism of electrons under rather general conditions cannot show any current if no external field is applied.

It can be said that all who have tried to construct a theoretical picture of a superconductor have been completely baffled by this dilemma.

The new conception I have developed in different papers, partly in collaboration with H. London¹, differs essentially from the earlier attempts in so far as it exhibits the possibility of representing

all supercurrents realizable in a simply connected superconductor by even one single electronic state alone; though to be sure, the presence of an external field has been found to be of fundamental importance.

A new experiment has given us the key to this possibility. Meissner and Ochsenfeld² found in 1933, that a superconductor behaves not only like an ideal conductor, but in addition also like a very strongly diamagnetic metal. According to the Maxwell equations, an ideal conductor would not show any change of magnetic flux in its interior; this signifies that one should find, so to speak, 'frozen in', that magnetic field which was present at the moment when the superconductivity was established. Meissner's experiment, however, has shown that in a superconductor the magnetic flux is always equal to zero. It has been observed that those magnetic fields, present before the superconductivity was established, are pushed out while the temperature is lowered below the transition point (provided the experiment is carried out under 'ideal' conditions; see further below).

According to Meissner's experiment, it looks as though the transition from the non-superconducting to the superconducting state in a magnetic field is *reversible*, so far as the magnetic flux can always be considered as equal to zero in any volume element in the superconducting state *independently of the way* in which the transition temperature has been passed. That is quite different from the case of infinite conductivity. There the transition is not reversible and the superconductor would show a kind of permanent memory of that magnetic field which was present when superconductivity was last established. The point of view, that *the transition into the superconducting state is a reversible phase transformation*, was already suggested by Rutgers and Gorter³, who, starting from this assumption of reversibility, derived certain thermodynamical relations between specific heat, magnetocaloric effect, etc., relations which have been verified in the meantime by many experimenters.

2. This state of affairs suggested an interpretation of superconductivity which is entirely different from that which considers this phenomenon as a limiting case of ordinary conductivity. Though it is not possible to consider the diamagnetic phenomenon as a consequence of the infinite conductivity, the converse can to a certain extent be done.

A diamagnetic atom, as is well known, exhibits the possibility of permanent currents flowing in a system which is in its most stable state. These currents, indeed, do not appear except in the presence of a magnetic field, and that is precisely the reason why this mechanism is not covered by the theorem of Bloch mentioned above; for Bloch's theorem deals only with systems with no external field.

Let us for a moment consider the behaviour of a diamagnetic atom in a magnetic field. We may describe such an atom by the following properties:

(a) Its lowest state is not degenerate and belongs to the discontinuous spectrum. Its wave function is real.

(b) In a weak magnetic field \mathbf{h} , the wave function ψ does not experience stronger perturbations than those proportional to the square of \mathbf{h} or still higher powers of \mathbf{h} :

$$\psi = \psi_0 + \mathbf{h}^2\psi_1; \quad (1)$$

where ψ_0 is the wave function for $\mathbf{h} = 0$.

In the (non-relativistic) wave mechanics, the density of current \mathbf{j} of an electron in the state ψ is known to be given by the formula:

$$\mathbf{j} = \frac{he}{4\pi im} (\psi^* \text{grad } \psi - \psi \text{ grad } \psi^*) - \frac{e^2}{mc} \psi \psi^* \mathbf{A} \quad (2)$$

where h , m , e , c are the well-known universal constants, ψ^* is the conjugate complex value of ψ and \mathbf{A} is the vector potential of the magnetic field \mathbf{h} ($\mathbf{h} = \text{curl } \mathbf{A}$).

Substituting into this expression the above ψ of the diamagnetic atom, one obviously obtains as the greatest term, the only one proportional to the field strength:

$$\mathbf{j} = - \frac{e^2}{mc} \psi_0^2 \mathbf{A} + \dots \quad (3)$$

All the other terms are of the order \mathbf{h}^2 or still smaller. Calculating the moment of this current, one obtains the well-known expression for the induced diamagnetic moment of the atom.

It is perhaps of some interest to discuss in more detail how the diamagnetic atom succeeds in representing an infinite number of currents by one single state.

In a magnetic field the total momentum \mathbf{p} of an electron is not simply proportional to the velocity \mathbf{v} ; it is rather

$$\mathbf{p} = m\mathbf{v} + \frac{e}{c} \mathbf{A} \quad (4)$$

This formula can be considered as the supplement to the well-known analogous resolution of the energy into 'kinetic' plus 'potential' energy, and accordingly the two terms $m\mathbf{v}$ and $\frac{e}{c}\mathbf{A}$ are sometimes distinguished as 'kinetic' and 'potential' momentum.

The formula (2) for the current is obviously based on the corresponding resolution of the velocity \mathbf{v} equivalent to (4):

$$\mathbf{v} = \frac{1}{m} \mathbf{p} - \frac{e}{mc} \mathbf{A} \quad (4')$$

For the term $(h/4\pi i) (\psi^* \text{grad } \psi - \psi \text{ grad } \psi^*)$ in (2) represents the local density of the total momentum \mathbf{p} in the state ψ . (This can easily be verified by putting, for example, a plane wave $e^{2\pi i p x / h}$ into this term.) It is a somewhat strange but quite characteristic feature of the wave-mechanical description that the wave-length of the de Broglie waves does correspond to the total momentum ($p = h/\lambda$) and not to the kinetic momentum, whereas the latter, being proportional to \mathbf{v} , is attached to the current. (Correspondingly the frequency is known to be attached to the total energy ($E = h\nu$) and not to the kinetic energy.)

Now, owing to equation (1), in a diamagnetic atom the term $(h/4\pi i) (\psi^* \text{grad } \psi - \psi \text{ grad } \psi^*)$ representing the mean total momentum \mathbf{p} remains everywhere practically zero, even in a magnetic field. In this case the currents occurring are, so to speak, a kind of image of the actual magnetic field. The local kinetic momentum, that is, the local current, given by (3), is throughout equal but opposite to the local potential momentum, represented by the vector potential of the magnetic field, so that the sum of both, \mathbf{p} , is everywhere zero. In such a manner a diamagnetic atom in its one lowest state can show an infinite variety of different currents corresponding to the infinite variety of orientations and intensities of the applied magnetic fields, whereas its wave function does not show any appreciable reaction.

This mechanism of conduction is entirely different from that considered in the customary theories of conductivity: the transport of electricity is not based, as usually, on progressive waves (or progressive wave packets), but on stationary waves. By these a transport of electricity can only be effected in the presence of a magnetic field and this is precisely our assertion as to the nature of the supracurrents.

3. Let us now assume that in a simply connected supraconducting metal there may be one or several discrete electronic states of the same properties (a) and (b) below the continuum of ordinary (Bloch-) states. Since in all these states by a given magnetic field practically the same current is evoked, the transitions between these states caused by the interaction with the lattice vibrations will effect no dissipation of the diamagnetic currents. This is exactly the mechanism by which the interaction with the nuclear vibrations in a diamagnetic molecule is prevented from effecting any dissipation of the diamagnetic currents evoked by an external magnetic field.

Thus for a supraconducting electron also we will suppose the same equation (3) to be valid :

$$\mathbf{j} = -\frac{e^2}{mc}\psi_0^2\mathbf{A};$$

where ψ_0^2 signifies the probability of finding this electron, which we will suppose to be practically constant throughout the metal. Summing over all electrons, we therefore obtain for the density of the total current :

$$\mathbf{J} = -\frac{e^2n}{mc}\mathbf{A} = -\frac{1}{\Lambda c}\mathbf{A} \tag{5}$$

where n signifies the number of supraconducting electrons per cm.³. $\Lambda = m/ne^2$ is a constant of the dimensions [sec.²] characteristic of the supraconductor in question. As $n \leq 10^{23}$, one obtains $\Lambda \geq 3.2 \times 10^{-32}$ sec.².

The vector potential not being uniquely defined has yet to be normalized in a definite way in order to obtain in (5) an unambiguous statement. We can, however, get rid of this ambiguity by forming the curl of (5) and obtain

$$\Lambda c \cdot \text{curl } \mathbf{J} = -\mathbf{h} \tag{6}$$

This is the fundamental macroscopic connexion between magnetic field \mathbf{h} and current density \mathbf{J} that we propose for the supraconducting state.

From our observations apropos of the diamagnetic atom, we may infer that in our model the notorious difficulties discussed above will not appear. Compared with the former conception of infinite conductivity the assumptions (a) and (b) certainly signify an appreciable *reduction* of the mechanism which remains to be explained by the theory of electrons. On the other hand, (a) and (b) form, of course, in no way a necessary basis of (6), and it is quite possible that the future development of the molecular theory will replace them by a still more reduced basis⁴.

4. In the following we shall discuss the *macroscopic description* furnished by (6). The currents which are admitted by this equation are very far from being identical with those which would correspond to an infinite conductivity. *The variety of possible currents is considerably more restricted* according to our interpretation, which admits *only currents, which are correlated in a very special manner with a magnetic field*. But it can be shown that it is really possible by just this restricted ensemble of currents to describe all the supracurrents which are actually observed.

Applying the Maxwell equation

$$c \text{ curl } \mathbf{h} = \mathbf{J}, \tag{7}$$

(neglecting here the displacement current) we can eliminate \mathbf{J} in (6) and (7) and get

$$c^2 \Lambda \text{ curl curl } \mathbf{h} = -\mathbf{h};$$

or since $\text{div } \mathbf{h} = 0$

$$c^2 \Lambda \nabla^2 \mathbf{h} = \mathbf{h} \tag{8}$$

This equation indicates that the magnetic field decreases exponentially from the surface to the interior of the supraconductor, in this way representing the Meissner effect. As in a diamagnetic atom, the induced currents behave like a screen; their magnetic field tends to diminish the original field. In a distance of the order of magnitude $\gg c\sqrt{\Lambda}$ ($\gg 10^{-5}$ cm.) the field can be considered as practically zero.

In Meissner's experiment, it is obviously the applied external magnetic field which evokes the supracurrent as soon as the supraconducting state is established. In the case of the permanent current in a ring (and also in the case of an open wire which is fed by normal conducting leads), the magnetic field which *maintains the current* proves to be *identical* with that which is *produced by the current* itself. The most stable state of a ring has no current, unless an external magnetic field is applied. To be sure, the states in which the ring possesses a permanent flux through its central hole, are not states of lowest energy but are *metastable under macroscopical conditions*: only by a *finite* variation of the macroscopic parameters of the system (for example, by passing the transition temperature or by cutting the ring open) can the ring be brought into the absolutely stable state which contains no flux.

To complete this theory it is necessary to add to (6) a further statement as to the behaviour of the electric field. In this regard the magnetic equation (6) as well as experience do not exclude a certain indeterminateness, and an experiment had, therefore, to be arranged in order to elucidate this point⁵. We cannot enter here into a detailed discussion of this question, and want only to state that as a result of this experiment the relation

$$\Lambda \dot{\mathbf{J}} = \mathbf{e} \tag{9}$$

(\mathbf{e} being the electric field strength) seems now to be the most simple formulation of this supplementary electric equation. The electric fields possible according to (9) and (6) are reduced to just those which are inseparably attached by induction to the magnetic field. The equation (9) simply states that there are no other currents in the supraconductor than those which, according to (6), are evoked and maintained by the magnetic field.

It might be emphasized that our conception differs essentially from a description which has sometimes been given, according to which supraconductivity should be characterized by the particular value $\mu = 0$ of the magnetic permeability. Though for simply connected isolated supraconductors both formulations give macroscopically

identical results, they prove entirely different if one has to deal with supraconducting rings.

The essential characteristic of our theory can be seen in the following: The *same* relation (6), between current and magnetic field, which represents the Meissner effect and which for simply connected supraconductors is practically identical with the description $\mu = 0$, is able, moreover, to describe the distribution of the permanent currents in supraconducting rings. The magnetic field of these rings, having a curl, requires, according to Maxwell's theory, the explicit introduction of the

macroscopic current. It cannot, of course, be described by a particular value of the magnetic permeability only.

¹ London, F. and H., *Physica*, 2, 341 (1935). London, F., *Proc. Roy. Soc.*, A, 152, 24 (1935). Comprehensive report: "Une conception nouvelle de la supra-conductibilité", *Actualités scientifiques et industrielles* No. 458 (Hermann et Cie., Paris, 1937.)

² Meissner, W., and Ochsenfeld, R., *Naturwissen.*, 21, 787 (1933); Meissner, W., and Heidenreich, T., *Phys. Z.*, 37, 449 (1936).

³ Appendix to Ehrenfest, P., *Leiden Comm. Suppl.*, 756 (1933). Gorter, C. J., *Arch. Mus. Teyler*, 7, 378 (1933).

⁴ London, F., *C.R.*, 205, 28 (1937).

⁵ London, H., *Proc. Roy. Soc.*, A, 155, 102 (1936). See also v. Laue, M., London, F. and H., *Z. Phys.*, 96, 359 (1935). Schrodinger, E., *NATURE*, 137, 824 (1936).

[To be continued.]

Obituary Notices

Dr. J. R. Airey

DR. JOHN ROBINSON AIREY died in his seventieth year at his home in Newtown, Montgomeryshire, on September 16, after an illness lasting more than six months. He was a native of Leeds, where he received his early education at the Blenheim Council School and the Central High School. After serving as an assistant in the science department of the latter he was, from 1896 until 1903, a master at the Porth County School, Glamorganshire.

Airey's first degree was a London B.Sc. in 1894. In 1903 he interrupted his teaching work for three years, and went up to St. John's College, Cambridge, as a foundation scholar; he took first-class honours in both parts of the Natural Science Tripos, and was awarded the Wright Hocking and Hughes prizes. From 1906 until 1912 he was principal of Morley Secondary School, and from then until 1918 principal of the West Ham Technical Institute. In that year he became principal of the City of Leeds Training College, where he was held in very high esteem by all with whom he came into contact. On his retirement in 1933 he was presented by his old students with his portrait in oils, which he gave to the College. This was accompanied by an illuminated letter, from which may be quoted "You will live in our memories as a principal and a friend whose words were few and whose happy and kindly disposition shone out so brightly that even your reproofs were tinged with humour". Another friend described him as "a verry parfit gentil knyght".

Airey became a D.Sc. of London in 1915, and in 1926 Cambridge conferred on him its coveted Sc.D. He will be best remembered in scientific circles for his work as a mathematician and computer, particularly in connexion with Bessel functions, in which he was deeply interested for thirty years. He became a member of the British Association Mathematical Tables Committee in 1911 and continued to serve uninterruptedly until his death; from 1918 until 1929 he held the office of secretary. His first published tables appeared in the report of this committee for 1911, and were of the so-called Neumann functions, which are related to the functions usually known as

Y functions or Bessel functions of the second kind; these tables were extended in 1913, 1914 and 1915.

The need for extensive tables of sines and cosines in radian measure to facilitate the rapid calculation of transcendental functions from their asymptotic expansions led Airey to prepare such tables. The first, in 1916, gave these functions to 11 decimals at interval 0.001 throughout the quadrant. 15-figure tables at varying intervals up to $x = 100$ appeared in the Reports for 1916, 1923, 1924 and 1928. These tables were reprinted, with some extensions, in volume 1 of the "British Association Mathematical Tables" in 1931, and are now widely used and appreciated by engineers and mathematical physicists. Since their publication Airey has prepared extensive manuscript tables to 13 decimals at interval 0.0001, but these have not yet been published.

It is not possible to enumerate all the tables computed by Airey of functions related to Bessel functions; a list of them occupies a page in the 1929 Report. It should, however, be mentioned that he made, in 1917, the first extensive calculations of what he called the Lommel-Weber function. Owing to war conditions they were not published until 1924, although mentioned in the reports of the two previous years; meanwhile similar figures appeared in Watson's "Theory of Bessel Functions" under the name of Struve function.

In 1918 Webb and Airey directed attention, in a paper in the *Philosophical Magazine*, to the importance of the confluent hypergeometric functions in the solution of a wide range of differential equations of the second order. This was followed, in the British Association Reports for 1926 and 1927, by tables of these functions for various values of the three arguments on which they depend.

The second volume of the "British Association Mathematical Tables", giving solutions of Emden's equation, is based entirely on methods suggested by Airey. He was, in fact, a master of the art of getting numerical solutions of equations that would not yield to formal treatment. In particular, he was conspicuously successful in dealing with asymptotic series, where the common practice is to compute to

the least term, and neglect the divergent part. He had the happy knack of discovering the form of 'converging factors', which, when multiplied by the least term, gave the effect of the divergent terms; in this way he was usually able to double the number of decimals that could otherwise be obtained.

Another phase of Airey's activity was his association with the production of the *Philosophical Magazine*, which goes back many years. In 1933 his name first appeared on the journal as a joint editor, and from that date onwards he read and passed for press every article. Although not a frequent contributor in recent years, his last task was the reading and correction of an article by himself, which will appear in a future number.

Airey was a fellow of the Royal Astronomical Society, the Physical Society and the Edinburgh Mathematical Society. He will be remembered as an inspiring colleague, and a friend who was always generous with his help. He is survived by a widow and a daughter.

L. J. COMRIE.

Mr. W. B. Ferguson, K.C.

WILLIAM BATES FERGUSON, who died on Thursday, October 7, in his eighty-fifth year, was educated at Manchester Grammar School and Merton College, Oxford, where in 1874 he graduated with first-class honours in natural science. At this time it was apparently his intention to enter the medical profession, but after another year or two engaged in study and lecturing, during which he became one of the original fellows of the newly founded Institute of Chemistry, he qualified for the Bar, to which he was called in 1882. He practised for some eighteen years and took silk in 1900, but then on urgent medical advice had to give up his profession and retire for several years to Arosa in Switzerland.

Ferguson was already keenly interested in photography, and having become a member of the Royal Photographic Society in 1895, was elected a fellow in 1900, in which year he published a paper on toning prints and slides with copper compounds. While at Arosa, in collaboration with B. F. Howard, he studied the influence of temperature on the rate of development of dry plates and devised his time-temperature system of compensating therefor, which has proved of permanent value. He was a close student of Hurter and Driffield's epoch-making researches, and the design of photometers for the measurement of photographic densities became one of his hobbies. His outstanding contribution to photographic science was undoubtedly the Hurter and Driffield memorial volume, in which he not only collected together in conveniently accessible form all their important papers, but also gave us the results of a painstaking study of their apparatus, laboratory notebooks and correspondence, a labour of love which occupied him for fully two years.

Ferguson's striking figure and charm of manner will not soon be forgotten by members of the Royal Photographic Society, and many are indebted to him for his unfailing interest and kindly encouragement in their work. Although repeatedly invited to become

its president, his precarious health always compelled him to decline, but on the Council and in numerous committees he served the best interests of the Society for many years. He was awarded the Society's honorary fellowship and the Progress Medal in 1914, the Hurter and Driffield Memorial Medal in 1918 and the Davanne Medal of the Société Française de Photographie in 1925, in recognition of his scientific work, and was throughout its existence a vice-president of the British Photographic Research Association. All who knew him will mourn the loss of a good friend and an outstanding personality, and will deeply sympathize with his wife and family in their sorrow.

