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Prices of Scientific Books

THERE are few libraries of scientific books, whether they be those of universities or other institutions or of private individuals, which have not been compelled during the last few years to cut down their expenditure upon periodicals. The loss is a loss to the library, to the scientific worker, and to the publisher, and has increased on the library shelves the much detested 'broken series'. Really the outcry on behalf of continuing old established series of periodicals may be more sentimental than rational; it is impracticable and impossible for any institution to continue all the old series and add all the new, and there is no sufficient reason why an old periodical should be continued if it has degenerated in quality or if it can be replaced by one better suited to the needs of the users of the library. Co-operation between libraries will often solve the problem of retaining the fullest possible range by avoiding duplication of the least necessary series.

The question, however, arises and is pressing. Since libraries must cut down expenditure upon periodicals, could a cut be organised which will have some effect in nullifying the conditions against which the libraries are struggling? We think it could.

Amongst many other services, the American *Quarterly Review of Biology* performs the annual service of analysing the cost of biological books received for review by that journal. The result of John R. Miner's analysis is always illuminating, sometimes astounding, and has been referred to on more than one occasion in the pages of NATURE. For 1933 the number of pages reviewed by the *Quarterly Review* was 104,725, and the comparisons are worked out on the average cost per page to the reader, the prices of foreign books having been converted into dollars at the rate current when the book was received.

In the first place it is satisfactory to notice that the general trend of prices continues to be downwards; thus a decrease of 3·6 per cent from 1932 to 1933, and of 8·9 per cent from 1926 to 1933, has brought the average price of all the books reviewed to 1·005 cents a page. This is in accord with the falling price of commodities in general throughout the world, but it is not so satisfactory to learn that the fall in price of biological books has lagged seriously behind the international decline. "Thus the books published in the United States show a decrease in price of 8·9 per cent

from 1926 to 1933, whereas the wholesale commodity price index of the United States Bureau of Labor Statistics declined about 40 per cent in the same period." The most striking decline in price has been in the books published in England (by which we imagine the author means Great Britain, for Scotland is by no means negligible as a producer of biological works), and there the fall from 0·89 to 0·66 cents a page represents more than 25 per cent. Since this difference, as converted into dollars, probably reflects the change in the relative value of the pound sterling, it is sad that we on this side of the Atlantic cannot appreciate it in buying our own books.

In the second place, it is noticeable that in spite of certain readjustments of price, a very marked discrepancy still exists between the prices of books published in different countries. Since the price comparison began in 1926, France has, until 1933, held pride of place for the cheapest commercially produced scientific books, but in 1933, with an addition to cost of 23·3 per cent, the price of 0·74 cents a page exceeds the cost of British books, which now are cheapest in the list.

We have not included in this comparison non-commercial books, such as Government publications the primary purpose of which is presumably propaganda for the good of the nation as a whole, for which end they are subsidised. Comparison of prices throws some light upon the value placed by governments upon the value of scientific work. U. S. Government publications are by far the cheapest in the whole list of publications, at 0·17 cents a page, for the encouragement of the application of scientific results, whereas the cost of British Government publications is 1·39 cents a page, *more than twice the price of commercial books*, and approaching very near to the cost of German books, which are the most expensive in the list. It would seem that either H.M. Stationery Office is inefficient as a producer of books, or that our Government does not consider the results of the work of its scientific staffs sufficiently valuable to be set before the public in the way deemed desirable in the United States. We suspect the presence of both adverse influences; but in any event it is difficult to understand why there should be this difference between the commercial price of British scientific books and the British Government price.

As to the discrepancy between the book prices of different countries: in 1933, while the French price rose 23 per cent, the German price fell 10 per cent, and yet in spite of that readjustment the price of German books is almost double that of French, 1·43 cents against 0·74 cents a page. The German prices for medical and scientific publications are so great in comparison with those of other countries (except British Government publications) that probably every scientific institution in the world has been discussing the matter as one of the serious library problems it has to face. There are several disturbing features. So great is the discrepancy that in most libraries of reasonable size a very large proportion of the annual grant for periodicals (two thirds or more in U.S.A. libraries) is swallowed up by expensive German publications chiefly in the hands of one or two large firms, leaving a third or less for periodicals from the rest of the world. That proportion clearly bears no relationship to the relative scientific value of the journals in question.

"The cost of some of these journals has now reached as high as 90.00 to 173.00 dollars a year, and as no definite yearly subscription price is announced, the subscriber cannot know beforehand what he will be called upon to pay." There is a remedy; it is a drastic one, but after mature consideration it has been adopted and recommended by the Medical Library Association, on the advice of a special committee which it appointed to inquire into the situation.

We quote in full the resolutions, as passed by the Association (*Science*, 78, 139; 1933); they may be helpful to the curators of libraries of scientific periodicals in Great Britain, suggesting that by co-operation an end may be put to what is no less than extortion, an exploiting of scientific workers, because of their desire to give due weight to the scientific results of every country.

"1. It is recommended that no library subscribe to any periodicals that do not have a fixed annual subscription price for the entire annual output of volumes or parts. That such price be stated in advance, and also a statement of the number and parts to be issued per year.

"2. That the Committee on the Cost of Current Medical Periodicals be empowered to invite the various library groups of this and other countries to co-operate with us in the above-mentioned and other measures, necessary to establish more equitable prices for medical and other scientific journals, and that the approach to library organizations in other countries be made first through the president of the International Federation of Library Associations.

"3. We believe there is a widespread opinion that there must be a substantial reduction in extent of, and in subscription prices for, the most expensive medical and other scientific periodicals,

and we further recommend that, unless definite word to this effect is received prior to renewal of subscriptions for 1934, libraries cancel their subscriptions to the most expensive journals, except one library in each of 6 to 10 zones throughout the United States and Canada."

Some of our British universities have found the strain of German periodical subscriptions to be so great that they have already drastically cut down the list. But isolated action penalises the pioneers and may not be sufficiently cumulative to have the effect desired; whereas co-operative action, even throughout the English-speaking world, could scarcely fail to bring about a more reasonable attitude on the part of the publishers concerned.

J. R.

Protozoology in the United States

The Biology of the Protozoa. By Prof. Gary N. Calkins. Second edition, thoroughly revised. Pp. xii+607+2 plates. (London: Baillière, Tindall and Cox, 1933.) 37*s.* 6*d.*

THE first edition of this book appeared in 1926, and was favourably reviewed in these pages at the time (NATURE, 118, 763, Nov. 27, 1926) by another hand: and since this new version is described as "thoroughly revised", one turns to it with confident hope that the shortcomings of the earlier volume have been, in the main, remedied. According to the author's preface, the chief amendments are as follows:

"After the first introductory chapter we plunge at once in Chapter II into the substances and structures of the fundamental organization. This is followed . . . by the development of these substances and structures into cytological derivatives (Chapter III) and taxonomic structures (Chapter IV) of the derived organization. In Chapter V the general physiological activities are considered in anticipation of Chapter VI on reproduction. The problem of general vitality and its significance in fertilization and the accompanying phenomena of sex differentiation, maturation, reorganization, adaptation and variations are treated in Chapters VII, VIII and IX. The special chapters on taxonomy, together with more elaborate keys to genera, are transferred from the middle of the book to the end in Chapters XI, XII, XIII and XIV."

This second edition also contains a new chapter entitled "General Ecology, Commensalism and Parasitism". As the author truly says, "Parasitism and disease should be considered in any work on general biology. These topics were omitted in the first edition but are introduced here in Chapter X". In this chapter is included a discussion of the dysentery amœba of man (*Entamœba histolytica*), in the course of which the author insinuates that the present reviewer comes "rather close to unfair dealing" in his interpretations of history and nomenclature. This charge should be answered at once, as it has already been singled out for commendation in the United States. But it will suffice to note that Calkins's other allegations are here often clearly incorrect, and his conclusions demonstrably wrong. For example, he tells us that Lösch, in his classical case of amœbic dysentery, "found an abscess of the liver containing amebæ": he gives Councilman and Lafleur credit for modern views which they did not express: and he concludes, apparently, that the correct name of the parasite in question is "*Endamœba dysenteriæ* (*histolytica*)"—an unorthodox combination in which every term appears to be unjustifiable. It may be noted further, as evidence of the author's own fairness and impartiality, that he finally assigns the reviewer's discovery of the complete life-cycle of the parasite *in vitro* to two later American imitators. Calkins is obviously unfamiliar with this branch of his subject, and his excursion into it seems therefore regrettable.

Unfortunately, many other pages in this book invite similar criticism. The "thorough revision" which it has undergone has neither brought it reasonably up to date nor corrected scores of factual mistakes in the first edition and its precursors. Proper names are still too often misspelled, or printed without their diacritical marks: no magnifications are noted for most of the figures, so that composite pictures are likely to delude the uninstructed (for example, Fig. 4, p. 23, where a *Chilomastix* cyst appears as large as an adult *Euglypha*): it is scarcely ever indicated whether the illustrations show living or fixed and stained specimens: the fabulous figures of "mitosis in *Endamœba coli*" (Fig. 26, p. 53—rightly claimed as "original") are still unblushingly displayed: and the bibliography is still carelessly done and unrepresentative. Many authors are hardly treated, and the references as a whole are still inadequate. As an example, it may be noted that Wenyon, our leading protozoologist—whose name was omitted altogether from the "Bibliography" in the first edition—is now credited with only two publications, both bibliographically inexact. Most other living English protozoologists are ignored. The "more elaborate keys to genera",

so far as we have tested them in detail, seem more likely to mislead than to direct the beginner —for whom they are presumably intended.

Some of the defects just noted are doubtless to be excused as survivals from earlier publications, yet even so it is hard to understand how they have escaped a reviser's eye. But Calkins is nothing if not conservative. In 1901 he called the Father of Protozoology "Anton von Leeuwenhoek"—as though he were a German—and he called Lederm̈uller "Ledenmüller"; and in 1933 he does so still. On the other hand, it should be added that both text and illustrations have now been slightly curtailed, while two coloured plates—borrowed from others—have been incorporated: but there is also now only a single index (19 pages) instead of the separate author and subject indexes (25 pages in all) in the first edition, though the price has been increased by approximately 7 per cent.

Errors in detail are present in every book ever printed, and we have no desire to lay undue emphasis on a few glaringly exhibited in the work under review. A book may be good in general, though bad in particulars: and the present volume must therefore be considered and judged also from a wider angle. Yet this is very difficult, because—despite its rearrangements, additions, and corrections—no rational plan seems to underlie the work as a whole. It seems still to be a medley of morphology, systematics, and physiology, precariously held together by loose generalities; while the very title, with its undefined term "biology", is apt to mislead us regarding the author's aim—if any. But it is "unfair dealing", perhaps, to ask for greater precision, since he tells us in his opening lines that he "has made no effort to give a complete account of the Protozoa" but "rather a study in biology illustrated by the unicellular animals". This is certainly very vague; yet it may possibly be brought to a sharper focus by the fine-adjustment of history—a method of approach to his subject for which the author himself has evidently but little liking.

Prof. Calkins has now published—including this second edition of the third—no less than four textbooks of protozoology: and this is a record. No other man has produced so many, single-handed. In 1901—when he was but thirty-two years of age—he gave us "The Protozoa"; in 1910, "Protozoology"; and in 1926 and 1933 his two versions of "The Biology of the Protozoa". All these works are genetically connected, and together they give us a rough picture of their author's protozoological progress. Their titles alone suggest his steady advance from the definite and concrete into the abstract and obscure.

This can also be shown in other ways. For example, in 1901 Calkins believed whole-heartedly that all Protozoa are "unicellular organisms". Apparently he does so still, but he now finds it necessary to qualify this definition and say that they are organisms "*usually* consisting of a single cell" [italics not in original]: but as this quibble clearly cannot evade the real difficulty, he attempts to safeguard himself by adding that "As organisms the Protozoa are more significant than as cells" (whatever that may mean); and to forestall the obvious rejoinder he roundly alleges that those of us who reject the cell-theory, as applied to the Protozoa, do so merely "through sophistry". Surely the boot is on the other foot.

In his preface to the original edition (1926), Calkins indicated his general views more fully than he does now. He drew a novel distinction between "Protozoa-study" and "Protozoology" as a science, and expressed a hope that his new presentation of the subject might convert the first into the second. "The underlying biological principle in this presentation," he wrote, "is the irritability of protoplasm, combined with protoplasmic organization. . . . Each such organization, under appropriate stimuli undergoes differentiation through which the derived or visible organization is developed from the fundamental organization. Through irritability of protoplasm and reactions to internal stimuli arising through metabolic activities as well as through reactions to external stimuli, the fundamental organization is progressively changed"—and so on, in the same strain. But protozoologists—like protozoa—consist of "protoplasm" and are therefore irritable: and some of us, at least, believe that what our science really needs most at present is more "Protozoa-study" and less "Protozoology" (in Calkins's sense). We want more facts, and fewer generalities and obsolete platitudes. We have no use for discussions about "the senescence of protoplasm" and similar fossils, because we regard all such antiquities as products of bad bacteriology and worse logic.

No one man can now compose an accurate and comprehensive treatise on protozoology in all its manifold ramifications. Prof. Calkins has been attempting this impossible task—for our instruction

and diversion—during more than thirty years; and though some English protozoologists dispute his knowledge and general notions, and few of us share his particular affection for *Paramecium* and *Uroleptus*, we can all admire his courage and feel grateful to him for his persistent presentation of the tenets of his own peculiar sect in America.

CLIFFORD DOBELL.

Towards a Planned Society

(1) *Education for Industry and Commerce in England.* By A. Abbott. Pp. xiv+228. (London: Oxford University Press, 1933.) 5*s*. net.

(2) *The Anti-Slum Campaign.* By Sir E. D. Simon. Pp. viii+206. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 2*s*. 6*d*. net.

(3) *Product Money: a Sequel to 'Riches and Poverty'.* By Sir Leo Chiozza Money. Pp. xv+172. (London: Methuen and Co., Ltd., 1933.) 5*s*. net.

(4) *Science and Democracy: adjusting the Laws of Advancing Mechanization to the Objectives of Civilized Policy.* By Frank Trinca. Pp. v+202. (Melbourne: Brown, Prior and Co., Pty., Ltd., 1933.)

THE four volumes under review deal with diverse subjects, but each subject is regarded from essentially the same angle—its place in a planned society and the contribution of science to those many vexed problems with which the advent of power production confronts our age.

(1) Technical education in Great Britain has in recent years had no abler expositor than Mr. A. Abbott, who in this volume gives us not only an admirable yet concise historical review of the development of commercial and technical education during the last century, but also a lucid statement of the present position and an eloquent plea for the framing and carrying out of a definite policy of recruitment and training for the personnel of industry and commerce. In his view, two main tasks now confront us. First, the conversion of the present secondary school into a more flexible instrument for the common welfare; and secondly, the correlation of our system of technical education with our methods of general education and with the needs of industry and commerce.

Both tasks call for a much closer co-operation between industry, commerce and education. If the secondary school by modification of its curriculum is to become a more suitable basis for the vocational education of the technical school, it must equally remain at all costs a place of general education, and Mr. Abbott does well to direct attention to the dangers of the present examination system in this respect. Equally he stresses the bearing of technical education on industrial efficiency and the restoration of our lost prosperity or maintenance of our higher standard of living. He makes the trenchant comment that the inefficiency of some industries is due to their failure to utilise the scientific knowledge now available for them, because they do not employ enough men with the necessary wide and thorough scientific training; and he observes that in many branches of industry there is no real hope of applying, on any adequate scale, the new knowledge gained by the various research associations, until the qualifications of the men at the top have been improved. The changing nature of industrial skill, which now demands considerable intelligence, a sound general education, a willingness to develop fresh interest and an ability to adapt oneself easily and completely to fresh tasks, enforces the pressing need for a policy of recruitment deliberately conceived by every industry; with this policy should be associated a definite plan of training and promotion in which the exact function to be exercised by the schools has been determined.

With this wide vision and emphasis on a definite policy, the individual aspect is not forgotten. On the contrary, the problems which arise from the decreased vertical mobility of labour are one of the grounds on which a considered policy of recruitment is urged, and the whole book is equally a plea for planned industrial and commercial education, and for an educational system which guarantees to our children expert and sympathetic guidance in choosing a profession and adequate training for its skilled practice. The problems of technical education are well and fairly stated, and the book has just claims on the attention of every scientific worker who is concerned with the future of industry and commerce.

(2) Sir E. D. Simon writes as an acknowledged authority on housing, but his book claims the attention of scientific workers as much for its clearly sounded call for national planning in this important field as for its lucid and readable description and analysis of the present housing situation. He sees the necessity for what he describes as a new type of politician, who

is able to come to a scientific conclusion on matters where his emotions or party interest are involved, and he deplores the weakness of our present party system that, in such matters as housing, each side prefers to urge a distorted version of the facts which suits its own prejudices rather than to ascertain the truth. He does more, however, than sound a warning as to the disastrous consequences which flow from a two-party system when each party as it comes into power spends its energy in such fields in reversing the plans of the other.

Sir E. D. Simon gives us the outlines of a national plan, which includes the provision of an adequate statistical department to prepare the estimates on which a scientific housing problem could be elaborated to meet the real needs of the population. It would include a strong technical department, comprising a research section and taking stock of the needs of the tenant, methods of municipal management, the construction and design of houses and tenements, etc., and a planning department covering planning in all its aspects—the estate, the city, the region and the country as a whole as well as the movements of population and industry. The mere enumeration of the essential activities indicates the many gaps which exist in our present knowledge and the inadequacy of our present attack on the problem.

The author states a masterly case for a Ministry of Housing or a National Housing Board, which could render services in elaborating new policies and guiding and helping local authorities comparable with those rendered by the Board of Education in its own field. It is obvious that he has himself a definite policy conceived on scientific lines, and it is urged with a reasonableness and an emphasis on practical issues which heartily commend it to the scientific worker.

(3) Sir Leo Chiozza Money faces the problems with which science confronts society and makes a bold plea for a planned economy. His explanation of the arrangement for the exchange of commodities which he describes as "product money" leaves the reader with many unanswered questions in his mind. His explanation is indeed merely a sketchy outline of his proposals, and much of the book is only a restatement of familiar criticisms of the existing credit and currency system. He is much more convincing in his exposition of the inadequacy of present exchange methods to cope with the increasingly rapid expansion of machine production, than in the presentation of his own proposals for the abolition of a circulating medium and the substitution of his product money—"a non-circulating order upon production".

The value of the book lies rather in the outlook, which refuses to accept the present unsatisfactory situation and seeks to find other and adequate methods of solving the problems of production, distribution and exchange.

(4) Mr. Trinca's essay in the same field is a somewhat disappointing effort. He endeavours to trace in turn the relations of science and industry, the limitations of the machine and the bearing of machine production on employment and finance, and finally the relation of industry to the wider background of economic and social life. At the outset he lays a good deal of stress on what he terms the wave-law of inventive progress, but without giving adequate evidence in support of his point; nor does he allow sufficiently for the lessening place of invention in modern industry as a result of the teamwork implicit in industrial research under present-day conditions. Mr. Trinca handles an interesting theme, another attempt to bring scientific thought to play in every department of life; but this book is marred by so much jargon and careless writing that he is sadly open to the charge of having something to say but not knowing how to say it.

R. BRIGHTMAN.

The Natural Resins

Die Harze: Die botanischen und chemischen Grundlagen unserer Kenntnisse über die Bildung, die Entwicklung und die Zusammensetzung der pflanzlichen Exkrete. Bearbeitet von A. Tschirch und Erich Stock. Dritte umgearbeitete Auflage von A. Tschirch: *Die Harze und die Harzbehälter.* Band 1. Pp. xv+418. (Berlin: Gebrüder Borntraeger, 1933.) 47.25 gold marks.

THE natural resins continue to increase in economic importance notwithstanding the competition from synthetic materials, and they are the subject of monographs in several languages. Prof. Tschirch is one of the pioneers in the field and his book has long been a standby for those seeking information. This, the third edition, has been completely rewritten with the assistance of E. Stock; it covers, as explained in the sub-title, the botanical and chemical basis of the knowledge of the formation, development and composition of the plant excretions. The volume before us contains the general principles of the subject,

subsequent volumes being devoted to the individual resins; it is divided into morphological, physical and chemical sections following a lengthy chapter on the formation of the exudates. This first chapter is copiously illustrated both with microscope drawings of cell structure and with photographs of the trees showing the method of collecting; it includes one fine plate in colours illustrating the fluorescence analysis of balsams and resins in the quartz lamp. The thorough and exhaustive nature of these sections which characterise the resins are exemplary.

The chemistry chapter commences with a section some hundred pages in length detailing the historical development of this special inquiry. It starts back in the sixteenth century with recollections of amber, which incidentally gave the name to electricity, and may be traced through the period of qualitative investigation in the eighteenth century and of quantitative study in the early nineteenth from the days of Unverdorben to those of Hlasiwetz. Dry distillation and fusion with alkali were among the processes summoned to help, and protocatechuic acid and phloroglucinol were recognised as important constituents. The application of newer methods to the inquiry largely begins with Tschirch's own work, commencing in 1886. The whole is a story of profound interest to the expert and the value of the section is enhanced by the copious references to the original literature from 1661 onwards; few subjects can have been more thoroughly monographed on the chemical side.

