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CONTENTS

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The Patents and Designs Act, 1932

THE new Patents and Designs Act, which comes into force on November 1, represents a serious attempt to remedy some of the outstanding defects of the patent system of Great Britain. The importance of the Act at the present time is due to the close relation, too little understood by politicians and administrators, that exists between invention and unemployment. A good patent system promotes employment by fostering inventions of the 'originative' class, which create new demands and so absorb labour, while it has little effect, one way or the other, on inventions of the 'intensive' class, which cheapen the production of existing commodities and so tend to displace labour. A bad patent system, on the other hand, is a fetter on the limbs of industry and an instrument of blackmail.

The present Act marks a definite advance, and the credit for it must go primarily to the British Science Guild. As the sequel to certain articles that had appeared in NATURE, the Guild appointed a strong committee in April 1927, "to consider what changes could advantageously be made in the British patent law", Dr. W. H. Eccles being chairman and Capt. C. W. Hume, honorary secretary. The report of this Committee, published in October 1928, was very widely discussed, and further reports, based upon it, were prepared on behalf of the General Council of the Bar, a joint committee representing the chemical industry, the Chartered Institute of Patent Agents, and a number of other bodies. In May 1929 the Board of Trade appointed a departmental committee under the chairmanship of Sir Charles Sargant to go into the whole matter, taking the British Science Guild's report as the basis of its discussions. The present Act embodies the findings of the latter Committee, and few pieces of legislation can have been subjected to more extensive expert scrutiny before being passed. Lord Marks remarked at the second reading in the House of Lords : "The bill comes to us from the committee who for sixteen months, with the assistance [*sic*] of the British Science Guild, gave very great attention to this very difficult matter with the object of finding a remedy. Subsequently another committee sat for twenty-six months dealing with the same matter, so that we have in fact a bill which has been, in effect, before a Select Committee for three and a half years."

Whether the new Act achieves a substantial

part of the purpose underlying the British Science Guild's report will depend very largely on the manner in which it is administered. If the Board of Trade is endowed with enterprise and vision, it will seize this opportunity of making British patents the most valuable and trustiest in the world, and so of encouraging the investment of capital under their shelter.

At the very worst, the improvement in efficiency and smooth working entailed by the Act marks a substantial gain. It is unnecessary here to enter fully into the numerous and highly technical changes that have been introduced. In one instance—the remedy against unjustifiable threats based on alleged patent rights—the Act prescribes even stronger remedies than the Guild thought it politic to suggest. Appeals from the Comptroller's decisions will in future go to a High Court judge specially appointed. Nugatory inventions, such as perpetual motion machines, will no longer be patentable. Anomalies and inconveniences arising out of the procedure under the International Convention have been removed. The Act also remedies an important defect that was missed by the Guild's committee—the notorious Section 32 A, which fostered the introduction of absurdly wide claims into specifications. These and many other changes introduced by the Act are definitely to the good.

A more important aim of the British Science Guild, however, and a policy that has always been advocated in these columns, has been to check the grant of invalid patents. In the grant by the Crown of monopolies that are legally invalid lies the root of the most undesirable features of the patent system. The new Act has not dealt very courageously with this problem, but it has allotted to the administration one discretion which, if exercised with vigour and wisdom, will yet make the British patent one of the safest in which a man can invest. The principal source of invalidity in patents is want of novelty. To test the novelty of inventions, the Patent Office has since 1905 made a search amongst British patent specifications, and by doing so it has greatly improved the status of British patents and diminished the facilities afforded to that form of blackmail which depends on the unscrupulous (or unintentional) use of invalid patents. Now, however, for the first time the examiners are given discretion to make a search, like those which are made in Germany and the United States, in technical periodicals, foreign specifications, and other published documents. Will this discretion be exercised, or will the great opportunity afforded by the Act be thrown away?

In the articles in NATURE from which the reform movement originated* it was estimated that a very thorough search of this kind would cost at least £120,000 a year, but it was pointed out that this sum could be provided mainly by the surplus of patent fees which is annually taken away from the Patent Office by the Treasury. Since that date, the annual surplus has risen to between £140,000 and £150,000, and moreover, under the new Act, the application fee is being raised by £1 for each complete specification. The principle underlying the Statute of Monopolies was that it is wrong for the Crown to look upon monopolies as a normal source of revenue. Monopolies for inventions were allowed for the sole reason that they encouraged new manufactures: but the use of them for raising revenue is certainly against the spirit of the constitution. The purpose of the patent system is to encourage inventions, not to raise revenue out of them. The surplus revenue from this source ought to be returned to industry in improved services.