F. F. R.

Dr. Carl Spengler

By the death on September 16 of Dr. Carl Spengler in his seventy-seventh year, one of the pioneers of tuberculosis research and treatment has passed away. He lived and died at Davos, and was one of those who made Davos the first, and for a time the chief, centre for the Alpine treatment of pulmonary tuberculosis.

Carl Spengler studied medicine at Heidelberg and Zurich, afterwards worked at bacteriology under Profs. von Stilling and de Bary, and from 1886 until 1889 was assistant physician in the University of Strassburg. He then returned to Davos in order to specialize on tuberculosis, and his work attracted the attention of Robert Koch, with whom he collaborated for a time, originating the preparation of tuberculins from the bovine type of bacillus, and devising the method of administering tuberculins now in general use. He also devised a special technique for demonstrating the tubercle bacillus, which still remains one of the best of the staining methods, and described the presence in tuberculous materials of spheroidal bodies derived from the tubercle bacillus, which he termed 'splitter' bodies, and the appearance of which he regarded as being of favourable import as indicating disintegration of the tubercle bacilli.

In addition to developing the climatic and open-air treatment of tuberculosis, Spengler also sought to discover an agent which would exert a curative action upon tuberculosis by the possession of lytic and antitoxic properties towards the tubercle bacillus. This he claimed to have done, and evolved his *I.K.* (= *Immun Körper*) treatment for the disease. He believed that the red blood corpuscles (and not the serum) of a specially immunized animal carry the bulk of the immunizing substances, and devised his *I.K.* remedy for treatment, which consists essentially of a solution of the anti-tuberculous immunizing bodies derived from the red blood corpuscles of a treated animal. He also applied the same methods in the treatment of other diseases, and during his last years devoted much time to research on cancer.

R. T. HEWLETT.

We regret to announce the death of the Right Hon. Sir Herbert Maxwell, Bt., K.T., F.R.S., chairman of the Royal Commission on Ancient Monuments (Scotland) in 1908-34, on October 30, aged ninety-two years.

News and Views

Prof. A. von Szent-Györgyi: Nobel Prize for Medicine

It is announced by the Stockholm correspondent of *The Times* that the Nobel Prize for Medicine for 1937 has been awarded to Prof. Albert von Szent-Györgyi, of the University of Szeged, in Hungary, for his work on vitamin C. More than fifteen years ago, experiments carried out by Szent-Györgyi on the adrenalectomized animal suggested to him that the adrenal cortex is in some way involved in biological oxidation. A detailed study of different animal, vegetable and synthetic oxidizing systems was made, but no connexion could be found between these and the function of the adrenal cortex. However, nine years ago, evidence was obtained that the cortex is in some way connected with the peroxidase system and at the same time a reducing substance, considered to be a 'hexuronic acid', was isolated from it. The same acid was also found in plants and shown to be an essential part of the 'reducing factor' of plant juices, being apparently connected with the function of the peroxidase system. Since the 'reducing factor' is found in fruit juices which contain vitamin C and cure both human and experimental scurvy, the antiscorbutic potency of the 'hexuronic acid' was investigated,

HOWEVER, it was not until four years later that Svirely and Szent-Györgyi were convinced that the potency of this acid was really due to the acid itself and not to its contamination by some more potent substance. Success was dependent on the possibility of obtaining large quantities of the acid, and the authors were finally successful when they discovered that paprika, the Hungarian red pepper, is an unusually rich source. Meanwhile, investigation in various laboratories of the chemical nature of 'hexuronic acid' had necessitated a modification of the structural formula originally proposed and Szent-Györgyi and Haworth (*NATURE*, 131, 24; 1933) suggested the name "ascorbic acid", by which vitamin C is now generally known. It was not long after Szent-Györgyi's isolation of ascorbic acid from natural sources before the vitamin was prepared by chemical synthesis, and the synthetic vitamin is now employed in medicine when large doses are required. Although Szent-Györgyi's brilliant research may have closed a chapter in vitamin chemistry, it has nevertheless opened one in the treatment of disease.

Representation and the Australian Aborigines

To those whose vocation it is to consider the Australian aboriginal mainly, if not exclusively, in a context in which he appears as the most primitive, physically and culturally, among existing peoples, there is something incongruous in the report from Canberra (*The Times*, Oct. 27) that the aborigines have petitioned the King, asking His Majesty, through the Australian Government, to empower them to

propose one of their own people, or a sympathetic white, to represent them in the Federal Parliament. The purpose of the petition, it is stated, is to prevent their extinction. It goes on to point out that the injunction laid on the first settlers in Australia, that the aborigines should be adequately cared for, has not been obeyed, since aborigines' lands have been expropriated and legal status has been denied them. This is the first occasion in Australian history on which such action has been taken by the aborigines; but as the eighteen hundred and fourteen signatories to the petition, drawn from all parts of Australia, are chiefly from mission stations, the circumstances which have determined their mode of action are not beyond conjecture. The petition has been forwarded by Mr. Lyons, as Prime Minister, to Lord Gowrie, the Governor-General, for submission to the King.

WHATEVER may be its ultimate fate, the fact of the submission of the petition is significant. It is one among a number of indications of the profound cultural changes which are taking place among even the least advanced races under Imperial administration. It points to the fact that neither segregation, the provision of reservations, nor even 'indirect rule' are to be regarded as the final solution of the problems which arise in modern conditions out of even the regulated cultural contacts of white and backward civilizations. Cultural change, it seems, is inevitable; but in recent discussion of the colonial question, it appears to be overlooked that under democratic institutions the growth of a native opinion cannot be ignored, and the crux of the colonial problem is not ownership, but the will, as well as the competence, to guide native development in the light of detached and scientific study along lines beneficial to the native himself, as well as to the larger world in which he will have to find his level some day when he emerges from tutelage.

The Progress of Engineering

IN his presidential address to the Institution of Civil Engineers on November 2, Mr. Bryan Donkin pointed out that it is nearly thirty years ago since Siemens and Kennedy, who preceded him in the chair and who were like himself connected with both the mechanical and electrical branches of engineering, described the latest advances which had then been made in the new industry. The intervening gap he filled up most satisfactorily. In an essay on applied science written in 1810, Shelley said of electricity, "What a mighty instrument it would be in the hands of him who knew how to wield it." Shelley referred to the aerial mariner who could swim in the air with bladders and said that such ingenuity was not to be condemned. "Why," he said, "have we not dispatched intrepid aeronauts to cross Africa in every direction to survey the whole peninsula in a few

weeks?" It is by these means "that we could advance civilization, emancipate every slave and improve generally the welfare of mankind." Now most of the things Shelley thought of have been done, and mankind has benefited.

MAN has become a more efficient unit, he performs more work in a given time, he lives longer, he has greater comforts, but with all these advantages, it is a misfortune that the necessity still arises for some to spend their energies and the wealth of their country in fruitless endeavours to kill, or to be ready to kill, their enemy in less time and at less cost than is possible for their adversaries. According to the best authority, it was shown in 1936, by statistics of the cost of various domestic commodities throughout Europe, ranging from electricity to coal and including butter, bread, milk, meat, potatoes and sugar, that the fall in the price of electricity since 1914 was greater than that of any of the others. In addition, the price of electricity in Great Britain had fallen more than in any other country. It is practically certain that it will fall still further. In conclusion, Mr. Donkin quoted with approval Lord Weir, who said that millions of pounds should be spent in research in the political sphere for the founding of a thinking department for the investigation and analysis of human qualities. It should explore the possibility of healing and softening racial bitterness and ultimately demonstrate to the world the utter inability of war to solve political problems.

Co-operation between the Engineering Professions

AT the beginning of his presidential address to the Institution of Electrical Engineers delivered on October 21, Sir George Lee re-echoed Sir Alexander Gibb's suggestion, given in his address to the Institution of Civil Engineers last year, for closer co-operation and co-ordination between the various engineering institutions. The engineering industry is now so large that amalgamation between the various institutions, even if desirable, would be practically impossible. But he made two suggestions of directions in which co-operation should be easy and an advantage to industry. The first was that facilities might be given to members of one institution to attend meetings of other institutions, to hold joint meetings on subjects of common interest and to give special library facilities to all. The second was that the full implications of social science can best be handled from the engineering side by the combined efforts of all the engineering professions. To an increasing extent the lives of our people are bound up with engineering development, and the economics of our welfare are dependent to a large extent upon the rate of this development. The closer association and meeting of people who are interested in different phases of what is actually the same subject would facilitate the recognition of common interests and ideas.

SIR GEORGE then passed on to give an interesting account of developments in some of the activities of the Post Office. He pointed out the success of the

new telephone tariffs. The shilling night rate has been a very successful psychological touch which succeeded beyond the wildest expectations. He laid stress on the difficulties of development forecasting. If a successful forecast is made, then the capital expenditure can be reduced to a minimum. When the sixpenny telegram was introduced in 1935, there was an immediate increase of 34 per cent over the corresponding period for the preceding year. The standardization of teleprinter working has paved the way for the development of a switched telegraph system utilizing the familiar methods of automatic telephony. Probably it will soon be possible for any teleprinter office in the inland service to obtain instant communication with any other teleprinter office simply by dialling.

Nuffield College, Oxford

MORE information relating to the proposed college for research in social studies, to be called Nuffield College (see NATURE of October 23, p. 697), is now available. The erection and equipment of the College and the laying out of its grounds will be in the hands of the governing body of the University, the Hebdomadal Council. It shall from time to time appoint the warden, the fellows and other officers, and generally take charge. It is proposed to have maxima of twelve official fellows, eight faculty fellows, twenty visiting fellows, and forty students. Women will be eligible for fellowships and studentships. The official fellows will be whole-time research workers, the faculty fellows teaching members of other colleges who do work on social studies, and the visiting fellows the possibly non-academic persons from outside. The students will be at least in their third term of residence at the University and working for research degrees. All classes of fellows (but not women fellows) will be entitled to rooms and dinner in college and students may also have rooms there. The visiting fellows and the students will receive honoraria or emoluments of the order of fifty pounds per annum. Lord Nuffield will be the first honorary fellow.

Comets and Problems of Cosmogony

THE presidential address at the British Astronomical Association was delivered on October 27 by the Rev. Dr. M. Davidson. He discussed comets, especially in connexion with the light that they throw on problems of cosmogony. Considering that comets move in orbits of such a diverse nature, direct and retrograde orbits being nearly equal in number, taking comets on the whole, he showed that there are difficulties in reconciling this fact with the tidal theory of the origin of the solar system. He referred to the families of comets which are associated with the major planets, stating that it is quite impossible to explain these on the capture theory. There is, he considers, some basis for the view that they were expelled by the planets, though there are certain objections here also. Various theories for the origin of both the short-period and long-period comets were dealt with in turn; but, Dr. Davidson

pointed out, none of these can be considered satisfactory. Bobrovinokoff's conjecture that the sun captured comets when it was passing through diffuse clouds of obscuring matter less than a million years ago would appear to be mere speculation, and great difficulties arise when we inquire how bodies of such diverse sizes as are found in the nuclei of comets should appear in diffuse clouds of obscuring matter. The whole subject is full of difficulties, and Dr. Davidson contented himself with expressing the hope that posterity would be able to solve the problem. At the close of his address, he presented the Walter Goodacre Gold Medal and Gift to Dr. A. C. D. Crommelin, whom the Council selected this year for this award, in consideration of the very valuable work that he has done for the Association, more especially in connexion with comets and minor planets, on which he is a recognized authority.

Easton Park Nature Sanctuary

EASTON PARK, Dunmow, Essex, which Frances, Countess of Warwick, has recently willed under terms to the Essex County Council to assure its future as a Nature reserve, covers a thousand acres of mixed wood and parkland, and has long been preserved as a wild-life sanctuary, with no shooting and only the rabbits killed. Although a little short of water except for the dewponds, the estate is rich in wild-life: there are considerable numbers of jackdaws, green and spotted woodpeckers, goldfinches and long-tailed tits; goldcrests, hawfinches, kestrels, the three common owls, nuthatches and many jays nest in the woods. In a recent autumn study of the bird sanctuaries there, by invitation of Lady Warwick, Mr. Eric Hardy noted fifty species of bird, including a roosting flock of 195 jackdaws. There are a few red squirrels in the park, but no grey squirrels and no nesting carrion-crows. Wild pheasants and partridge are numerous, and there are two large duck ponds where Lady Warwick intends to introduce ornamental waterfowl. A large four-acre wood around Stone Hall on the south side of the estate is permanently fenced and padlocked and kept as a specially secluded sanctuary for woodland nesters.

In the grounds of Easton Lodge, Lady Warwick has had erected a number of large aviaries, and converted old conservatories to heated aviaries, totalling eight aviaries in all, the largest, as high as the big aviary at the London Zoo, enclosing a full-grown yew tree. The collection comprises some 17 species and about four hundred specimens, chiefly of foreign finches, and is also used as a 'flying school' for injured or rescued British birds before their release. The aviaries are in the charge of Mr. Gilbert, formerly a keeper of aviaries under Mr. D. Seth-Smith at the London Zoo. The park also contains large herds of red and fallow deer, a herd of Highland cattle, some 700 Shetland sheep, including four-horned rams, a number of Shetland ponies, and some very outstanding trees, including some of the country's best specimens of cedar, wych-elm, oak, maiden-hair, palm and *Ailanthus* or tree of heaven.

Electron Diffraction and Surface Structure

THE thirty-ninth Bedson Lecture was delivered on October 25 in King's College, Newcastle-on-Tyne, by Prof. G. I. Finch, on "Electron Diffraction and Surface Structure". Prof. Finch stated that patterns are obtained on a photographic plate placed in the path of an electron stream which has been allowed to graze the surface of a solid body, and from these diffraction patterns an accurate indication of the surface structure is obtained. The diffraction patterns tend more and more towards well-defined rings with decreasing crystal size and more random orientation, until eventually an effect similar to the Debye-Scherrer pattern is obtained. Experiments with thin films of nickel deposited on a copper surface show that the nickel crystals follow, up to a certain thickness, the orientation and size of the original copper crystals. As the thickness of the nickel film increases to about 30,000 A., the crystals orient themselves in directions independent of the original copper crystals, although ordinary microscopic examination indicates a continuance of the original orientation. Electron diffraction experiments have also been used for determining the chemical composition of thin surface films, where ordinary chemical analysis has failed; for example, the composition of the blue film on tempered steel razor-blades was successfully determined in this manner. Sir George Beilby's theory of surface liquefaction of solids during polishing has received experimental proof from electron diffraction experiments on polished surfaces, and extremely important work is being carried out in this field in connexion with the 'running-in' of machinery.

Pottery in the Palaeolithic Period

FURTHER evidence on the disputed question of the occurrence of pottery in the later phases of the palaeolithic period was brought forward by Mr. J. P. T. Burchell at a meeting of the Society of Antiquaries held on October 28. Pottery has now been found by him on several sites in the Thames Valley in circumstances which, he maintains, warrant a dating in Upper Palaeolithic times. At a site in the Bean Valley, Kent, which he has excavated recently, pottery occurs between the fourth and the fifth of a series of seven separate deposits of windborne loams. Of these deposits the lowest and oldest is linked with the glacial deposit on which it lies. The first four deposits in the series contain no sign of man, but with the pottery between the fourth and fifth deposits were bones and implements. It has been suggested that the pottery belongs to the bronze age, but Mr. Burchell maintains that the absence of any evidence of a mesolithic culture in the lower beds precludes that view. He relies further on the evidence of the occurrence of the extinct shell *Helicella striata* in beds 2-4. This shell has not been recognized as occurring after the Upper Palaeolithic period. Collateral evidence which possibly may appear more convincing was obtained at Springhead, in the Ebbsfleet Valley, Kent. Here implements similar to those found in the Bean Valley, as well as

those found at Ipswich, with the pottery for which Mr. Reid Moir claims a palæolithic age, were found in an unworn condition in a gravel bed underlying alluvium and peat and resting on a glacial bed. On top of the gravel occurred a large number of scrapers of a type not hitherto recognized and showing marked eolithic characters. These were striated, presumably by floating ice or the movements of semi-frozen material, indicating that the implements, and therefore, presumably, the pottery, dated from before the last glacial manifestation; in other words, that both pottery and implements belonged to Upper Palæolithic times.

Meteorite Craters

THE crater-lake of Kaalijärv, one of the group of craters on the Island of Oesel off the coast of Estonia, has been described on several occasions since 1827, and many suggestions have been made as to its mode of origin. In 1927 and 1929 Mr. I. Reinvald, Inspector of Mines in Estonia, made a detailed survey of the craters with borings and trenches, and he was himself convinced of their meteoritic origin, although he was then unable to find any traces of meteorites at the locality. With remarkable persistence he has again returned to the work of excavation, and in July last he was rewarded by finding in the smaller craters, Nos. 2 and 5, thirty small rusted fragments of nickel-iron, which on a polished and etched surface show a characteristic though rather unusual type of structure. These remnants of the Kaalijärv meteorite finally settle the question of the meteoritic origin of these craters.

ANOTHER meteorite crater has been discovered by Dr. C. T. Madigan, lecturer in geology at the University of Adelaide, during his recent expedition in Central Australia. This was found on the Box Hole station by Plenty River, which is about 200 miles north-east of the famous Henbury craters. It has the form of a shallow basin measuring 200 yards across the rim. During the brief visit no meteoric iron was found on the spot. Another noteworthy discovery made by Dr. Madigan during this expedition is a large meteorite of the rarer siderolite (stony-iron) type, which was seen on the Huckitta station near the Hart Range, about fifty miles from the crater and with no relation to it. It measures 4 ft. 5 in. long and 20 in. high, and is estimated to weigh 2-3 tons. This is considerably larger than any stony-iron meteorite previously recorded, including the original pallasite (Pallas iron) of about 700 kgm. found in 1749 in the Krasnoyarsk district in Siberia.

Distribution of Raw Materials

AN important aspect of the problem of access to raw materials is the consideration of their position with regard to export. This, among other bearings of the question, is discussed by Prof. I. Högbom, in the report of the League of Nations Committee for the Study of the Problem of Raw Materials (Geneva: League of Nations. London: G. Allen and Unwin, Ltd., 1937. 2s.). Prof. Högbom points

out that for certain minerals, the bulk of which is great in comparison to their value, anything more than a relatively short distance from the sea is an almost insuperable bar to exploitation. The same is true of the cheaper and bulkier vegetable products. Thus for many forms of raw material the potential production of the great colonial areas of the interior of Africa and of certain sovereign States is not commercially accessible. Transport cost and not occurrence is the decisive factor in availability. Thus coal and iron ore, if mining for local ore is left out of account, can be economically produced only in Europe, North America, certain parts of the Far East and elsewhere only in a coastal strip some sixty miles in width. The same applies to phosphates. Mineral oil is profitably exportable within about a hundred and fifty miles from the coast. More valuable ores such as tin, copper, manganese and chromium ores can be mined over a much wider area. Prof. Högbom has illustrated these conclusions in a map incorporated in the report.