The problem of the resins is far from solved; like other complex polymers of high molecular weight, such as starch and the proteins, they are mixtures—a point emphasised by Tschirch.

The chemical section describes the generalities; the details of each resin will follow in the subsequent volumes. E. F. A.

Short Reviews

A Modern Outline of Evolution. By George Whitehead. Pp. vii+324. (London: John Bale, Sons and Danielsson, Ltd., 1933.) 7*s.* 6*d.* net.

MANY books on organic evolution written by scientific men famous for their researches are suitable to students but not to the public, who do not desire more than passing references to the facts and the general outline of theories. The book before us has no illustrations; it is reasonably cheap and as it nowhere labours, it is comfortable reading. It thus should be a useful guide to those who wish to understand 'the complex manifestations of life'. It is frankly a compilation, the story of the origin of the earth leading up to that of life. Evidences of evolution are next given and then the theories as to how it comes about, suitably ending up with a chapter on vitalistic evolution. Unfortunately there is a certain lack of understanding of the physiology of animals, function and anatomy being two inseparable factors. The chapter on Kropotkin's 'mutual aid' seems a curious and unnecessary interpolation between Darwin and Weissmann; and that on "Mutations and Mendelism" should in our opinion be entirely rewritten.

There can be no clear differentiation in the reader's mind between fluctuations and mutations, and the author's references to the opinions of those who are not researchers in this field are often valueless. The term 'character' or 'characteristic' has a clear meaning, and why it is stated that only about seven such "can be found" in the pea is extraordinary, since recent research suggests that all characters are Mendelian, and more than 400 characters have been determined in *Drosophila*.

Further, no book on evolution can be regarded as complete which does not give some account of recent research on genes, hereditary structural units responsible for every transmissible character. This is now the chief field of research leading up to the understanding of the mechanics of organic evolution, and one which the author need not fear to summarise in his second edition.

Dr. H. G. Bronns Klassen und Ordnungen des Tierreichs. Band 4, Abt. 2, Buch 2: *Acanthocephala.* Bearbeitet von A. Meyer. Lief. 1. Pp. 332. 39.60 gold marks. Lief. 2 (Schlusslieferung). Pp. vi+333–582. 32 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932–1933.)

DR. MEYER gives an interesting historical account of the Acanthocephala from their discovery by Leeuwenhoek (1695) who found two species in the gut of the eel. Koelreuther (1771) and O. F. Müller (1776), who independently recognised that these worms were different from other helminthes, named the first two genera, *Acanthocephalus* and *Echinorhynchus*. Bremser (1811), who is stated to have examined 40,000 individual animals for the presence of Acanthocephala, and Rudolphi, whose published accounts extend over the period 1795–1820, added much to our knowledge of these parasites. Westrumb produced in 1821 the first monograph of the group, which included a description of 90 species and an account of the anatomy and physiology. Leuckart (1862) initiated the studies on the life-history, and various writers, including the author, have developed the systematics of the group.

The historical account is followed by the

systematic consideration of twelve families, 58 genera and 258 species and by an admirable description of the external features, biology, anatomy and development. In a short chapter of ten pages the damage caused by these worms in fish and domestic animals and in man is considered. Tables are given showing the hosts, both invertebrate and vertebrate, of Acanthocephala, and the geographical distribution of the genera and species. A key for distinguishing the genera, a detailed bibliography and three indexes (author, systematic and structural) are added. The illustrations, 382 in the text and one plate, are well chosen and excellently reproduced, and the work forms an admirably planned and executed monograph.

Handbuch der physikalischen und technischen Mechanik. Herausgegeben von Prof. Dr. F. Auerbach und Prof. Dr. W. Hort. Band 7: *Grenzgebiete der technischen und physikalischen Mechanik.* Lief. 1. Pp. iv+238. Lief. 2. Pp. vi+239–490. Lief. 3. Pp. vii+491–814. Lief. 4: *Alphabetisches Sachregister zu Bände 1–7.* Pp. xv+815–853. (Leipzig: Johann Ambrosius Barth, 1928–1931.) 72 gold marks.

THE appearance of vol. 7 completes the publication of this great handbook of physical and technical mechanics (the successor to the famous Winkelmann's "Handbuch der Physik"). Publication has proceeded at intervals since 1927, and previous parts have already been briefly reviewed in NATURE. The present volume is devoted to border-line branches of mechanics. Its articles and their authors are as follows: capillarity (Auerbach, 168 pp.), capillary chemistry (Freundlich, 19 pp.), disperse systems and the Brownian motion (Fürth, 40 pp.), thermodynamics (Auerbach, 48 pp.), kinetic theory of gases (Auerbach, 52 pp.), statistical mechanics (Fürth, 48 pp.), fluctuations (Fürth, 32 pp.), theory of solid states (Braunbek, 38 pp.), atomic mechanics (Joos, 33 pp.), constitution of matter (Bennewitz, 27 pp.), chemical status and dynamics (Bennewitz, 34 pp.), adsorption (Blüh, 42 pp.), technical application of adsorption (Berl and Andress, 20 pp.), the flotation process (Berl and Schmitt, 20 pp.), diffusion without dividing walls (Fürth, 70 pp.), osmosis (Fürth, 35 pp.), technical applications of electro-osmosis (Berl and Andress, 8 pp.), solutions (Fürth, 46 pp.), electro- and magneto-mechanics (Auerbach, 20 pp.). An alphabetical subject index to the whole of the seven volumes completes the work.

Plant Ecology: for the Student of British Vegetation. By Dr. William Leach. (Methuen's Monographs on Biological Subjects.) Pp. vii+104. (London: Methuen and Co., Ltd., 1933.) 3*s.* 6*d.* net.

THE increasingly prominent position occupied by habitat factors in modern ecological work is reflected in this book, more than half of which is devoted to a discussion of climatic, physiographic and biotic factors and the methods employed in their practical investigation. A particularly large section is devoted to soil problems and, having regard to their all-important ecological influence in Great Britain, this section should prove one of the most acceptable features of the book.

The sections dealing with biotic factors and plant succession are well done, the numerous examples illustrating clearly their mode of operation in specific plant communities. A chapter is given to the practical side of the subject in which directions are given for mapping vegetation, quadrat and transect observations, and estimating water content, organic matter and hydrogen ion concentration of soils. The book concludes with a short account on broad lines of the principal present-day types of British vegetation and of the post-Glacial changes which have occurred as revealed by peat investigations.

Diseases of the Heart: described for Practitioners and Students. By Sir Thomas Lewis. (Department of Clinical Research, University College Hospital, London.) Pp. xx+297. (London: Macmillan and Co., Ltd., 1933.) 12*s.* 6*d.* net.

THE name and reputation of the author of this book are sufficient guarantee of the accuracy of its contents and the wisdom of its teaching; but what makes it particularly attractive is its unusual arrangement, which is that of disorders of cardiac function, rather than of diseases of the heart. The distinction is no small one; a patient's heart concerns him only in its degree of competence to carry out its work; that this aspect should be the main concern of the physician is the basis of Sir Thomas Lewis's teaching, and one of the best features of his book is its departure from the traditional arrangement of "diseases of the pericardium, of the muscle, of the valves", preceded by the stock "anatomy and physiology". If any practitioner tends to forget that his work is to treat patients, not diseases, this book, and in particular a certain half-dozen paragraphs in the last chapter, will provide the reminder.

Epidemiology, Historical and Experimental: the Herter Lectures for 1931. By Major Greenwood. Pp. x+80. (Baltimore, Md.: The Johns Hopkins Press; London: Oxford University Press, 1932.) 9*s.* net.

IN this little book are reproduced the twentieth series of the Herter lectures, delivered in 1931 by Prof. Major Greenwood. The first lecture is historical, the second describes a biological experimental study of epidemics, and the third considers the subject of immunity. The biostatistical method of investigating disease in experimental communities leads the author to some interesting conclusions relating to the influence of the introduction of non-immune members into a herd; and although it does not yet contribute any suggestion to the problem of controlling epidemics, its more extended application may indicate the means by which real progress can be made.

The New Hydrogen*

By THE RIGHT HON. LORD RUTHERFORD, O.M., F.R.S.

FOR more than a century scientific men believed with confidence that pure water was a well-defined chemical substance, H_2O, of molecular weight 18. This belief was shown by the fact that the unit of mass, the kilogram, consisting of a cylinder of platinum-iridium, was initially chosen to be of the same mass as 1,000 cubic centimetres of water at the temperature of maximum density. Subsequent measurements showed that this was slightly in error, so that the unit of mass was defined in terms of the metal standard. It was only about four years ago that this confidence was slightly disturbed as a result of the study of the isotopic constitution of oxygen. Instead of being a simple element of mass 16, oxygen was found to contain in small quantity isotopes of masses 17 and 18. It was clear from this that pure water must contain some molecules of weight 19 and 20 as well as the normal 18. Since, however, it seemed very unlikely that the proportion of the isotopes could be sensibly changed in the processes of preparation of pure water, this result, while of much theoretical interest, did not appear to have any practical importance.

As a result of investigations during the last two years, there has been a revolutionary change in our ideas of the constancy of the constitution of water. This has resulted from the discovery that a hydrogen isotope of twice the normal mass is always present in preparations of ordinary hydrogen. While this isotope of mass 2 exists only in small proportion—only about 1 in 6,000 of the main isotope of mass 1—yet, on account of the marked difference in mass of the two components, the relative concentration of the two isotopes can be varied in a marked way by various physical and chemical processes. This is seen by the fact that we are now able to obtain preparations of water in which the isotope of hydrogen of mass 1 is completely replaced by the isotope of mass 2. The density of the heavy water is about ten per cent greater than ordinary water; while its freezing point is 3·8° C., and its boiling point 1·42° C., higher. Though in outward appearance this heavy water resembles ordinary water, yet in general its physical and chemical properties show marked differences. Not only does the vapour pressure vary markedly from the normal, but also the latent heat is considerably higher. Both the surface tension and specific inductive capacity are lower while the viscosity is much greater.

It is of interest to indicate briefly the almost romantic history of this rapid advance in knowledge, and to note that there are certain points of analogy between the discovery of heavy hydrogen and the discovery of argon in the atmosphere by the late Lord Rayleigh. In both cases the clue to the discovery depended on the recognition of the importance of small differences observed in accurate measurements of density.

When the relative abundance of the isotopes of oxygen was first measured, Birge and Mendel showed that there was a slight discrepancy—only about 1 in 5,000—between the ratio of the masses of the atoms of hydrogen and oxygen measured by Aston by the method of positive rays and the ratio deduced by direct chemical methods. They concluded that this small difference was greater than the probable experimental error in the measurements and in explanation suggested that hydrogen might contain in small quantity—about 1 in 4,000—an isotope of mass 2. Let us consider for a moment how the presence of such an isotope could be demonstrated by direct experiment. Both the H^1 and H^2 isotopes would have the same nuclear charge of 1, and have one external electron, and would thus be expected to give the same type of optical spectrum under the influence of the electric discharge. It is to be remembered, however, that the electron, the movements of which when disturbed give rise to its characteristic radiations, is coupled to the nucleus; and that the rates of vibration, although mainly governed by the nuclear charge, are slightly affected by the mass of the nucleus itself. On account of the greater mass of the H^2 isotope, it can readily be calculated that the Balmer lines in the spectrum of heavy hydrogen should appear slightly displaced towards the red. In the case of the α line, the displacement amounts to 1·78 angstrom units. When an electric discharge is passed through ordinary hydrogen, weak satellites should thus appear on the side towards the red. The presence of such weak satellites in the right position was first detected in experiments made for the purpose by Urey, Brickwedde and Murphy. The intensity of the satellite compared with the strong H_α line was difficult to measure with certainty but was found to be of the order of 1 to 5,000.

Experiments were then made to enrich the H^2 isotope by fractional distillation of liquid hydrogen; and with some success. Another important observation was made by Urey and Washbourn, who found that the water in old electrolytic cells contained a larger proportion of heavy hydrogen than the normal. The concentration of H^2 was found to be rapidly enriched by continued electrolysis. This gave the key to a successful method of obtaining heavy hydrogen in quantity. The processes involved were carefully investigated by Lewis and Macdonald, and the electrolysis of water was carried out on a comparatively large scale. Nickel electrodes were used, and sodium hydroxide as an electrolyte. In general, it was found that the escape of H^1 during electrolysis was five to six times faster than that of H^2 relative to their

* Discourse delivered at the Royal Institution on Friday, March 23.

concentrations in the solution. There was in consequence a steady accumulation of the heavy isotope in the water in the process until nearly pure heavy water was obtained. Assuming that the initial concentration of H^2 in the water was 1 in 6,000, about 1 c.c. of pure heavy water should be obtained by electrolysis of 6 litres of water.

Lewis succeeded in preparing many cubic centimetres of heavy water in which ordinary hydrogen was present in very small quantity. He and his collaborators investigated the main physical and chemical differences between heavy water and ordinary water, to some of which I have already referred. Our congratulations are due to our American colleagues for the masterly way they have opened up and developed so rapidly this new field of knowledge, which it is certain will prove of great scientific and practical importance in many directions in the near future. Prof. G. N. Lewis, of the University of California, who was the first to prepare nearly pure heavy water, generously presented samples of this water to a number of investigators, not only in his own country but also in Europe, in order to give them an early opportunity of testing its properties. I am personally much indebted to Prof. Lewis for a sample of this heavy water with which we were able to make a number of experiments on the transformation of matter to which I shall refer later.

We are all aware of the important part that hydrogen plays in many chemical compounds and particularly in organic molecules. When reasonable supplies of heavy water are available to the experimenter, there will no doubt be great activity in preparing and studying many compounds in which H^1 in the molecule is wholly or partly replaced by H^2. Already a few investigations have been carried out, for example, with ammonia and with hydrogen iodide, in which H^1 is replaced by the heavy isotope. It has been found that in mixtures of light and heavy hydrogen gas, the atoms interchange on a nickel surface at a temperature of about 600° C. and the conditions of equilibrium and heat evolution have been investigated. During the next few years we may expect an intensive study to be made of the change of properties of compounds in which heavy hydrogen is used. It will be of particular interest to examine the changes in the rates of reaction at different temperatures when heavy hydrogen is substituted for ordinary hydrogen.

The discovery of the new water will be of great importance in another direction, namely, its effect on the processes occurring in animal and plant life. There has not yet been sufficient time to make more than a few preliminary experiments in this field, and then only on a small scale. Lewis finds that seeds of a certain tobacco plant did not germinate in pure heavy water but did so when the concentration of heavy hydrogen was about one half. In experiments by other observers, well-defined physiological effects have been obtained for quite small concentrations of heavy hydrogen in water. Further observations in this highly important field of inquiry will be awaited with much interest.

It is widely recognised that the new hydrogen will prove of so much general importance to chemistry and physics that it is desirable to give it a definite name and symbol. Prof. Urey, its discoverer, has suggested that the isotope of mass 1 should be called 'protium' and the isotope of mass 2 'deuterium'; while the nucleus of heavy hydrogen, which has already been found very efficient as a projectile in transforming matter, should be called 'deuteron' or 'deuton'. The question of a suitable nomenclature is one of general importance to scientific men and deserves careful consideration. The name 'diplogen' (διπλους, double) for H^2 and 'diplon' for the nucleus seemed to find some favour in England as an alternative. The symbol D for the heavy isotope seems appropriate.

While diplogen (or deuterium) may be separated in quantity from heavy water in nearly a pure state, it is of interest to refer to another method of separation employed by Hertz. By utilising a special diffusion method devised by him, he has been able to separate from ordinary hydrogen gas about 1 c.c. of diplogen in such purity that the Balmer lines of hydrogen were not visible in its spectrum. With such pure material, it should be possible to study in detail the complicated band spectrum of diplogen and compare it with that of hydrogen.

We have not so far considered the question of the nuclear structure of diplogen and its relation, if any, to that of ordinary hydrogen. We first of all require to know its mass with accuracy; this has been measured by Bainbridge by using a modification of the positive ray method, who found that the mass of the atom is 2·0136 while the mass of the hydrogen atom is 1·0078 in terms of the mass of the main isotope of oxygen taken as 16. This mass is slightly less than the combined mass of two H atoms. Sufficient evidence is not yet available to decide whether the D nucleus is simple or composite, and there are a number of possible combinations to consider between the four units, the electron, positron, neutron and proton. If we assume, as seems not unlikely, that the D nucleus consists of a close combination of a proton with a neutron, it can be shown from the masses concerned that its binding energy should be somewhat less than 1 million volts if we take the value 1·0067 for the mass of the neutron as estimated by Chadwick. If this be the case, we should expect the diplon to be broken up occasionally into a proton and neutron as a consequence of a close collision with a fast α-particle. Experiments to test this have so far yielded negative results. If this dissociation occurs at all, the probability of such an event must be very small. Lawrence, from a study of the bombardment of elements by diplons, suggests that the diplon may break up into a proton and neutron in the strong electric field close to the bombarded nucleus, but the interpretation of his results is not yet

certain. At the moment, therefore, the experimental evidence is insufficient to give a definite decision with regard to the structure of the diplon.

By comparing the scattering of α-particles when passing through diplogen and hydrogen gas, Mr. Kempton and I have found that as the result of a head-on collision with an α-particle, the recoiling diplon travels about eight per cent farther than the proton in a corresponding collision. Such a result is in agreement with calculation. It also seems clear that the field of force round the diplon must be very similar to that of the proton, although it may be expected that some differences would be shown for very fast α-particles if the diplon is composite as we have supposed.

Transmutation of Elements

The discovery of heavy hydrogen has provided us with a new form of projectile which has proved markedly efficient in disintegrating a number of light elements in novel ways. It was a very fortunate coincidence that, when Prof. Lewis had prepared some concentrated diplogen, his colleague in the same University, Prof. Lawrence, had available his ingenious apparatus for producing high-speed protons and other particles with an energy as high as two million volts. When diplogen was substituted for hydrogen, the diplon (D^+) was found to be about ten times as efficient in promoting some transformations in lithium as H^+ of equal energy. It will be remembered that Cockcroft and Walton found two years ago that lithium, when bombarded with fast protons, was transformed, with the emission of swift α-particles. It seems clear that in this case the lithium isotope of mass 7 is involved. A proton is captured by the nucleus and the resulting nucleus breaks up into two α-particles, ejected in nearly opposite directions, according to the relation

$$Li_3^7 + H_1^1 \rightarrow He_2^4 + He_2^4$$

The emission of other particles of short range has also been observed but the exact nature of the transformation which gives rise to them is not yet clear.

When lithium is bombarded with diplons instead of protons, different types of transformation occur. In one case it seems that the lithium isotope of mass 6, after capturing a diplon, breaks up into two α-particles according to the equation

$$Li_3^6 + D_1^2 \rightarrow He_2^4 + He_2^4$$

In this case also, as has been shown beautifully by the expansion photographs obtained by Dee and Walton, the two α-particles are shot out in opposite directions and with a speed greater than the swiftest α-particle from radioactive substances.

Still another interesting type of complex transformation occurs in this element. Oliphant and Rutherford observed that lithium when bombarded by diplons gave, in addition to the group of fast α-particles first observed by Lawrence, a distribution of α-particles of all ranges from 7·8 cm. to 1 cm. in air. It is believed in this case that the isotope of mass 7 captures a diplon and then breaks up into two α-particles and a neutron according to the relation

$$Li_3^7 + D_1^2 \rightarrow He_2^4 + He_2^4 + n_0^1$$

This transformation is in close accord with the conservation of energy when the change of mass and the energies of the expelled particles are taken into account. The emission of neutrons from lithium has been observed by Lauritsen and also in our experiments. In addition, Lawrence has shown that a number of other light elements give rise under bombardment to groups of fast protons and in many cases also to α-particles and neutrons. While the interpretation of the experimental results is as yet only clear in a few cases, there can be no doubt that the use of heavy hydrogen will prove invaluable for extending our knowledge of transformations and thus in helping to throw light on the structure of atomic nuclei.

The importance of this new projectile in studying transformations is well illustrated by some recent experiments made in Cambridge with Oliphant and Harteck. When diplons were used to bombard compounds like ammonium chloride, NH_4Cl, and ammonium sulphate, $(NH_4)_2SO_4$, in which ordinary hydrogen was in part displaced by diplogen, enormous numbers of fast protons were found to be emitted, even for an accelerating voltage of 100,000 volts. In fact the number of expelled particles is far greater than that observed in any other type of transformation at this voltage. The main groups of expelled protons had a range in air of 14 cm., corresponding to an energy of 3 million volts. In addition to this group, another strong group of singly charged particles were observed of range in air only 1·6 cm. Both of these groups contain equal numbers of particles.

In order to account for these observations, it seems likely that, as the result of a close collision, the diplon occasionally unites with the struck diplon to form a helium nucleus of mass 4 and charge 2, but containing a large excess of energy over the normal helium nucleus. The new nucleus is in consequence explosive and breaks up into two parts, one a fast proton and the other a new isotope of hydrogen H_1^3 of mass 3. If this be the case, the proton and H^3 nucleus should fly apart in opposite directions. It can be simply calculated that the range of the recoiling H^3 nucleus under these conditions should be 1·7 cm.—a range agreeing closely with that actually observed. The changes occurring are illustrated by the equation

$$D_1^2 + D_1^2 \rightarrow He_2^4 \rightarrow H_1^3 + H_1^1$$

From the known masses of D and H^1 and the energy of the observed motion of the H^1 and H^3 particles, it can be deduced that the mass of this new hydrogen isotope is 3·0151.