However that may be, the inventor will expect full measure for his additional £1 of fees. He waits with some little anxiety to see how it will be expended. Here is a great opportunity to improve the status of the British patent. Is it appreciated? Will it be seized upon with statesmanlike understanding and foresight? Or will these troublesome men of science, who have clamoured so obstreperously for mysterious improvements relating to the encouragement of invention, be thrown just so much of a dry bone as may serve as an excuse for refusing them a fair meal? It is not unreasonable to feel some perturbation on this point. The recent report on the Post Office shows that British commerce has been prejudiced because Whitehall, having little insight into technical mysteries, could see nothing in the communication services but a possible source of revenue. In mixed metaphor, 'the goose that laid the golden eggs was milked of its last drop of blood.' Now the function of the Patent Office is not to produce revenue but to foster new industries by giving to capitalists and investors a justifiable feeling of confidence in the security of British patents. Will it be deprived, as the Post Office was, of the means for carrying out its new duties efficiently?

* NATURE **116**, 121, July 25; 157, Aug. 1; 1925.

Brighter Babies

An Outline for Boys and Girls and their Parents. Edited by Naomi Mitchison. Pp. xi+916. (London: Victor Gollancz, Ltd., 1932.) 8*s.* 6*d.* net.

IF the plethora of encyclopædic outlines published during the past decade is a welcome indication of a growing demand for scientific knowledge, it is doubtful whether it shows a widespread understanding of what the scientific outlook is. It is still more doubtful whether many of their authors are capable of communicating the scientific outlook in the way which Kelvin, Tyndall and some of the foremost expositors of the nineteenth century attempted to do. The prevailing fashion in scientific exposition is to conduct a Cook's tour round the outer and most thinly peopled fringe of the universe of science, leaving the holiday-maker in complete ignorance of the populous cities and well charted roads of the older countries. The practice of doing so has partly arisen because scientific writers who are in a muddle themselves find it helpful to explain their difficulties to a sympathetic and appreciative, if somewhat bewildered, audience. The audience knowing nothing of the vast territory of experimental knowledge which lies behind the proliferation of contemporary hypotheses is fitly impressed. The man of science takes the place of the priest and the successful magician. Kelvin's way was different. His addresses are no spectacular display of the latest and least digested marvels of science. He could be content to select a few of the more homely and firmly established truths of science, leading his audience up to the table and showing them that there is a real rabbit in a quite ordinary hat. As all conjurers know, mystification is more remunerative than straightforward explanation. Publishers have discovered the same truth. For those who enjoy the thrill of being mystified Mrs. Mitchison's collection of contributions from twenty-three authors will provide a powerful magic.

This does not mean that the book is without merit. To avoid confusing the persons it is necessary to divide the substance. Only a third of the book is devoted to natural science. An outline of all human knowledge in nine hundred pages for children and parents alike might conceivably attempt three tasks. One is to communicate to the adolescent what the scientific outlook involves. One is to awaken in the child an intelligent recognition of social obligations. A third and necessary evil, since it is what most publishers prefer to print, is to provide gossip for adults who move in circles where it is fashionable to talk most about what is least understood. The latest undertaking of Messrs. Gollancz strives to fulfil all of these. John Pilley contributes a sensible statement about the nature of scientific laws for those who already know what scientific laws are. Olaf Stapledon discusses (with refreshing sanity) the chaos of a world which is rushing from one financial crisis to another. Dr. Strauss illustrates what he means by psychology with the assistance of a picture in which the human mind is made to look like an iceberg. The illustration is reminiscent of the visions of St. Hildegarde and the text is the spiritual co-twin of the tableau.