The Empire's Mineral Wealth

THE leading article in the September issue of *Sands, Clays and Minerals* develops the theory that the Empire can be made in Dr. Johnson's words "rich beyond the dreams of avarice" by economic development of known mineral resources and by systematic exploration of every country within the Empire for hitherto undiscovered deposits. It is no longer practicable to await accidental discoveries of valuable mineral resources: they must be looked for scientifically. Admittedly an exhaustive Imperial mineral survey is a Herculean task, but certain suggestions are made which should go far towards this ultimate aim. It is too great a task for any private concern or individual, or indeed for any Government. It must be undertaken corporately by geologists, metallurgists, economists, Government officials, and others equipped for different phases of the investigation, all of whom must take a share of executive authority. Aerial survey is the means by which information can be obtained on the resources of every country, but this should be conducted on a more scientific basis than hitherto. Present-day mining and metallurgical technique should at the same time be scrutinized and improved wherever possible on the advice of experts. Moreover, ancillary investigations of transport systems, market conditions, currency, tariffs, banking and finance in general, should be undertaken in order to provide a central body with all the information necessary to co-ordinate survey results. Finally, the technical education of the coming generation of geologists, chemists, mineralogists and industrialists, and of the mature worker in these fields should be broadened to give an imperial view-point of mineral resources rather than a restricted outlook on one part only.

British Museum (Bloomsbury): Recent Acquisitions

RECENT accessions to the collections of the British Museum (Bloomsbury) reported at the October meeting of the Trustees include a number of ethnographical

and archaeological objects of exceptional interest. Among these is a war-drum presented by H.M. the King, which was captured from the Khalifa at Khartum in 1898 and given to Queen Victoria by Lord Kitchener. It is of the split-gong type, is made of wood, and is some seven feet long. It is shaped like an animal with a horned head at one end, and is carved with geometrical ornament in relief on the sides. A ceremonial staff from Ashanti, formerly the property of Nana Kobina Amponsah II, Ohene of Busumtwi Stool, has a gold top surmounted by a bird pecking two skulls. Sir Aurel Stein has now decided that the objects allotted to him by the Persian Government from the finds of his journeys of archaeological exploration in Iran should be sent to the British Museum, and the pottery and sherds from his third journey in 1934, on which he traversed the modern province of Fars in south-west Persia, have now been received. They date from well before 3000 B.C. and are of importance as showing affinities with such early sites as Susa and El Obeid in Irak.

THE Department of Oriental Antiquities has received an accession of exceptional importance in the form of five sculptured stone heads from the Buddhist cave temples of T'ien Lung Shan, near Taiyuanfu in Shansi, dating from the sixth to the tenth centuries A.D. They represent a highly developed phase of Chinese religious sculpture, of which very few examples are to be found in British collections. They were given through the British Ambassador in Tokyo by Mr. Kachiro Nezu as a token of friendship to the British nation. Among the British antiquities is a large Roman pottery basin, about seventeen inches in diameter, with figures of horsemen and floral design, which appear upside down. It was found by Colonel and Mrs. A. Ogilvie, by whom it is presented, inside a larger vessel in a kiln at Linwood in the New Forest. It dates from the third century A.D.

Fruit-Cooling Plant at Cape Town

IN *Electrical Industries* of August 11 a description is given of the largest pre-cooling plant in the world, dealing with the fruit exported from Cape Town docks. This installation, which was completed twelve years ago, has made it easy to ensure the low-temperature preservation of fruit as soon as possible after picking. It ensures also that the temperature of the fruit when loaded is comparable with that maintained in the ship's storage chambers on the voyage. Thanks to the Government policy of insisting on high standards and of providing research and educational facilities for fruit growers, the plant is now working at its full capacity and more accommodation is urgently needed. To meet this need, large pre-cooling chambers were projected, and when the entire scheme is completed next year they will have a capacity of 6,000 (shipping) tons. When the fruit trains reach the store from the country, they are shunted into the 'air-lock', a large asphalt-floored shed 74 feet wide by 900 feet long. The fruit is examined and tested there by the Government in-

spectors, and that which does not reach export standard is rejected. The standard fruit is then transferred by battery vehicles to the ship's side and by crane to the hold. The ammonia method being economically impracticable, the underground storage chambers are cooled by brine circulated through coils. At a considerably lower level is the large engine room containing electric transformers and ammonia compressors. An automatic recorder keeps a visible record of the temperature in every cooling chamber taken every eight minutes. The engine room is provided with an emergency lighting battery plant.

New "North-West Passage"

A BULLETIN from the office of the High Commissioner for Canada announces the receipt of a radio-telegram from the S.S. *Nascopie*, a vessel now under charter to the Canadian Government for the 1937 Arctic Expedition, in which it is stated that the vessel has effected the first crossing of Bellot Strait, forming a second North-West Passage across the Canadian Arctic. The strait separates Somerset Island from the Boothia Peninsula, the northern tip of Canadian mainland. The original "North-West Passage", the discovery of which was for many years the dream of Arctic navigators, as a short route from Europe to Asia, runs farther north than the Bellot route. So early as 1585, John Davis set sail to locate this passage, but it was not until 1903-7 that Captain Roald Amundsen made the voyage along Lancaster Sound, Barrow Strait and Peel Sound which defined the route. The Bellot route, a shorter and possibly better passage, has engaged the attention of Arctic explorers since 1858, when Captain Thomas McClintock, searching for the lost Franklin expedition, endeavoured to make his way through. The attempt, unfortunately, was futile, and other later attempts were equally unsuccessful. The Strait was discovered by Captain W. Kennedy in 1852, when he crossed it by dog-team. The appearance of the waterway is that of a Greenland fjord. It is about twenty miles long and barely a mile wide at its narrowest part. The shores are of granite formation of bold and lofty elevation, with a fair sprinkling of Arctic vegetation. Some of the hill ranges attain heights of 1,500-1,600 feet.

Symbols for Thermodynamical Quantities

THE report of a joint committee of the Chemical Society, Faraday Society and Physical Society on symbols for thermodynamical and physico-chemical quantities and conventions relating to their use has been published. It contains symbols for use in thermodynamics and physical chemistry, with explanatory matter. The objects of the joint committee, it is stated, were to correlate the views of chemists and physicists with regard to the use of symbols for thermodynamic quantities and to deal similarly with symbols for other quantities which are of interest to both chemists and physicists. The committee was very representative, and the report, which is a document of sixteen pages, is of considerable interest. The symbols and conventions of the report have

been adopted as recommended practice by the three societies responsible for it and by *British Chemical Abstracts*. Copies of the report may be obtained by non-members at 6d. per copy or 7s. 6d. per 25 copies, post paid, from the Assistant Secretary, Chemical Society, Burlington House, Piccadilly, London, W.1.

Biological Station in Memory of Pavlov

THE biological station being built at Pavlovo (formerly Koltushi) in memory of the late Prof. I. P. Pavlov is almost completed (Soviet Union Year Book Press Service). The department of evolutionary physiology of the Leningrad Branch of the All-Union Institute of Experimental Medicine is being transferred to Pavlovo, where it will be housed in a newly built laboratory, equipped with the most up-to-date appliances for research, and under the directorship of L. A. Orbeli. The reconstruction of Pavlov's own laboratory is now finished, as are also the new kennels and stables and administrative offices.

Richard Watson (1737-1816)

IN an article on the bicentenary of Richard Watson, professor of chemistry at Cambridge and afterwards Bishop of Llandaff, Prof. J. R. Partington (*Chemistry and Industry*, 56, 819; 1937) directs attention to his important experimental work, particularly on the freezing points of solutions of salts, and to the valuable information on contemporary chemical industries contained in Watson's "Chemical Essays". He gives reasons for concluding that some of the unfavourable criticisms of Watson are unjustified. Although Watson was ignorant of chemistry on his appointment to the professorship, he quickly made himself proficient in the subject and carried out original work of considerable merit, whilst his knowledge of pure and applied chemistry was certainly very extensive. Mr. J. P. de Castro (*ibid.*, p. 846) also directs attention to a portrait of Watson apparently engaged in lecturing on chemistry.

Science, Invention and Society

IN a paper entitled "Science, Invention and Society" at the second Congress on Industrial Physics, Pittsburgh, U.S.A., on May 22 (*J. Applied Physics*, 8, 449; 1937), W. Kaempffert, reviewing some of the technical aspects of society as well as the economic aspects of mass production, stresses the need for government to rely not on politicians but on experts. More organization and control are required. Social invention must become as systematic and as well organized as mechanical invention and scientific discovery if it is to keep pace with the laboratory. We can no longer make the utmost use of scientific and mechanical innovations without social adjustments and social invention. We do not yet know what form of government will be evolved to meet the social needs which have come with science and the machine. At present the tendency appears to be towards a collectivism in which private profit will be severely limited or abolished entirely. This in itself demands more expert control, and whatever form future democratic government may take, it

must be a government by technicians or experts. If democracy itself is to survive the increasing strain to which machine methods and scientific progress subject it, its own character must inevitably be immensely changed from that of eighteenth century egalitarianism.

Eighth International Conference of Genetics

WE are informed by Prof. O. L. Mohr, of Oslo, chairman of the International Committee of Genetics Congresses, that the question as to the place for the next International Congress of Genetics has now been considered and voted upon by the International Committee, which has by a large majority resolved to invite the British geneticists to arrange the next congress in Great Britain in 1939. The committee of the British Genetical Society has passed a resolution welcoming the invitation. British geneticists will shortly appoint an organization committee, after which further information concerning the date and place of the congress will be published.

Announcements

IT will be remembered that the late Lord Rutherford had consented to preside over the jubilee meeting of the Indian Science Congress Association to be held in Calcutta next January, which will be attended by a representative British scientific delegation organized by the British Association (see *NATURE*, October 9, p. 609). We are glad to announce that Sir James Jeans has consented to fill the vacancy caused by the lamented death of Lord Rutherford.

THE Society of Glass Technology will hold its twenty-first anniversary meeting on November 9-10, under the presidency of Prof. W. E. S. Turner, at Sheffield, where the inaugural meeting was held in 1916. On November 9, the Society will attend the laying of the foundation block for the new building at Elmfield for the University Department of Glass Technology, towards which the Society has already raised more than £1,500. The Wood Memorial Library will also be opened at Elmfield by Sir Frank Heath on the same day.

DR. H. LOWERY, principal of the North-Western Polytechnic, London, and honorary secretary of the London and Home Counties Branch of the Institute of Physics, has been appointed principal of the new South-West Essex Technical College at Walthamstow as from April 1938.

WE have received from British Drug Houses, Ltd., a priced catalogue of B.D.H. laboratory chemicals. This is a volume of more than two hundred pages, with thumb indexes, and includes indicators, reagents, microscopical stains, minerals and laboratory sundries. It is very gratifying to note what a wide range of chemicals of high quality of British manufacture are now available. The items include both inorganic and organic chemicals, and the prices are quoted for quantities based on the metric system. The address of the firm is Graham Street, City Road, London, N.1.

Letters to the Editor

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 811.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Development of the Spark Discharge

SOME time ago, one of us¹ photographed the long electric spark with a rotating camera and showed that a preliminary discharge occurred prior to the

former experiments under a variety of physical conditions and have now shown that the pre-discharge traverses the whole of the inter-electrode gap, and only after it reaches the opposite electrode

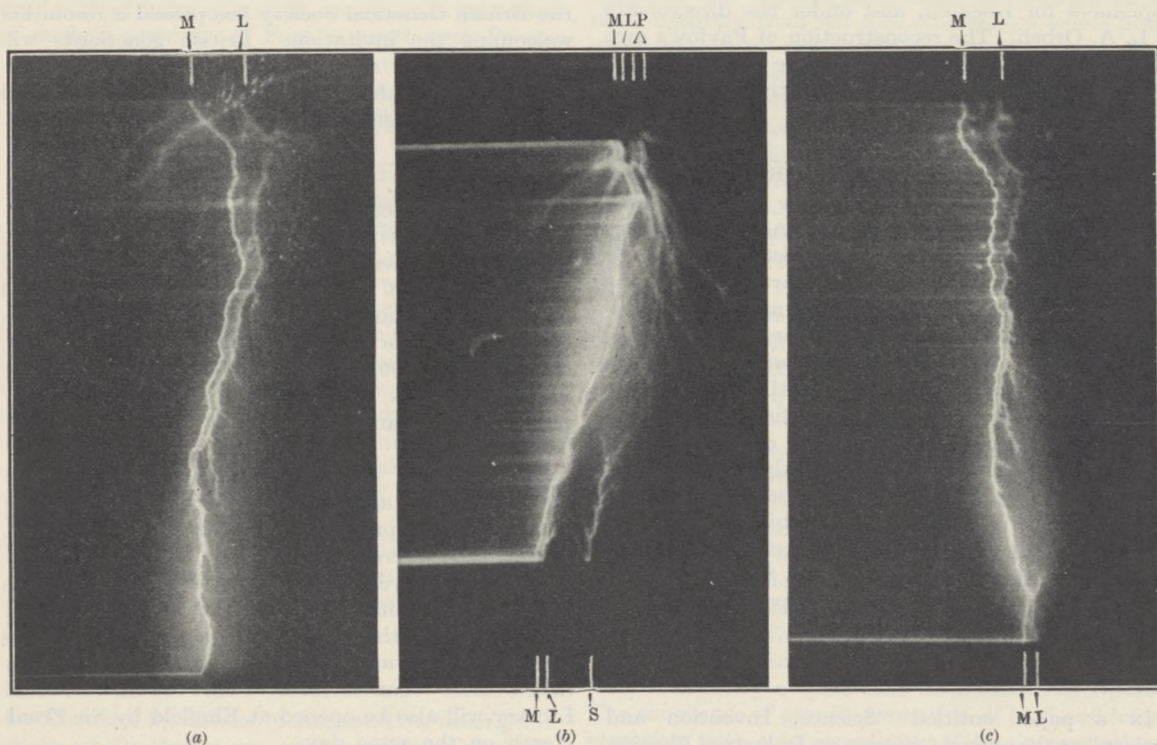


Fig. 1.

- (a) LEADER (*L*) AND MAIN (*M*) STROKE FROM POSITIVE HIGH-VOLTAGE POINT TO EARTHED PLANE.
 (b) LEADERS (*L*) AND MAIN (*M*) STROKE FROM NEGATIVE HIGH-VOLTAGE POINT AND FROM EARTHED PLANE.
P = TWO PREDISCHARGES AT THE CATHODE. *S* = INDEPENDENT STREAMER DISCHARGE RISING FROM THE PLANE ANODE.
 (c) LEADERS (*L*) AND MAIN (*M*) STROKE FROM POSITIVE HIGH-VOLTAGE POINT AND FROM POINTED PROJECTION ON THE EARTHED PLANE.

main spark, just as in the case of the lightning discharge studied by Prof. B. F. J. Schonland and others. The original photographs of the spark between a pointed high-voltage electrode and a plane earthed electrode showed the course of this 'leader' discharge for about 20 per cent of the inter-electrode spacing the luminosity diminishing with increasing distance from the high-voltage electrode. The time interval between the leader and the main stroke corresponded to the time-to-sparkover as recorded on the oscillograph. Leader strokes preceded positive and negative discharges.

We have recently had an opportunity of extending

does the main spark develop. Thus the pre-discharge is a 'leader-stroke' exactly analogous to the leader-stroke of the lightning flash. Fig. 1 *a* shows such a discharge at 600 kv. between a positive point electrode and an earthed plane; the time-interval between the leader and the return flash is 72 micro-seconds. The main stroke develops at a much higher speed than the leader stroke, so that it is possible to quote the average speed of development of the leader with fair accuracy. For a succession of sparks at this voltage its average speed was 1.9×10^8 cm./sec., but we have found that the speed increases as the leader approaches the opposite electrode.

When the high-voltage point is of negative polarity, the spark presents a rather different appearance. In addition to the leader from the high-voltage point, a leader also precedes the main stroke at the earthed plane, and the two leaders develop towards one another, meeting at mid-gap as in Fig. 1 *b* for a 900 kv. spark. This type of leader has not hitherto been observed in the lightning flash, but its appearance is not surprising, as upward directed streamers are often observed developing from a plane electrode in a negative field. The time interval between the negative leader and the main stroke at the cathode is generally greater than between the positive leader and the main stroke at the anode. The velocity of the negative leader in Fig. 1 *b* is 2.4×10^6 cm./sec. and that of the positive leader is 4.4×10^6 cm./sec. Generally one or more discharges develop from the cathode but fail to bridge the inter-electrode gap; however, they ionize a path which the final leader stroke takes. Two such pre-discharges can be observed in Fig. 1 *b* at the cathode.

If a pointed electrode projects out of the earthed plane for a fraction of the inter-electrode gap, a leader stroke develops from this point upwards irrespective of the applied polarity. Such a double leader is shown in Fig. 1 *c* for a positive high-voltage point electrode; the point at the cathode projects 4 in., and the gap is 40 in. In Figs. 1 *b* and *c* it will be seen that the leader stroke developing upwards from the earthed electrode is also branched upwards, and we have now definitely established that the direction of branching indicates the direction of propagation of the leader stroke, since the leader stroke is initially responsible for all branching. These results should suggest therefore that Boys camera photographs of upward branched lightning strokes will show upward propagation of the leader stroke.

Experiments at pressures down to one tenth atmospheric pressure substantiate the above and indicate that the time intervals between the leader and the main stroke increase rapidly with diminishing pressure.

We desire to thank Dr. A. P. M. Fleming for permission to publish this note.

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¹Allibone and Schonland, *NATURE*, **134**, 736 (1934).

Splitting of the Hæmocyanin Molecule by Ultra-sonic Waves

EMULSIONS and colloidal solutions may be produced by means of ultra-sonic waves^{1,2}. Compounds such as starch and gelatine are depolymerized^{3,4}. It seemed, therefore, of interest to study the action of sonic waves on high-molecular proteins such as the hæmocyanins, the molecules of which are of 'colloidal' size. In the investigation I used hæmocyanin from *Helix pomatia*, which has a molecular weight of 6,740,000, a sedimentation constant of 99×10^{-13} and which, upon change of the pH, gives three dissociation fragments with the sedimentation constants 62, 16 and 12×10^{-13} respectively (correspond-

ing to $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{6}$ molecules). These fragments may reversibly recombine to form the original molecule^{5, 6, 7}.

Dilute solutions of the hæmocyanin (0.1-0.4 per cent) were treated by sonic waves with a frequency of 250,000 per sec. and the effects were studied by means of the ultra-centrifuge. The solution of the protein was centrifuged before and after the treatment, and it was found that the sound-waves had partly split the hæmocyanin. The fragments obtained were uniform (monodispers) and were equal to $\frac{1}{2}$ and $\frac{1}{3}$ of the molecule, that is, in size corresponding to the fragments which are obtained by changing the pH. A solution of pH 6.2 containing only the original molecule gave after treatment 20 per cent of half molecules. A solution of pH 7.2 containing 64 per cent of the original molecule and 36 per cent half molecules gave 35 per cent original molecules, 44 per cent half molecules and 21 per cent eighth molecules. Usually the one-eighth molecule is obtained only when the pH reaches 8.0. The total concentration of the different kinds of soluble molecules was in most cases the same in the treated and in the non-treated solutions. In a few cases, however, when the initial solution was not clear due to precipitated hæmocyanin, a larger total concentration of soluble molecules occurs in the treated solution. In these cases the sound-waves may have brought a part of the precipitate into solution.