In these experiments, large numbers of neutrons are also emitted. It appears probable that these

arise from another mode of disintegration of the newly formed helium nucleus according to the relation

$$D_1^2 + D_1^2 \rightarrow He_2^4 \rightarrow He_2^3 + \text{neutron},$$

an isotope of helium of mass 3 and a neutron being expelled in opposite directions. There is strong evidence that such an isotope of helium also appears when the lithium atom of mass 6 is bombarded by protons, and from this transformation it appears that the mass of this isotope is 3·0165. It is quite likely that the helium nucleus of mass 3 formed in this way is unstable and may possibly break up into H_1^3 and a positive electron. While the conclusions outlined above are to some extent provisional and require confirmation by other methods, there can be no doubt that the effects which follow the collisions of a swift diplon with another are of much importance and interest in throwing light on possible modes of formation of some of the lighter nuclei.

It is of interest to speculate why the heavy isotope of hydrogen appears in many cases far more effective, for equal energies, in producing transformations than the lighter isotope. On the general theory of transformation proposed some years ago by Gamow, it is to be anticipated that, for equal energies of motion, the diplon on account of its heavier mass would have a smaller chance of entering a nucleus than the swifter proton. It may be, however, that normally only a small fraction of the protons which actually enter a nucleus are able to cause a veritable transformation, the others escaping unchanged from the nucleus. On this view, the greater efficiency of the diplon in causing transformation may be due to the fact that a much larger fraction of those which enter the nucleus are retained by it, leading to a violent disintegration of its structure. It may be too that the diplon on entering a nucleus breaks up into its component parts. The appearance of the proton as well as the neutron in some of the transformations may be connected with the composite structure of the diplon.

Deep Water Circulation of the Atlantic

DR. G. WÜST, oceanographer in the German research vessel *Meteor*, has recently published the first part of vol. 6 of the reports of the German Atlantic expedition*. The report is not only a description of the *Meteor*'s results, but is also a history of the investigation of the Atlantic deep waters, and gives a critical summary of all the observations that have been made from those of H.M.S. *Challenger* (1873–1876) to those of the R.R.S. *Discovery II* (1929–1931). At the end of the report is a complete list of the observations used.

Dr. Wüst has made extensive use of the principle that if the water in a deep current sinks to a lower level, its temperature will increase as the water becomes adiabatically compressed; and conversely, that if the deep current rises, the water in it is cooled owing to adiabatic expansion. Any attempt to follow the path of a deep current in a vertical section showing temperature distribution is made much more difficult by these changes. It was first suggested by Prof. Helland-Hansen that the difficulty should be removed by using vertical sections showing the distribution of potential temperature—the temperature to which the water would be cooled if it were raised adiabatically to the surface. This report is a striking tribute to the advantage of this method.

In the report there are charts showing the actual temperature, the potential temperature, and the salinity of the bottom water (at depths greater than 4,000 metres) over the whole of the Atlantic Ocean. There are also vertical sections which show the distribution of potential temperature, and salinity, along the east and west Atlantic basins, on either side of the mid-Atlantic ridge. With their help, Wüst shows that the flow of antarctic and arctic bottom waters is much more asymmetrical than it was thought to be. Antarctic bottom water flows northwards along the sea bottom, mixing with the warmer North Atlantic deep water which is flowing southwards above it. The last traces of the antarctic water reach as far as 34° N. in the east Atlantic basin and to 40° N. in the western basin. The influence of bottom water of arctic origin can only be detected north of these latitudes as a very weak current.

From the relations between potential temperature and salinity, Wüst has been able to find the percentage of antarctic water at the bottom in both basins in all latitudes. These percentages are shown by two curves. The decrease of the antarctic water along the western basin is almost regular; it is hastened in about 5° S. where the Para rise obstructs the bottom current. In the eastern basin the northward flow is stopped at the Walfish ridge, which extends transversely from the African coast to the mid-Atlantic ridge. The antarctic bottom water north of this ridge enters the basin from the west through the Romanche channel, a break in the mid-Atlantic ridge near the equator. The bottom water flowing through this channel spreads southwards to the Walfish ridge and northwards to 34° N. By means of a chart showing the distribution of potential temperature at the bottom of the Scotia Sea, based principally on the observations made by the ships of the "Discovery" Committee, Wüst has been able to show that antarctic

* *Schichtung und Zirkulation des Atlantischen Ozeans.* Lief. 1: *Das Bodenwasser und die Gliederung der Atlantischen Tiefsee.* Von Georg Wüst. (Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition auf den Forschungs- und Vermessungsschiff *Meteor* 1925–1927, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft von A. Defant, Band 6, Teil 1.) Pp. 107+8 Beilagen. (Berlin und Leipzig: Walter de Gruyter und Co., 1933.) 20 gold marks.

bottom water also flows westwards into the Pacific Ocean.

It is interesting to note that the increase in temperature of the bottom water in the direction of flow can be accounted for solely by mixing with the North Atlantic deep water. No increase in temperature due to heat conducted through the earth's crust can be detected, and earlier attempts to measure the speed of the bottom current based on the assumption that the increasing temperature is the result of such conduction have been proved worthless.

The vertical distribution of potential temperature far south has changed Wüst's views on the origin of antarctic bottom water. He now believes that the coldest water is that which is cooled right through on the antarctic shelf in winter and sinks down the continental slope. This was the view held by Drygalski and Brennecke, but it could not be proved, because all the observations made in the open sea show that the bottom water is always covered with a layer of warm deep water through which the bottom water cannot be seen to sink. This warm layer is only absent from channels or basins adjacent to the antarctic continent which are cut off from the open sea by well-defined ridges rising above the level of the layer. In such basins there may be almost complete mixing from the surface to the bottom.

Wüst, in attempting to find a vertical series of observations which showed the cold water from the shelf sinking down the continental slope, has used a series (Deutschland St. 125) in such an enclosed basin, from which the water cannot sink because of a ridge. His failure to recognise this fact and the omission of the ridge makes the diagram on p. 45 misleading. He distinguishes a slightly warmer bottom water which he calls antarctic deep water; he believes it to be formed by the effect of strong cooling and formation of ice in autumn and winter on the surface water in a convergence region situated near the edge of the pack-ice between 60° and 66° S. In this theory, Wüst appears to be making a determined attempt to bring the views which he and Nansen have expressed on the formation of antarctic and arctic bottom water into accord with the known data regarding the circulation of the Weddell Sea. There is very little reason for believing that a convergence region exists; the deep water is probably bottom water which upwells in the middle of the cyclonic movement.

Wüst has shown that there is very close agreement between the distribution of antarctic bottom water and the distribution of sediments poor in calcium (particularly the red clay). North of 34°–36° N., where the streams of antarctic water die away, the bottom deposits are no longer poor in calcium. The antarctic water dissolves calcium and over each of these poor deposits it has been found to be enriched. The report shows that in such places the density of the water calculated from the usual chlorinity ratio is too low. By means of sections giving the distribution of potential density, it is shown that the density of antarctic bottom water calculated from the usual ratio is less than that of the North Atlantic deep water. This is because there is a chlorine deficit in the bottom water, or as there is some reason to believe, a chlorine excess in the North Atlantic deep water. Wüst points out that there is a pressing need of accurate physical and chemical determination of these small density differences, and of new tables and methods for the practical determination of density and salinity and the correction of densities calculated from chlorine contents. G. E. R. D.

Obituary

Dr. F. A. Bather, F.R.S.

FRANCIS ARTHUR BATHER, born in 1863, was the eldest son of the late Mr. A. H. Bather. From Winchester he gained a scholarship at New College, Oxford, where he graduated in 1886, taking first class honours in natural science. In 1887 he entered the Department of Geology in the British Museum (Natural History), where his care was chiefly the fossil echinoderms, and notably the crinoids. In 1892 he gained the Rolleston prize of the Universities of Oxford and Cambridge for research in biology. His first scientific publication of importance was on the Crinoidea of Gotland, in 1893. He was married at Stockholm in 1896; and in 1897 he was awarded the Wollaston fund of the Geological Society. On the retirement of Dr. Henry Woodward in 1902, Dr. Bather was appointed deputy-keeper, a position which he held until 1924, when he assumed the keepership vacated by Dr. (now Sir) Arthur Smith Woodward. He was elected fellow of the Royal Society in 1909; and in 1911 was awarded the Lyell medal of the Geological Society, and served as president of that body in 1926–28. He was also a member of several foreign scientific societies. Retiring from the Museum in 1928, he still visited the Department of Geology to pursue his researches on crinoids, which had been seriously interrupted by his administrative duties as deputy keeper and keeper. Though failing in health during the past year, he was active until the last; and when, after two days' illness, he passed away on March 20, the sad news came as a shock to his many friends.

Such, in bare outline, was the professional career of one whose many-sidedness was continually a surprise to those who knew him; and, of course, such a bald enumeration of facts can give no distinctive picture of the man, even as a professional palæontologist. Nor is it always easy, in considering Dr. Bather's many activities, to draw the line between his professional and other interests.

The need of clear thinking in scientific researches, and of lucid exposition in scientific description, developed in him a mastery of style in writing and diction which harmonised with his appreciation of literature, and especially with his love of Shakespeare. That, in turn, found a further outlet in his dramatic talent—the practical expression of literature—just as museum 'curating' gave scope to the practical side of his scientific interest. He always insisted that all who could do so should draw the illustrations for their own scientific papers, and it is not, therefore, surprising to learn that he appreciated art, and to some extent practised both drawing and painting. So his many outside activities could be seen to spring from qualities which, used and developed in his professional work, demonstrated the essential harmony of his nature.

More closely bound to his strictly professional work were what were perhaps the two greatest preoccupations of Dr. Bather's unofficial life—museum technique and scientific journalism. His chief official duties were 'curating' and identifying; and, as a wide knowledge of museum technique is obviously desirable for making a perfect curator, so research is necessary for identifying material; and the critical faculty which research engenders, easily developed in Dr. Bather into a flair for reviewing and other journalistic activities. It was to be expected, then, that when the Museums Association was founded, Dr. Bather from the first was one of its most active supporters and inspirers and, through the *Museums Journal*, its most eloquent mouth-piece. He presided at the Aberdeen conference in 1903, and his enthusiasm for the Association continued until his death. His journalistic activities were widely spread. Early in life he edited the periodical *Natural Science*, and for many years the *Museums Journal*. Articles, notices and letters were ever flowing from his pen; but perhaps his most appreciated efforts were the delightful reviews which he wrote for the *Times Literary Supplement*.

But all Dr. Bather's outside interests, his zeal for museum technique, and his critical and literary talent, were subordinated to his professional work. Were the foreign museums ahead of the British Museum in this respect? Corresponding improvements must be procured for the Department of Geology. Did that standard obtain in any journal or scientific publication? The Department's publications must set the standard for all outside bodies. So keen was he upon the adoption of this or that improvement, even in the little things of curatorial practice, that he appeared more pleased with the appreciation shown him by the application of one of them, than by a favourable reception of his scientific papers. I know that he sometimes felt that his labours for improved curating were not fully appreciated; whereas an enumeration of the improvements, great and small, in curatorial practice introduced by him should have effectively silenced that misgiving. He has been considered to have had too great a consideration for minutiæ. Indeed, his mind marched with his who wrote :—

> "Thus, if this Age but as a comma show
> 'Twixt weightier clauses of large-worded years,
> My calmer soul scorns not the mark: I know
> This crooked point Time's complex sentence clears."

Dr. Bather insisted on the comma because he appreciated its relation to the whole.

If his colleagues have not always appreciated as fully as Dr. Bather would have liked all his curatorial 'gadgets', there is no fear of their ever under-rating the brilliance of his scientific work. His clear exposition, clean style, and description couched in the most direct language, as well as his orderly presentation and accuracy of detail, are nowhere better shown than in what he himself considered his master-work—"Caradocian Cystidea from Girvan". This and his other scientific treatises are the standards to which his colleagues aspire in their own publications, and in which they recognise him as indeed a master.

It was Dr. Bather's expressed intention, when at last relieved of administrative duties, to resume his interrupted researches upon fossil echinoderms, and particularly crinoids. It was the hope of some, at least, of his friends, that his last years would produce some masterpiece of synthetic thought dealing with the evolutionary aspects of palæontology. But, when Dr. Bather retired, he no longer possessed the energy needed to disengage himself from the multifarious interests which entangled him, and prevented him from resuming his studies uninterruptedly. Thus we consider his life-work incomplete. The larger vision may see in his widely-flung helpfulness a life better proportioned and more complete than we suppose.

Dr. Bather suffered fools kindly, and with humour; and if at times, like Wisdom, he led them by crooked ways and tormented them with his discipline, his patience with stupidity was remarkable; and no one who has been through his 'mill' will deny that it has been worth while to have been taught by Dr. Bather how to write a paper or arrange a collection, or will fail in gratitude to him. His intellectual honesty, and devotion to duty, tempered with a most kind heart, and lightened by a charitable sense of humour, indicated the quiet flow of his genius beneath a restless exterior. W. D. LANG.

PROF. S. F. OLDENBURG

WE regret to record the death on February 28 at the age of seventy years of Prof. Sergius Fedorovitch Oldenburg, the well-known Russian orientalist and former permanent secretary of the Russian Academy of Sciences.

Prof. Oldenburg was born at Byanking in Siberia and was educated at Warsaw and the University of St. Petersburg, where he specialised in oriental languages and more particularly the Indian dialects. After graduation he was for a

time engaged in research work at Cambridge. His first book on "Buddhist Legends" appeared in St. Petersburg in 1894. In 1895 he was appointed to the chair of Indian languages and literature in the University of St. Petersburg, which he held for thirty years. His election to the Academy of Sciences in 1903 was followed in the next year by his appointment as permanent secretary of the Academy and soon after he was made director of its Asiatic Museum.

At this time Germany, France and Great Britain, through Grünwedel and von Le Coq, Pelliot and Stein respectively, were engaging in a campaign of intensive archæological exploration in Chinese Turkestan. Attention had been attracted to this territory by the Russian expedition under Klements in 1898 and by Sven Hedin's explorations ; but the full extent of the opportunities for archæological research had been revealed only by Stein's discoveries. Russia's desire to participate in this important work in the field was met by the organisation under Oldenburg's direction of an expedition of exploration to the oasis of Kucha under the leadership of Berezowski (1906–7). Later, another expedition was sent out by the Academy under Oldenburg himself, which explored Karashahr and Turfan and brought back a rich store of manuscripts, paintings and sculpture from the caves of Tung-hwang discovered by Sir Aurel Stein. The results of the expedition were published in Oldenburg's valuable book, "The Russian Expedition to Turkestan" (1914 : in Russian).

After the revolution of 1917, Oldenburg retained his chair and his secretaryship of the Academy for twelve years. His experience in the organisation of research both at home and in the field was of material assistance to the Soviet Government in carrying out its desire to re-establish archæological and ethnological exploration. In 1929, however, he was dismissed from his posts for political reasons by the Government ; but he was so far readmitted to favour that the Academy and other scientific bodies were permitted to express recognition of the celebration of his seventieth birthday.

WE regret to announce the following deaths :

Col. Arthur Lynch, author of several original books on psychology, philosophy and relativity, on March 25, aged seventy-two years.

Prof. C. Matignon, professor of inorganic chemistry in the Collège de France, president of the Société Chimique de France, on March 18, aged sixty-six years.

Sir Thomas Muir, C.M.G., F.R.S., formerly superintendent-general of education in Cape Colony, author of works on the history of determinants, on March 21, aged eighty-nine years.

Prince Sixtus of Bourbon-Parma, whose expeditions to Central Africa produced valuable scientific results, on March 14, aged forty-seven years.

Dr. E. W. Washburn, chief chemist in the United States Bureau of Standards, on February 5, aged fifty-two years.

News and Views

Petroleum in Great Britain

OCCURRENCE of petroleum in Britain is once again in the limelight, this time focused by what, from a public point of view, seems to be sudden and dramatic action on the part of the Government. On March 22, the President of the Board of Trade announced in the House of Commons that the whole question of oil exploration has recently been reviewed following renewed activities in this direction. It is intended to introduce legislation forthwith to remove certain difficulties existent under the Petroleum (Production) Act 1918, and to secure orderly development of any oil which may be discovered. The most far-reaching and drastic proposal is that ownership of all petroleum at present unknown shall be vested in the State. A licence to explore for oil must be obtained from the Board of Trade, payment being made to the Exchequer on any oil produced. The bill was introduced in the House of Lords on March 22. In addition to the provisos mentioned above, the bill makes possible compulsory acquisition of rights to enter on land ; further, that in considering any application made to the Railway and Canal Commission under that Act, the Commission shall have regard to the effect on the amenities of the locality. Compensation in respect of granting prospecting rights is to be made subject to additional allowance of not less than ten per cent on account of compulsory acquisition.

OTHER clauses of the bill deal with the Board of Trade receipts and expenses in connexion with licences ; payments to the Exchequer ; the manner in which and persons by whom applications may be made ; fees ; size and shape of chosen areas ; right to inspect all plans, etc., the Board throughout exercising its powers through the Secretary for Mines. The opportunity was obviously one too good to be missed by certain more sensational sections of the Press, which translated what is essentially a sober, political measure into actual discovery of oilfields ; one paper even going so far as to give a map depicting the 'track of the oil belt' from the Humber to Cardigan Bay ! In a long experience we doubt whether British geology has ever received such flagrant affront. Aside from technicalities, it is common knowledge that the existing licences held under the Act of 1918 are in respect of Hardstoft, Derbyshire (1923), Heathfield, Sussex (1930) and Three Bridges, Sussex (1931), trial borings also being made at Hythe, Kent, in 1929. In no case have these activities attained commercial status. The drilling epic of 1918–22, a War-time measure, though forgotten by the public, is still fresh

in the minds of oil technologists in Great Britain, and no Government bill, reports of foreign enterprise, secret explorations in Derbyshire or elsewhere, animates us from resignation to facts which one-time emergency and progressive geological knowledge have taught.

OIL pools of commercial magnitude (*pace* natural gas, shale oil and allied indications and potentialities) cannot reasonably be anticipated in any known area in Great Britain. Many years of official geological survey—a centenary in 1935 in point of fact—together with much independent work, leave few spots unknown, if not in detail, at least in sufficient outline to preclude even faint hope. The Government measure is discreetly, if not satirically, worded: it refers to oil which *might* be discovered or *may* exist; it excludes Northern Ireland from the Bill, presumably on political grounds; in this, as with the rest of Great Britain, it has the silent approbation of British geology, though it is in the public interest that that silence should be officially broken if the present bill is in any way interpreted as supporting authoritative views that oil does indeed exist in Great Britain and only awaits public money for its development.

Royal Botanic Gardens, Regent's Park

WHEN the lease of the Royal Botanic Society, Regent's Park, terminated in 1931, the grounds were thrown open to the public, but arrangements were made with the Office of Works for continuing the investigations in genetics which had been carried on there since the War. This arrangement has now been placed on a permanent basis, a portion of the original Gardens, including a quadrangle of buildings and the adjacent grounds, having been set aside for this work on rental from the Office of Works. Through the action of Prof. R. Ruggles Gates, the Courtauld research fund of £5,000 has been obtained as an endowment for this work, which is an important extension of the research facilities of the Department of Botany, King's College. The facilities include two greenhouses with boilers for heating, a potting shed, tool house, cold frames and a laboratory of four rooms. The latter is being fitted up for the examination of genetical material and the collection and treatment of cytological material from plants grown in the Gardens, as well as for photographic work. The Empire Cotton Growing Corporation is also making a grant for three years in aid of further researches on cotton and its relatives. Various other temperate and tropical economic plants are being investigated. The fundamental researches in cytogenetics, with which the name of Prof. Gates has been connected for many years, have now been extended to include a study of the native species of *Œnothera* in eastern Canada. The phenomena of distribution, relationships and hybridisation of the native species and varieties (many of them undescribed) found in this area constitute a genetic survey which throws light on many phases of the complicated evolutionary problems in this genus.

Sir Charles Parsons Memorial

THE Sir Charles Parsons Memorial Executive Committee, composed of the presidents of thirteen scientific and technical societies, with the Engineer-in-Chief of the Fleet, and presided over by Sir Frederick Gowland Hopkins, has just issued a statement of its aims and an appeal for subscriptions. Observing that the name of Parsons will ever be remembered with those of Newcomen, Watt, Trevithick and Stephenson, and that his fame was due not only to his work in marine and electrical engineering, but also to his investigations in various branches of physics, the statement says that it has been decided that the memorial shall take several forms. It is proposed, first, to place a memorial to him in Westminster Abbey; secondly, to found an annual lecture to be given by a distinguished man of any nationality, who will be chosen in turn by the various scientific and technical societies; and thirdly, it is proposed to arrange with the governors of London House that the library in that House shall be called the "Parsons Research Library". A bronze medal will be established in connexion with the annual lecture and a bust of Sir Charles Parsons will be placed in the library. London House was founded in 1931 as a hall of residence for Dominion and Colonial men students of white parentage, from the Empire overseas. The property, now under development, covers an area of about 1½ acres in the Bloomsbury district close to the University of London, and the proposed library will contain scientific and technical works. To carry out the whole scheme, it has been estimated that a sum of at least £12,000 is required. Copies of the appeal are being sent to members of the societies concerned, and the Executive Committee suggests that in general the maximum subscription should be two guineas. Donations should be sent to the Royal Society, Burlington House, W.1, and cheques made payable to the "Sir Charles Parsons Memorial Fund".