Of the three parts into which the book is divided the middle one, dealing with civilisation, is most clearly written for children by writers who have some conception of how much a child of average intelligence can digest. Parents who sympathise with the sane and generous perspective of the contributors will think that the book is well worth buying for the sections by Margaret Cole, Lancelot Beales, Gerald Heard and Olaf Stapledon. Hugh Gateskill is to be congratulated upon having written an intelligible account of money. Those who want their children to grow up with a red blooded 'he-creed' need not be discouraged. They can turn to an earlier article in which eugenics is expounded as the belief that "it would be better if the most successful people had most children". Taken as a whole, the book is too well balanced as a commercial venture to be wrecked by the social intelligence of those who contribute to the second part. The third division illustrates the thesis of some of the articles in the second by showing how intellectuals create the demand for the commodities which they wish to sell.

The first part, which covers the whole of natural science in three hundred and eighty-five pages, raises the greatest expectations. There is no difficulty in deciding which parts are intended for children and which for their parents. The biographical sketches at the beginning of each article are suitable for a backward and ailing child of eight. What follows can sometimes be understood by a university graduate. Among those who have no practical experience of education it is a common delusion that intrinsically

difficult intellectual tasks are somehow facilitated by baby talk. So we read that Richard Hughes "can invent wonderful games. He is rather younger than *me* and has very bright blue eyes" (italics inserted). A few pages later this occurs:

"There are three Pure-Number-Ratios. The simplest is $\frac{M}{m}$: the ratio, that is to say, of the mass of the proton to the mass of the electron (it is about 1,750 times as big). The other two are more complicated: $\frac{2\pi e^2}{hc}$, called the 'fine structure constant', and $\frac{e^2}{GM^2}$ which compares the electric and gravitational forces between two protons."

If scientific knowledge is nothing more than verbal assent to a religious creed or an artistic dogma, the scientific part of Mrs. Mitchison's anthology is above criticism. Parents who live in the suburbs will find in it all the passwords they require, when they visit their relatives in Bloomsbury. If scientific knowledge is an understanding of the path traversed in the process of discovery, it is a monument of educational blunders. It is a verbal statement of the latest conclusions of scientists divorced from the practical basis of any well-established scientific truth. In other words, it magnifies all the defects of science teaching in the school. The chief defects of science teaching at present reside in failure to arrange the subject matter presented in stages adapted to the logical equipment of the learner and failure to adapt the logical technique which the learner acquires in the study of mathematics to the scientific problems which emerge in the laboratory. At present the divorce between symbolism and experience is so grotesque that a constructive educationist would welcome the opportunity of contributing to an outline from which a child might learn good reasons for persevering in some of the apparently useless tasks presented by the school curriculum.

The naturalistic portion begins with an all too short historical survey by Dr. Singer and his wife, followed by two intelligible chapters upon biology. Biology is split into two sections called physiology and biology, as if the latter did not include the former. Chemistry follows. After that there is a section upon mathematics, physics and astronomy treated together. For this order of treatment much might be said. Modern chemistry has some of its roots in the study of respiration. So has the generalised doctrine of the conservation of energy. The study of the constant relation between chemical output and animal heat in the experiments of Laplace and Lavoiser might lead naturally to the search for some measure of mechanical activity with a definite relation to heat production. This opens a safer experimental route to the notion of work than the traditional method employed in teaching mechanics to pupils without a knowledge of the calculus. Adopting this approach, the instructor might be congratulated if a fairly bright child of fifteen succeeded in carrying away a clear understanding of what energy means and why we believe in the atomic structure of matter. Few, if any, with practical experience of education would hope to surpass an achievement so praiseworthy.

The contributors to this "Outline" have other ambitions for their children. These bright babies—bless them—can grasp in two pages that atoms exist. Then they plunge into X-ray analysis and are soon wallowing in "energy-levels". The brighter babies have no difficulty in polishing off energy levels. They already knew all about energy before they read the book. It was not necessary to insult their intelligences by explaining what energy is. So they can trip lightly on to residual forces (p. 296). They reach the Michelson-Morley experiment on p. 314, and pause five pages later to study the implications of Planck's constant. This offers no insuperable obstacle. "John Pilley has told you that the electrons belong in energy levels." Refreshed with a little baby talk they can face the Cepheid variables on p. 335 and digest the Fitzgerald contraction on p. 340. Leaving on one side the Arithmetic Continuum on p. 354, while noting that "π can never be the solution of an algebraic equation", they toy awhile with imaginary numbers. The theory of a complex variable is expounded off on p. 354. After that they are ready to sleep peacefully upon Cantor's unresolved paradox of the last of all transfinite numbers. This takes up the greater part of p. 355.