The action of the sound-waves was accompanied by a rise in temperature to about 40° C. Heat treatment alone at 50° C. of a solution with whole and half molecules did not, however, change the relative percentage of the two molecules. By heating to 60° C. non-uniform compounds of association were obtained.

The fragments, $\frac{1}{2}$ and $\frac{1}{3}$ molecules, formed by action of the ultra-sonic waves, do not, upon a change of pH from 7.2 to 6.2, show any tendency to recombine to the original molecule. Apparently there is a difference between the hæmocyanin molecule in the native state and that treated with sonic waves.

During the sonic treatment amino-acids or similar low-molecular compounds may have been split from the molecule. Since in some cases small amounts of such foreign substances are known to cause dissociation of proteins^{8,9}, this might be a possible explanation of the splitting of the hæmocyanin molecule to halves and eighths. Therefore the treated solution was dialysed before centrifuging, but the same results were obtained.

The electrophoretic properties were not changed by the treatment.

Details concerning the apparatus and results will be published elsewhere.

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¹Wood, R. W., and Loomis, A. L., *Phil. Mag.*, (7), **4**, 417 (1927).

²Freundlich, H., Söllner, K., and Rogowski, F., *Kolloidchem. Beih.*, **37**, 223 (1933).

³Szent-Györgyi, A., *NATURE*, **131**, 278 (1933).

⁴Szalay, A., *Z. phys. Chem.*, **A**, **164**, 234 (1933).

⁵Svedberg, T., *NATURE*, **139**, 1051 (1937).

⁶Svedberg, T., and Hedenius, A., *Biol. Bull.*, **66**, 191 (1934).

⁷Eriksson-Quensel, I.-B., and Svedberg, T., *Biol. Bull.*, **71**, 498 (1936).

⁸Lundgren, H. P., unpublished.

Action of Iodoacetate on Dehydrogenases and Alcoholic Fermentation

It is well known that iodoacetate produces a complete inhibition of alcoholic fermentation in yeast and of lactic acid formation in muscle even in very dilute concentrations ($M/3000$ or less). Up to the present, however, its mode of action and the precise point at which it attacks the catalytic systems are unknown, for none of the enzymes which has been tested is inhibited by such low concentrations. In high concentrations ($>M/20$) iodoacetate is a general enzyme poison and inhibits almost every enzyme tested. In moderate concentrations ($M/100$), it has no action on most enzymes and has hitherto only been shown to inhibit aldehyde mutase¹ and glyoxalase (the latter by an action not on the enzyme but on its coenzyme glutathione). These systems, however, are not inhibited by $M/3000$ iodoacetate, so that we must seek elsewhere for an explanation of its action on fermentation and glycolysis.

A systematic study of the action of iodoacetate on the dehydrogenases has not previously been made, but the results of such a survey are summarized in the accompanying table. It will be seen that while several of the dehydrogenases show a partial inhibition by $M/100$ iodoacetate, they are, with one exception, unaffected by a concentration of $M/3000$. The alcohol dehydrogenase stands out in a remarkable way as being the only dehydrogenase, and indeed the only enzyme, to be inhibited by this concentration. The inhibition becomes complete on slightly longer incubation.

Dehydrogenase	Source	% inhibition after 10 min. incubation with iodoacetate	
		$M/3000$	$M/100$
Lactic	Yeast	0	7
Alcohol	"	92	100
Triosephosphate (Hexosediphosphate)	"	5	95
α -Glycerophosphate	"	3	60
Lactic	Muscle	0	62
α -Glycerophosphate	"	0	42
Succinic	"	0	11
Fumaric	"	0	3
Malic	"	0	0
Xanthine	Milk	0	0
Aldehyde	"	0	5
Aldehyde mutase	Liver	0	95

The enzymes were prepared and tested with methylene blue at 38° and pH 7.4 essentially as described by Leloir and Dixon². Before testing, the enzymes were incubated at 38° for 10 minutes with the above concentrations of iodoacetate in the absence of substrates and co-enzymes. Owing to dilution on adding these, the iodoacetate concentrations during the actual tests were reduced to one half. The controls without iodoacetate were always incubated similarly before testing.

That the iodoacetate acts on the dehydrogenase (that is, Warburg's 'specific protein'; Euler's 'apodehydrase') itself, rather than on the coenzyme or on any enzyme-coenzyme complex, is clearly shown by the following experiment, which is made possible by the fact that the inhibition is not instantaneous but is set up by a time-reaction.

Thunberg tubes with hollow stoppers were used, so that either the enzyme or the coenzyme could be exposed to the iodoacetate during the preliminary incubation period. The reagents were distributed as follows:

In tube	In stopper
2 c.c. enzyme in phosphate	1 c.c. M alcohol
1 c.c. $M/2000$ methylene blue	0.2 c.c. cozymase
	1.5 c.c. phosphate, pH 7.4
	(0.3 c.c. $M/50$ iodoacetate)

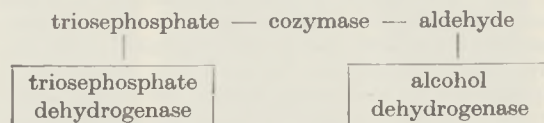
The tubes were evacuated and incubated for 20 minutes at 38° before mixing.

Tube	Contents	Reduction time at 38°
Tube 1	No iodoacetate	3 m. 0 s.
Tube 2	Iodoacetate in tube	∞
Tube 3	Iodoacetate in stopper	3 m. 55 s.

(Controls without cozymase or alcohol were negative.)

It will be seen that tubes 2 and 3 contained the same reagents, but these were differently distributed during the initial incubation. When the iodoacetate and enzyme were incubated together, complete inhibition resulted, but incubation of the coenzyme with iodoacetate had little effect. Another tube, as tube 2 but with the alcohol and methylene blue interchanged, gave almost as much inhibition, showing that the enzyme was not appreciably protected by the presence of its substrate.

The specific poisoning of the alcohol dehydrogenase by small concentrations of iodoacetate provides a possible explanation for the inhibition of alcoholic fermentation in yeast. This dehydrogenase (=the 'aldehyde reductase' of Warburg) is a reversible system, catalysing the reduction of aldehyde to alcohol as well as the oxidation of alcohol. According to v. Euler³, it plays an essential part in the main processes of fermentation, namely, the oxido-reduction reaction between triosephosphate and acetaldehyde, which we may represent as follows:



The aldehyde, activated by the alcohol dehydrogenase, is reduced to alcohol by activated triosephosphate, cozymase acting as a hydrogen carrier. If then the alcohol dehydrogenase is inhibited, this can no longer occur. Thus at any rate one point of attack of iodoacetate on the fermentation system has been found.

While this effect may be adequate to account for the inhibition of alcoholic fermentation, it is still possible that the iodoacetate acts also at some other point in the yeast system. In the glycolytic system of muscle, the lactic dehydrogenase, which occupies a position corresponding to the alcohol dehydrogenase in yeast, is completely resistant to dilute iodoacetate. These results, therefore, cannot account for the inhibition in muscle; the iodoacetate acts elsewhere in the muscle system and hence possibly in the yeast system also, in addition to the action described above. It is believed by many that iodoacetate acts on the initial stages of glucose fermentation by inhibiting the phosphorylating mechanism, for in yeast (unlike muscle) no glucose disappears and no intermediate products are found in presence of iodoacetate. But this is to be expected if we assume that the energy required for the phosphorylation is derived from the oxido-reduction, for inhibition of the latter process will obviously produce an indirect inhibition of the phosphorylation also.

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Oct. 5.

¹ Dixon and Lutwak-Mann, *Biochem. J.*, **31**, 1347 (1937).

² Leloir and Dixon, *Enzymologia*, **2**, 81 (1937).

³ v. Euler, Adler and Hellström, *Hoppe-Seyl. Z.*, **241**, 239 (1936).

Reaction between Proteins and Metaphosphoric Acid

In connexion with a publication by R. K. Schofield¹, we have prepared and analysed precipitates obtained from pure proteins with metaphosphoric acid.

1 c.c. of either egg albumen or clupein sulphate solution was mixed with 0.5 c.c. or 1 c.c. respectively 0.1 *n* metaphosphoric acid, centrifuged and washed with distilled water. When the washings were found free from proteins and metaphosphoric acid the precipitates were dissolved in concentrated sulphuric acid and analysed. (Content of precipitates of P and N in the table are mgm.)

Protein	Solution					Precipitate		
	Total N	Amino N		Total N/Amino N		Total N	Bound P	Ratio of total N to amino N calc. from bound P
		van Slyke	titr. ²	van Slyke	titr. ²			
Ovalbumin 1.8 per cent	3.1	0.22	0.25	14.0	12.5	2.99	0.49	13.2
						2.90	0.48	13.6
						2.90	0.46	13.9
						2.89	0.46	13.9
Clupein 1 per cent	2.18	Pos. charged amino N calculated		Ratio of total N to pos. charged amino N		2.18	1.06	4.55
		(3)	(4)	(3)	(4)			
		0.475*	0.475*	4.6*	4.55*			
		0.499	0.505	4.4	4.3			
						2.16	1.05	4.55
						2.14	1.02	4.70
						2.15	1.02	4.70

* Calculated for arginine.

The table shows a good agreement between the amount of phosphorus bound and the number of the free amino groups in the egg albumen and the number of positively charged amino groups (guanido groups of the arginin radicals) in the clupein.

We intend to publish a full report of this work later, but we mention these results because according to some workers⁵ the products obtained with precipitants of this kind should have no fixed composition, whereas other investigators⁶ suppose them to be true salts.

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¹ Schofield, R. K., *Trans. Farad. Soc.*, (1) 31, 164 (1935).

² Linderström-Lang, K., *Compt. rend. Lab. Carlsberg*, 17, 4 (1935).

³ Waldschmidt-Leitz, E., Ziegler, F., Schäffner, A., and Well, L., *Hoppe Seylers Z.*, 197, 219 (1931).

⁴ Linderström-Lang, K., and Rasmussen, E., *Compt. rend. Lab. Carlsberg*, 20, 10 (1935).

⁵ Dulliere, W. L., and Mine, R., *Compt. rend. Soc. Biol.*, 25, 1040 (1937).

⁶ Meyer, K., Palmer, W. Y., and Smyth, E. M., *J. Biol. Chem.*, 119, 501 (1937).

Action of Auxin on Protoplasmic Streaming

STUDIES on the mechanism by which auxin exerts its growth-promoting action on plant cells have indicated that, although ultimately detectable on the cell-wall, the effect is exerted in the first instance on the protoplasm. The results of Bonner¹ established a close connexion between growth and respiration, although pure auxin was not found, either by him or by van Hulssen², to increase respiration appreciably.

In an attempt to analyse the initial stages of auxin action, we have studied protoplasmic streaming in the epidermal cells of *Avena* coleoptiles. The streaming rate, as was shown by Bottelier³, is dependent upon oxygen supply. Low concentrations of indole-3-acetic acid, from 0.003 to 0.02 mgm. per litre, accelerate the streaming. Coumaryl-acetic and allocinnamic acids, which also possess growth-promoting activity, have a similar effect. The acceleration is ordinarily transient, lasting only about 30 minutes, but if after a lapse of a further 30 minutes auxin is again added, a second acceleration similar to the first is obtained.

When, however, fructose is added with the auxin, the acceleration is maintained for at least two hours. The limiting factor is, therefore, the carbohydrate supply.

The effect of higher concentrations of auxin depends upon the oxygen supply. In 5 cm. coleoptiles, if ample oxygen is available, all auxin concentrations up to 5 mgm. per litre cause about the same acceleration. If oxygen is more nearly limiting, the auxin causes a retardation of streaming. This retardation is removed by oxygen, but is increased

by dinitrophenol. We therefore conclude that auxin accelerates a respiratory process which controls streaming, and of which carbohydrate is the substrate. Auxin must also accelerate another respiratory process which, by consuming the available oxygen, makes the first process oxygen-deficient and hence retards the streaming. Both processes together probably make up only a small part of the total respiration of the coleoptile.

In younger (3 cm.) coleoptiles, the respiration rate is greater and consequently the streaming soon slows down in presence of insufficient oxygen. If auxin, 0.01 mgm. per litre or above, be added, the retardation is more rapid. On the other hand, if histidine, 6×10^{-7} molal, be added, this retardation is delayed. Since histidine alone does not accelerate streaming, it follows that histidine decreases the consumption of oxygen by those processes which do not control streaming. This may explain the well-known experiments of Fitting on *Vallisneria* leaves, in which the streaming, after stoppage, is retarded by dilute histidine solutions.

The respiration of the coleoptile must therefore be regarded as comprising at least three processes:

- (1) A reaction oxidizing sugar, which controls the rate of streaming and of growth; accelerated by auxin, not affected by histidine or dinitrophenol.
- (2) A reaction oxidizing sugar, which does not affect the rate of streaming; accelerated by auxin.
- (3) Other oxidative reactions, which do not affect streaming or growth; insensitive to auxin, accelerated by dinitrophenol, inhibited by histidine. These reactions account for the larger part of the observed oxygen consumption.

On this view the rates of streaming and of growth are controlled by the same process, and thus the

effect of auxin on streaming is probably one of the first stages of its effect on growth. This agrees with the rapidity of its action, the acceleration of streaming beginning within two minutes of auxin application. Correspondingly, those concentrations of auxin which affect streaming in coleoptiles with ample oxygen supply, show close agreement with the concentrations which affect growth in measurements made over the same short period. Thus the effects of auxin on streaming, and presumably also on growth, arise from the acceleration of a respiratory reaction.

Harvard University
Biological Laboratories.
Cambridge, Mass.
Sept. 30.

KENNETH V. THIMANN.
BEATRICE M. SWEENEY.

¹ Bonner, J., *J. Gen. Physiol.*, **20**, 1 (1936).

² van Hulssen, C. J., Dissertation, Utrecht (1936).

³ Bottelier, H. P., *Rec. trav. bot. néerl.*, **32**, 287 (1935).

Photoperiodic After-Effect

SEVERAL workers, notably Eghis, Rasumov and Dolgušin, claim to have demonstrated a photoperiodic after-effect with short-day plants, that is, an acceleration of flowering in such plants exposed to short days during the early stages of growth and afterwards grown in long days. This work has been done mainly on cereals and fodder plants, and so far as we are aware the existence of such an after-effect has not been demonstrated with any ornamental flowering plants.

Experiments have been in progress for some time in this department with a Mexican short-day plant, *Tithonia speciosa*. During this year the existence of a photoperiodic after-effect has been demonstrated. Seeds were sown in a glasshouse on April 19, and some of the seedlings covered with black shades from 5.0 p.m. to 7.0 a.m. daily (10-hour day), from germination. Sixteen plants received five weeks of short-day treatment and a similar number seven weeks. A further sixteen plants received the normal day length of fourteen to sixteen hours. All plants were planted in the open (in four randomized plots) on June 9. The first flowers of the seven-week treatment plants opened on June 21. The mean number of days from sowing to opening of the first and second flowers respectively for each treatment were as follows:

	Untreated	Five-week treatment	Seven-week treatment
No. of days to first flower	127	80	71
No. of days to second flower	136	97	83

This acceleration in flowering date was accompanied by a change in the entire habit of the plants. The control plants grew to the normal height of more than six feet with a thick, straight, main axis and lateral branches bearing very large leaves, deeply lobed. The plants receiving the longer short-day treatment were, in contrast, much less in height (about 2-2½ feet) freely branched, with in many cases no well-developed main axis and with unlobed leaves about a third of the normal size. The plants of the remaining treatment were intermediate in character.

The early-flowering habit of the treated plants was maintained throughout the season. The total number

of flowers produced by the sixteen plants of each series up to September 21 was as follows:

	Untreated	Five-week treatment	Seven-week treatment
Total no. of flowers (16 plants) ..	231	616	855

Further experiments will be carried out to determine the minimum exposure to short-day necessary to produce an effect, the maximum day-length, relation to temperature, etc.

R. H. STOUGHTON.
D. R. HOLE.

Department of Horticulture,
University, Reading.
Oct. 8.

Flaked Flints from the Bone Beds of Bethlehem

OWING to absence abroad, I have not been able to write sooner on the subject of the very interesting article on "The Bone-Bearing Beds of Bethlehem" in *NATURE* of September 4.

I visited the Bethlehem site several times while Miss Bate and Miss Gardner were working on it in the spring of 1935, and was able to see the geological conditions described by Miss Gardner so far as they were then exposed. In July of this year I visited the Wellcome Museum with Miss Caton-Thompson in order to examine the flints which are thought to be artefacts, and came to the conclusion that none of them showed any flaking that could not be explained by the action of the mechanical forces to which they had admittedly been subjected. In contrast with the sub-Crag industry, there is an absence of flakes showing anything that could truly be described as a bulb of percussion, and the edge-trimming, which has rightly been compared with that of the Harrisonian eoliths, is of the vertical type well known as an effect of flaking by pressure in the soil.

A few weeks after I had seen the flints, Miss Gardner and I were able, by kind permission of Mr. Starkey, to show the whole collection to the Abbé Breuil, who was passing through London. He examined the flints and studied Miss Gardner's sections at some length, and his final opinion was that none of the specimens showed any flaking that could not be explained by the condition of the deposit in which they were found. He compared the Bethlehem site with that of Saint-Prest, near Chartres, where a hollow in the chalk had been filled up with an *argile à silex* yielding remains of *Elephas meridionalis*. The associated flints, which he said closely resembled those from Bethlehem, had at one time been claimed as artefacts by the Abbé Bourgeois and others, but were now generally admitted to be flaked by mechanical action.

Miss Caton-Thompson has herself stated and discussed so clearly the case for and against the human origin of the Bethlehem flints that further comment is scarcely necessary. I differ from her only in her final conclusion that these specimens are "less easy reasonably to explain as the accidental work of natural forces, than as the deliberate experimental work of man. . . ."

D. A. E. GARROD.

One Huntingdon Road,
Cambridge.
Oct. 8.

Meteorites: the Number of Pultusk Stones, and the Spelling of "Widmanstätten Figures"

(1) Since writing my first note¹ I have come across a passage in meteorite literature which, I think, definitely establishes the view that the high figure usually quoted for the number of Pultusk stones was based on a reasonable estimate and was not due to a misreading of a Warsaw publication, as suggested by Dr. Stenz². Daubr e³ mentions this very publication, and refutes energetically the low figures therein given as being "bien loin de la r alit ". He knows already (August 1868) of more than 3,000 stones actually found, and emphasizes the exceptionally unfavourable circumstances for their collection. So, evidently, it was not ignorance of the statement made by the Haute  cole de Varsovie, but opposition to it, based on more extended knowledge which induced French, Austrian and German authorities to adopt the high value for the total number of the stones.