The New Hydrogen

IN the course of Lord Rutherford's Friday evening discourse on March 23 at the Royal Institution (see p. 481), experiments were shown to illustrate the differences in freezing point and in vapour pressure between ordinary and heavy water, and the differences in heat conductivity between ordinary and heavy hydrogen. For the first time, experiments were made to show the artificial transformation of lithium by protons and diplons of energy corresponding to about 100,000 volts. The enormous emission of fast protons when ammonium sulphate containing heavy hydrogen was bombarded by diplons was clearly shown by counting methods. The transformation apparatus was designed and operated by Dr. Oliphant, while Messrs. Watson and Sons (Electro-Medical) Ltd. loaned an installation to provide a steady potential of 100,000 volts to accelerate the ions.

Developments of Television

AN application of science has enabled a chairman of a company to become a historic figure. At the

annual general meeting of Baird Television, Ltd., held in a theatre in the west end of London on March 20, the shareholders heard and saw distinctly the chairman address them from a studio at the Crystal Palace, nearly eight miles distant. To the shareholders, and afterwards to representatives of the Press, the Baird Company arranged a programme of transmissions by radio from the Crystal Palace to enable the audience to see persons talking on various subjects, a cartoonist sketching at his easel, excerpts from popular films and 'still' pictures. All these items were reproduced in the receiver with sufficient detail for an audience of more than a hundred persons to 'look in', although the receiver was devised for use in the home rather than a theatre. The success of these demonstrations is attributed to the state of perfection of the large cathode ray oscillographs made exclusively for the Baird Co. by the research staff of a British industrial concern, the excellence of the photoelectric cells in use at the transmitting end, and the construction of amplifiers which are capable of dealing without phase distortion with a range of frequencies from 25 to 1,000,000 cycles per second. The subject matter to be televised is divided up into 180 lines (or strips) corresponding to 24 times the definition obtainable with the old 30-line apparatus. Vision is being transmitted from a dipole aerial on a wave-length of 6·0 metres, and sound on 6·25 metres.

JUDGING from the demonstrations given last week, the Baird Company's engineers have successfully overcome interference effects due to motors, lifts and other electro-magnetic disturbances met with at these short wave-lengths. A series of experiments have been carried out to ascertain the effective range of reception, as a result of which it is claimed that the Crystal Palace transmitting station can provide an ultra-short wave high definition television service for the whole of the Greater London area, which includes a population of about eight millions. Capt. A. G. D. West, who joined the board of the Baird Company last June to direct its technical development, is to be warmly congratulated on his achievement; and the Company on the first public demonstration of the broadcasting possibilities of high-definition television. We understand that a demonstration will shortly be given of the intermediate film-method, described by Major A. G. Church in NATURE of September 30, 1933, by means of which televised images of topical events will be thrown on screens in cinema theatres as well as on home-receivers within a few seconds of their occurrence. Another series of experiments on a new system of 'scanning' invented by Mr. Baird is nearing completion. These experiments aim at securing sufficient illumination in a studio to enable 'crowd' scenes to be televised directly with detailed fidelity.

Statistics in India

IN a paper on "India's Trade and Industrial Statistics", read before the Royal Statistical Society on March 20, Sir H. A. F. Lindsay, the Government of India Trade Commissioner in London, pointed out that progress in the compilation and preparation of official statistics in India has been from departmental to expert control. In 1871, when Sir William Hunter was appointed as the first Director-General of Statistics, the local authorities submitted their statistics to the appropriate Government department, which was responsible for tabulating and publishing them. Afterwards, expert control was gradually introduced, and now the Director-General is directly responsible for compilation and review. A new series of monthly statistics recently introduced relates to the output of the more important Indian industries and includes jute manufacture, paper, cement, matches, sugar, iron and steel, kerosene, petrol, sulphuric acid and sulphate of ammonia. In addition, cotton spinning and weaving statistics have been collected and published for many years past. The main difficulty has been to obtain statistics of the output of the numerous cottage industries which exist alongside modern large-scale factories, sometimes in active competition with these factories and sometimes catering for quite a different class of consumer. The Indian factory, however, provides a useful unit for the collection, compilation and publication of statistics of industrial output, and India has made a good start in this direction. There are many countries of no little industrial importance which have not yet made comparable efforts in the sphere of industrial statistics.

Origin of Bronze

AT a meeting of the Newcomen Society held on March 21, three short papers were read. The first of these, entitled "The Origin of Bronze", was by Prof. C. H. Desch, who gave an account of the results of the inquiries made for the committee of the British Association appointed to investigate the sources of the copper used by the Sumerians. Many specimens of objects found recently at Ur, Kish, Tell Asmar and other places have been analysed, and earlier analyses have been critically examined. A striking discovery is that true bronzes were made at a very early date and some of these contain certain 'key' elements, such as nickel and arsenic. So many of the early Mesopotamian objects examined contained small quantities of nickel that a search was made for copper ores containing nickel. One ore was found, accompanied by slag, at Jabal al Ma 'adan, in the State of Oman, and there are reasons for supposing this was a source from which the Sumerian cities drew their copper. Bronze, said Prof. Desch, must have originated in the East, and for further light on its origin an examination of ores from such places as Anatolia, northern Persia and Baluchistan must be made.

Early Dredging Machine

ANOTHER paper read at the meeting of the Newcomen Society on March 21 was by Mr. G. Bathe and dealt with the dredging machine of Oliver Evans. Oliver Evans was one of the outstanding pioneers of American engineering, constructing machinery for flour mills and introducing high-

pressure steam engines. In 1804 the authorities at Philadelphia commissioned him to construct a steam dredging machine which, because it could propel itself on land and in the water, Evans called the *Orukter Amphibolos*. Evans died, a disappointed man, in 1819. Before his death he destroyed a lot of drawings, and with them probably was lost the sketches of his dredger, the details of which to-day are very imperfectly known.

A Vitamin A Concentrate of High Blue Value

IN *Science* of March 16, p. 255, Prof. H. N. Holmes, in association with H. Cassidy, E. Hartzler and R. Manly, reports the preparation of a concentrate of vitamin A having a blue value of 144,000, that is, 14,400 times greater than the blue value of an average good medicinal cod liver oil. The starting material was the non-saponifiable fraction of halibut liver oil. This was chilled in methyl alcohol solution, to freeze out cholesterol, etc., filtered cold under nitrogen, transferred to pentane by addition of water, dried over anhydrous sodium sulphate and then, in pentane solution, cooled to about − 70° C. with the aid of carbon dioxide snow mixed with alcohol and again filtered, with careful exclusion of oxygen. The cold pentane solution was next filtered through a Tswett column of very specially prepared carbon and washed completely through with pure pentane. The product obtained was a pale yellow viscous oil; different preparations showed blue values ranging from 105,000 to 144,000. The authors have not yet had time to analyse their concentrate or determine its molecular weight, spectral absorption bands, extinction coefficient or biological potency. Further reports of their work will be awaited with interest.

Recent Acquisitions at the Natural History Museum

AMONGST recent accessions to the Zoological Department of the British Museum (Natural History) is a valuable collection of mammals, including a large series of duikers and some specimens of the giant forest hog, which has been received from Mr. G. Foster, assistant game warden of Uganda. A small collection of important Russian mammals, which has been received in exchange from the Moscow Museum, contains specimens of *Dipus*, *Spalax*, *Citellus*, *Ochotona*, *Alactagulus*, and *Cricetulus*. As a gift from the trustees of the estate of the late Mrs. Mary Joicey, the Department of Entomology has received the most valuable present of butterflies and moths to reach it since the War. The collection comprises more than 300,000 specimens and includes the types of 3,000, descriptions of which were published in the main in the *Bulletin of the Hill Museum*. During his life-time, the late J. J. Joicey probably did more to stimulate the study of butterflies and moths, especially those of Africa, than any other private individual in Great Britain. The Department of Geology has received the skull of a child, about six years old, of the extinct Neanderthal race, discovered by Miss Garrod in 1926 in a cave near the Devil's Tower, Gibraltar.

IN the Department of Mineralogy 474 individual masses of meteoric iron with a total weight of 165½ lb., from the meteorite craters at Henbury, Central Australia, have been received by exchange from the Kyancutta Museum, South Australia. The larger masses weigh 46¼ lb., 25¼ lb. and 24¼ lb., the majority are small twisted pieces (meteoric shrapnel) torn from the main masses by the force of the explosions that made the craters. This completes a unique display of 1,000 lb. of material collected from the Henbury craters. Large blocks of long-fibre satin-spar (gypsum) from East Bridgford, Nottinghamshire, have been presented by Mrs. A. Coville. This material is exported to the United States for the fashioning of small fancy articles, which are sold at Niagara Falls, the material being stated to come from under the Falls. This export resulted from an inquiry from the United States made to the Museum about twenty years ago. Mr. W. C. Barton has presented to the Department of Botany about 8,500 sheets of flowering plants. The remainder of his herbarium will be handed over shortly. The present instalment includes the genus *Hieracium* and the families Ranunculaceæ to Rosaceæ with the exception of the genus *Rosa*, which was presented some years ago, and the genus *Rubus*, on which the donor is specialising in collaboration with the Rev. H. J. Riddesdell. The herbarium includes those of H. J. Riddesdell and Mrs. Foord Kelsey; the first, which is large, is particularly rich in Gloucestershire and South Wales, and the second in Berkshire, plants. The first portion of the lichen herbarium of Mr. D. A. Jones has been purchased. This includes nine hundred British specimens and five hundred European. Many of the British specimens are those on which records are based, and the collection supplements the very extensive Museum collections. Among the purchases is a set of 149 flowering plants from Galapagos Islands collected by H. J. F. Schimpff.

British Polar Year Expedition, 1932–33

THE Symons Lecture of the Royal Meteorological Society was given on March 21 by Mr. J. M. Stagg, who spoke on "The British Polar Year Expedition, Fort Rae, Canada, 1932–33". The activities during the International Polar Year 1932–33 really constituted a jubilee repetition on a more extensive and intensive basis of a co-operative scheme of observational work in meteorological and allied sciences so fruitfully carried out by fifteen countries during the First Polar Year. As in that year, 1882–83, part of Britain's share in the new international effort consisted in equipping and maintaining a station at Fort Rae, a trading outpost of the Hudson's Bay Company on the Great Slave Lake, north-west Canada. The programme of work of the party of six, who remained at Rae from July 1932 until September 1933, consisted primarily in obtaining as complete records as possible of the main elements in meteorology, terrestrial magnetism, aurora and atmospheric electricity; and the proximity of Fort Rae to the zone of maximum auroral frequency around the polar cap made the auroral investigations specially important. Methods of parallactic photography were employed to determine the precise position of the aurora in space. The information brought back will be studied

in conjunction with similar data gathered by the forty-six other co-operating countries with the view of obtaining fuller insight into the synchronous large-scale events in meteorology, magnetism and aurora, over the earth and in the atmosphere up and into the conducting layers. A large amount of material is also available for the study of the interrelationships among the varied phenomena observed and recorded during the year's activities.

The New Coast-line of Antarctica

FURTHER information has come to hand concerning Consul L. Christensen's discoveries in the Antarctic referred to in NATURE of March 17, p. 409. Princess Astrid Land, as it was named, is now reported in the *Times* to lie in about long. 86° 45′ E. and a little south of the Antarctic Circle. This is to the west of and adjoining Kaiser Wilhelm Land, discovered by Dr. E. von Drygalski in 1902, and east of Princess Elizabeth Land, discovered by Sir Douglas Mawson in 1931. The land was sighted from an aeroplane from a distance and reported to rise for a distance of about 150 miles. It is further reported that the Douglas Islands, off MacRobertson Land, do not exist. Consul Christensen then took the *Thorshavn* eastward and reports that in lat. 71° 44′ S., long. 134° 11′ E. (? W.) his seaplane could find no land to the south. Proceeding via Peter Island, the ship rounded Cape Horn, discovering a new bank to the south, and made for Montevideo. A number of soundings were taken in hitherto uncharted waters.

Early Science in Poland

A STUDY of the development and position of science in Poland up to the end of the sixteenth century is given by Prof. Kazimierz Dobrowolski in the recent issue of *Nauka Polska* (vol. 17 ; 1933), an annual publication devoted to the organisation and progress of science in Poland. Prof. Dobrowolski's account (132 pages) of Poland's contributions to early science is especially detailed for the sixteenth century itself and is well documented throughout. It refers not only to the natural sciences, so far as they had then developed, but includes also incursions into theology, philosophy, logic, law and history. It is evident that 'science' as understood in Poland, and in Europe generally for that matter, up to the seventeenth century was closely associated with alchemy, astrology and occult practices. But towards the close of the period under review, Prof. Dobrowolski points out that real scientific inquiries were being prosecuted in Polish centres of learning, so far as political upheavals permitted. The work of Copernicus is not only important in itself but also because it was followed by that of Francis Bacon, Galileo, Descartes and others. Early English and French contributions to scientific knowledge, for example, Roger Bacon's discoveries and writings and those attributed to Thomas Aquinas, had reached Poland and exerted some influence upon thought there. The same volume of *Nauka Polska* contains some notes by Dr. M. Wolfke on certain recent developments in pure and applied physics and another contributor describes life in scientific circles at Lodz.

High-Voltage Testing Equipment

ECONOMICAL considerations are leading electrical engineers to use very high voltages for transmitting electrical energy over long distances. The accessories used with high-voltage cables or overhead lines require to be specially tested. This has made it necessary to build high-voltage laboratories and to design insulating devices which will withstand these high pressures. In the early days of testing, the perfection of a testing set was judged mainly by the length and appearance of the spark and the loudness of the noise it made. Nowadays these measurements have to be made with high accuracy in accordance with stringent specifications. On the result of the acceptance tests, errors of a few per cent may turn the scale for rejection, leading to losses of thousands of pounds to the manufacturer. In certain cases discrepancies of ten per cent are shown in the results obtained in different laboratories, leading to considerable dissatisfaction.

IN a paper on high-voltage testing read on December 21 to the Institution of Electrical Engineers by B. L. Goodlet, of the Metropolitan Vickers Electrical Co., Ltd., it is shown that the discrepancies are mainly due to badly designed equipment and insufficient knowledge of the performance of the testing set under various conditions. They also arise sometimes from differences in the technique used in testing. Single units for testing purposes are usually built for a million volts, but it is often more advantageous to utilise the well-known cascade connexion which produces the required total voltage by adding up the individual voltages of several smaller units. The high voltage and low power rating of these transformers lead to difficulties in designing them. The authors illustrate this by showing oscillographic records of the distorted wave forms of the current and voltage sometimes obtained. In the third part of the paper a complete mathematical and experimental discussion is given of the impulse generator.

Economic Survey of Agriculture in the East of England

AN excellent economic survey, the second of the series, based on a sample of more than a thousand farms, has recently been published (University of Cambridge : Department of Agriculture, Farm Economics Branch. Report No. 21 : "An Economic Survey of Agriculture in the Eastern Counties of England, 1932". Pp. vi + 89. Cambridge : School of Agriculture, 1933. 2*s*. 6*d*. net). As a record of what is actually happening to the individual units of agriculture in the eastern counties of England, it could scarcely be bettered. Reality is an excellent antidote to indiscriminate theorising in any subject ; surveys such as this enable the hard facts of an industry of small units like agriculture to be ascertained. Without a factual basis of this type there can be no sound future planning or adequate criticism of past planning.

THE broad facts revealed by the survey are sufficiently disquieting. The depression of agriculture

is common knowledge; here the extent of the depression is measured. Except for the wheat deficiency payments, the year 1932 appears to have been even worse than 1931. Of the individual farms the most profitable are the most progressive, those which aim at a high level of productivity and low labour costs per unit output; but specialisation, which would lead to the most complete mechanisation, is unsuccessful, for labour and by-products cannot be efficiently utilised. The general purpose farm is the one most adapted to economical production. The whole report gives a picture of economic laws striving to operate, but without their natural consequence, the elimination of the least efficient. The moral of it all is plain: overproduction of food. Whether the English farmer should be allowed to suffer as a result of what is after all a world phenomenon is a matter of politics. What is abundantly plain is that salvation is only to a very limited extent in his own hands. Mere increase in efficiency is patently not enough. In fact such increase, if world wide, will merely aggravate the disease.

Recent Research in Building Practice

THE annual report of the Building Research Board for 1933 (London: H.M. Stationery Office, 2*s*. 6*d*. net) contains an account of several interesting investigations. The failure of lime-plaster ceilings on lathing, whilst of frequent occurrence, is not generally due to defective materials, but to hasty work and disturbance by other types of work in the building at a time when the plaster ceilings are very sensitive to vibration. Damp walls are often caused by penetration of rain through fine cracks between the bricks and mortar. Most colourless waterproofing materials are ineffective, but an imitation stone paint showed a good resistance to weathering. Experiments on heating showed that intermittent heating from 9.30 a.m. to 5.30 p.m. required only three quarters of the electrical energy for continuous heating, although the latter method has been said by heating engineers to be equally economical. Testing of bricks by exposure, and of concrete piles by an ingenious piezoelectric method, are described.

Science Abstracts

THE issue of the two index parts of *Science Abstracts* completes the physics and the electrical engineering volumes for 1933. More than 260 periodicals are dealt with by the editor and his 71 abstractors for physics and 57 for electrical engineering. Each volume has between 30 and 40 more pages than the volume for last year. 5,491 abstracts of average length 0·247 page relate to physics and 3,078 of average length 0·257 page to electrical engineering. In each case the average length is nearly the same as last year. Reference to the abstracts is greatly facilitated by the extensive indexes provided. In the physics volume the subject index covers 208 pages and there is a key to the subject index of 15 pages and an author index of 76 pages. In the electrical engineering volume the subject index has 109 and the author index 45 pages, but there is no key. Each volume seems indispensable to the physicist or to the electrical engineer who wishes to keep himself up to date, but while every member of the Physical Society and possibly of the American Physical Society gets a copy of the physics volumes the Council of the Institution of Electrical Engineer, reported in May last that only 9 per cent of its members subscribed for copies of the electrical engineering volume.

German Association of Men of Science and Physicians

THE German Association of Men of Science and Physicians (Gesellschaft Deutscher Naturforscher und Ärzte) is modifying its policy with the view of overcoming excessive specialisation. It is proposed to emphasise the tasks and problems common to many or all branches of science and medicine, and to promote discussion on these common topics on the widest possible basis. The annual meeting of the Association will last not more than three and a half days. The Council of the Association will only arrange the general sessions, the main group and joint sessions, and popular evening lectures. The general sessions will be devoted to topics in which some definite results have been reached or to problems of immediate importance. If discussion does not follow these addresses by selected speakers, the same theme may be handled more freely in joint sessions of sections. The Council will abandon the attempt to arrange meetings of the separate sections, leaving them to deal individually with the local committee. It has been the custom for some years past that allied and associated societies should meet at the same place, and either before or after the formal meetings of the Association. This custom is to be continued at the next meeting in Hanover (Sept. 16–20, 1934), and with the help of the local committee. An innovation is the *Zweckverband* of German scientific and medical congresses, the aim of which is to maintain contact between these congresses so that whilst specialisation goes forward they shall not be shut off from each other. The purpose of this union is to publish the dates, places and programmes of these congresses; for example, various medical congresses take place in April and May next.

Royal Geographical Society's Awards

HIS MAJESTY THE KING has approved the award of the Royal medals as follows: *Founder's medal* to Mr. Hugh Ruttledge, for his journeys in the Kumaon and Garwhal Himalaya extending over eight years and his leadership of the Mount Everest Expedition, 1933; *Patron's medal* to Capt. Ejnar Mikkelsen, for his explorations in the Arctic between 1900 and 1912 and for his work in Eskimo re-settlement on the east coast of Greenland. The Council has made the following awards: *Victoria medal* to Mr. Edward Heawood, for his work on the history of geography and cartography and his devoted service to the Society as its librarian; *Murchison grant* to Mr. John Rymill, for his work in Greenland and leadership of the party after the death of Mr. H. G. Watkins on his second expedition; *Back grant* to Dr. D. N.

Wadia, for his studies of the Himalayan axis and other problems of Indian geomorphology of importance to geographers; *Cuthbert Peek grant* to Mr. Edward Shackleton, to assist him in his proposed expedition to Ellesmere Land; *Gill memorial* to Mr. W. B. K. Shaw, for his explorations and studies in the Libyan desert.

The Night Sky in April

JUPITER is now exceedingly well placed for observation, as it is in opposition on April 8. It is a very conspicuous object in the sky, rising a little after sunset. The bands and satellites make this planet a very interesting telescopic object. The planetary nebula, N.G.C. 3242, R.A. 10h. 21m., Dec. 18° 15′ S, a little south of μ Hydræ, is now conveniently placed for observation. It is of slightly elliptical shape and bears magnifying well. There are two clusters visible to the naked eye which repay examination with a small telescope. These are N.G.C. 2632 at 8h. 35m. and 20° 15′ N (Præsepe), and N.G.C. 2168 at 6h. 4m. and 24° 20′ N. The last mentioned is in Gemini, and now appears in the western sky in the early evening.