If this is what the children of the most "successful" people can really understand, there is something to be said for eugenics. A scientific editor equipped with a good knowledge of the history of mathematics and a modest recognition of the fact that education is a skilled job, might have made a constructive contribution of great importance to the task of reforming present methods of science teaching in the school. Instead, the articles

which deal with the physical and mathematical branches of modern science in this outline can only add to the number of children who think that algebra and geometry are mysterious and terrifying branches of poetry with no applications to everyday life. The scientific articles represent a conception of education which is the consistent outcome of an idealistic orientation. For after all, the materialistic outlook, as one much abused philosopher of the nineteenth century remarked, is "the unity of theory and praxis".

LANCELOT HOGBEN.

Elementary Modern Physics

(1) *Electrons and Waves : an Introduction to Atomic Physics.* By Prof. H. Stanley Allen. Pp. viii + 336. (London : Macmillan and Co., Ltd., 1932.) 8*s.* 6*d.*

(2) *Matière et atomes.* Par Prof. A. Berthoud. (Encyclopédie scientifique : Bibliothèque d'histoire et de philosophie des sciences.) Deuxième édition revue et augmentée des "Nouvelles conceptions de la matière et de l'atome". Pp. vii + 324. (Paris : G. Doin et Cie, 1932.) 26 francs.

(1) A SHORT book like this on modern physics, sufficiently technical to make it of use as an introduction to advanced work for a university degree, but easy enough to be comprehensible for more general readers, has been wanted for some time. Its plan is to show the development of those parts of physics which are now of special interest, from ancient times, but to do little more than refer to the older work, and to give quite full accounts of certain aspects of current and recent research. In this way, the interest of the history of the subject has not been entirely lost, but the interconnexions of various parts which have only recently appeared have been kept continually to the foreground

The ground covered is atomicity, relativity, radioactivity, and the old and new quantum theories. The detail presented can be gauged from the index of sixteen pages of small print, but the charm of Prof. Allen's style is such that after reading the book, the fact that it contains so much comes as a surprise. The book is based on lectures delivered in the University of St. Andrews, and the last chapter, a summary of the others, contains the substance of a supplement to NATURE for Dec. 8, 1928. Illustrations are numerous and well-chosen.

One naturally inquires how far Prof. Allen has met in advance the problems which this work presents to a careful reader approaching it for the first time. This he appears to have done unusually well, very largely by introducing a number of apposite quotations from other authors, some of considerable length. In connexion with the general theory of relativity, one notices that the fiction of the freely falling lift has again been employed ; this is not an entirely happy illustration, as the process to be visualised is not a common experience, and the whole difficulty with beginners at relativity is, as Prof. Allen realises, to obtain anything more than polite assent to the propositions. Could not the lift be replaced to advantage with something more vivid, for example, a falling aeroplane ? In the matter of general presentation, the only criticism which is offered is that perhaps insufficient stress has been put upon the extent to which physics advances through measurements of high precision —in particular, through the accurate work possible with comparatively simple spectroscopic apparatus ; some account of, say, H. N. Russell's work on the spectrum of titanium would not have been out of place, and, after all, the process of finding terms in a spectrum has more than a little in common with the solving of cross-word puzzles.

There is a misprint on p. 278, *l* being used for 1 in the table. On p. 193 there is some confusion, not serious, between the different forms of Geiger counters. Philosophers will also certainly quarrel with some of Prof. Allen's remarks and quotations, although to a physicist they are very interesting. These points are, however, trivial, and do not detract from the value of the book, which is likely to be widely read.

(2) The aim of this book is similar to that of "Electrons and Waves". It is the second edition of Prof. Berthoud's "Nouvelles conceptions de la matière et de l'atome" (1923), with a change in title to avoid the implication that it is chiefly concerned with the new quantum mechanics. This is dealt with in an additional chapter, and in all, about half the volume rewritten. Compared with Prof. Allen's book, it covers less ground, but is rather more pretentious mathematically ; there is less philosophy, but more space given to the properties of atoms which find expression in the periodic table, as is to be expected with the author a physical chemist. In style, Prof. Berthoud is more dogmatic than Prof. Allen, but still very interesting. The two books can well be read together, and, at the very lowest estimate, Prof. Berthoud's is a good introduction to French scientific literature.