Dr. L. J. Spencer's contribution⁴ to the question contains interesting details about the transfer of Pultusk stones from the Krantz collection to that of the British Museum. He is right in saying that I over-estimated the proportion of small stones originally present in the former. While the expression used by vom Rath is ambiguous, fortunately it happens that in a paper by Buchner⁵ definite figures are given concerning the unsorted material which had been collected for Dr. Krantz. The average weight of Krantz's 2,012 stones was 61.2 gm. His collectors seem to have paid somewhat more attention to the small stones than did those of Daubr e—who had 942 stones of an average weight of 67.5 gm.—but even in Krantz's material the small stones were certainly not represented in the same proportion as in the original shower, because of the difficulty, or impossibility, of finding them. For other reasons (as Dr. Spencer puts it, because "the best museums strive to acquire the best specimens") there is a further shift towards the big stones in most of the museum collections. In the British Museum the average weight of the Pultusk stones is as high as 252 gm.

A characteristic feature of the Pultusk shower was the high proportion of small stones. None were collected of less than 1 gm., but the reports mention black 'dust', and we know that in meteorite showers of this type the stones between 0.1 gm. and 1 gm. may outnumber all those between 1 gm. and 10 kgm. Statements as to the supposed total number of stones should be accompanied by an indication as to the supposed average weight; to speak of 100,000 Pultusk stones may be misleading if the reader, or visitor, visualizes the average composition of certain museum collections. The weight of the total shower was perhaps only a small multiple of the 200 kgm. recovered, while 100,000 stones of the British Museum quality would make a total weight of more than 25,000 kgm.

(2) As to the spelling of "Widmanst tten figures", the issue now simply is whether we want to adopt the form of the name used by other members of the family, or the one chosen by the man himself. Dr. Spencer prefers the former alternative; those who share his opinion should speak of Beckh-Widmanstetter figures, or simply Beckh figures, for Beckh is the real family name. The discoverer of the etching figures, however, had dropped the Beckh entirely, called himself Widmanst tten, and was officially and privately known under this name.

Since Dr. Spencer does not appear to dispute this fact, I do not think it necessary to quote more of the historic material from the Austrian archives than was given in my first note; but I should like here to express my thanks for all the trouble they have taken in making, or answering, inquiries, to Dr. H. A. Beckh-Widmanstetter, and Profs. H. Benndorf, A. Lecher, S. Meyer and P. Puntschart. I am especially indebted to Prof. S. Meyer for collecting and forwarding the material to me.

F. A. PANETH.

Imperial College of Science and Technology,
London, S.W.7.
Oct. 9.

¹ NATURE, 140, 504 (1937).

² Stenz, E., NATURE, 140, 113 (1937).

³ Daubr e, A., *Compt. rend.*, 67, 369 (1868).

⁴ Spencer, L. J., NATURE, 140, 589 (1937).

⁵ Buchner, O., *Poggendorff's Annalen*, 136, 589 (1869)

The Sign and Symbol of Heat of Reaction

THE recent report of the Joint Committee of the Chemical, Faraday, and Physical Societies on Symbols for Thermodynamical and Physico-Chemical Quantities may be taken as an occasion for some remarks on the sign and symbol of heat of reaction and allied quantities. As is familiar, the heat of a reaction may be defined as the heat generated or *lost by the system*, when unit mass of reactants passes into resultants, the unit of mass being the number of grams represented by the sum of the molecular weights multiplied by their respective coefficients on either side of the chemical equation.

Confining ourselves for present purposes to constant pressure conditions, and representing the enthalpy of the system by H , the mass of resultants in the above units by m , the heat of reaction is expressed by $-\partial H/\partial m$. If the process considered is that of solution, the same expression holds, the unit in which m is expressed being either the gram or the mol according to convenience. In contrast to these 'chemical' cases, we have the 'physical' cases of fusion and evaporation. In fusion, the solid is the reactant, the liquid the resultant, but here the heat of fusion is defined as the heat *taken up by the system*, and is expressed by $+\partial H/\partial m$, a similar expression holding for heat of evaporation.

These facts illustrate a fundamentally different outlook on the part of the physicist and the chemist. Considering the matter thermodynamically, the universe, regarded as an insulated system, is divided into two portions, the 'system considered', and the 'surroundings', which obviously include the observer. All changes of total energy and all reversible changes of available energy in these two portions are equal but of opposite sign. The physicist concentrates his attention on the former, the chemist tends to concentrate his on the latter portion. This has in the past gone beyond the instances considered, and some physical chemists of unassailable position have used ordinary thermodynamical symbols to express the negative values of the quantities usually associated with them.

With the view no doubt of counteracting the confusion thus created, the Bunsen Gesellschaft some years ago recommended that whereas quantities entering a system should be indicated by ordinary symbols, the quantities leaving the system should be indicated by the same symbols with a minus sign or bar drawn through them. I

should have liked to extend this recommendation, and to express the negative values of most thermodynamical functions where suitable by their signs with a bar drawn through them.

This leads us to the recently issued report. Although slightly diffident in view of its general excellence, and the distinguished names attached to it, I am yet impelled to enter a protest against a group of condemnations or bans contained in it on page 6. They are as follow: (1) The ban on the use of bars discussed above. (2) The ban on the use of a single symbol for such familiar concepts as heat of reaction. (3) An implied ban on the employment of simple thermochemical equations as hitherto used. A mode of expressing thermochemical data is given. I am in agreement with this for purposes of tabulation, although a purist might correctly object that the thermodynamical expression adopted for heat of reaction endows it with the dimension of "calorie" instead of "calorie per equational mol". Most readers of the report will, however, infer that the ordinary thermochemical equations of the past, all the symbols of which represent fully defined mathematical quantities, and which can therefore be treated by the ordinary methods of algebra, are banned. (4) The ban on the use of symbols such as U to express changes or differences in the magnitudes represented. When we remember that such symbols are by original definition referred to an arbitrary zero condition, it becomes obvious that by making the 'reactant' state the arbitrary zero, the quantity ΔU becomes equal to U , and an insistence on the use of Δ is unnecessary. Arising out of this ban we have the abbreviations proposed for $X_2 - X_1$, which are as long as the expression abbreviated. I prefer the symbol X_{2-1} , which is clear, and useful in such cases, say, as the summing of potential differences, etc.

HENRY J. S. SAND.

Sir John Cass Technical Institute,
E.C.3.
Oct. 2.

Effect of Viscosity on Ionic Mobilities

IN the course of some measurements of electrolytic conductivity, I have determined the effect of increasing concentrations of phenol upon the equivalent conductance of a very dilute solution of hydrochloric acid in water at 25°. Using the viscosity data of Swearingen¹, m is found to be 1.000 in the equation $\lambda' = \lambda F^m$, where λ' is the measured equivalent conductance, λ the predicted equivalent conductance in the absence of phenol, and F the relative fluidity of the phenol solution. Above 0.30 normal phenol concentration, m becomes increasingly less than 1. Stokes's law would predict $m = 1$. The concentration of hydrochloric acid was 10^{-4} normal.

This type of measurement is of particular interest for the following reason. The deviation of the stoichiometric ionization constant of a weak acid from the Debye-Hückel limiting law: $\log K_T = \log K_S - 1.013\sqrt{C_i}$, where K_S and K_T are the stoichiometric and thermodynamic ionization constants respectively, and C_i the ionic strength, can only be explained by a decrease in the ionic mobilities as the proportion of unionized acid increases. Progressive change in the activity coefficients of the ions and molecules concerned can explain only a small fraction of the deviation. This is clearly shown by the work of MacInnes and Shedlovsky² on acetic acid, and by similar investigations on propionic and

normal butyric acids which I shall publish shortly. Davies³ was the first to point out that if mobilities are corrected for viscosity according to the simple law $\lambda' = \lambda F$, the observed deviations largely disappear. This is an indirect demonstration that viscosity is mainly responsible for what MacInnes and Shedlovsky term the medium effect.

It is not feasible to measure the medium effect directly, but the kind of experiment I have performed for phenol approximates closely to a direct method, since, due to the high mobility of hydrogen ion, the effect on hydrogen and chloride should not differ markedly from that on hydrogen and phenate ions. The ionization of the very weak phenol will be inappreciable in the presence of hydrochloric acid.

Many years ago experiment⁴ showed that for various systems the exponent m differed widely from 1. It is to be wondered whether, if these experiments were to be repeated to-day with all the benefits of modern technique, m would not turn out to be 1, at least at the lower concentrations of the non-electrolyte.

I understand that Dr. Shedlovsky has made a similar investigation of the medium effect in acetic acid. It is hoped that he will be stimulated to publish these experiments, which precede mine by many years.

DONALD BELCHER.

Laboratory of Physical Chemistry,
Cambridge.
Sept. 24.

¹ Swearingen, *J. Phys. Chem.*, **32**, 785 (1928).

² MacInnes and Shedlovsky, *J. Amer. Chem. Soc.*, **54**, 1429 (1932).

³ Davies, *Phil. Mag.*, **4**, 249 (1927), and "The Conductivity of Solutions" (1933), p. 141.

⁴ Green, *J. Chem. Soc.*, **83**, 2023 (1908).

Neutrino Theory of Light in Three Dimensions

THE neutrino theory of light is based on a fundamental hypothesis of Jordan¹, according to which the emission of a photon must be considered either as emission of two 'coherent' (parallel) particles—neutrino and antineutrino—or as a kind of neutrino Raman effect, without change of direction. This hypothesis permitted Jordan to construct, in the one-dimensional case, the Bose amplitudes required for photons, from the neutrino amplitudes which satisfy the Fermi statistics.

When attempting to construct the commutation rules in the three-dimensional case, the main difficulty is to obtain coherent emission of neutrino and antineutrino².

We should like to propose the following three-dimensional generalization of the one-dimensional expression given previously³ for the relation between the amplitude of photon (b) and neutrino or antineutrino respectively (a or c , respectively):

$$b(\mathbf{k}) = \lim_{\sqrt{2}} \frac{\varepsilon_i}{\sqrt{2}} \int d\mathbf{l} \left\{ \frac{a^+ + (1)a(1+\mathbf{k}) + c(1+\mathbf{k})c^+(1)}{[\sqrt{(\mathbf{k}+1)^2 + k_0^2} - \sqrt{l^2 + k_0^2} - k] \sqrt{[(\mathbf{k}+1)^2 + k_0^2][l^2 + k_0^2]}} - \frac{c(\mathbf{k}-1)a(1)}{[\sqrt{(\mathbf{k}-1)^2 + k_0^2} + \sqrt{l^2 + k_0^2} - k] \sqrt{[(\mathbf{k}-1)^2 + k_0^2][l^2 + k_0^2]}} \right\}$$

$$\text{where } \varepsilon = \mu \sqrt{\frac{c^3}{4\pi h}}, \quad k_0 = \frac{\mu c}{h}, \quad d\mathbf{l} = dl_x dl_y dl_z$$

and μ is the mass of neutrino.

With $b^+(\mathbf{k})$ constructed analogously, the required Bose commutation rules are verified immediately for $b(\mathbf{k})$ and $b^+(\mathbf{k})$ if the amplitudes of neutrinos and antineutrinos obey the Fermi statistics, and if all the states above a certain one are unoccupied.

Regarding ε as the 'charge' of neutrino, we see that the coherence condition is fulfilled, both 'charge' and mass of the neutrino particles tending to zero, but their relation remaining finite and equal to

$$\sqrt{\frac{c^3}{4\pi h}} \text{ (neutrino) and } -\sqrt{\frac{c^3}{4\pi h}} \text{ (antineutrino).}$$

In the same way, it is possible to take into account the spin of neutrino particles and to obtain a formula⁴ correspondingly generalized.

A. SOKOLOW.

Siberian Physical-Technical Institute,
Tomsk.
Sept. 13.

¹ Jordan, P., *Z. Phys.*, **93**, 464 (1935).

² cf. Jordan, P., and Kronig, R. de L., *Z. Phys.*, **100**, 569 (1936).

³ Sokolow, A., *NATURE*, **139**, 1071 (1937).

⁴ cf. Sokolow, A., "On the Neutrino Theory of Light (three dimensional case)", *Phys. Z. Sowjetunion*, in the press.

Dry Crossing of the Nile

READERS who have followed the correspondence under this head^{1,2} may be interested to learn that the dry crossing, which is situated at a point some

10½ miles downstream of Nimule, is definitely reported by Mr. N. B. Watney, district commissioner, West Nile, to be breaking up³.

My original informant, a native, told me that the crossing formed in 1917, disappeared in 1921, and reformed about 1930—it was certainly well in evidence when I first saw it from the air in the following year. Tradition has it, I learnt, that the dry crossing forms in times of famine and disappears in times of plenty. Recorded famine years are 1898, 1908, 1918–19 and 1928. Thus if these figures are any guide, we should be on the verge of another famine; but administrative precautions in this regard have been well in hand for some time.

Dr. Hurst suggests¹ that he saw the beginnings of this dry crossing in 1924, but it seems that this is not so, for the sudd he refers to was "at a point where the river narrowed suddenly". This it does not do at the dry crossing, and a satisfactory explanation of its repeated formation at that particular spot has yet to be found.

There is a mistake in my original letter¹; "1930" should read "1931".

E. J. WAYLAND.

Geological Survey Office,
Entebbe, Uganda.
Oct. 14.

¹ *NATURE*, **139**, 961 (June 5, 1937).

² *NATURE*, **139**, 994 (June 12, 1937).

³ *Uganda Journal*, **4**, No. 4, 350 (May 1937).

Points from Foregoing Letters

PHOTOGRAPHS taken with a rotating camera by Dr. T. E. Allibone and J. M. Meek show that, in laboratory spark discharges as in lightning, a pre-discharge or 'leader stroke' traverses the whole of the inter-electrode gap before the main discharge occurs. The leader stroke begins from one or both electrodes, travelling at a rate of 20–40 km. per second (faster at reduced pressures). Its direction may be deduced from the branching of the discharge.

The hæmocyanin molecule is split into halves and eighths by means of ultra-sonic waves with a frequency of 250,000 per sec. This is inferred by Sven Brohult from sedimentation experiments carried out with the ultra-centrifuge.

Dr. M. Dixon states that iodoacetate, in the concentration required to abolish yeast fermentation, completely inhibits the alcohol dehydrogenase but does not affect any other dehydrogenase tested. This may explain the inhibition of the fermentation. The action is on the enzyme itself and not on the coenzyme or an enzyme-coenzyme complex.

When egg albumen is precipitated with metaphosphoric acid, the ratio of 'bound' phosphorus to nitrogen corresponds to the free amino groups in the albumen, according to Dr. H. Herrmann and G. Perlmann. If clupein solution is used, the ratio corresponds to the number of positively charged amino groups in the clupein molecule.

The growth-promoting hormone, auxin, accelerates the streaming of protoplasm in cells of coleoptiles of young oats, according to Prof. K. V. Thimann and Miss B. M. Sweeney. The effect lasts about half an hour, longer if fructose is added; oxygen supply also is a factor. The authors conclude that the respiration of the young oat coleoptiles comprises at least three processes: one, accelerated by auxin, controls proto-

plasmic streaming and growth; another, also accelerated by auxin, oxidizes sugar and accelerates growth but does not affect streaming; other oxidation reactions which do not affect streaming or growth and are not affected by auxin, are influenced by substances such as histidine and dinitrophenol.

Prof. R. H. Stoughton and D. R. Hole find that, as in the case of cereals and fodder, when the short-day ornamental Mexican plant *Tithonia speciosa* is exposed to short days during the early stage of growth and afterwards to long days, there is a notable acceleration of flowering, and a change in the entire habits of the plant.

Dr. H. J. S. Sand criticizes some of the recommendations made by the Joint Committee of the Chemical, Faraday and Physical Societies on Symbols for Thermodynamical and Physico-Chemical Quantities, namely, its ban on (1) the use of symbols with a bar drawn through them to indicate quantities leaving the system; (2) the use of single symbols for familiar concepts such as the heat of reaction; (3) the employment of simple thermochemical equations as hitherto used; (4) the use of symbols such as *U* to express changes or differences in the magnitudes represented.

Mr. Donald Belcher finds that, in aqueous solutions of phenol at 25°, the ionic mobilities of hydrochloric acid are proportional to the fluidity to a high degree of accuracy up to 0.3 normal phenol. If this is true for other systems, it is of importance in the interpretation of dissociation constants as determined from conductance measurements.

A. Sokolow proposes a formula for the relation between the field of the photons and neutrino in the three-dimensional case.

Research Items

Boats of Victoria Nyanza

THE question of the origin of the boats of Victoria Nyanza is raised by Mr. G. W. B. Huntingford (*Man*, September) in reference to a suggestion by Mr. J. Hornell that they were due to a possible Indonesian migration to the highlands of Kenya or a long-continued contact with Indonesia along the east coast of Africa. Mr. Hornell pointed out that the peculiar features of these boats, a bifid bow and penetration of the thwarts through the side planks, are features of Javanese and Maduran construction. Mr. Huntingford argues that there are no other traces of Indonesian influence in the Lake region. The Nyanza boats have nothing in common with the coast boats, and there is no sign of Indonesian influence in the Kenya highlands. The enlarged false prow of the Nyanza boats may be an African adaptation without understanding of the branch found on drawings of early Egyptian boats. The Bantu may have taken it over from the Nilotes. Further, both the Egyptian and the Scandinavian types may have originated in Crete. A clay model (Early Minoan I) has something that looks remarkably like a bifid prow. In the same issue of *Man*, Mr. Hornell replies. Against the Egyptian origin, the Egyptians always pegged, and never sewed, the planking of their boats; and the beak of the bifid prow has been much exaggerated in representation. It is not structural but ornamental. Against the argument for an indigenous origin is the lack of skill in boat-construction of the Bantu. As regards the argument against Mr. Hornell's hypothesis of an Indonesian origin, there are cultural features suggesting Indonesian influence in Tanganyika; and there are resemblances to the present-day coast boats in, for example, the sewn planks which characterize Nyanza boats. The absence of outrigger is not vital.

Ethnology of Wallis Island

UVEA (Wallis Island) was visited by Mr. Edwin G. Burrows in 1932 for the purpose of furnishing a report on the ethnological relations of the inhabitants (*Bernice P. Bishop Museum, Bull.*, 145). The nearest islands are Futuna (112 miles), Samoa (186 miles), Fiji (240 miles) and Tonga (332 miles). Uvea has an area of 23 sq. miles. It has been known to Europeans since 1767; and since 1837 there has been a French Catholic Mission in the island, which has strongly affected the culture of the inhabitants, especially in such matters as marriage. The population is increasing. In 1837 it was estimated at not more than three thousand. In 1923 it numbered 4,878. In physical appearance the inhabitants are described as tall, light brown to copper, robust and well proportioned. The cranium is brachycephalic, but occipital flattening is practised. The language is a dialect of Polynesian. Kinship governs social and economic groupings, but politically is important only as limiting succession to titles, the political unit following territorial lines regardless of kin. Yet there are indications that the names of certain villages indicate clusters of kinsfolk. Exogamy has been supplemented by church regulation of marriage.

Brother and sister avoidance formerly was very strict. Polygyny was formerly permitted to certain chiefs. There is no term in the language for the biological family, and the recognized kinship group is the lineage, tracing descent from a common ancestor through the father. The mother-line is recognized secondarily. The nucleus of the kin is the group sharing a homestead. The culture relation is Western Polynesian with elements from Tonga and other islands.