Announcements

THE Chemical Society will celebrate the centenary of the birth of Mendeléeff in 1834 by a meeting, on April 19 at 8 p.m., to be held in the lecture theatre of the Royal Institution, when Lord Rutherford will deliver a lecture entitled "The Periodic Law of Mendeléeff and its Interpretation". The lecture is open to fellows of the Chemical Society and their guests.

PROF. J. C. MCLENNAN will deliver the twenty-fifth Kelvin lecture before the Institution of Electrical Engineers on April 26, taking as his subject "Electrical Phenomena at Extremely Low Temperatures".

PROF. JOHAN HJORT will deliver the Huxley Memorial lecture of the Imperial College of Science at the Huxley Building, Exhibition Road, South Kensington, S.W.7, on May 4, at 5.30. The subject of the lecture will be "The Restrictive Law of Population". Prof. Hjort is professor of marine biology in the University of Oslo, and is well known for his work on the development of the fishing industry and oceanographical research in North European, Atlantic and Canadian waters. He was elected a foreign member of the Royal Society in 1916.

SOME details were given in NATURE of March 17, p. 412, of the mirror which is to be made for the new 200-in. telescope for the California Institute of Technology. According to the New York correspondent of the *Times*, the glass was poured on March 25, an operation which took ten hours to complete; ten months are to be allowed for the twenty tons of glass used to cool.

MR. EDWIN THOMPSON, of Liverpool, has been selected by the Council of the Society of Chemical Industry as president for the year 1934–35. He will take office at the annual meeting of the Society which is to be held in Cardiff on July 16–20. Mr. Thompson is governing director of Messrs. Thompson Capper Wholesale, Ltd., manufacturing chemists of Liverpool, and has for many years been associated with the work of the Society. He is on the General Committee of the British Association, and at the Liverpool meeting in 1923 he did valuable work as honorary secretary. He was president of the British Waterworks Committee when in 1930 it held its annual meeting in Liverpool. Mr. Thompson originated the idea which eventually led to the formation of the Lancashire Industrial Development Council.

AT the first scientific meeting of the Microchemical Club held at the Lister Institute on March 17 the following officers were elected for the year 1934–35: *Chairman*, Dr. Janet Matthews (Imperial College of Science); *Hon. Treasurer and Librarian*, Dr. L. H. N. Cooper (Marine Biological Laboratory, Plymouth); *Honorary Secretary*, Dr. S. J. Folley (National Institute for Research in Dairying, Shinfield, near Reading).

THE Ministry of Agriculture and Fisheries has recently issued two new Advisory Leaflets, "Turnips, Swedes and Kohl-Rabi" (No. 189) and "Bracken" (No. 190). The former discusses the soils and climate most suitable for the growth of the three root crops mentioned, their varieties and cultural treatment. Many useful practices are described, and the subject matter is quite up-to-date. The leaflet on bracken shows that this plant has a few slight uses—as bedding and food for pigs—but causes damage far beyond its benefits. The chief methods of eradication are cutting off the shoots in June for two or three years in succession, and the application of lime and phosphate. It is suggested that dragging a chain harrow over the newly-emerged sprouts in early spring is also a good method of control.

MESSRS. DULAU AND COMPANY, LTD., of 32 Old Bond Street, London, W.1, have recently published Catalogue No. 218, containing an extensive list of books on botany and gardening, which they have for sale. More than eight hundred volumes, mainly of historical interest, are enumerated, and a further extensive list of standard modern works on gardening is given. Such outstanding contributions to botanical science as Nehemiah Grew's "Anatomy of Plants", several writings of Linnæus and a few early "Herballs" are combined with more modern writings.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A mechanical engineer at the Royal Arsenal, Woolwich—The Under-Secretary of State (M.G.O. 4), The War Office, London, S.W.1 (April 7). A head of the Physics Department, a lecturer in electrical engineering, and a teacher of geometrical drawing and elementary mathematics at the Wigan and District Mining and Technical College—The Principal (April 9). A lecturer in geography at the Homerton Training College for Women, Cambridge—The Principal (April 23). A lecturer in chemistry at the University of Reading—The Registrar (May 7). A resident woman tutor in mathematics at the Edge Hill Training College, Ormskirk—The Principal.

Letters to the Editor

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

Œstrogenic Hormone in the Urine of the Stallion

IN further investigations on the œstrogenic hormone, which to a large extent is excreted in the urine of the stallion[1], we have examined the influence of this hormone on the secondary sexual characteristics, especially on the mammary gland. By the use of follicular hormone, Laqueur was able to induce lactation of male guinea pigs. We have now observed the same effect with the hormone obtained from the urine of the stallion and in the actual cases the lactation of the male animals has continued for 21 days.

Another typical effect of the follicular hormone, the hyperpigmentation of the mamillæ and the areolæ of the nipples (Bloch and Schrafl), is also exhibited after the injection of the œstrogenic hormone of the urine of the stallion. These investigations show that all the *biological reactions which are characteristic of the follicular hormone are exhibited by the œstrogenic hormone of the urine of the stallion.*

How can the occurrence of so great a quantity of œstrogenic hormone in a male organism be explained ? I believe that the female hormone which is regularly present in the male organism represents a normal physiological product of the metabolism of the sex hormones, especially since—due to our present chemical knowledge (Butenandt, Marrian, Doisy)—a conversion of the male hormone into the female one appears to be quite possible. I am further of the following opinion : the metabolism of the sex hormones is, in the main, the same in both sexes. At first, the male sex hormone is synthesised from substances which are still unknown, and the male hormone is then converted into the female one. The specific sexual characterisation is solely due to a quantitative regulation of this general process of metabolism. In my opinion, the observations with male equines support this hypothesis from the biological point of view. From the fact that production of the female hormone in large quantities in the stallion occurs only during sexual maturity—when the male hormone is produced—it follows that there exists a connexion between the male and the female hormone. It is possible that in the testes of the stallion—as compared with other organisms—a very great production of male hormone occurs, and that this surplus of male hormone is immediately destroyed by converting it into female hormone and then rapidly excreting the latter. It is impossible to say why this hyperproduction is characteristic of equines. The fact that a not inconsiderable amount of male hormone is to be found in female animals, including women (Loewe, Tscherning), is also in harmony with this hypothesis.

The male hormone represents an intermediate product in the formation of the female one. The regular occurrence of female hormone in the male organism is explained as due to the conversion of part of the male hormone into the female one. In the female organism the male hormone is supposed to constitute a previous product of the female hormone and in the male organism the female hormone is supposed to constitute a degradation product of the male hormone. The dehydrogenation products which Girard has isolated from the urine of pregnant mares (equilin, hippulin and equilenin) do accordingly constitute the final products (which at the present time are known) of the degradation series of the male hormone.

Metabolism of sex hormones outside the sexual glands (extragonadial metabolism) can also occur and this has been the object of a joint communication of H. v. Euler and myself[2].

BERNHARD ZONDEK.

Biochemical Institute,
University of Stockholm.
Feb. 22.

[1] NATURE, **133**, 209, Feb. 10, 1934.
[2] *Scand. Archiv Physiol.*, **67**, 261 ; 1934.

A Rapid Test for the Diagnosis of Pregnancy

CURRENT biological tests for the diagnosis of pregnancy or detection of ovary-stimulating substances in gland extracts and body fluids have the main disadvantage that several days must elapse before a result can be obtained. Attempts have been made to remedy this by making use of the doe rabbit, because in this animal a response (ovulation) can be obtained in less than 14 hours[1]. The rabbit, however, requires a good deal of care in order to obtain consistent results. It is essential to know the previous history of does employed, and preferably only to use them a short time after parturition. Even so, variation in response to injection may be so great as to necessitate the use of more than one doe in order to be sure of the result.

The test described in the present note depends upon the observation by Hogben[2] that extraneous ovulation in the South African clawed toad (*Xenopus Lævis*) can be induced by injection of extracts of the anterior lobe of pituitary. *Xenopus* can be obtained easily and cheaply in large numbers. Several hundreds can be kept without difficulty at the sole cost of a few handfuls of raw meat once a week, provided that they are kept in a warm well-lit room and that their water is changed after feeding. Ovulation does not occur spontaneously in captivity. Ova shed as a result of injection are clearly visible and extruded in large numbers. No doubt exists, therefore, as to the validity of a response.

During the past two years, work has been carried out on the use of *Xenopus* for detecting and estimating ovary-stimulating substances in tissue extracts and body fluids such as pregnancy urine. The following main points have emerged[3].

(*a*) At a temperature of 20°–25° a single injection of an active preparation into the lymph sac is followed in the great majority of cases by complete ovulation within 9 hours. Very often a response is obtained in less than 6 hours.

(*b*) A given batch of toads can be used repeatedly, provided that a rest of at least one week is allowed to elapse between successive injections.

(*c*) A definite quantitative relationship holds between dosage and response.

As a result of the first observation, a test for early pregnancy has been elaborated, the exact procedure of which depends upon the time which has elapsed from the last missed menstrual period :—

(1) If one month or more has elapsed, untreated urine from the suspected case is used. Ten toads

are injected in the lymph sac with 1 ml. A positive diagnosis is made if ovulation occurs in at least 5 out of 10 animals within 9 hours. The correct temperature is obtained by keeping vessels containing the toads in a room heated to 20°–25° by means of an electric fire.

(2) If less than one month has elapsed, a sample of 100 ml. of urine is precipitated with acetone and centrifuged. The residue is suspended in 10 ml. of distilled water and 1 ml. of the suspension injected into each of 10 toads. A positive result is indicated as before. This procedure is necessary owing to the facts that in very early pregnancy there is an insufficient amount of ovary-stimulating substance in 1 ml. of urine to produce a response, and that a volume of fluid greater than 2 ml. cannot be injected into the lymph sac without risk of non-absorption.

A full account of this work will appear later. So far no incorrect diagnosis has been made. In view of the quantitative nature of the test, it is hoped to distinguish normal early pregnancy from ectopic pregnancy or conditions such as hydatidiform mole.

C. W. BELLERBY.

Department of Social Biology,
University of London.
March 19.

[1] Bellerby, C. W., *J. Physiol.*, **67**, *Proc.* xxxii ; 1929.
[2] Hogben, L. T., *Proc. Roy. Soc. S. Africa*, March, 1930.
[3] Bellerby, C. W., *Biochem. J.*, **27**, 615, 2025 ; 1933.

Uniformity in Bibliographic Particulars

THE excellent letter from the librarian of the John Innes Horticultural Institution, published in NATURE of March 10 (p. 380), is welcome to the Committee on Zoological Bibliography and Publication appointed by the British Association in 1895 and still working. Most of Miss Schafer's recommendations have from time to time been made by this Committee in its published reports as well as in its considerable correspondence. May I dot the i's of one or two ?

In the order of citation the date should occupy a more prominent position : in making references my Committee would place it immediately after the author's name ; in catalogue slips it is usual to place it at the end. In any case the month, and even the day when known, should precede the year.

The practices to which Miss Schafer rightly objects are sins of omission ; but there are sins of commission. Details given by a publisher, or appearing on the printed cover, should never be taken at their face value, until one has learned by experience that the particular publisher or editor is to be trusted, and even of them the most accurate can make mistakes. The printed date, as Miss Schafer has noted, is frequently wrong ; I have catalogued one paper that had four dates—all incorrect. When priority is in question a printed date inclines to be earlier than the correct one ; but textbooks tend to bear a date later than the actual publication. The title on the wrapper is often inexact and sometimes absurd ; it is made up by the printers. The use of the term 'plate' is frequently incorrect. A plate, properly speaking, is an addition or insertion and not part of the printed sheet ; the fact that an illustration occupies a whole page does not make it a plate, neither should an inserted plate bear a page-number. But the issue of plates without any numbers at all is probably more exasperating, only outdone by the numbering of some and not of others.

For the worker, as distinct from the cataloguer, it is a convenience to have on every page-opening the name of the journal, the volume number, and the date, as well as the running title of the article. But even the cataloguer benefits by this when separates have been formed by the breaking up of a volume.

Printers have a habit, not only of re-paging, but also of rehandling the type so that a paragraph originally on, say, p. 15 is shifted to p. 14. They may even change the numbering of the text-figures. Printers cannot be expected to know better ; authors rarely have a say in the matter ; therefore my Committee has always appealed to the editors. Editors unfortunately are not permanent, so that one has to be constantly repeating one's protest. It is comforting to find that one is not alone.

Just one point in Miss Schafer's letter leaves me uncertain. Why does she call roman numerals "eye-straining" ? I will grant that the present generation does not seem educated up to them, but they have their advantages. Instead of printing 'Series 3, vol. 12, pages 31–43, plates 7–10', it is convenient to print or write '(3) XII, 31–43, vii–x'. The modern use of clarendon arabics for the volume number may be an improvement, but it involves intermittent recourse to a different fount by the compositor, which must be rather worrying to him.

F. A. BATHER.

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Diplogen and Fish

IN recent months we have been carrying out experiments on the behaviour of fish in heavy water. We find that goldfish (*Carassius auratus*) behaved quite normally in the heavy water in which they were kept. As heavy water was to be used as indicator of normal water, we had to carry out our experiments in water containing only 0·5 mol. per cent of diplogen, and it is therefore still possible that a higher concentration of this isotope in water exerts effects upon fish.

The aim of our experiments was to follow the exchange of water between the fish and their surroundings, using heavy water as an indicator of the movement of the total water. The use of radioactive isotopes for such purposes is well known. While the latter are practically chemically identical, and as such are entirely trustworthy indicators, that is not the case with the isotopes of hydrogen. Heavy water is, therefore, only to be used with great caution as an indicator of ordinary water. However, when using very dilute solutions of heavy water, we may expect that the rate of exchange of heavy water molecules between the fish and its surroundings will not be very different from that of the normal water molecules. By measuring the speed at which the heavy water enters the body of the fish we can therefore conclude at what rate approximately the exchange of water between the fish and its surroundings takes place.

Some twenty fish having a total volume of about 10 c.c. were kept in about 60 c.c. of water containing 0·5 mol. per cent diplogen water. After a certain time the fish were removed and the decrease of the density of the surrounding water was determined. The fish were then placed in normal water, and the rise in the density of the latter due to the entrance of heavy water molecules leaving the body of the fish

was determined. The results are as shown in the accompanying tables.

TABLE 1

Rate of entrance of heavy water into fish

	Time in hours	Decrease of the heavy water content of the surrounding water	Decrease expected in the case of equal distribution of the heavy water between fish and surrounding water
I	1	32 p.c.	30 p.c.
II	4	32 p.c.	29 p.c.
III	15	33 p.c.	30 p.c.

TABLE 2

Rate of loss of heavy water by the fish

	Time in hours	Initial heavy water content of the fish	Decrease of the heavy water content of the fish after the experiment	Decrease expected in the case of equal distribution of heavy water between fish and surrounding normal water
I	1	0·27 p.c.	68 p.c.	51 p.c.
II	4	0·27 p.c.	68 p.c.	67 p.c.
III	10	0·26 p.c.	86 p.c.	86 p.c.

It follows from the above that, at least in a small fish, within a few hours nearly all the water molecules leave the body of the fish, making way for water molecules derived from the surrounding water. It should be borne in mind that most fish contain about 80 per cent water.

G. HEVESY.
E. HOFER.

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Feb. 20.

Band Spectrum of Aluminium Deutride

BEING in possession of heavy water obtained by the electrolysis of some hundreds of litres of water, kindly furnished us from Nordiska Syrgasverken in Örebro, we have started investigations on the isotope effects in the band spectra of hydrides. The following preliminary results are given for the spectra of AlH and AlD; the former spectrum is reanalysed in order to get more exact data for comparison.

Table 1 gives the origin of the bands in $^1\Pi \rightarrow {}^1\Sigma$ from measurements in the second order of a 21-ft. concave grating (dispersion 1A./mm.). The bands of the new AlD molecule are indicated by asterisks.

Table 1.

v'' \ v'	0	1	2
0	23470·91 23536·79*	24554·29 24379·89*	
1	21845·73 22354·75*	22929·11 23197·85*	—— 23868·54*
2		21359·81 22045·29*	—— 22715·98*
3		19844·94 20921·67*	

We have applied the theory on isotope effects in band spectra to the normal state $^1\Sigma$ as being most favourable on account of its regular structure. The harmonic frequencies ω_e of the nuclear vibrations and their anharmonic corrections are given below:

AlH		AlD	
ω_e	= 1682·45 cm.$^{-1}$	ω_e^i	= 1212·04 cm.$^{-1}$
$\chi_e\omega_e$	= −29·029 ,,	$\chi_e^i\omega_e^i$	= −15·145 ,,
$y_e\omega_e$	= 0·242 ,,	$y_e^i\omega_e^i$	= 0·090 ,,

Our third order polynom, representing the vibrational levels in $^1\Sigma$, does not converge at high v numbers and must therefore be completed by terms of higher order to fit into the known value of dissociation ($D = 3{\cdot}1$ volts). The small corrections to be applied on the frequencies given above are, however, of minor importance in this connexion.

From analysis of the band structure we have calculated the coefficients of rotation in $^1\Sigma$ up to the sixth order in $(k+\frac{1}{2})$ as follows:

AlH		AlD	
B_e	= 6·3955 ± 0·0003	B_e^i	= 3·3190 ± 0·0003
α_e	= 0·1850	α_e^i	= 0·0689
D_0	= −3·8 × 10^{-4}	D_0^i	= −0·98 × 10^{-4}
F_0	= 3 × 10^{-7}	F_0^i	= 0·05 × 10^{-7}

These data applied to the general problems on isotopes are of interest as will be discussed below to some extent. Primarily, we assume that the mass-spectroscopic value based on the atomic weight of the heavy isotope of hydrogen 2·0136, obtained by Bainbridge[1] is correct. If this is true, $\rho^2 = 0{\cdot}51838$ corresponds to the ratio of the reduced masses of the isotopic molecules as deduced from the atomic weights 1·00778 and 26·97 of hydrogen and aluminium respectively. Errors in the latter value amounting to 3 parts in 1000 will be of no influence on the value of ρ^2 given above. Now generally,

$$\frac{\omega_e^i}{\omega e} = \rho \left(\frac{\varkappa^i}{\varkappa}\right)^{\frac{1}{2}}$$

where $\varkappa^i$ and $\varkappa$ are the forces of direction in the case of harmonic vibrations. As these forces are to be derived from the interaction between the charged particles in the molecule, the isotope principle requires their ratio to approach unity to a very high degree of exactness. However, inserting our values for ω_e^i and ω^e ($\rho^2 = 0{\cdot}51898$), we find $\frac{\varkappa^i}{\varkappa} = 1{\cdot}00057$, corresponding to an increase in the binding forces of the nuclei at their position of equilibrum in AlD as compared to the ordinary AlH.

A similar effect appears in the values of the nuclear separations, as shown by finding the ratio of the moment of inertia ($B_e^i/B_e = \rho^2$) in both molecules. With the same assumptions as before, we get $\rho^2 = 0{\cdot}51896$, corresponding to an approach of the nuclei in AlD amounting to 0·056 per cent, which means a small displacement of 9×10^{-12} cm.

On the other hand, rejecting the mass-spectroscopic value of ρ^2, our results point at an atomic weight for deuterium of 2·0113, far less than that found by Bainbridge. At present, however, we postpone the discussion of the causes of these divergencies, awaiting the results of investigations of the band spectra of other deutrides (BiD, HgD, etc.) now in progress in this laboratory.

Details regarding the structure of the activated $^1\Pi$ state in AlD will be given later, after we have investigated the remarkable pressure effect which governs this rather unstable state. Incidentally, it may be mentioned that the measured Λ-doubling agrees with the formula: $T_d - T_e = q\,k(k+1)$, where $q_{AlH} = 0{\cdot}009$ cm.$^{-1}$ and $q_{AlD} = 0{\cdot}00225$ cm.$^{-1}$.

W. HOLST.
E. HULTHÉN.

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Jan. 23.

[1] *Phys. Rev.*, **41**, 115; 1932.

Crystal Structure of 1, 3, 5–Triphenylbenzene

IN a recent communication on the crystal structure of 1, 3, 5–triphenylbenzene, Dr. Kathleen Lonsdale[1] discusses the results of recent X-ray measurements on the crystal and concludes that the planes of the benzene rings of the molecules cannot coincide with the (001) plane of the crystal, as has been suggested by earlier investigators, but must be inclined to this plane.

This conclusion is fully supported by the results of our magnetic measurements on this crystal, and the magnetic data further enable us to calculate approximately the inclinations of the benzene rings to the (001) plane. The crystal is orthorhombic and its principal gram molecular susceptibilities along a, b and c axes are :

$$\chi_a = -141\,;\ \chi_b = -155;\ \chi_c = -309$$

respectively, in 10^{-6} C.G.S. E.M.U.

The c axis is thus an axis of approximate magnetic symmetry, the susceptibility along this axis being numerically greater than that along perpendicular directions by 161×10^{-6} per gram molecule. Had the planes of all the benzene rings in the unit cell been coincident with the (001) plane, the difference between the susceptibilities along the c axis and along perpendicular directions would have been much higher, namely, 216×10^{-6} per gram molecule. This shows that the benzene rings are inclined to the (001) plane, the angle of inclination θ being given by the relation $\cos^2\theta - \frac{1}{2}\sin^2\theta = \frac{161}{216}$; that is, $\theta = 24°$.