K. G. E.

The Place of Origin of Yellow Fever

Yellow Fever: an Epidemiological and Historical Study of its Place of Origin. By Dr. Henry Rose Carter. Edited by Laura Armistead Carter and Wade Hampton Frost. Pp. xii + 308. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1931.) 26*s.* 6*d.* net.

THE history of yellow fever, notorious for the dramatic suddenness of its outbreaks, and for two centuries an ever-present terror to the crews of old sailing ships, and the coastal towns on both sides of the Atlantic, as might have been expected, has attracted the attention of many writers. Most of these histories, however, were written before the method of transmission of the disease had been discovered; consequently it was very desirable that these earlier accounts of epidemics should be re-examined in the light of more exact information as to the epidemiology of yellow fever. The early history of the disease has now been very carefully investigated by Henry Rose Carter, a well-known authority, who after retiring from the position of assistant surgeon-general in the United States Public Health Service, devoted the last three years of his life to this subject. At his death in 1925, the present work had been fully drafted, but it has been prepared for publication, with some additions, by L. A. Carter and W. H. Frost. The result is a fascinating account of a subject interwoven with the early history of all maritime nations, since yellow fever is essentially a disease of seaports and ships.

The first part of the book is devoted to the epidemiology of the disease, including recent work on the subject; the second part to maladies which have, or might have, been confused with yellow fever in the past; and the third, and greater part of the book, to the place of origin of yellow fever.

Spirochætal jaundice, or Weil's disease, is a serious omission from the long list of diseases that have been confused with yellow fever, since it has been mistaken for this malady up to very recent times, the most notable example of this error being the cases from which Noguchi isolated "*Leptospira icteroides*", the supposed causative agent of yellow fever. It is now clear that these must have been cases of Weil's disease, erroneously diagnosed as yellow fever, since the etiological agent of the latter has been shown to belong to the rapidly increasing group of filterable viruses.

The place of origin of yellow fever resolves itself into a discussion of the rival claims of the only two regions in which it is known to have become permanently endemic—tropical America and West Africa. Although many epidemics have been recorded in western Europe, since the first European outbreak in Cadiz in 1730, there is no evidence that the disease ever became permanently established in this region. The majority of writers in the past, with the notable exceptions of Sir James Kingston Fowler, Sir Robert Boyce and other members of the British West African Yellow Fever Commission, have generally assumed that yellow fever was introduced to the Old World from America, but in recent times evidence has been accumulating to show that West Africa is the original home of the disease. The author discusses the data on this problem under two headings, biological and historical. With regard to the former, it is pointed out that the West African negro possesses a certain tolerance toward the disease, in contrast with the American Indian, who is as susceptible as a white man. The main vector of the disease, *Aëdes* (*Stegomyia*) *aegypti*, has no near American relatives, but many in Africa, a strong argument in support of the view that the yellow fever mosquito was originally an African species, which has been carried in ships to all parts of the world where favourable breeding places and suitable temperatures were present.

The historical evidence is next considered and includes the most interesting chapters of the book. Starting with the assumption that the disease, together with the transmitting mosquitoes, was carried across on ships travelling between West Africa and tropical America, it is shown that a brisk slave trade sprung up between these two regions soon after the discovery of America, for although the first general licence for this trade to the Spanish Indies was not issued (by Charles V) until 1516, already in 1503 the Governor of Hispaniola, Ovando, complained that too many negroes had been admitted for good order. The author then examines the early Mexican records, contained in the hieroglyphic manuscripts or codices, and the writings of the earlier Spanish historians, and shows that, from the symptoms, the epidemics described among the ancient Mexicans could not have been yellow fever, a view supported by the absence of any disease of this nature from the earlier Spanish troops. The Maya records also provide negative evidence for the 120 years previous to 1648, when the first known epidemic of yellow fever in America occurred in Yucatan

and the French Antilles, followed in 1686 by an epidemic in Bahia.

By excluding the presence of yellow fever from America until after 1648, West Africa is considered to be established as the place of origin, but the historical evidence concerning African epidemics is very incomplete. There have not been the same numbers of white settlers in West Africa as in tropical America, and an endemic disease of this nature might well have passed unnoticed among the numerous other diseases.

Nevertheless, the available historical evidence is consistent with the view, also supported by biological evidence, that the original home of yellow fever is West Africa and not tropical America. E. HINDLE.