Linkage Relations of Parallel Mutations in *Drosophila*

A COMPARISON of the known genes in *Drosophila melanogaster* and *D. pseudo-obscura* is made by Dr. A. H. Sturtevant and Dr. C. C. Tan (*J. Genetics*, 34, No. 3). Some 25 new mutations of *D. pseudo-obscura* are pointed out as parallel or homologous to those of the other species, in addition to 29 already known; but their arrangement in the chromosomes is different in the two species. *D. pseudo-obscura* has 5 pairs of chromosomes whereas *D. melanogaster* has 4 pairs. The right arm of the X-chromosome in *D. pseudo-obscura* is also known to be homologous with the left arm of chromosome III in *D. melanogaster*. Four or five other species appear to agree in having a two-armed X-chromosome like that of *D. pseudo-obscura*. Chromosomes III and IV of *D. pseudo-obscura* are joined to form II of *D. melanogaster*. The mechanism by which such exchanges of chromosome arms can have happened is discussed. The linkage relationships show that many rearrangements of genes within the arms have taken place, and that since these two species diverged from a common ancestor, at least nineteen such inversions have occurred and become established. By similar methods it is hoped to work out the phylogenetic relationships of other species in the genus, such as *willistoni*, *virilis*, *hydei* and *funbris*.

A New Blow-fly Repellant

FOR the prevention in sheep of myiasis, which exacts a heavy toll in most sheep-rearing countries, many tests have been carried out with a multitude of chemicals, without revealing any thoroughly satisfactory repellant for blow-flies. In Great Britain the most promising recent dip is W. Moore's oil emulsion dip containing paradichlorobenzene used by the team of workers at Aberdeen under Prof. James Ritchie, but every new suggestion should be thoroughly tested. H. O. Mönning has been experimenting with some oils of common South African plants and shows that steam-distilled oil of *Tagetes minima* has strong repellant properties for blow-flies and that it is suitable for use in a blow-fly dressing. (*Onderstepoort J. Vet. Sci. Anim. Ind.*, 7, 419; 1936). As larvicides, carbon tetrachloride and tetrachlorethylene were found to be effective against the maggots, but the latter had a harmful effect upon wounds. The materials were used as a dressing in an emulsion, the emulsifier which acted most satisfactorily being wool-grease. The author gives particulars for the preparation of a suitable emulsion.

Enzymes of Wood-Rotting Polypores

THE study of fungi which induce the rotting of wood is of great importance, from both practical and theoretical points of view. Polyporaceous fungi often bring about such rotting, and their enzyme equipment has been the subject of study by Dr. S. R. Bose and S. N. Sarkar (*Proc. Roy. Soc., B*, 123, 193-213; July 1937). Eight species of polypore fungi were examined, and an imposing array of enzymes has been found. Invertase, raffinase, maltase, amylase, emulsin, hemicellulase, cellulase, pectinase and ligninase seem to furnish the possibility of destroying, extra-cellularly, almost any common carbohydrate. Lipolytic and proteolytic enzymes were present in small quantities, catalase appeared as an intra-cellular enzyme, whilst laccase was found in *Poly-stictus sanguineus*, *Dædalia flavida* and *Trametes lactinea*. Extra-cellular enzymes were more abundant than those inside the cell, and their activity appeared to be greater in the vegetative fungus than in the fruiting organism.

Hybrids of the Rhododendron

A PAPER by Mr. F. C. Puddle (*J. Roy. Hort. Soc.*, 62, 9, 393-398, Sept. 1937) gives some useful information about the possibilities of hybridizing the numerous species of *Rhododendron* now available to horticulturists. The activities of plant collectors have added the beauties of the eastern kinds to the better-known European species. Taxonomists have recognized two sections, the Lepidote and the Elepidote, in the genus *Rhododendron*. It is usually difficult, and frequently impossible, to hybridize between these sections. The Elepidote species of *Rhododendron*, however, interbreed readily with the Luteum series of *Azalea*, although they are plants with more remote taxonomic relationship. Practical considerations for the prosecution of experiments in hybridization are given, and breeders are invited to consult the Stud Book of the Rhododendron Association, which shows the results of more than four hundred crosses the offspring of which have possessed horticultural value.

Antarctic Structure

SOME further evidence in favour of the probable structural relationship of New Zealand to King Edward Land in the Ross Sea is adduced in certain of the bathymetrical work of the Byrd Antarctic Expedition 1933-35. Mr. S. E. Roos, in a paper on the Ross Sea in the *Geographical Review* of October, notes the discovery at the entrance to the Ross Sea, some two hundred miles south of Scott Island, of the Iselin Bank, with a minimum depth of 700 metres and a length of about 200 miles and separated by a deep gully from the continental shelf. Further to the south-east lies the Pennell Bank. The course of the Antarctandes may possibly run from New Zealand via Macquarie and Scott Islands and these two banks into King Edward Land. Thus the Pacific Basin appears to be separated from the deep water farther west. King Edward Land turns out to be peninsular in character, extending south-east from Cape Colbeck, and there is considerable evidence that the line of folds is continuous with the Edsel Ford Range farther east. Mr. F. A. Wade, writing on the borderlands of the Ross Sea in the same review, points out the resemblances of this range of folded sedimentaries and intrusive igneous rocks to the

Graham Land region, in spite of the igneous rocks being of the Atlantic rather than the basic Pacific type. It is noteworthy that many indications of former more extensive glaciation were found in this range.

Lhuyd's Maps of England and Wales

THE Ortelius atlas published in Antwerp in 1573 included maps of England and Wales and of Wales prepared by Humphrey Lhuyd. In "Humphrey Lhuyd's Maps of England and of Wales" (National Museum of Wales, 1937. 1s.), Dr. F. J. North discusses these maps, particularly that of Wales, as regards means of preparation and sources of information. The outline of Wales is reasonably good and many rivers and places are shown. Mountains are indicated by conventional hummocks. The scale is about 8 miles to an inch. The manuscript of the map is unknown and probably does not exist. Dr. North gives reasons for his belief that Lhuyd's map was not based on angular measurement but that it was founded on one of the editions of the Ptolemy map of Great Britain, or some other maps which was based on Ptolemy. In his compilation Lhuyd probably owed some details to Lily's map of the British Isles (1546), Mercator's map (1564) and Nowell's manuscript maps. The basis of the English part of Lhuyd's map appears also to be Nowell's, Mercator's and an unknown map related to both.

Coal Measure Rocks

THE Safety in Mines Research Board has published as Paper No. 98 a report by H. M. Hudspeth and D. W. Phillips entitled "Coal Measure Rocks: Part I.—Classification, Nomenclature and Relative Strengths" (London: H.M. Stationery Office. 1s. net). The more important rock structures bearing on the strengths of rocks and on roof control are discussed with special reference to the programme of research on rock falls in mines which was initiated some years ago. The strata are classified into five standard groups—sandstones, siltstones, mudstones, shales and clays—according to grain size and constitution. The general petrological characters of the chief rock types are summarized and also their relative strengths and bending capacities. The varied nomenclature used to describe the rocks in the different coalfields of Britain is listed with a brief description of each term. A scheme of strata notation is suggested which is sufficiently comprehensive to illustrate the rocks met with during coal mining. The report will in due course be supplemented by others dealing with Coal Measure rocks in relation to roof control.

Meteorology of Lower Egypt

In a paper entitled "Temperature and Relative Humidity in the Atmosphere over Lower Egypt" (Prof. Note 75. M.O. 3360. London: H.M. Stationery Office. 2d. net.) Mr. W. D. Flower gives tables of monthly mean values of these quantities from the results of observations made in aeroplanes in the early morning from 1922 until 1930 at three inland stations in Lower Egypt—Helwan, Heliopolis and Ismailia—covering roughly the range 30°-32° north latitude. The observations were made while the aeroplanes were ascending, the time taken to reach the height where pressure was only 650 millibars being about an hour, and the ascents generally began

between 7 a.m. and 8 a.m. local time. Temperature means are for 500-metre intervals, and are based on a good number of observations up to 4,000 m. They show little lag with height in the time of the maximum and minimum of the annual march. There is a gradual increase of temperature from January until August and a rapid decrease in the last three months of the year, but the rate of rise between April and May is retarded above 1,000 m., owing doubtless to a tendency for short periods of very high temperature in April at such levels that has been noted by earlier writers. The mean lapse rate is not very different from that observed in England in the early morning, but observations made in the early afternoon show that it then exceeds the dry adiabatic rate from January until August up to 1,000 m. and exceeds it at times in all months, while in May and June this is often the case up to 2,000 m. The observations of relative humidity show that the mean is so low as 24 per cent at 4,000 m. in August; the mean vapour pressure, however, is higher than that in England at all levels, in spite of the occurrence of such extremely low values as 0.1 millibars at 2,500 m. on one occasion in March and at 3,000 m. once in October. The paper concludes with a discussion of the formation of early-morning clouds in summer, which are attributed to the greater radiation from layers of moist air; they sometimes develop downwards from the top of the moist layer so as to reach the ground and cause fog.

A New Purine in Tea

THE known purines occurring in plants are caffeine $C_8H_{10}O_2N_4$, theobromine, $C_7H_8O_2N_4$, and theophylline, $C_7H_8O_2N_4$. These may be considered as end-products of purine metabolism in plants. In addition to these, some substances such as adenine and guanine, adenylic acid, vernine or guanosine, xanthine and hypoxanthine occur, the non-methylated purines being probably degradation products of plant nucleic acids. While uric acid has long been known as a characteristic oxidation product of purines in animals, it has only recently been found to exist in small quantities in plants (30–250 mgm. per kgm. dry plant). A methyl derivative of uric acid has now been detected for the first time in tea by T. B. Johnson (*J. Amer. Chem. Soc.*, 59, 1261; 1937). A residue from several million pounds of tea obtained in the commercial removal of caffeine was available and from this about 10 gm. of crystals were picked out. These were found by very careful examination, both chemical and crystallographic, to be 1,3,7,9-tetra-methyl-2,6,8-trioxypurine, derived from 2,6,8-trioxypurine (uric acid). It had been synthesized by Emil Fischer in 1884. As Prof. Johnson says: "By the discovery of this purine in tea, we not only increase the number of characteristically methylated purines occurring in the plant kingdom to four (theobromine, theophylline, caffeine and tetramethyl uric acid), but we also stimulate a new interest in the possible natural occurrence of other methyl derivatives of this series, and also in the mechanism of the plant metabolism of purines in general."

Sublimation and Condensation of Crystals

T. ALTY (*Proc. Roy. Soc., A.*, 161, 68) has investigated the interaction of vapour molecules with a crystal surface by measuring the rate of sublimation of crystals into a vacuum. When the crystal is in equilibrium with saturated vapour the number of molecules incident on the surface can be determined

from the vapour pressure. The number retained by the surface is equal to the number which leave it, and is assumed to be the same as the rate of evaporation in vacuum. The fraction of the incident molecules which condense is called the condensation coefficient. Measurements on liquids have shown that it is nearly unity for benzene and carbon tetrachloride and is of the order 0.04 for water and alcohol. Similarly, the present work shows that iodine and naphthalene have coefficients of condensation unity, while camphor and benzoic acid have much smaller coefficients. The value 0.17 was obtained for camphor. As in the case of the liquids, it seems that non-polar substances have unity values for the condensation coefficient.

A Theory of Ball Lightning

THERE exists a considerable number of descriptions of ball lightning, usually associated with thunderstorms. Th. Neugebauer (*Z. Phys.*, 106, 474) has now produced a theoretical explanation of the phenomenon. He shows that a number of charged particles—electrons and positive ions—may form a compact gaseous mass if the electron density is very high, and of the same order as the density of gas molecules. The mass of gas is held together mainly by the 'exchange forces' of quantum mechanics—the electrons form, under the assumptions made, a non-degenerate gas. The theory shows that the ball may disappear in one of two ways as the electron density falls owing to recombination—either the ball may collapse or it may explode, according to whether the radiative loss of energy keeps pace with the falling exchange forces. These modes of disappearance both occur in the descriptions of ball lightning. The electron density necessary for a coherent ball is much higher than can be attained in laboratory discharges, but it is suggested that it may be reached in lightning flashes of normal type.

Ionosphere Observations in Japan during a Solar Eclipse

THE results of observations on the ionosphere made in Japan during the total solar eclipse of June 19, 1936, are described in a paper by T. Minohara and Y. Ito published in the *Electrotechnical Journal* of October 1937. This journal is an abstract section in English of the *Journal of the Institute of Electrical Engineers* of Japan. The observing station was at Iwamizawa, Hokkaido, and this site was selected because maximum totality of the eclipse occurred in the ionosphere at a height of 260 km. above the observing station. Using the usual type of pulse emitter, the effective heights and critical frequencies of the E , F_1 and F_2 regions of the ionosphere were measured with automatic recording apparatus covering the frequency range 1.5–15 Mc./sec. The results reproduced in the paper show that the effect of the eclipse was very distinct in the case of the F_1 region, but very obscure in the other cases. The ionization density in the F_1 region was approximately proportional to the exposed area of the sun's disk, thus indicating that the ionization was due to ultra-violet light. In the case of the F_2 region, the ionization increased somewhat during the eclipse, an effect which might have been due to decrease in temperature, with consequent contraction and increase in ionization density in the region of the ionosphere concerned. Alternatively, the effects observed may be attributed to the magnetic disturbance which accompanied the eclipse.

Lubrication and Lubricants

UNDER the auspices of the Institution of Mechanical Engineers, in collaboration with some forty-five other technical institutions and societies, a general discussion on lubrication and lubricants was held in London on October 13-15. The discussion centred around more than a hundred papers contributed by leading authorities throughout the world: the meetings were extremely well attended and the essential objects of the promoters—to review the present state of knowledge and to discuss the major problems of lubrication and lubricants—were attained with a considerable degree of success. Much valuable and interesting information and data were made available, while pleasing evidence was afforded of the great amount of research attention now being given to every aspect of lubrication, also of the growing concern and interest in its problems shown by designers and operating engineers. Not the least valuable feature of the discussion was the interest in, and the divergence of views on, certain fundamental aspects, which will undoubtedly stimulate further research in this field.

An adequate review of the papers, all of which were available at the meeting*, cannot be attempted in a limited space, but it may be useful to give an indication of some of the problems revealed and discussed. For convenience of discussion, the papers were placed into four groups.

JOURNAL AND THRUST BEARINGS

The first group of papers relate to the problems of journal and thrust bearings. Swift describes the application of the results of his modified Reynolds' theory of the journal bearing film to design; he uses the correction for end leakage deduced by Kingsbury from experiments with an electrical analogy apparatus. Boswall gives data for the 120° journal bearing, and Prandtl and Hanocq report experimental work which indicates that partial bushes behave like articulated plane pads. It is apparent that experimental results and theory are in agreement in a general way for thick film conditions in journal bearings. A number of papers deal with the more critical conditions as failure is approached. Needs, also Bradford and Vandegrift, consider the effect of pressure on viscosity, and its relation with friction, pointing out that what might appear to be an 'oiliness' effect of a fatty oil could be due actually to the smaller effect of pressure on its viscosity. This pressure effect on viscosity can only become material, however, when the film thickness is of the order of 1μ , and the irregularities of the surfaces with present-day standards of finishing begin to affect the behaviour as this thickness is approached. Moreover, Kyropoulos mentions another complicating phenomenon in the decrease of viscosity which accompanies flow-orientation of a lubricant consisting of long-chain molecules. Heidebroek and Brillé describe the local interference of surface irregularities with the film pressure development, and the latter refers to the increase of friction due to oil whirls which, he considers, are formed in the tiny valleys of the surface.

* Institution of Mechanical Engineers. General Discussion on Lubrication and Lubricants. Group 1: Journal and Thrust Bearings. Pp. 300. 2s. 6d. Group 2: Engine Lubrication. Pp. 216. 2s. 6d. Group 3: Industrial Applications. Pp. 162. 2s. 6d. Group 4: Properties and Testing. Pp. 226. 2s. 6d. (London: Institution of Mechanical Engineers, 1937.)

Experimental work on the approach to failure is included in the papers by Tenot and Jakeman and Fogg, the latter showing the effects of the usual variables on 'seizing' temperature; also Clayton shows how the change of shape of the bush due to running-in increases the safety of a bearing. Guy and Smith, also Soderberg, describe current practice regarding turbine bearings, emphasizing the cooling function of the oil. These authors mention the troublesome vibration which occurs with these lightly-loaded high-speed bearings, and Newkirk refers to suggested means of combating this difficulty; it is apparent that the phenomenon is not yet fully understood. Risk of ignition of escaping oil due to contact with the hot parts of a turbine is considered by Chittenden; with the view of avoiding this difficulty Samuelson has carried out experiments with a water-base lubricant, and shows that the bearing performance is in some respects improved, even though the viscosity is only one tenth of that of the usual oil. Guy and Smith refer to the great need for co-operative research into bearing behaviour under the high-speed conditions of turbine operation.

Thrust bearing design is based mainly on Michell's original work. Reference may be made to the use of pivoted pads for journal bearings (Gibson), and to the mass-produced, low-friction Nomy bearings (Odqvist), which work on the Michell principle but have rotating instead of stationary pads. Linn and Sheppard describe a thrust bearing in which the pressure film is induced by tapering the leading edges of the lands, there being no tilting elements. Several papers describe the use of synthetic resin bonded materials, and two the use of rubber, for journal bearings, both being water-lubricated.

INTERNAL COMBUSTION ENGINES

In the section devoted to the lubrication of internal combustion engines, many papers deal with bore wear, and it is apparent that both corrosion and abrasion are involved. The much greater wear due to starting than to running is brought out by Yeates. On the other hand, Taub and Young do not consider that corrosion is normally the main cause of wear. Everett and Keller refer to the very sensitive iron contamination method of measuring wear. Williams shows that lower viscosity gives higher wear under cold conditions, but this may be offset to some extent by the more rapid arrival of a thin oil after starting; Barrington and Lutwyche show the decrease of cranking torque with decrease of viscosity. Bass, Bouman and Norlin agree that 'oiliness' dopes have little effect, though Taylor considers the piston rings to operate most of the time under boundary conditions in which 'oiliness' dopes would be expected to have an effect. Rosen, however, shows that anti-oxidation dopes reduce wear considerably, and Barrington and Lutwyche show a decrease of cranking torque due to additions of oleic acid, but not with compounded oils.

Opinions differ on the question of oil consumption. Taub advocates plentiful supply to the cylinder with drastic scraping by high-pressure rings, while Ottaway does not favour high-pressure rings and regards limitation of the supply from the big-ends

as necessary. Taylor suggests that the sudden increase of consumption at high speeds is due to change from boundary to fluid film conditions, but Taub ascribes it to ring flutter.

The problem with internal combustion engine bearings is temperature rise. White-metals lose fatigue strength rapidly with increase of temperature (Macnaughtan, Williams), and consequently crack in service unless the temperature can be kept down. Williams gives results of actual temperature measurements in the bearings of an engine, showing the increase with increase of speed and inlet oil temperature, and decrease with increase of oil flow. Neave and Sallitt review the various copper-bearing alloys, including lead bronze, which is often used as a substitute for white-metal under high-duty conditions. Mickelsen suggests that, in view of the importance of cooling, it might be possible to lubricate the bearings with water or a water-oil mixture.