The optical constants of the crystal also support the above orientation of the benzene rings. The gram molecular refractivities (defined as usual by $R = \frac{n^2-1}{n^2+2}\cdot\frac{M}{\rho}$) of the crystal for vibrations along the a, b and c axes are[2] :

$$R_a = 115{\cdot}5\,;\ R_b = 115{\cdot}0\,;\ R_c = 77{\cdot}6$$

respectively, for the D lines. R_a and R_b are thus nearly equal and much greater than R_c, as we should expect. If we assume all the benzene rings to lie in the (001) plane, and *neglect the mutual influence of the optical dipoles induced in the different benzene rings*, we obtain for the birefringence of the crystal

$$R_a - R_c = R_b - R_c = 65.$$

The much smaller birefringence actually observed for the crystal, namely, $R_a - R_c = R_b - R_c = 38$, points to an inclination of the benzene rings to the (001) plane, at an angle θ determined, as in the magnetic case, by the equation

$$\cos^2\theta - \tfrac{1}{2}\sin^2\theta = \frac{38}{65}, \text{ or } \theta = 32°.$$

Since the mutual influence of the dipoles is by no means negligible as we have assumed in the calculation, this value of θ must be taken to represent only the *order of magnitude*, and is therefore not inconsistent with $\theta = 24°$ obtained from the magnetic data.

K. S. KRISHNAN.
S. BANERJEE.

210, Bowbazar Street,
Calcutta.
Feb. 5.

[1] NATURE, **133**, 67, Jan. 13, 1934.
[2] Groth, *Chem. Krist.*, **5**, 342.

Production of Heat in Supraconductors by Alternating Currents

IT has frequently been suggested[1] that supraconductivity is a phenomenon not due to the normal electrons which cause ordinary electrical conductivity, but that one may have to take into account supraconducting electrons as opposed to the ordinary electrons. Such a hypothesis would seem to be in accord with the observed fact that there is no discontinuity in the heat-conductivity at the transition point[2]. In this case the following method would seem to enable one to determine the number of supraconducting electrons.

If the electrons taking part in the ordinary conduction above the transition point preserve their properties below it, their damping, characterised by the specific electrical conductivity σ, would presumably not vary appreciably. This cannot be observed with direct current, since the supraconducting electrons prevent one applying the electrical field. With an alternating current of sufficiently high frequency, however, this screening effect is not complete on account of the inertia of the electrons ; one might therefore expect an alternating current to produce motion of the normal conducting electrons with a consequent production of heat. By measuring this heat, it should therefore be possible to demonstrate the existence of these normal electrons and prove whether their general properties change at the transition point.

For ordinary electrons the relation between the current density $\mathbf{J}$ and the strength of electric field $\mathbf{E}$ is :

$$\mathbf{J} = \sigma\mathbf{E}$$

If we take into account the existence of the supraconducting electrons, we must because of their inertia replace this equation by :

$$\dot{\mathbf{J}} = \frac{1}{\Lambda}\mathbf{E} + \sigma\dot{\mathbf{E}} \qquad (1)$$

where the inertia term

$$\Lambda = m/ne^2 \qquad (2)$$

depends, apart from universal constants, only upon the number n of electrons per cubic centimetre.

If we calculate the distribution of an alternating current in a supraconductor according to formula (1), we find that the current flows near the surface in a layer of finite thickness d. Considering in the first place not too high frequencies ν, such that $\sigma\Lambda\nu \ll 1$, and neglecting terms of second and higher powers in $\sigma\Lambda\nu$ (and the influence of the displacement current) we find :

$$d = \sqrt{\Lambda c^2/4\pi} \qquad (3)$$

In this approximation the thickness is therefore independent of the second term in (1), that is, the term taking account of the normal electrons, and is also independent of the frequency[3].

This term is important, however, for the production of heat. While with direct current only the magnetic field $\mathbf{H}$ occurs in the layer, with alternating current an electric field $\mathbf{E}$ appears which is given by Maxwell's equation $\text{curl}\,\mathbf{E} = -\frac{\mu}{c}\dot{\mathbf{H}}$. It is this which gives rise to the heat.

The amount of heat Q produced per unit volume

in unit time (neglecting higher powers of $\sigma\Lambda\nu$) amounts to :

$$Q = (2\pi\nu)^2\sigma\Lambda^2\,\overline{\mathbf{J}^2} \qquad (4)$$

where $\overline{\mathbf{J}^2}$ represents the mean value of $\mathbf{J}^2$ averaged over the time. By means of this equation we can therefore determine either the number n of supraconducting electrons (by (2)) or the thickness d of the layer in which the current flows (by (3)). In this effect, in contrast to others, the proportionality with ν^2 is characteristic. Thus a production of heat which might occur each time the supraconducting current was switched on would, of course, be proportional to ν only.

For high frequencies, for example infra-red radiation, in which the value $\sigma\Lambda\nu$ is no longer small compared with 1, the inertia of the normal conducting electrons must be taken into account. For at low temperatures the value of the normal conductivity is very large and therefore the inertia term is much more important than it is at room temperature. In this case it is therefore necessary to distinguish between Λ_s and Λ_n, corresponding to the supraconducting and normal electrons, and formula (1) must be replaced by :

$$\dot{\mathbf{J}} + \sigma\Lambda_n\,\ddot{\mathbf{J}} = \frac{1}{\Lambda_s}\,\mathbf{E} + \sigma\,\dot{\mathbf{E}}\left(1+\frac{\Lambda_s}{\Lambda_n}\right) \qquad (5)$$

If the number of supraconducting electrons is small compared with the number of normal electrons ($\Lambda_s \gg \Lambda_n$), their influence at these frequencies will be so small that the absorption of infra-red radiation should be nearly the same both above and below the transition point.

Though the conditions we have considered have been idealised considerably, yet it stands to reason that the supraconducting currents are not surface currents in the mathematical sense. Once one admits any finite thickness for the layer in which the current flows (even though it be represented by a formula different from (2)), there must always be in the case of alternating current an inner electric field. If therefore normal conduction electrons exist, we must expect a production of heat characteristic of each supraconductor.

Experiments to measure this production of heat with the view of determining whether such normal electrons exist and, if a positive result were obtained, to make deduction of the number n of supraconducting electrons, or at any rate the thickness d of the layer, were carried out in Prof. Simon's laboratory in Breslau in 1933[4]. As they were prematurely interrupted, definite results are not yet available. They are being continued and it is hoped to report upon them in due course.

HEINZ LONDON.

Clarendon Laboratory,
Oxford.
Feb. 19.

[1] W. Meissner, "Ergebn. exact. Naturwissenschaften", **11**, 251.

[2] W. J. de Haas and H. Bremmer, Comm. Leiden, No. 214 *d*, 1931.

[3] This thickness is, of course, the same as that which has been calculated independently for direct current by R. Becker, G. Heller, F. Sauter, *Z. Phys.*, **85**, 772 ; 1933. These authors, however, do not take into account the possible existence of normal electrons, which are of no interest for direct current problems but would be fundamental if they exist for the effect we are considering here. (Added in proof.) Therefore W. Braunbeck in a recently published paper (*Z. Phys.*, **87**, 470 ; 1934) obtains no production of heat calculating the propagation of electric waves through a supraconductor without considering the existence of normal electrons.

[4] Dissertation Breslau.

Vitamin B_2 and the Pellagra-like Dermatitis in Rats

IN our first experiments on the concentration and isolation[1] of vitamin B_2, we failed to observe definite changes in the skin and fur, such as those described by J. Goldberger and R. D. Lillie[2], and by H. Chick and M. H. Roscoe[3] and several other authors, in rats fed on diets containing the antineuritic vitamin in a purified form (for example, alcoholic extracts of wheat or maize, Peters's antineuritic concentrate from yeast, crystalline vitamin B_1 preparations). The flavin pigment was identified by us with vitamin B_2 by its growth-promoting properties. It was therefore a question for further investigation whether in these circumstances it was also identical with the 'anti-dermatitis factor' and in particular with the 'pellagra preventing factor'.

The chief and obvious reason for designating as pellagra-like this peculiar condition produced in rats receiving the antineuritic vitamin as their sole source of 'vitamin B' is the general symmetric dermatitis. This occurs especially on the backs of the forepaws, forearms and backs of the hind paws, the medial surface of the fore and hind legs, and the ears. It has also been the basis for its supposed identification with human pellagra (which has not been sufficiently corroborated clinically). In addition to this pellagrous condition, several authors take account of other less special symptoms : soreness of the mouth, nose, and spectacle-like rings of inflammation around the eyes, a tendency for lids of one or both eyes to adhere together, with an accumulation of dried secretion on the margin of the lids, in some instances loss of fur, particularly on the neck, shoulders or back (saddle-like areas of baldness), small, dry, cream coloured scales or yellowish crusts over a large part of the body. Occasionally these less specific symptoms may prevail and give quite a different aspect to the pathological appearance.

The view has already been considered by J. Goldberger that these two classes of dissimilar skin changes are to be ascribed to a deficiency not only of vitamin B_2 but also of another component of the vitamin B complex. Hitherto no definite proof of this has been given.

In recent investigations, we have been able to fill this gap. The result was an unexpected one. We fed rats with an ordinary vitamin B-free diet (caseinogen A.B. Glaxo 18 per cent, rice starch 68 per cent, butter fat 9 per cent, cod liver oil 1 per cent, salt mixture 4 per cent) supplemented by a vitamin B_1 preparation from yeast highly purified by the method of Windaus *et al.* (1 pigeon-unit = 8–12 γ) and with vitamin B_2 (lactoflavin 10 γ daily). In a large number of the animals we observed pellagra-like changes in the skin. In order to avoid symptoms of B_1 deficiency (loss of co-ordination, ataxia, spastic gait) it appeared necessary to give a higher dose of the vitamin B_1 preparation. The appearance of pellagra-like symptoms was accelerated by the administration of 4–6 pigeon units, whereas when smaller doses were given the skin symptoms were not observed at all or else only in a very moderate degree[4]. When the B_2-free diet of A. Bourquin and H. C. Sherman[5] was used, the addition of B_1 and B_2 supplements produced pellagra-like skin changes. The classical picture of the symmetrical pellagra-like dermatitis, with reddening and swelling of the fore and hind paws and ears as the specific characteristics of the condition, occurred particularly distinctly when egg-white (3–5 c.c. daily) was added to a vitamin B-free diet

supplemented by vitamin B_1; or to the Bourquin-Sherman diet. Administration of vitamin B_2 (lactoflavin) intensified the symptoms even more, and here it should be mentioned that egg-white is already known to be rich in vitamin B_2 (H. Chick and M. H. Roscoe[6]).

These effects were obtained with remarkable regularity and we must conclude from the results that the 'pellagra-like' dermatitis is not produced by a lack of vitamin B_2, as it is isolated in flavin pigment. We are much more readily able to produce the pellagra-like dermatitis, unaccompanied by non-specific and uncharacteristic secondary symptoms, in the presence of B_1 (perhaps contaminated with B_4) and B_2. This pellagra-like dermatitis can be cured by the administration of the B_1+B_4 eluate from the charcoal adsorbate from yeast extract as prepared by the method of Kinnersley, O'Brien, Peters and Reader[7]. This antidermatitis factor cannot be identical with B_4 for the following reasons: (1) our animals show no signs of B_4 deficiency; (2) the skin lesions can be alleviated by alkaline autoclaved marmite, in which according to Reader the vitamin B_4 must have been destroyed. One might rather identify it with the alkali stable factor *Y* of H. Chick and A. M. Copping or the B_5 pigeon factor. In order to avoid confusion, we have for the time being named this 'rat pellagra preventive factor' in its narrow sense vitamin B_6.

By the administration of B_1+B_4 ($+B_6$) or Peters's yeast eluate for 10–15 weeks, skin changes were certainly produced, but they were never pellagra-like, but 'unspecific' as above mentioned and mostly only trivial. These skin changes can be cured by B_2. In this sense, B_2 is also a skin factor and it can be understood that egg-white, for example, which contains no B_6, can cure these 'non-specific' skin changes because it is rich in B_2 (cf. Chick and Copping).

So we have been able to separate vitamin B_2, the antidermatitis factor, into two components—the real vitamin B_2 (flavin) and vitamin B_6.*

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Feb. 6.

* The vitamin B_1 was prepared by the I. G. Farbenindustrie, Elberfeld, Germany, and the lactoflavin was kindly prepared by my colleagues, R. Kuhn and Th. Wagner-Jauregg (Heidelberg), at my request.

[1] P. György, R. Kuhn and Th. Wagner-Jauregg, *Naturwiss.*, 560; 1933. *Klin. Wschr.*, 1241; 1933. *Z. physiol. Chem.*, 1934.
[2] Public Health Rep. Wash., **41**, 1025; 1926.
[3] *Biochem. J.*, **21**, 698; 1927.
[4] cf. M. Kellog and W. H. Eddy, *Science*, **33**, 609, Dec. 29, 1933.
[5] *J. Amer. Chem. Soc.*, **53**, 3501; 1931.
[6] *Biochem. J.*, **23**, 498; 1929.
[7] *Biochem. J.*, **27**, 225; 1933.

Effect of Mitogenetic Rays on Eggs of *Drosophila melanogaster*

THE different methods for the demonstration of Gurwitsch rays have in common that the technique is always subtle and requires much practice; Magrou alone has described a simple method while using the eggs of the sea-urchin, but these eggs are only obtainable in certain months of the year and in marine laboratories; so we have sought for a more convenient object and have found it in the eggs of *Drosophila melanogaster*.

We used strips of paper, with a layer of agar and ordinary treacle; after deposition of the eggs by the flies, we put the paper strips into Petri dishes and moistened them with water. The source of our Gurwitsch rays was a culture three hours old of *Staphylococcus pyogenes aureus* in ordinary broth. The broth was put into test-tubes of fused silica closed by corks, and placed on the opened Petri dishes containing the paper strips with the eggs. The most suitable time for irradiation was found to be 20 minutes. Afterwards the two Petri dishes (irradiated and control) were closed with their covers of glass, and kept under the same conditions. We counted the larvæ that were hatched each day and sometimes every couple of hours; so we could always choose an epoch, when only 20–60 per cent of the control eggs were hatched, while a much greater number of the irradiated eggs were hatched.

The following results, which speak for themselves, were obtained from nine experiments.

Controls			Irradiated Eggs				
No. of eggs	No. hatched	Per cent hatched	No. of eggs	No. hatched	Per cent hatched	Time of irradiation	Diff. (per cent)
39	25	64	51	45	88	15–20 min.	24 ± 10·6
81	15	18·6	72	30	41·7	15–20	23·1 ± 7·45
52	18	34·6	60	49	81·7	15–30	47·1 ± 8·1
304	210	69	312	300	96·1	20	27·1 ± 8·5
324	147	45·4	304	228	75	20	29·6 ± 3·7
344	255	74	327	323	98·4	20	24·4 ± 2·6
366	136	37	357	244	68	20	31 ± 3·5
118	79	67	117	98	83·5	20	16·5 ± 5·5
74	38	51·3	85	60	70·6	20	19·3 ± 7·7
1702	923	54·2 ± 1·2	1685	1377	81·7 ± 0·95		27·5 ± 1·54

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The Pectoral Fin of *Coelacanthus tingleyensis*

THE structure of the internal skeleton of *Coelacanthus tingleyensis*, Davis, was first described[1] and figured[2] by Wellburn as having six basal supports radiating out from the shoulder girdle in a manner similar to those in a pectoral fin described by Woodward[3] from the Talbragar Beds. In view of the recent work of Stensiö[4] on the structure of this fin in the Triassic Coelacanth *Laugia groenlandica*, we have re-examined Wellburn's specimen, which is now in the Leeds City Museum (No. D17), and found that the fin does not show the radials described by Wellburn. This we consider is important and worth putting on record, for it would have been difficult to reconcile the actinopterygian-like arrangement described by Wellburn with the archipterygial type of fin present in the later Triassic Coelacanths.

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[1] *Geol. Mag.*, dec iv, **8**, 71; 1901.
[2] *Proc. York. Geol. and Polyt. Soc.*, **14**, 483; 1902.
[3] Mem. Geol. Survey of New South Wales. Pal. No. 9. 1895. P. 3. Pl. II fig. 1.
[4] Med. om Grønland, **83**, 62; 1932.

Research Items

Archæology of Hawaii. A survey of the archæology of Oahu based on field work in 1930 by Mr. J. Gilbert McAllister (*Bull.* 104, Bernice P. Bishop Museum, Honolulu) has been undertaken in order to place on record such evidence as remains of the people who were in Hawaii when it was first visited by European voyagers. European culture and exotic vegetation introduced into the island are rapidly destroying the sites; but knowledge of them is still treasured by the older inhabitants. Various types of remains are here recorded. The old Hawaiian places of worship fall into two groups, large communal places of worship, for which the term *heiau* is generally employed, and small shrines at which offerings were made. The former are the most interesting remains now found on Oahu. Of these there are 27, while on 19 other sites portions remain. In size they range from 50 ft. × 40 ft. up to 570 ft. × 170 ft. They may be classified into walled structures, terraced structures and walled and terraced structures. The sacrificial *heiau* was the highest type. On it human sacrifices were offered, and it could be built only by a king. It was essentially a war temple. The husbandry *heiau* was used chiefly to ensure the prosperity of the people. With few exceptions the *heiau* were built of natural basalt. The smaller places of worship were fishing shrines, family shrines and road shrines, those functioning in connexion with fishing rites being by far the most important of these. The ceremony consisted in making an offering. It was made by one individual who was regarded as the guardian of the shrine. Several were sacred to certain fish only. Four shrines consisting of small enclosures were noted, but probably most shrines consisted of single stones. The family shrine was an integral part of every household; while the road shrine was a place where offerings were made to some spirit.

Ostracod Feeding Mechanisms. Prof. H. G. Cannon has already given us valuable information on the feeding mechanism of various Crustacea and has evolved a very effective technique in studying them. A recent paper, "On the Feeding Mechanism of Certain Marine Ostracods" (*Trans. Roy. Soc. Edin.*, **57**, Part 3, No. 30; 1933), concerns *Asterope* and *Cypridina* and the comparison of their mouth parts. Also those of *Cytherella* are described. *Asterope* is a purely filtratory feeder with a perfect filter apparatus; no large particles are taken and there are no labral glands, the labrum being very small. *Cypridina* feeds both on large food masses and on minute detritus which it abstracts from the water in the same way as *Asterope*, but the labrum is large, with a labral gland the slimy secretion of which entangles the food particles, and there are biting jaws. Prof. Cannon believes that the asteropids are probably derived from some detritus-eating cyprinids, *Asterope* being extremely specialised. *Cytherella* is a purely filtratory feeder, the mechanism being of a similar type to that of *Asterope*, but the processes are carried on by different limbs.

Plankton of the North Sea. Mr. R. S. Wimpenny in his paper "Variations in North Sea Plankton, 1923–24" (Ministry of Agriculture and Fisheries. Fishery Investigations, series 2, vol. 13, No. 3. 1933) studies the plankton of six stations running from Flamborough Head, east by north, to the "S.W. Patch" of the Dogger Bank. This is in accordance with the recommendations of the plankton section of the Conseil Permanent International pour l'Exploration de la Mer at Copenhagen in September 1932 "that the importance of the range of variation be kept in view". In addition, some work is included bearing on seasonal variation on the "Hydrographic Line" cruises across the whole North Sea in 1923 and the spring of 1924. The importance of the edges of marine banks for supporting a rich diatom flora is shown, especially the Dogger Bank, where there was more phytoplankton than on the Flamborough line towards the shore. Peridinians always followed diatoms, *Ceratium* being very abundant. It is pointed out that those organisms which store fat as food reserves are thus succeeded by those which store carbohydrates. This has a notable physiological aspect. The distribution of *Calanus*, *Apherusa* and *Themisto* suggests their dispersion around the North Sea from west to east. The following recommendations are made: (1) a general investigation of the life-cycle of each important species individually, and its feeding habits over a wide area; and (2), a study of the direction and speed of currents in the area by direct comparison of current measurements and plankton.

Parasites of Carrion-infesting Flies. Observations on the morphology and biology of some hymenopterous parasites affecting blow-flies of the genera *Lucilia* and *Calliphora* form the subject of a recent paper by Mr. A. C. Evans (*Bull. Entomol. Res.*, **24**, pt. 3). As regards the braconid *Aphaereta*, its behaviour in relation to its hosts suggests that the fore tarsi play an important function in egg-laying and possibly contain receptor organs of a tactile or other nature. The eggs of *Aphaereta* increase their volume 2,900 times between the time they are laid and when they are ready to hatch. Nourishment for the rapidly growing embryo is stated to be obtained by its diffusion through the chorion of the egg. As regards *Alysia manducator*, there is but little increase in the size of the developing egg. The modifications resulting from a gradual change from an ectoparasitic to an endoparasitic life, as revealed in the larvæ of the several genera studied, are discussed in some detail. In *Alysia* the egg can successfully develop when withdrawn from the body-cavity of its host, while the newly hatched larva bears a pair of open mesothoracic spiracles and closed rudiments of spiracles on the seven following segments. From these facts, and other structural features, such as the presence of a cocoon, the author concludes that the endoparasitism of *A. manducator* is a recent acquirement or, at any rate, has not reached the advanced condition displayed in other endoparasites of the same hosts. In a third parasite, *Habrobracon brevicornis*, which is an ecto-parasite, the spiracles remain open throughout larval life, locomotory spines and protuberances are present and a well-developed cocoon is formed.

Arizona Cacti. The first Biological Bulletin of the University of Arizona Bulletin (**4**, No. 3) contains an account of the Arizona cacti by W. P. Stockwell and L. Breazeale. It is a non-technical compilation based on Britton and Rose's standard work, primarily intended to facilitate identification and prefaced by a short illustrated account of the vegetative and

floral parts of a cactus. A feature of the work is the large number of illustrations; line drawings of joints and spines accompany the keys to the genera and species, and photographs of most of the seventy-seven species described are included. Points of interest connected with the form and usage of the species are included in the generic and specific descriptions given in the body of the work: thus *Carnegiea gigantea* is recorded as reaching a height of forty feet and an age of 150–200 years.

A New Genus of Phycomycetes. Whilst investigating certain fungi which attack snapdragon plants, Mr. C. G. C. Chesters found a peculiar fungus which produced chlamydospores in abundance, and also thick-walled spores which were often bicellular ("A Phycomycete associated with a Diseased Condition of *Antirrhinum majus*", *Trans. Brit. Mycol. Soc.*, 18, part 3, 199–214, December 1933). The fungus produces spiny chlamydospores in the host plant and also on all the numerous kinds of culture media which have been used. The formation of the thick-walled spores is described, and shown to be roughly similar to the development of zygospores, though there are important differences. No thick-walled spore has yet been germinated, and it is supposed that the fungus represents an intermediate stage between Zygomycetes and other groups of the Phycomycetes. The organism cannot apparently be included in any existing genus, so the euphonious name of *Azygozygum chlamydosporum* nov. gen. et sp. has been suggested.

Origin of Apple Varieties. In a genetical investigation of cultivated apples, Messrs. Crane and Lawrence (*J. Genetics*, 28, No. 2) have obtained important results bearing on the production of new varieties. Many of the crosses between varieties produce few viable seeds and most of the resulting seedlings are lacking in vigour owing to aneuploid chromosome constitution. Among 50 varieties, varying degrees of self-incompatibility were present, but only two failed entirely on selfing. Certain varieties and crosses also produced albinotic seedlings. With this exception, intergrading variation was the rule as regards such fruit characters as skin and flesh colour, size, shape, flavour and time of ripening, indicating the presence of polymeric factors. It is known that many common varieties of apple are triploid, the remainder being diploid, none tetraploid. The n number of chromosomes is 17, while in most other Rosaceæ $n=7$, or in certain genera 8 or 9. Various views of the origin of $n=17$ from the lower numbers are held, based on the secondary pairing of the chromosomes and other evidence, but all are agreed that some of the chromosomes are present several times, thus giving a basis for polymeric factors and graded inheritance. Such well-known varieties as Baldwin, Blenheim, Gravenstein and Ribston have $3n=51$ chromosomes. From Vavilov it appears that wild apples occur widely in Asia. He reports that in the Caucasus the fruits are small, while in Turkestan a great range of size and quality occurs, some wild trees bearing fruit of excellent flavour and large size.

Air Currents Around the Rock of Gibraltar. In *Geophysical Memoir* No. 59 of the Meteorological Office, J. H. Field and R. Warden describe "A Survey of the Air Currents in the Bay of Gibraltar, 1929–30", but the investigation, which was undertaken owing to accidents to aircraft in the lee of the Rock of Gibraltar, was confined to the disturbances set up by easterly winds, these being of the greatest practical importance to aviation. The work divides itself into two distinct sections; first, experiments with a model of the Rock on a scale of 1 : 5,000 in a wind tunnel at the National Physical Laboratory, and secondly the study on the spot of actual wind currents at different heights with the aid of pilot balloons and kites, in order to form an idea of the extent to which the system of currents observed in the wind tunnel corresponds with reality. The unusually large figure for the scale ratio model : actual (a ratio somewhere between 1/10 and 1/200 is usual in work of this kind) made this practical verification the more necessary, but it was found that on the whole the indications of the model were reliable in so far as they gave a correct picture of the directions of the different currents and of the types of permanent or temporary eddy set up. Great turbulence extended for fully two miles to the west of the Rock in easterly winds, from sea-level up to at least a height of 5,000 ft. The system of vortices included two that were large and permanent for a given wind direction, and with a shift of wind from due east there was generally a corresponding shift of the areas of danger, and at the same time changes in the permanent vortices. For the immediate purpose of the inquiry—the avoidance of further accidents—the most important item in the work is probably the map showing the positions of the danger areas for different wind directions, but there are many items of interest to meteorologists; for example, the conclusion that the obstruction caused by the Rock in a wind of only Beaufort force 6 caused vertical velocities of about twenty-five miles an hour for short periods. The conclusion was also reached that in such investigations the use of a kite balloon for a single day can give more information than many months of pilot-balloon work.

Action of β- and γ-rays on Rock Salt Crystals. When crystals of rock-salt (and many other substances) are exposed to β-rays, γ-rays or X-rays, they acquire a new spectral absorption band (giving a characteristic colour) and a photoelectric conductivity when illuminated by light frequencies within this band. Burbidge (*Proc. Camb. Phil. Soc.*, 30, Part 1) has made experiments on this effect. Using small exposures to the activating agent, he found that the photo-current obtainable died away with time, so that in a few minutes he could collect all the charge that the crystal was capable of carrying. If the crystal is left in the dark, the 'activation' gradually decays, but in any event the number of electrons collected is only of the same order as the number of β-particles or γ-quanta absorbed. This is peculiar, since it is known that ultra-violet light of quantum energy 5 volts will cause activation and the β-particles have, of course, energies of 10^5–10^6 volts. It is suggested that the activation is confined to comparatively rare centres such as foreign atoms or micro cracks. During the activation, a large number of electrons are disturbed from their normal levels to the lattice conduction levels, but except at such singular points, they rapidly revert to their original state. At the singular parts they revert to comparatively stable intermediate levels from which they can be raised by the absorption of blue-light quanta. Further work is contemplated—it would clearly be very interesting to determine the efficiency of activation for ultra-violet radiation of comparatively low quantum energy.

Thirteenth Annual Report of the Forestry Commissioners*

THE Forestry Commission is in its second decade. For the work proposed for the decade it had been estimated that a sum of about 11¼ million pounds would be required; working receipts were estimated at £2,160,000, the net contribution from the Exchequer being £9,115,000. The chief works to be carried out were the afforestation of 353,000 acres and the establishment of 3,000 workers' holdings. For the purposes in view it would be necessary to acquire each year 6,000 acres of plantable land and 2,500 acres of agricultural land. These proposals were subject to a severe cut at the hands of the May Committee in the interests of economy (NATURE, Sept. 17, 1932, p. 427). As a result of subsequent discussions between the Commissioners and the Chancellor of the Exchequer, the latter undertook to provide annually for the next five years a sum of £450,000, this with working receipts giving the Commissioners about £600,000 annually for forestry operations.

Changes of policy in Government departments other than that dealing with forestry, however admirable their main aims at retrenchment may be, often result, in the first instance, in unavoidable losses. In the case of forestry, sudden fluctuations of policy, justified apparently by the necessities of the Exchequer, are particularly liable to lead to loss and waste. In the present case, where so large an amount of the work of the Forestry Commission is planting and the provision of the plants required annually for the estimated area to be afforested, a serious annual curtailment of the land to be planted up would of necessity be followed by a drastic decrease in the number of plants required for the purpose. This inevitable result was foreseen at the time the recommendations of the May Committee were accepted and at the subsequent discussion between the Commission and the Chancellor of the Exchequer. Questions asked in the House of Commons on the subject in July last appeared to show that the unavoidable outcome in this respect had not been appreciated. The Report for 1932 thus alludes to this important matter, and merits putting on record:

"It will be appreciated that the sudden change in the Commission's planting programme could not be made without waste. The material losses are most apparent in respect of nursery plants. . . . In view of all the facts it was decided to retain in the nursery only those surplus plants which were within the economic limit of age [four years old] and, further, did not necessitate additional expenditure in weeding, etc. There has thus been a destruction of surplus plants beginning in the nursery season 1932 and not yet at an end. When the readjustment has been completed it is estimated that the cost price of the plants involved will amount to approximately £50,000."

The net total area acquired in Great Britain to September 30, 1932, was 709,008 acres, of which 439,885 acres were classified at the time of acquisition as plantable. Of the plantable area 265,275 acres (60 per cent) are situated in England and Wales and 174,610 acres (40 per cent) in Scotland. The total area planted or sown during the year was 22,663 acres, of which 21,277 acres were placed under conifers and 1,386 acres under broad-leaved species. Included in the above are 522 acres reafforested in the former Crown woodlands and 182 acres replanted after damage by fire. The 'Cost of Planting' still unfortunately remains at a high figure. It is stated that "The outlay per acre on labour and material on the areas planted between 1919 and 1932 was as follows: England and Wales, £9 3*s.* 0*d.*; Scotland, £9 15*s.* 1*d.*; Great Britain, £9 7*s.* 3*d.* These figures cover the cost of preparation of ground, drainage, fencing, plants, planting, replacement of failures and weeding but do not include expenditure on forest protection, overhead charges and supervision." Perhaps 'Cost of Formation' would be a better term than 'Cost of Planting' for operations which cover a great deal more than the mere 'planting'.

The total addition to the forest area of Great Britain during the year was 16,927 acres. In forming plantations and beating-up previous years' plantations 51,600,000 trees were used, of which 39 per cent were Norway and Sitka spruces; 32 per cent Scots and Corsican pines; 14 per cent European and Japanese larches, and 3 per cent Douglas fir. An area of 242 acres of existing woods was underplanted, necessitating the use of 217,000 plants.

Grants to private individuals and local authorities for planting and scrub-clearing (on the basis of £2 per acre for planted conifers and £4 per acre for approved hardwoods to be maintained thereafter as forest crops; and £1 per acre for clearance of scrub on areas of not less than 20 acres) amounted to £11,710, advances in respect of a proceeds-sharing scheme to £1,483 and overhead and supervisory charges to £3,148.

In connexion with afforestation schemes generally, many countries are now interested in the question of the annual production of seed of a varying number of important timber trees, both conifer and hardwoods; the failure of a seed year of an important species becoming of almost world-wide importance. In this matter the British Empire has an interesting record, for it is many years since interchanges or gifts of forest tree seeds were started between Australia, India and South Africa, to mention three countries only. The competition in modern times for the seed of certain species has become greater and this applies more especially to some of the temperate conifers such as Sitka spruce, Japanese larch and so forth. With this competition the prices of seed of certain species have risen considerably. It is pleasant to recognise that inter-Empire and international courtesy results in handsome gifts of seed being made by one country to another. On this interesting matter the report has the following: "The only seed which had to be imported from North America was Sitka spruce from the Queen Charlotte Islands: Japanese larch could not be obtained from Japan. Norway spruce and European larch were in abundant supply from the Continent, but only a moderate quantity of Corsican pine was procurable. As regards Great Britain, Scots pine seed was plentiful, but requirements of European larch could not be met; seeds of hardwoods with the exception of ash were again scarce." The Commissioners acknowledge their thanks for gifts of seed from the

* Forestry Commission. Thirteenth Annual Report of the Forestry Commissioners for the year ending Sept. 30, 1932. Pp. 43. (London: H.M. Stationery Office.) 9*d.* net.

forest authorities of Bulgaria, France, Greece and Portugal.

Acquisitions of land on a reduced scale were sanctioned, as also the inauguration of a certain number of forest workers' holdings. Acquisitions of land during the year amounted to 81,933 acres, of which 46,437 acres were classified as plantable; whilst 115 holdings were completed during the year, the total number now amounting to 1,156 at an average cost per holding of £499.

The balance in the Forestry Fund at the commencement of the forest year was £446,432. Receipts from Parliamentary votes (£447,000) and forestry operations (£151,466) amounted to £598,466. Payments amounted to £761,220, so that the balance in the Fund at the end of the year was £283,678.

During the year the Commission lost Lord Lovat, its first chairman, and Mr. H. A. Pritchard, assistant commissioner for England and Wales. This thirteenth annual report may be regarded as a most fitting memorial to Lord Lovat, to whose remarkable energy and enthusiasm, supported by a strong body of commissioners and a keen staff, the present position of forestry in Great Britain must be ascribed.

Racial Distributions and Archæology

IN a lecture delivered in January last year at the John Rylands Library, Manchester, and recently available (*Bull.* John Rylands Library, vol. 17, No. 2. Separates, Manchester University Press, 1*s.* net) Prof. H. J. Fleure puts forward a tentative correlation of the evidence of archæology, human palæontology and ethnology. Prof. Fleure aims at showing that certain phases of culture may be associated with certain physical types of man in the past, and that, subject to the reservation that modification of culture may have taken place from outside, this association still holds good in modern representatives of, or approximations to, these ancient physical types. He also suggests the possible lines along which races have attained their present distribution.

Homo sapiens and *Homo neanderthalensis* clearly were differentiated at an early date. The former is known from East Africa, the latter essentially belongs to Eurasia. In the Old Stone Age, the flake implement is associated generally with Neanderthal man, while the finer technique of the core implements points to it being the work of *Homo sapiens*. The distribution of the core implement suggests that it may have arisen in Africa or south-west Asia and spread, on one hand to India, and on the other to western Europe.

The rise of hunting differentiates the work of the men from that of the women, the latter continuing to be food gatherers. Among modern food gatherers and hunters are the pygmy peoples of Africa and south-east Asia. Their breadth of head is possibly an ancestral trait derived from extinct types of man, such as Neanderthal man, whose heads incline to brachycephaly, if the torus is ignored. Unfortunately, no ancient skeletons of pygmies are known. On the other hand, a majority of the representatives of early *Homo sapiens* have long heads and most of the characters of the one of the two types into which these can be differentiated, are found among primitive hunter and collector groups, such as the jungle tribes of India, the Veddah of Ceylon and the Australian. The Bushmen and the extinct Tasmanian also include a good proportion of extreme long heads, as also do the Eskimo. These two groups may represent two early drifts of man, pushed to the farthest corners of the earth, while the pygmies took refuge in the equatorial forests.

There are numerous groups in which most have moderately long heads, while a few have extremely long heads. These are common in Africa, around the western Mediterranean, in North Africa and a related type is found in the Deccan of India, while much the same may be said of large groups in the East Indies. All are essentially herdsmen or cultivators. African groups show that hunter men acquired cultivator women. The herdsman grew from the hunter. Herding made men more predominant than ever and increased their pride in their breed. Cultivation first arose in north-east Africa and south-west Asia, perhaps in India as well, and there may have been a primary spread thence to the west and south-east. The spread to the south in Africa encountered difficulties of climate and the cultivator remained essentially a woman. It is, therefore, probable that much of the stock whence springs the pygmies was handed down in Africa, while in south-east Asia, there are traces, if rare, of this early stock, and the inhabitants of Papua have kinky hair. It seems useful, therefore, to think of a gradation with an increase in importance of the older types and style of life as one goes south in Africa, or through south-east Asia to Papua; while the absence of cultivators in Australia and Tasmania points to the isolation of these two areas before the arrival of cultivators in Papua.

North of this area of culture and drift lies the mountain mass of Tibet with its westward extensions. North of this the ways would be open only after the last glaciation. The north-eastward drifts through Asia, continuing into America, belong to a Tardenoisian or late Capsian phase.

In this connexion the rise and spread of broad-headed man must be considered. The main area of distribution is the mountain zones of Asia, Anatolia and Central Europe. Tentatively it may be suggested that the type came into existence in south-west Asia, in or near the Anatolian peninsula. Knowledge of ancient skulls is still insufficient to say when these broadheads moved into Central Europe; but there are broadheads from an epipalæolithic station at Ofnet; and from the beginning of the Bronze Age there is a peasantry in Central Europe. Some of the peoples of the Pamirs are broad-headed and in other respects like the people of Central Europe. It is difficult not to suggest a common intermediate origin for the two. In Anatolia and the western part of the Balkan peninsula there is a very broad-headed type with very straight occiput. This may be a specialisation which has superseded the older form.

Farther east and associated with the high plateau of the Gobi is a different intensification of broad-headedness, the most marked form being that with the face flattened, oblique eyes, yellow-brown skin and lank hair.

It is possible that these broad-headed types spread in the early days of the development of cultivation. There was evidently an important spread of popula-

tion about the middle of the third millennium B.C. in and around the great steppe, which reached north China and may be responsible for some of the drifts to America.

So far as the steppes of western Asia and southern Russia are concerned, the broad-headed type was not the earliest in the population. The graves of the third millennium yield a majority of extreme long heads, differing from the hunter and collector people surviving farther south. This type spread into Europe from the early Bronze Age onwards. Later in the Bronze Age came a period of warmth and drought which leaves the steppe poor in remains and probably accounts for the small extent to which inter-tropical Africa was influenced by Bronze Age movements. The Bronze Age movements distributed skilled craftsmen with a high grade of organisation far and wide; while as regards the steppe the movements had acquired the driving power of the acquisition of the horse. Hence their movements were turned towards Iran and India, in directions in which conditions were suitable, rather than to the north-east. These peoples are generally credited with being the authors of the Aryan languages. Their relation to the people of the Old Stone Age is not clear.

There remains a long-headed element, or rather on the long-headed side of medium, found in western Europe, as for example in Britain and eastern Asia, notably in China. There are indications of a spread of early agriculturists through south-eastern Asia to north China, which included moderately long-headed elements as well as broad-heads; and this element may also have been included in a similar migration to western Europe, but lack of data precludes dating.

Industry and the Research Associations

ON March 22, the Department of Scientific and Industrial Research convened an important conference at the Institution of Civil Engineers, at which Lord Rutherford presided, and more than one hundred representatives of the twenty-one research associations formed under the auspices of the Department were present. The object was to provide an opportunity for frank discussion with officers of the Department and members of its Advisory Council on the present position of the research association movement and its future.

On the eve of the conference, Sir Kenneth Lee, who is a member of the Advisory Council closely identified with the work of the research associations, and whose firm belief in industrial research is well known, entertained the representatives to dinner at the Dorchester Hotel. Mr. Runciman represented the Government and many prominent men in industry, finance and in the Civil Service were present. Among the speakers were Mr. Runciman, Lord Rutherford and the Right Hon. Reginald McKenna. In the course of his remarks, Mr. Runciman read a statement from the Lord President of the Council, in which Mr. Baldwin said that those present no doubt shared the opinion of the Advisory Council that the present scale of operations of the research associations is totally inadequate if they are to serve their full purpose. He looked forward, with confidence, to industrialists improving matters in that respect, especially now that the prospects of trade are more promising. If they do so, Mr. Baldwin's message continued, they can rely on the Government on its side being prepared to play some part in the forward movement and to help in extending the scale of operations.

The views expressed at the conference left no doubt that the Advisory Council of the Department is right in believing that the time is ripe for a great development in the research association movement. The associations have already made a deep impression on British industry, not only in producing practical results of great monetary value, but also in bringing about a more sympathetic attitude towards the usefulness of scientifically trained men in the works. Several speakers emphasised the paramount duty of research associations of carrying out long-range investigations essential to widening the boundaries of knowledge. Reference was made to the benefits conferred on the consumer by the improvement in products as regards utility and price and to the raising of the standard of living resulting therefrom, and for this reason it was urged that a continuation of a substantial contribution from Government sources is fully justified. Attention was also directed to the importance of achieving stability of finance for the research associations as a means of securing the best work from those employed by them, of ensuring that the best scientific brains are available for that purpose and of making possible the planning of long-distance programmes.

At the conclusion of the proceedings, Lord Rutherford referred to the statement made by Mr. Runciman the previous night on behalf of the Lord President as to the willingness of the Government to afford increased financial help, and urged that as a next step the councils of the research associations should consider the scale of work required to meet the needs of their particular industries and submit proposals for the consideration of the Department, in order to bring about at the earliest possible date a very different scale of operations.

University and Educational Intelligence

CAMBRIDGE.—The following appointments have been made: Dr. W. A. H. Rushton, of Pembroke College, to be University lecturer in physiology. Mr. O. A. Trowell, of St. John's College, to be University demonstrator in physiology and Dr. H. N. Green to be University demonstrator in pathology.

LEEDS.—The following appointments have recently been made: Dr. Douglas H. Collins, to be research fellow in rheumatism under the scheme of co-operation between the University of Leeds and the Harrogate Royal Bath Hospital, for the institution of research into the cause and cure of chronic rheumatism and allied conditions; Dr. W. A. Bain, to be lecturer in physiology.

THE Educational Advisory Board of the British Social Hygiene Council is proposing to form a permanent central exhibit of biological teaching material and apparatus. In view of the increasing demand for including biology in school curricula, such an exhibit should prove useful to teachers. The Board is therefore seeking suggestions in connexion with all forms of biological material. Further information concerning the proposal and a list of suggested headings under which information is sought can be obtained from Mr. Percy F. Lee, Education Officer, Educational Advisory Board, British Social Hygiene Council, Carteret House, Carteret Street, London, S.W.1.