Several papers deal with filtration and oil purification by various types of apparatus, including de Langen's magnetic filter for removing iron particles. The importance of removing the fine particles which get into the clearance spaces of bearings is being realized, though it is difficult to achieve this with a filter of reasonable size.

RECIPROCATING STEAM ENGINES

Turning to the subject of the lubrication of reciprocating steam engines, the French and German State railways consider that various grades of superheated cylinder oil are desirable according to the degree of superheat in the cylinder, whereas Canadian National and English railways use only one grade; the majority favour compounded oils, the decomposition products of the fatty oil being thought to form stable and resistant boundary films. The oil is now supplied by pump instead of by a hydrostatic system, but there is some difference of opinion between the English and French railways as to the part of the stroke at which it is best to supply the oil.

In marine practice, according to Freeman, superheated steam valves, pistons and liners are lubricated by mechanical lubricators feeding into the steam pipe or round the high-pressure liners. Auld and Nicholson deal with oil circulation systems, and the changes that may occur in the oil. Nicholson emphasizes the advantages of a small amount of oil of the correct type properly applied; overfeeding may result in deposits in the cylinders and steam chests.

H. J. G.

[To be continued.]

Adult Education in the United States

ADULT education has been much discussed of late, especially from the point of view of education for citizenship in a democracy. This is a point of view now very widely canvassed in America, having found an enthusiastic advocate in Dr. J. W. Studebaker, the United States Federal Commissioner of Education. A year ago his bulletin "Education for Democracy: Public Affairs Forums" was noticed in these columns, and an appreciation of the 'Forum' system, based on six weeks' personal participation, by the secretary of the British Institute of Adult Education, was published in Bulletin No. VII of the World Association for Adult Education. The Forums are organized within the framework of the public school system under the control of the local education authority and are conducted by expert leaders using varying techniques according to the size and composition of the membership. Addressing the National Education Association last February on "Crucial Issues in Education" (Pamphlet No. 74. Superintendent of Documents, Washington. Pp. 20. Price 5 cents), Dr. Studebaker announced that nineteen public forum demonstration centres, officially sponsored by him and financed, as a temporary measure, with federal funds, were operating in as many States. In the preceding five months more than 350,000 people had attended 3,854 forum meetings.

Closely associated with the public affairs forums is the Commissioner's educational radio service, exemplified by a series of thirteen half-hour dramatic items broadcast on Monday evenings at 10.30, having as their theme, under the title "Let freedom ring", the "long struggle for the rights and liberties set forth in the Bill of Rights of the Constitution of the United States". The Commissioner stated that his office had received in seven months, in connexion with this radio service, 250,000 communications from

radio listeners. A radio script exchange service has been organized, moreover, and "hundreds of student groups are adapting and rewriting these radio scripts for their own productions", in association with dramatic art and social science classes and radio workshops. The Commissioner announced that he had officially made a request for the reservation in Washington of certain high-frequency wave-lengths for the exclusive use of local educational agencies and for the free discussion of civic affairs.

The address terminated on a note of urgency: "There is no time to lose. These programmes for popular enlightenment in the protection of popular self-government must be promoted in every State and community. I leave this crucial issue upon your conscience." The issue in question, arising out of the conflict between dictatorship and democracy, "a major conflict which is swiftly reaching the stage of a crisis throughout the world" is elsewhere phrased as "What more can education do to undergird American democracy".

One of the speakers at a discussion on adult education in the Education Section of the British Association at the recent meeting in Nottingham suggested that education unrelated to a specific social ideal is, in our day, an impossibility, that real education must be propagandist, aiming *either* at assisting to maintain stability *or* at preparing for change, and that adult education, to be a live force, must support "the organized working-class movement". Dr. Studebaker's adult education policy is frankly propagandist but exposes the fallacy of representing the aims of stability and change as mutually exclusive. He defines education's social ideal as a society where the majority will is law and in which the right and privilege of the minority to advocate a change are protected.

A New Hydro-Electric Power Scheme in Sweden

A FULL description of the hydro-electric power scheme at Krangede, Sweden, which has been in operation for six months, is given in the *Asea Journal* of May and June, published by the Asea Company of Vasteras. Krangede is situated in about lat. 63° N. at the site of a natural fall on the lower part of the Indalsalven, an important river in the Jamtland district of Sweden draining a large area containing many lakes and extending back to the Norwegian borders. The link with the power station lies well up in 'Norrland', and in the south consists of a high-voltage feeder carried direct down to a main substation at Horndal in South Dalecarlia. It is thus within convenient range of Stockholm and is in touch with the large supply networks of central and southern Sweden.

It was anticipated long ago that before 1940 the demand for electrical energy in the southern and middle parts of Sweden would make the delivery of large bulk supplies from the north economically feasible. The great industrial activity of the last few years has accelerated the increasing demand for electrical power. The Krangede scheme was carried out and is owned by a private company comprising several large industrial businesses and the Stockholm municipality. The scheme has several unique features. The whole generating plant is underground, and the equipment is of the most modern design, as it has to deal with a transmission voltage of 220 kilovolts.

Unregulated, the water flow in the river at Krangede is very variable. The maximum flow is about 2,000 cubic metres per second and the minimum is often only about 100 cubic metres per second. Work at present proceeding on one of the lakes near the source of the river on the Norwegian borders is expected to increase the minimum flow by about 40 per cent. The power station is designed for a head of 190 feet, and with the plant at present installed it has a consumption of about 140 cubic metres per

sec. The dam has a length of about 240 yards and has four spillways. The generating plant is housed in a chamber blasted out of the solid rock, the machine room floor being 131 feet below the surface of the ground.

To prepare a turbo-alternator for starting, a special switch is operated and a window in it becomes illuminated by a flickering light. Until the lubricating oil and cooling water are circulating properly and other starting devices have moved into the starting position, this light goes on flickering. When everything is ready to start up the turbine, the light becomes steady. The control room is situated on the top story of the building and its windows command a good view over the outdoor switchgear and the dam. A mimic busbar system is provided at the control desk and includes switches and position indicators. On the front of the control desk are push-buttons controlling the operating of the system.

The two generators at present working are each of 35,000 kilovolt ampere capacity when running at 167 revs. per min. The height of each generating unit is nearly 30 feet and its total weight is 427 tons. The main transmission line connects the generating station to the Horndal substation, and as the transmission conductors work at 220 kilovolts, it was necessary to make their diameters large so as to avoid the formation of coronae (brush discharges) on them. The supporting towers are 56 feet in height and the conductors are hung on suspension type insulators with sixteen insulators per string. The normal span is 263 yards and the spacing between the phases 23 feet.

The official tests made on the generators at full load and a pressure of 8,400 volts gave an efficiency of 97.8 per cent at unity power factor. The voltage wave generated is practically sine shaped, the maximum deviation from this form being only about one per cent.

Woods on Private Estates

IN his presidential address as chairman of the Department of Forestry of Section K (Botany) at the meeting of the British Association at Nottingham, the Hon. Nigel Orde-Powlett took as his subject "The Present and Future of Estate Woodlands". Mr. Orde-Powlett first dealt with the value of the existing private woods to Great Britain during the Great War, pointing out that although the Forestry Commission is now planting on some scale, its area under forest is only one eighth of the nominal woodland area of the country, the remainder being privately owned. It is therefore a matter of vital national urgency that it should be made possible for owners to institute a wise forest policy on their estates. There is also the social aspect of the problem—the drift from country to town. This is due to many causes, but Mr. Orde-Powlett holds the opinion that woodlands afford employment which is congenial, and that well-managed woods can afford to give adequate pay to the staff maintained. Since the

majority of the private woodlands are not run on business lines they are under-staffed. If properly run, many thousands of additional men could be employed, with an increase of small-holders—and the forest worker forms the best type of small-holder.

The attitude of the private owner of woodlands varies. Most woods are run at a loss and their owners are incredulous as to their financial possibilities; or they are regarded as a nest-egg only to be realized in dire necessity; or the owner is averse from even cutting a single tree. It has been estimated that the average annual output per acre in Great Britain is less than 20 cu. ft., whereas under good management three to four times that volume might be produced.

There are three causes for this position, says Mr. Orde-Powlett, and all of probably equal importance. The first, and it may be asserted in the interests of continuity and good forest management, the most important, is taxation, and especially the death duties. It is true that duties are not payable on the

timber until the woods are felled; but on a private estate, although the woods may form only a portion, perhaps only a small percentage, of the total area, they may yet have to pay a share of the duties out of all proportion to the income of the person concerned. This spells chaos in management and precludes an owner from having a proper 'working plan' in force, since death will probably result in its clauses becoming unworkable. In other words, continuity in the management of the woods is an impossibility. Moreover, as under the present system of taxation every proprietor knows that in the course of three or four generations the estate must be broken up, there is no encouragement towards correct woodland management. Mr. Orde-Powlett suggested conditional remission of death duties on agricultural land, the condition being that the sum so remitted should be spent on improvements which would be defined over a period of years.

Another cause is the neglect of owners to thin their woods properly and so obtain an intermittent revenue and also to fell the timber when it has reached maturity for market purposes. In this connexion, it has been suggested that all woodlands should be taken over by the State. Not only is this in opposition to the ordinary forestry economy in those European States where the best forest management is in force, but also it would be quite impracticable in Great Britain; and the same objections apply to the introduction of any form of compulsion on the part of the Government.

Mr. Orde-Powlett dealt with the present assistance available from the woodmen's training schools in existence, with the efforts of the various forestry societies, and the new type of consultant forester of which there are now a few firms. Good as is the work done by all these, their efforts only apply to those

owners whose interest in their woods is already awakened. The majority do not fall within this category. As Mr. Orde-Powlett says, "a real comprehensive improvement depends on the arousing of forest consciousness amongst owners and in providing them with means to acquire knowledge". He advocates the establishment by the Forestry Commission at a cost of twenty thousand pounds or so a year of a comprehensive advisory service throughout the country.

"I would have woodland advisers, highly trained foresters, each with his area of country," says Mr. Orde-Powlett. This would be an excellent scheme if it was inaugurated by the owners themselves, a group of owners in a locality engaging and paying the salary of the highly trained woodland adviser. Otherwise, if engaged by Government (a sum of £20,000 is to cover salaries, offices, etc.) what prospects of a career would these advisers have? Even if such a service were inaugurated, what continuity to their work could be assured, as Mr. Orde-Powlett points out, with estates being broken up and dispersed in four generations, if not sooner, as a result of death duties. It would be quite impracticable for the State then to step in and take over as a working proposition small areas of woodland, however good the local management may have been, scattered all over the country.

If the Government has a real belief in the possibilities of forestry or its necessity in the interests of the community, the land must be so taxed that continuity of management—and in forestry this means a continuity throughout a century and more—is assured. Without such an assurance it is difficult to see how the expenditure of public money in the interests of the private landowner can be justified.

Fibre Cores in Winding Ropes

WE have received the Safety in Mines Research Board Paper No. 97 upon "The Effect of Fibre Cores on Internal Corrosion in Colliery Winding Ropes", by J. E. O. Mayne*. The author states that the fibres used for the cores belong to the 'hard' group, the object of which is to provide a firm support for the steel strands of the rope. The material arrives in Great Britain in bales containing a number of so-called 'heads' and are subjected to the following four processes: (1) 'hackling', (2) spinning the fibre into yarn, (3) spinning the yarn into strands, and (4) spinning the strands into a complete core. To enable the fibre to be spun, it must be wetted by a so-called 'batching' fluid, which is 5-15 per cent of the weight of the fibre in thin mineral oil; the core is then treated with heavy mineral oil, which forms a lubricant; severe internal corrosion has been found in ropes containing Stockholm tar, and this material should on no account be used; this is perhaps one of the most valuable observations in the whole work. It is stated that "It is understood that the use of coal tar is also objectionable."

The author, who has experimented upon the subject

* Mines Department: Safety in Mines Research Board. Paper No. 97: The Effect of Fibre Cores on Internal Corrosion in Colliery Winding Ropes. By J. E. O. Mayne. Pp. 38+4 plates. (London: H.M. Stationery Office, 1937.) 1s. net.

for some time, arrives at the following conclusions: "(1) Batching and impregnating oils used in core manufacture do not decompose sufficiently, in practice, to cause appreciable corrosion of wire; on the contrary they protect it. (2) Darkening of the oil is due to the presence of impurities such as coal dust and iron oxide, and the oils retain their protective value until they are squeezed out. (3) Internal corrosion can take place without penetration of the rope by water containing harmful salts or acids derived from sources external to the rope. (4) Manila (and some other) fibres used for cores contain an are liable to develop formic and acetic acids as a result of bacterial action. (5) These acids can corrode wire ropes in the presence of moisture, even in the absence of oxygen; pressure between wire and core tends to accelerate the rate of attack, since it tends to remove the protective oils and increase the contact between fibre and steel. (6) The erratic distribution of corrosion is due to the sporadic nature of bacterial action. (7) Most of the harmful acid in raw manila fibre can be removed by cold water treatment, and it is suggested that subsequent bacterial action might be prevented by treating the washed fibre with an antiseptic which would not corrode steel. The practicability of these preventive measures has not yet been demonstrated."

Science News a Century Ago

Instructions for Travellers

IN the *Athenæum* of November 11, 1837, a note said: "In the instructions drawn up by the scientific men of France, for the use of the two vessels, the *Astrolabe* and the *Gelée*, which are about to circumnavigate the globe, we perceive that Mr. Ward's plan of transporting plants is highly recommended, as well as that of Mr. Luschnath, which can also be applied to seeds, in order to preserve their germinating powers. M. de Blainville eagerly requires microscopic marine animals, the *Spirula* with its inhabitant, that of the *Nautilus flammeæ*, which is wanting in the collections in France, parasitical insects and worms; and strongly urges experiments to be made on the temperature of living man, and beings of an inferior order, under different circumstances. . . . He sets forth the important novelties likely to be found in New Guinea, the Moluccas, and Celebes, in the creeks and bays of which probably exist a multitude of fishes and Mollusca, and particularly requests the acquisition of the *Apterya*, from the New Holland region, which is supposed not to have any wings. . . . M. de Freycinet recommends hydrography, observations of the tides and currents, such descriptions of the countries visited as will set forth their resources to future navigation . . . and M. Corder states the ignorance which prevails concerning the southern hemisphere, and the consequent value of the smallest atom of rock from this quarter."

Hybrid Ferns

IN the *Athenæum* of November 11, 1837, it is stated that "A triumph has been obtained by M. Martens, the professor of chemistry at the University of Louvain, and Dr. l'Herminier, over those who assert that no hybrid plant can be produced where no stamina exist. The former shook the fronds of the *Gymnogramma calomelanos*, and the *G. chrysophylla*, reciprocally over each other, at the time when the fructification was fully developed, and thus produced a new plant which is to be called *G. Martensii*. It is worthy of remark that the hybrid plant bids fair to be easily propagated in our greenhouses, while the parents constantly languish and die. While M. Martens was making his experiments at Louvain in Belgium, Dr. l'Herminier watched the same process taking place naturally in the woods and savannahs of Guadaloupe, and sent some dried fronds (in excellent preservation) of the hybrid to M. Bory St. Vincent."

The Moon's Equatorial Horizontal Parallax

ON November 11, 1837, Thomas Henderson, Astronomer Royal for Scotland, read a paper to the Royal Astronomical Society entitled "The Constant Quantity of the Moon's Equatorial Horizontal Parallax, deduced from Observations made at Greenwich, Cambridge and The Cape of Good Hope in 1832 and 1833." Previous to this, by using a method based on the theory of gravity, Burchardt had found that the constant part of the lunar parallax under the equator amounted to $57' 0''$ while Damoiseau arrived at $57' 0.9''$ for the constant and Plana computed it at $57' 3.1''$. By another method founded on observations made simultaneously at different parts of the earth, Lacaille had obtained $57' 4.6''$, Lalande $57' 3.7''$ and Du Séjour $57' 6.0''$. While at the Cape

in 1832-33, Henderson determined a great number of declinations of the moon with the view of arriving at a more accurate value of this element, and by a comparison with his own observations made at Greenwich and Cambridge, obtained $57' 1.8''$ for the constant of the equatorial parallax.

Observations on Rain

THE issue of the *Gentleman's Magazine* of November 1837, contains the following account of a paper recently communicated at a meeting of the Warwickshire Natural History and Archæological Society: "The Rev. G. Childe made public his observations on Rain. He said it was a general but erroneous opinion that the greatest quantity of rain that fell in any month of the year fell in February. From his own observations (during eight or more years) he ascertained that in July was the greatest quantity, September second, August third, October fourth, June fifth, April sixth, November seventh, May eighth, February ninth, instead of first, December tenth, January eleventh and March twelfth. It would be found that if there were a deficiency of rain in the winter months December, January and February, that deficiency would be in great part compensated by an excess in the three summer months July, August and September."

University Events

CAMBRIDGE.—Dr. H. Brück, of the University of Berlin, has been appointed first junior observer in the Solar Physics Observatory.

W. G. Palmer, of St. John's College, has been approved for the degree of doctor of science.

It is proposed to confer the degree of M.A. on Dr. D. G. Catcheside, University lecturer in botany, and S. D. Elliott, University demonstrator in the Department of Pathology.

Miss M. L. Tomlinson has been elected to a staff fellowship at Girton College.

OXFORD.—On November 2 in Congregation the degree of M.A. by decree was conferred on Lord Nuffield, so that he is now a full and voting member of the University.

On November 16 the Chancellor will preside at the Congregation at which Lord Nuffield will be thanked for his recent gifts. There will then be voting on the decrees relating to the new benefaction to the medical school and promulgation of the statute relating to the gifts to the proposed Nuffield College (see p. 799) and the chemistry school.

Dr. L. J. Witts has been appointed Nuffield professor of clinical medicine as from 1938.

H. J. B. Atkins, Trinity College, R. B. Scott, Brasenose College, A. W. D. Leishman, University College, and E. P. Edmonds, Keble College, have been granted the degree of M.D.

J. G. Daunt, Exeter College, has been awarded the Scott scholarship for research in physics.

The curators of the University Chest have been authorized to receive from the Rockefeller Foundation in the year beginning October 1, 1937, a sum not exceeding 3,000 dollars as a contribution towards scientific apparatus, material and special cages for primates required for research in the Department of Human Anatomy.

Societies and Academies

Paris

Academy of Sciences, September 13 (*C.R.*, 205, 473-500).

GABRIEL BERTRAND : The presence and distribution of boron in the potash salts of Alsace. The quantities of boron found ranged from 1 to 10 parts per million in the salt, and from 50 to 500 parts per million in the interposed clay sheets.

ALBERT F. BLAKESLEE : Doubling the number of chromosomes in plants by chemical treatment.

J. G. VAN DER CORPUT : The Goldbach-Vinogradov theorem.

OCTAV ORICESCU and GH. MIHOC : The asymptotic trend of the sum of the variables of a discontinuous Markoff chain.

PAUL PÉTRY : The interpretation of observations and measurements relating to breakers. Study of the forces produced by waves striking a breakwater and of the velocities of the parts of the breaker.