Science News a Century Ago

A Charter for the University of London

At a Court of the Common Council of the City of London held on April 3, 1834, the Lord Mayor stated that he had received a request, numerously signed, calling on him to convene a special meeting to consider the propriety of presenting an address to His Majesty praying that a charter might be granted to the University of London. A supporter stated his belief that the King and Ministry agreed in the desirability of granting the charter, and that the signature of His Majesty would have been put to the charter had not a petition against it been presented by the University of Oxford. It was urged against the proposition that Oxford, Cambridge, and other colleges never had the power of conferring degrees until they had gained a high reputation for ecclesiastical and scientific learning. The speaker looked upon the University of London as a mere joint stock company, and stated that he held in his hand a £100 share of the University of London, which had been sold that very morning for £23. He proceeded to ask how the Corporation could be justified in going to the King for a charter for a concern the shares of which were sold for £23 apiece. The motion to present an address to His Majesty in favour of granting a charter to the University of London was carried without a division.

Paris and London Geographical Societies

The Paris Geographical Society was founded in 1821, that of London in 1830. From the time of institution of the latter, the two bodies were on most friendly terms, and exchanges of courtesies were frequent between the respective officers.

The French society was itself considerably assisted in its early years through the co-operation of the reigning house. On January 1, 1834, the president, M. le duc Decazes, with many members, waited upon the King and Queen at the Palace of the Tuileries, and were received in audience for an hour and a half. The heir to the throne, the Duke of Orleans, was also present, and various State functionaries. In an address to the King, the president alluded to the interest of the Duke of Orleans in the Society. The King in his reply confirmed his own good wishes and desire to secure for France the honour of geographical discovery. An address to the Queen followed.

On April 4, 1834, at a general assembly of the Society, it was announced that the Duke of Orleans had offered a prize of 2,000 francs to the navigator or traveller whose geographical observations and results should be useful to agriculture, or in the industrial arts, in the course of 1834 and 1835. At this assembly, also, the award of a gold medal was decreed to Capt. John Ross for his recent discoveries and additions to geographical knowledge. (*Bull. Soc. de Géog. Paris*, ser. 2, vol. i.)

Surrey Zoological Gardens

The Surrey Zoological Gardens on the south side of the Thames in London were opened in 1831 by Edward Cross, who had previously had a menagerie at Exeter. On April 5, 1834, the *Times* announced that "a most important addition has just been made to the already valuable collections in these gardens, in the acquisition of a fine young rhinocerous, the only one of the species which has been in this country for the last 20 years. . . . The great value attached to the possession of a living specimen of this animal, and the difficulty in procuring one may be inferred from the fact that the cost of the present, from the time it was taken in the Birman Empire, and the charge of its food and conveyance to England have exceeded 1000£ though it is yet little more than a year and a half old". After describing the animal, its food and its habits, the *Times* said : "The present specimen, owing to its youth, is as we have already stated, very harmless, and will follow in a fawning manner those who feed it ; yet we understand that as it approaches to mature age its native fierceness will break out and will not tolerate the familiar approach of man, nor at times can its keeper enter its den without considerable danger. The last rhinocerous in this country was so fierce that it could not be exhibited until it was secured in its den by very heavy chains."

Death of Baron de Lesseps

On April 6, 1834, Jean-Baptiste-Barthélemi, Baron de Lesseps, the traveller and diplomatist, died suddenly at Lisbon at the age of sixty-eight years. For many years he had represented France, first in Russia and then in Portugal, and had held a post in Moscow previous to the disaster of 1812. He was born at Cette on January 27, 1766, and in 1785, when La Pérouse was fitting out the frigates *Boussole* and *Astrolabe* for an expedition to the Pacific, de Lesseps was appointed to accompany him as interpreter. The ships left Brest on August 1, 1785, doubled Cape Horn, visited the shores of California and in January 1787 reached Macao. Thence they proceeded to the coasts of Tartary and Kamtschatka, and at Avatska de Lesseps was sent home overland with the journals of the voyage ; the journey across Siberia and Russia taking about a year. In December 1787, La Pérouse, leaving the north, called at the Friendly Islands and in January 1788 sent home from Botany Bay his last letter. Thirty-eight years later the remains of his ships were found by an English captain in the Queen Charlotte Islands. In 1790 de Lesseps published a journal of his journey from Kamtschatka, and in 1831 enriched with notes an edition of the "Voyage" of La Pérouse.

Mrs. Somerville Honoured

In 1831 Mrs. Somerville had published her "Mechanism of the Heavens" and in the beginning of 1834 her "Connexion of the Physical Sciences". These works gave her a place among the most eminent women of science of all time. She was honoured by various scientific societies and on April 6, 1834, Mrs. Marcet wrote to her from Geneva : "I am desired by Professor Prevost to inform you that you were elected an honorary member of the Société de Physique et d'Histoire Naturelle de Genève on the 3rd April, and that a diploma will be forwarded to you by the earliest opportunity. After all the honours you have received, this little feather is hardly worthy of waving in your plume, but I am glad that Geneva should know how to appreciate your merit. You receive great honours, my dear friend, but that which you confer on our sex is still greater, for with talents and acquirements of masculine magnitude you unite the most sensitive and retiring modesty of the female sex ; indeed, I know not any woman,

perhaps I might say any human being, who would support so much applause without feeling the weakness of vanity. Forgive me for allowing my pen to run away with this undisguised praise, it looks so much like compliment, but I assure you it comes straight from the heart, and you *must* know that it is fully deserved." Mrs. Marcet was the author of "Conversations on Chemistry", which Faraday said "gave me my foundation in that science".

Societies and Academies

LONDON

Institute of Metals (Annual General Meeting), March 8. H. A. SLOMAN: Alloys of silver and beryllium. The constitution of the whole range of alloys in the silver-beryllium system has been redetermined by thermal and micrographic analyses. Modifications and amplifications of Oesterheld's original constitutional diagram are proposed. A description is given of new tarnish-resisting silver alloys obtained by the addition to silver and to some 'standard' silvers of very small quantities of beryllium. C. E. PHILLIPS and J. D. GROGAN: Transverse tests of sand-cast aluminium alloy bars. The transverse test in the measurement of the ductility of alloys of low elongation does not yield information concerning ductility which is not obtained equally readily from the tensile test when a high degree of accuracy of measurement is available. D. HANSON and E. G. WEST: Constitution of copper-iron-silicon alloys. The solubility of iron in copper is decreased by the presence of silicon. Over the greater portion of the range of compositions examined, iron exists in the alloys as such; its solubility in the solid state decreases rapidly with fall of temperature and becomes very small below 700° C. Within certain ranges of composition, iron and silicon combine to form another constituent, probably FeSi, which forms a series of alloys with the *a* solid solution. FeSi also appears to form systems of alloys with the alpha, beta, gamma, delta and epsilon constituents of the copper-silicon series. The shape of the liquidus and solidus curves has been determined. R. TAYLOR: Transformations in the copper-palladium alloys. The determination of the electrical resistance-temperature curves has been carried out with a much slower change of temperature than had previously been used. The occurrence of two transformations at 10–30 atomic per cent and 35–50 atomic per cent, respectively, and associated with different types of electrical resistance curve, has been confirmed. OWEN W. ELLIS: The malleability of nickel and of monel metal. A discussion of the effect of annealing temperature on the hardness of two rods, ½ in. and 1 in. in diameter, respectively, of cold-drawn nickel, which were the subject of malleability tests at temperatures varying from 250° to 1,100° C. The relationship between energy of blow and percentage reduction in height of normal ½-in. samples is demonstrated, as is the influence of the initial hardness of the same material on its resistance to deformation at 750° C. JOHN L. HAUGHTON and J. M. PAYNE: Alloys of magnesium research. (1) The constitution of the magnesium-rich alloys of magnesium and nickel. The constitution of magnesium alloys containing up to 50 per cent nickel has been studied by thermal and microscopic methods. Magnesium forms a eutectic with the compound Mg_2Ni at a temperature of 507° C. and a composition of 23·5 per cent nickel. The solubility of nickel in solid magnesium is less than 0·1 per cent.

Royal Meteorological Society, Feb. 21. CHANG-WANG TU: China rainfall and world weather. Walker's shorter method has been used for the calculation of the correlation coefficients and his criteria have been applied for testing the reliability of the coefficients. Four fairly homogeneous regions have been chosen and the rainfall of each region is correlated with the pressure, temperature and rainfall of different seasons of various important stations of the world. Increased circulation of the southern oscillation is generally responsible for the heavy rainfall of the rainy season in China. The total correlation coefficients obtained from the equations for the North China coast, Yangtze Delta, Yangtze Valley and south-east China coast are respectively 0·78, 0·62, 0·68 and 0·68. C. E. P. BROOKS: The variation of the annual frequency of thunderstorms in relation to sunspots. Annual frequencies of thunderstorms are formed for 22 groups of stations in all parts of the world, over periods up to 66 years, and are compared with the annual sunspot numbers. When sunspots are numerous, thunderstorms are more frequent than usual in high northern latitudes and in the tropics, but in temperate latitudes the relation, if any, is small. The 11½-year 'thunderstorm cycle' is then compared with the sunspot cycle, and the two are found to run parallel in Sweden and Siberia, but in maritime tropical areas the thunderstorm cycle lags about five months behind the sunspot cycle. Over the earth as a whole, the frequency of thunderstorms at sunspot maximum averages about 22 per cent greater than the frequency at sunspot minimum.

EDINBURGH

Royal Society of Edinburgh, February 5. R. A. FLEMING: The psychology of crime and criminals, with special reference to measures for reformation. The importance of mental defect, of the evil effects of newspaper and other accounts of crimes, and of the influence of detective stories in cinema and theatre were stressed. The great value of Borstal training, provided there was careful grading of inmates, was emphasised and its extension to cases outside the terms of the existing Act was urged. Freud's preconscious and unconscious theories which presuppose a dynamic energy, attached to the thoughts in both, striving for expression in the conscious are accepted, although the present methods of psycho-analysis which take for granted the necessity of unearthing all the sexual thoughts of the analysand, a procedure harmful for patient and psycho-analyst alike, are deprecated.

PARIS

Academy of Sciences, February 5 (*C.R.*, 198, 513–624). JULES DRACH: Systems of partial differential equations with two variables reducible to a Laplace linear system. GABRIEL BERTRAND and P. SERBESCU: The toxicity of aluminium according to its mode of entrance to the system. Continuing their experiments on the alleged poisonous action of aluminium derived from cooking utensils, the authors describe experiments on rabbits proving that when the metal

is introduced through the stomach its toxicity is only one fourth of that when introduced by injection. The view that aluminium introduced into food from cooking vessels is less poisonous than other metals such as copper and nickel introduced into food in the same way is confirmed. J. HAAG : The decomposition of a nucleus into canonical nuclei. LOUIS ROY : The separating power [of telescopes] for two equal components. E. MATHIAS : The storm of June 1, 1933, at Hanoï (Tonkin). J. DIEUDONNÉ : The maximum modulus of the zeros of a polynomial. SERGE TCHOUNIKHIN : The problem of the two classes of a finite group. BERTRAND GAMBIER : Tetrahedra inscribed in a skew cubic and circumscribed with a developable of class 3 or a quadric. J. DELSARTE : The application of the theory of mean periodic functions to the resolution of certain integral equations. J. AVANESSOFF : Inequalities concerning the movements of revolution of a viscous fluid. CAÏUS JACOB : The problem of local unicity concerning the flow of heavy liquids. TCHANG TE-LOU : A new mode of ignition in the internal combustion motor. The action of the high temperature of a disruptive discharge is not always indispensable for ignition ; the silent discharge (*effluve*) is equally efficacious. JEAN MASCART : The light of shooting stars. Discussion of the mechanical and electrical theories regarding the production of light by meteorites : the author considers the mechanical theory best accords with the known facts. CH. FABRY : Remarks on the preceding communication. While it is clear that the greater part of the light from a shooting star and the whole of that from its luminous trail is due to the luminosity of a gas, the mechanism of this emission is not clear. L. GOLDSTEIN : The theory of the electric discharge. EMMANUEL GAMBETTA : The measurement or the detection of weak alternating currents. Y. ROCARD : The working of bigrid frequency changers. JEAN PELTIER : The magnetic exploration of metallic specimens. P. DAURE and A. KASTLER : The fluorescence of iodine vapour excited by circularly polarised light and observed longitudinally. MME. IRÈNE CURIE and J. JOLIOT : The chemical separation of new radio-elements emitting positive electrons. Study of the effects of the irradiation of boron, aluminium and magnesium with the α-rays of polonium. The results obtained furnish the first chemical proof of the transformations and the capture of the particles by the transformed nuclei. The new elements are named radionitrogen, radiophosphorus and radiosilicon. JEAN THIBAUD : The dematerialisation of the positive electrons. GÉRARD PETIAU : The representation of the nuclear transformations. ALBERTO BETIM : The kinematic method of quantitative spectrum analysis. The method depends on the measurement of the mass of the chemical elements by means of the variation of one of their lines during its electro-vaporisation made with the electric arc. W. BRONIEWSKI and K. WESOLOWSKI : The mechanical properties of the gold-copper alloys. EDOUARD RENCKER : Study of the softening of vitreous bodies. The velocity of penetration of a needle at constant temperature under the action of a spring is taken as an index of plasticity. GUICHARD : Adsorption and catalysis on alumina. J. P. MATHIEU : The hydrolysis of some alkaline metallotartrates. MARCEL BALLAY : Some properties of a cupronickel containing beryllium. M. HAÏSSINSKY : The nature of the radiocolloids. The colloidal solutions given by bismuth nitrate. J. PRAT : The action of hydrobromic acid on phenylarsinic acid and *p*-aminophenylarsinic acid. L. ROYER : The experimental study of the modification of the facies of crystals which grow in a solution containing certain foreign substances. H. DERVILLE : The dome-shaped ridge of the Cambrian limestones of the region of Carteret (Manche). J. BONDON, L. CLARIOND and L. NELTNER : A new section of the Djebel Sarro (Saharan Morocco). EMM. DE MARTONNE : The *areique* diagonal of South America. PAUL CHAUCHARD : The proportion of dissolved oxygen in the waters of the estuary of the Seine. F. M. BERGOUNIOUX : The group of pleurodire Chelonians in the course of geological time. L. JOLEAUD : Subfossil vertebrates of Azaoua (Niger Colony). MLLE. R. LE BLANC : The reproduction of *Chœtoceros pseudocurvisetum*. P. LAVIALLE and P. JAEGER : Floral polymorphism : Gynomonœcia and gynodiœcia in *Knautia arvensis*. MLLE. BOUGES : Some results of embryonic over- and under-feeding in oats. MAURICE PIETTRE : The ripening of wheat grains. The influence of some physicochemical phenomena. MME. L. NOUVEL : Regenerating power in shrimps. The relations with the casting of the shell and the existence of a critical threshold of differentiation of the regenerate. M. PAIÓ and P. HABER : The action of the infra-red, visible and ultra-violet rays on hæmolytic alexin (complement) and the absorption spectrum of guinea pig serum. H. BIERRY and B. GOUZON : Proof of the presence of protoporphyrin of the blood by the fluorescence of its stannous complex. In the action of stannous chloride on hæmatin and on hæmoglobin, a complex is formed which by its fluorescence spectrum can be identified with certainty as the stannous derivative of protoporphyrin. N. KOBOZIEFF : The mortality of mice with and without tails. Statistics of abortive embryos. RENÉ LEGROUX and GASTON RAMON : The properties of the tetanus toxin made hypertoxic (hypertoxin). By the action of acids the toxic power of tetanotoxin can be increased thirty to eighty times. S. NICOLAU and MME. L. KOPCIOWSKA : The transformation of the fixed rabic virus into the common virus.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **19**, 991–1058, Dec. 15, 1933). L. HARRIS, W. JOST and R. W. B. PEARSE : Separation of hydrogen isotopes by diffusion through palladium. Hydrogen, produced by passing steam from 'electrolysed water' containing 1 part in 1,000 of heavy isotope over heated iron, was passed through an electrically heated palladium tube. The gas was enriched in the heavier isotope 5–8 times when the pressure was reduced from 750 mm. to 39 mm., and a further 1·5 times when it was reduced to 8 mm. Thus a ten-fold increase in concentration is produced at one stage. The method is not considered as likely to compete with the electrolytic method, except in special circumstances. Theoretically it suggests that diffusion of hydrogen through palladium is an atomic process and that there is an activation factor operating in favour of the heavy isotope. HARLOW SHAPLEY and JENKA MOHR : Summary of a variable star survey in an external galaxy. A survey of Cepheid variable stars in the Large Magellanic Cloud. As a whole, about 1·5 per cent of the supergiants between absolute magnitudes − 1 and − 4 are Cepheid variables. The most numerous periods are 2–3 days, and no important

correlation exists between amplitude of variation and luminosity or period. The diameter of the Cloud is about twelve degrees and its linear diameter not less than 15,000 light years. HENRY NORRIS RUSSELL and DONALD H. MENZEL: The terrestrial abundance of the permanent gases. Although nitrogen is one of the most abundant elements in stars and nebulæ, on the earth it forms 0·02 per cent only even of the superficial material. A theoretical discussion leads to the view that the so-called permanent gases were mainly lost by escape into space within a short time of the birth of the earth as matter ejected from considerable depths in the sun. HARLOW SHAPLEY: On the linear diameters of 125 large galaxies. Nothing comparable in size to our galaxy has been found (diameter 30 kiloparsecs). The average galaxy is a little less than 2 kiloparsecs in diameter; the Large Magellanic Cloud is comparable with the mean of the 125 largest systems in 25 selected groups. New values are derived for distances and mean density of matter in these groups. W. E. CASTLE and HANS NACHTSHEIM: Linkage interrelations of three genes for rex (short) coat in the rabbit. Three races of these rabbits, with abnormally short, soft and plush-like hair and curly whiskers have arisen in recent years by a recessive mutation in a different gene. The genes responsible for two of the mutations are in the same chromosome (10–12 per cent crossing over), but the other is in a different chromosome. These races may become important commercially for their pelts. W. E. CASTLE: The gene theory in relation to blending inheritance. Generally speaking, alternative characters (gene determined) characterise individuals; blending characters are more fundamental and characterise species, genera and families. The cytoplasm of the egg affords a mechanism (for example, the organiser of the amphibian egg) for the transmission of such blending characters, though genes borne in chromosomes may modify them. The present assumption that they are determined indirectly by genes is unproved. M. DEMEREC: The effect of X-ray dosage on sterility and number of lethals in *Drosophila melanogaster*. Working under standardised conditions, induced sterility and frequency of induced lethals are approximately proportional to dosage. HARRY H. LAUGHLIN: The specific formula of heredity. MARCUS M. RHOADES: (1) A cytogenetical study of a reciprocal translocation in *Zea*. (2) A secondary trisome in maize. G. H. PARKER: The colour changes of elasmobranch fishes. Two skates, indistinguishable in colour, became lighter and darker respectively when placed in a white and a black tank. Changing the fish over reversed the changes, one assuming a pinkish hue. Two to twelve hours was required for the changes. EDWIN B. WILSON: On overlap. PAUL S. EPSTEIN: On the temperature dependence of ferro-magnetic saturation. The theory of ferro-magnetism deduced by the author in 1932 fits very well data published by Allen and Constant, which lead to the rule that the ratio of saturation intensity at any temperature to that at the absolute zero, plotted against the ratio of temperature to Curie point, for all ferro-magnetic crystals of the cubic system gives one universal curve. J. L. WALSH: A duality in interpolation to analytic functions by rational functions. G. A. MILLER: Groups involving a small number of squares. F. J. MURRAY: A theory for *-operators analogous to the theory of reducibility for self-adjoint transformations in Hilbert space.

Forthcoming Events

Friday, April 6

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP)—at Leeds. Joint meeting with the Yorkshire Section and the Food Group. Conference on "Air Conditioning, with special reference to the Food Industries". Papers by Dr. Ezer Griffiths, Dr. M. C. Marsh and Dr. L. H. Lampitt.

NINTH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY, April 5–11, to be held at Madrid. Prof. O. Fernández: president.

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1304 (T.V.C. 64): Torsional Resonance Characteristics of a Twelve Cylinder Vee Aero Engine. By B. C. Carter and N. S. Muir. Pp. 39+33 plates. 3*s*. net. No. 1554 (Strut. 91, 97 and 146): Buckling of Thin Plates in Compression. By H. L. Cox. Pp. 21+8 plates. 1*s*. 3*d*. net. No. 1556 (T. 3374): Pitching Moment due to Rotation in Pitch. By Dr. A. S. Halliday, L. W. Bryant and C. H. Burge. Pp. 27+20 plates. 1*s*. 9*d*. net. No. 1558 (I.C.E. 946): Tests of a Roots Type Aircraft Engine Supercharger. By the Staff of the Engine Experimental Dept., R.A.E. Pp. 23+16 plates. 1*s*. 9*d*. net. (London: H.M. Stationery Office.)

Researches published from the Wards and Laboratories of the London Hospital during 1933. 31 Papers. (London: H. K. Lewis and Co., Ltd.) 7*s*. 6*d*. net.

University of London: University College. Annual Report, February 1933–February 1934. Pp. ii+156. (London: Taylor and Francis.)

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1932–1933. (Cmd. 4503.) Pp. 161. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

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