PIERRE ERNEST MERCIER : Parameters and characteristic curves of careening with circulation.

JEAN HÉLY : The gravific wave induced by an electromagnetic wave in a refracting medium.

JEAN CAYREL : Absorption measurements of thin plates of copper sulphide. Application to the comparison of their thicknesses.

HUBERT GARRIGUE : New results on the green, yellow and red radiations emitted by the night sky.

ROGER LAMBERT : The Miocene of Boutoutou, Niger Colony.

ANTOINE DE CUGNAC : A new hybrid of bromegrass obtained experimentally. The uncertainty of the systematic determination of spontaneous hybrids.

MARCEL AVEL : The experimental study of the part played, in the regeneration of the head in worms, by the old parts in the immediate neighbourhood of the surface of amputation.

C.R., 205, 501-528.

EMILE BOREL : The regular distribution of the points of a linear enumerable ensemble.

LOUIS LAPICQUE : Neuro-muscular isochronism as an empirical fact. Historical résumé of work in this field, with special reference to objections raised by A. V. Hill.

GEORGES CHARPY : The determination of silicon in steels. In a specification giving a maximum figure for the silicon allowed, it is essential that the method of analysis should be given. Examples of the differences introduced by the method of analysis are given.

ANTOINE APPERT : Nearly isometric measurement.

GEORGES CALUGARÉANO : Invariants of prolongation connected to integral functions.

CHARLES SCHMERBER, PIERRE TARDI and PAUL CAILLOL : A method of measuring angles by fractional repetitions.

MAURICE FALLOT : The magnetic properties of alloys of iron and iridium. Determinations of the Curie points, points of transformation and ferromagnetic moments show a close resemblance with the analogous properties of the alloys of iron with ruthenium and with osmium.

Mlle. YVETTE CAUCHOIS : Study of the *L_z* satellites for some heavy elements and rare earths.

PIERRE NOBÉCOURT : Cultures in series of plant tissues on artificial media.

MARCEL AVEL : Study of some complex cases of regeneration of the head in worms.

CH. BRIOUX and Edg. JOUIS : Diacetyl in Normandy butters. Results of the examination of 150 specimens.

Moscow

Academy of Sciences (*C.R.*, 15, No. 8, 1937).

L. B. ROBINSON : A system of Riquier and the tensor calculus.

J. D. DUBNOV and N. EFIMOV : Single geodesic grids and the Lie surface.

V. KOZLOV : A relation between the absolute convergence and the unity of trigonometrical development.

H. HILMY : The ensembles of movements that cannot be represented as sums of invariant positive ensembles.

A. L. ŠAGINJAN : The theory of orthogonal polynomials in a variable complex.

S. MICHLIN : On a certain problem of the theory of singular integral equations.

N. REIN : The Whittaker integral and the periodic solution of the problem of three bodies.

J. MALKIN : The stability of movement in Liapounoff's sense.

V. A. GAVRILENKO : Comparison of experimental and theoretical curves showing distribution of velocities in turbulent uniform flow through pipes.

N. AKULOV : The theory of dependence of the ferro-magnetic properties of metals on temperature.

V. FABRICANT : The theory of radiation of a gaseous discharge.

E. KUNDORSKIJ : The problem of the nature of coercive force.

N. A. ŠIŠAKOV : Standard substances for exact measurements in the electron diffraction method.

D. I. MIRLIS : Kinetics of wetting and linear corrosion of metals in polyphase systems: metal-liquid-liquid and metal-liquid-gas (3).

V. G. KUZNECOV : Röntgenographical investigation of anomalous solid solutions of ammonium chloride in the chlorides of manganese, cobalt and nickel formed in aqueous solutions.

J. L. GOLDFARB and M. V. ANDRIJCHUK : Condensation of α -aminonicotine with ω -bromoacetophenone.

V. I. NIKOLAJEV : Chemical signs of the presence of salt deposits and the method of their physico-chemical investigation.

B. N. MAKHAEV : Algæ as characteristic fossils.

I. A. SMORODINCEV and S. A. PAVLOV : The method for the determination of the coefficient *D*.

I. A. SMORODINCEV and A. M. FELDT : Determination of the isoelectric point of thyroglobulin.

B. A. RUBIN, N. M. SISAKIAN and O. T. LUTIKOVA : Measurement of the oxidizing-reducing power of living vegetable tissue.

A. ZAMORSKIJ : Algebraic symbolism of the law of hybridization.

S. MEDVEDEVA : The toxins of *Fusarium buchari-cum* Jacz. and *Fusarium graminearum* Schw.

V. M. KATUNSKIJ : Dependence of photoperiodic reactions of plants on the spectral composition of light.

L. V. ARNOLDI and K. R. FORTUNATOVA : A contribution to the experimental study of the nutrition of Black Sea fishes.

S. E. KLEINENBERG : Distribution of some fishes and of *Idothea algerica* Lucas in the eastern part of the Black Sea.

P. L. PIROŽNIKOV: A contribution to the study of the origin of northern elements in the fauna of the Caspian Sea.

A. A. VOITKEVIČ: The morphogenetic activity of different parts of the hypophysis (5). Experiments with the implantation of substances from the 'eosinophilous zone' of anterior lobes of hypophysis on tadpoles under natural conditions.

Rome

National Academy of the Lincei (*Atti*, 25, 197-244; 1937).

T. LEVI-CIVITA: Canonical forms of the ds , binaries with a given total curvature.

L. AMERIO: Some complements of the theory of the Laplace transformation.

S. MARTIS IN BIDDAU: Functions of linear operators (1).

I. POPA: Projective-differential geometry of the singularities of plane curves.

G. RACA: Lagrangian form of electromagnetic forces.

C. TOLOTTI: Problems of plane elasticity with a polydrome Airy function.

P. UDESCHINI: A relative solution to the expansion of the universe.

L. GIALANELLA: Results of the new longitude determination of the axis of the Senatorial Tower of the Capitol and of the Tower of the First Meridian of Italy at Monte Mario.

Atti, 25, 253-348; 1937.

G. ABETTI: Height of the chromosphere in 1936, and the progress of the solar cycle.

S. MARTIS IN BIDDAU: Functions of linear operators (2).

M. PASTORI: Influence of small viscosities of a fluid in the determination of pressure in single regions.

V. ZAGAMI: Experimental researches on the seminal liquid. Value of the pH of normal human seminal liquid.

E. BIANCHI: Commemoration of the Dalmatian astronomer Ruggero Giuseppe Boscovich.

G. A. MAGGI: Tangential derivatives of the potential function of surfaces.

G. ARMELLINI: Reduced problem of two bodies of variable masses.

U. CASSINA: An integral-differential equation.

A. DE MIRA FERNANDES: A formal aspect of the tensorial derivation.

E. FROLA: Functional linear transformations and singular integral equations.

M. HAIMOVICI: Metric spaces with an allied connexion.

A. PUPPO: Researches on the solar radiation at Col d'Olen (1).

A. MANGINI: Aromatic nitroderivatives (12). The action of some hydrazines on 1-chloro-2:4-dinitro-naphthalene.

G. MARTINO: Probable existence of an unknown alimentary factor which stimulates sexual development.

M. ROMANO: Contribution to the study of the skin of anurans during metamorphosis.

G. SCHREIBER: Definition of the stages in the metamorphosis of *Bufo vulgaris*.

Sydney

Royal Society of New South Wales, September 1.

E. C. ANDREWS: The structural history of Australia during the Palæozoic.

H. W. WOOD: Note on the Shortt clock at Sydney Observatory.

F. LIONS: Synthetic substances allied to strychnine.

G. K. HUGHES and F. LIONS: The synthesis of 2-aminomethyl-benzimidazole and related substances.

Vienna

Academy of Sciences, July 1.

F. WESSELY and K. SCHÖNOL: Chasmanthin.

H. PETERSSON: Abundance ratio of thorium to uranium in rocks and in the sea. The abundance ratio of thorium to uranium is less in the sea than in rocks of volcanic origin. This is ascribed to the precipitation of thorium along with iron from sea water. In agreement with this view, the amount of thorium in sedimentary rocks is relatively high. The precipitation of ionium along with thorium may account for the ratio of radium to uranium in sea water being less than the equilibrium value.

J. SCHINTLMEISTER: Shortening of the range of polonium α -particles by oblique emission from the source. The mean range is greatly influenced by the purity of the preparation and the angle of emission; the extrapolated range, however, is not affected. The effect of oblique emission on mean range persists even with very pure preparations.

W. JENTSCHKE and G. STETTER: Short-range particles emitted when polonium α -particles are scattered by heavy nuclei. These particles are probably scattered α -particles, the range of which has been shortened by oblique emission from the source.

J. HOFFMANN: Photochemical changes in phosphate compounds.

MARIETTA BLAU and HERTHA WAMBACHER: Photographic study of cosmic rays: occurrence of proton-like tracks corresponding to a range in air of several metres.

H. KUN and O. PECZENIK: Oral administration of male sex hormone, alone and in combination with female hormone. Study of the electrical rat test.

O. PECZENIK and L. POPPER: Posterior lobe of the hypophysis and the thyroid gland. The excitation of the sympathetic by thyroxin can be prevented by the parasympathetic action of vasopressin.

H. DOSTAL: Reaction kinetics of chain polymerizations.

L. POLLAK and GABRIELE FLAUM-FEHER: The distribution of sugar in the body, and the action of insulin. Phlorizin diminishes the absorption of injected galactose into the organs of the body, but has no effect on the absorption of xylose. This action of phlorizin is inhibited by insulin.

H. KONZETT: Promotion of sleep and narcosis by dyes. Certain dyes, which are not themselves narcotics, are able to reduce the minimum dose of a narcotic required to produce unconsciousness.

E. AHL and O. SCHINDLER: *Pyrrhulina macrolepis* sp. nov. (Pisc., Microcyprini).

F. LIEBEN and BELLA BAUMINGER: The combination of sugar and amino-acid.

Forthcoming Events

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

Monday, November 8

ROYAL GEOGRAPHICAL SOCIETY, at 5.—J. A. Steers: "The Culbin Sands of the Moray Firth".

UNIVERSITY OF LEEDS, at 5.15.—Prof. H. H. Read: "The Natural History of Metamorphic Rocks".*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Prof. A. I. Virtanen: "Biological Nitrogen Fixation" and "Production of Vitamins in Agriculture" (succeeding lectures on November 10 and 12).*

Tuesday, November 9

ROYAL COLLEGE OF PHYSICS, at 5.—Dr. Harold Scott: "Conquest of Disease in the Tropics" (Fitzpatrick Lectures. Succeeding lecture on November 11).

PHARMACEUTICAL SOCIETY, at 8.30.—Dr. T. A. Sprague: "Early Herbs".

ROYAL ANTHROPOLOGICAL INSTITUTE (at the Royal Society, Burlington House, London, W.1), at 9.—Prof. H. J. Fleure, F.R.S.: "Racial Evolution and Archaeology" (Huxley Memorial Lecture).

Wednesday, November 10

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Colour Films of Tibet, taken by B. J. Gould.

ROYAL SOCIETY OF ARTS, at 8.15.—Sir Ambrose Fleming, F.R.S.: "Guglielmo Marconi and the Development of Radio Communication".

Thursday, November 11

ROYAL ASIATIC SOCIETY, at 4.30.—(at the Royal Geographical Society).—Sir Aurel Stein: "A Journey of Archaeological Exploration in South West Iran (1935-36)".

Friday, November 12

ROYAL INSTITUTION, at 9.—Sir Daniel Hall, K.C.B., F.R.S.: "Soil Erosion: the Growth of the Desert in Africa and Elsewhere".

Appointments Vacant

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

ASSISTANT to develop the Information Department and Library Service of the British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M.R.A., Reguart Buildings, Euston Street, N.W.1.

LECTURER IN ORGANIC CHEMISTRY in the City Technical College, Liverpool—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (November 19).

SENIOR RESEARCH WORKER in the Institute of Animal Pathology, Milton Road, Cambridge—The Secretary (November 27).

LECTURER IN ORGANIC CHEMISTRY in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

Official Publications Received

Great Britain and Ireland

Imperial Bureau of Plant Genetics: Herbage Plants. Bulletin 22: Technique of Grass Seed Production at the Welsh Plant Breeding Station. By Gwilym Evans. Pp. 36+8 plates. 5s. Bulletin 23: Production of Seed of Herbage and Forage Legumes. Edited by R. O. Whyte. Pp. 48+1 plate. 5s. Bulletin 24: Collection of Native Grass Seed in the Great Plains, U.S.A. By E. J. Crider and M. M. Hoover. Pp. 16. 2s. (Aberystwyth: Imperial Bureau of Plant Genetics, Herbage Plants.) [1810]

Technical Publications of the International Tin Research and Development Council. Series A, No. 60: A Plane Binding Apparatus with Interferometer Strain Recorder for Metallurgical Investigations. By J. W. Uthbertson. Pp. 14. (London: International Tin Research and Development Council.) Free. [1810]

Forest Bibliography to 31st December 1933. Part 2: B. Silviculture (continued); 3: Natural Reproduction; 4: Artificial Reproduction; 5: Tending; 6: Silvicultural Systems; 7: Notes on Trees. Pp. ii+79-199. (Oxford: Department of Forestry, The University.) 12s. 6d. net. [1910]

Ministry of Health. Fourth Report of the Joint Advisory Committee on River Pollution. Pp. 18. (London: H.M. Stationery Office.) 3d. net. [1910]

Ministry of Health and Scottish Office. Inland Water Survey (Committee: Second Annual Report, 1936-37. Pp. 26. (London: H.M. Stationery Office.) 6d. net. [2010]

Medical Research Council. Special Report Series, No. 226: Medical Uses of Radium; Summary of Reports from Research Centres for 1936. Pp. 41. (London: H.M. Stationery Office.) 1s. net. [2010]

Technical Publications of the International Tin Research and Development Council. Series A, No. 61: The Constitution of Tin-Rich Antimony-Cadmium-Tin Alloys. By Prof. D. Hanson and Dr. W. T. Pell-Walpole. Pp. 44+8 plates. Free. Series A, No. 62: A Study of the Mechanical Properties of Tin-Rich Antimony-Cadmium-Tin Alloys. By Prof. D. Hanson and Dr. W. T. Pell-Walpole. Pp. 18+1 plate. Free. (London: International Tin Research and Development Council.) [2110]

Metallurgical Abstracts (General and Non-Ferrous). Vol. 3 (New Series). Edited by G. Shaw Scott. Pp. viii+897. (London: Institute of Metals.) £4, inclusive of 2 "Proceedings" vols. [2110]

Education in 1936: being the Report of the Board of Education and the Statistics of Public Education for England and Wales. (Cmd. 5564.) Pp. xii+200. (London: H.M. Stationery Office.) 3s. 6d. net. [2110]

National Institute of Poultry Husbandry. Bulletin No. 14: Table Poultry Production. By A. J. Macdonald and Jean W. T. Kay. Pp. 21. (Newport, Shropshire: Harper Adams Agricultural College.) 6d. [2310]

Other Countries

Colony of Mauritius: Department of Agriculture. Seventh Annual Report of the Sugarcane Research Station for the Year 1936. Pp. 45. (Port Louis: Government Printer.) 60 cents. [1810]

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 27: Reports of the Field Branch for the Year 1936. Pp. iii+157. (Kuala Lumpur: Department of Agriculture.) 50 cents. [1810]

Rubber Research Institute of Malaya. Pp. 20. Annual Report, 1936. Pp. ii+158. 1 dollar. (Kuala Lumpur: Rubber Research Institute of Malaya.) [1810]

Annals of the Observatory of Lund. No. 6: A Study of Double and Multiple Galaxies, together with Inquiries into some General Metagalactic Problems; with an Appendix containing a Catalogue of 827 Double and Multiple Galaxies. By Erik Holmberg. Pp. 160+6 plates. Meddelande från Lunds Astronomiska Observatorium, Ser. 2. Nr. 84 (Historical Notes and Papers, Nr. 8): Über die ersten astronomischen Photographien und ihre Reproduktion; Die Form der Sonnenkorona am 28 Juli 1851. Von Björn Svenoönus. Pp. 22. Nr. 87: Formulae and Tables for Computation of the Integrated Magnitude of Stars. By W. Gyllenberg. Pp. 22. Nr. 88 (Historical Notes and Papers, Nr. 10): Studies in Spanish Sources, I. A Medieval Series of Statements on the Colours of the Plants. By Per Collinder. Pp. 16. Nr. 89 (Historical Notes and Papers, Nr. 11): The Arabic Names of the Stars. By Abdel Hamid Mahmoud Samaha. Pp. 8. (Lund: Lunds Astronomiska Observatorium.) [1910]

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 176: Giza 27, a Wilt Immune Strain of Long Staple Cotton. By Dr. Tewfik Fahmy. Pp. ii+13+13 plates. (Cairo: Government Press.) P.T. 4. [2010]

Astrophysica Norvegica. Vol. 2, No. 6: Application of Line Integral Theorems to the Hydrodynamics of Terrestrial and Cosmic Vortices. By V. Bjerknes. Pp. 283-340. (Oslo: Jacob Dybwad.) [2110]

The Rockefeller Foundation: International Health Division. Annual Report, 1936. Pp. v+278. (New York: Rockefeller Foundation.) [2210]

U.S. Department of the Interior: Geological Survey. Bulletin 868-B: Kodiak and Vicinity, Alaska. By Stephen R. Capps. (Mineral Resources of Alaska, 1934.) Pp. iv+93-134. 25 cents. Bulletin 879: Geology and Mineral Resources of the Baker Quadrangle, Oregon. By James Gilluly. Pp. vi+119+3 plates. 65 cents. Professional Paper 186-F: American Cretaceous Ferns of the Genus *Tempskyia*. By Charles B. Read and Roland W. Brown. (Shorter Contributions to General Geology, 1936.) Pp. ii+105-131+plates 27-43. 15 cents. Water-Supply Paper 795: Surface Water Supply of Hawaii, July 1, 1934, to June 30, 1935. Pp. 138. 25 cents. Water-Supply Paper 811: Surface Water Supply of the United States, 1936. Part 11: Pacific Slope Basins in California. Pp. 331. 45 cents. (Washington, D.C.: Government Printing Office.) [2210]

International Hydrographic Bureau. Special Publication No. 23: Limits of Oceans and Seas. Second edition. Pp. 25. (Monaco: International Hydrographic Bureau.) 9 francs. [2310]

Catalogues, etc.

Classified List of Second-hand Scientific Instruments. (No. 112.) Pp. 58. (London: C. Baker.)

The "Newton" and "Wigmore" British Epidiascopes. Pp. 28. The "Ampro" 16mm. Motion Picture Equipment. Pp. 8. The Newton Projection Microscope. Pp. 12. (London: Newton and Co.)

Watson Centenary, 1837-1937. Pp. viii+40. (London: W. Watson and Sons, Ltd.)

The Protexray Tube, Series 3. Pp. 20. (London: Cuthbert Andrews). Die Askania-Warte. Nr. 7, September-Oktober 1937. Pp. 24. (Berlin-Friedenau: Askania-Werke A.G.)