Short Reviews

Allen's Commercial Organic Analysis: a Treatise on the Properties, Modes of Analysis, and Proximate Analytical Examination of the various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, etc. Vol. 9: *The Proteins of Plants, the Proteins of Milk, Milk, Milk Products, Meat and Meat Products.* By the Editor and the following Contributors: D. Jordan Lloyd, G. D. Elsdon, H. Leffmann and John Golding, E. R. Bolton, C. Robert Moulton. Editor: Dr. C. Ainsworth Mitchell. Fifth edition, revised and partly rewritten. Pp. ix+617. (London: J. and A. Churchill, 1932.) 32*s.*

IN the previous volumes of this comprehensive work, the general aim has been to deal with separate branches of chemistry in a particular volume. Thus, such subjects as sugars, starches, soaps, explosives, essential oils, etc., require less than one volume each, for their detailed study. The subject of protein analysis, however, receives much wider consideration. The proteins generally have been dealt with in the eighth volume and in the present volume of 600 pages the whole book is given over solely to the examination of proteins of plants, milk and meat. This will necessitate the issue of a new volume for special subjects, such as hæmoglobin, albuminoids, structural proteins, etc.

The detailed and specialised information on protein analysis and related subjects given in the volume under review is more exhaustive and the references more complete, than that in any work of a similar nature hitherto published in English. The most recent methods of analysis are given, especially in the sections on milk and meat products, and special emphasis is placed on methods of practical importance.

The work as a whole is remarkably free from errors and the revision has been thorough and accurate. The high standard of the earlier volumes is being maintained. J. REILLY.

Comparative Ethnographical Studies. Edited by Erland Nordenskiöld. Vol. 9: *Origin of the Indian Civilizations in South America*, by Erland Nordenskiöld; *An Arrow Poison with Cardiac Effect from the New World*, by C. G. Santesson; *The Ancient Peruvian Abacus*, by Henry Wassén. Pp. iv + 205. (Göteborg: Göteborgs Museum; London: Oxford University Press, 1931.) 18*s.* 6*d.* net.

IN this volume of the "Comparative Ethnographical Studies" the main theme, both in respect of the space it occupies and of significance, is the question of diffusion versus independent origin in America. Baron Nordenskiöld examines the Indian cultures of South America in detail with the view of determining how far they have been introduced *ab extra* and how far they have developed on the spot. By means of tables of geographical distribution, he shows that certain elements—a considerable number in fact—have a sufficiently wide range from the north of North America to the extreme south of the southern half of the continent to be regarded as belonging to a basic Indian culture. The variations in South American Indian cultures are, he holds, developments in response to local conditions, for example, the cultures of the tropical belt. Certain elements are distinctive of American culture and must be regarded as local. Such, for example, are the cultivation of domesticated food-plants peculiar to America, and metal working.

The author sets aside, as outside his province, the resemblances which Dr. Rivet sees between the languages of Melanesia and America; but as regards cultural affinity he argues that any introduction from Oceania must be extremely remote, as it must have preceded the introduction into the Pacific of sugar-cane, the banana, fowls and pigs. The argument is supported by a body of detailed evidence which cannot fail to carry great weight.

The Principles of Epidemiology and the Process of Infection. By Dr. C. O. Stallybrass. Pp. xii + 696. (London: George Routledge and Sons, Ltd., 1931.) 30*s.* net.

THIS book, by the chief assistant medical officer of the City and Port of Liverpool, represents an ambitious effort to link up the observational data of epidemiology as closely as possible with the basic facts and theories of immunological science. It contains nearly seven hundred closely written pages interspersed with numerous charts and tables and displays wide and catholic reading on the part of the author, as the bibliography at the close of the book testifies. The wealth of detail with which certain portions of the book dealing with periodicity in disease, statistical studies and methods of prophylaxis are furnished, will prove most useful to interested readers, as such data are not too readily accessible.

We doubt, however, whether the author was wise in attempting to assemble and evaluate the immunological data appropriate for his purpose without the critical aid that only first-hand know-

ledge and experience of the science of immunology can supply. As they stand, the chapters dealing with the basic data must give a somewhat confused picture to health officers to whom the book is chiefly addressed, and to the bacteriologist some feeling of irritation at the mishandling of his archives. In spite of these faults, the book is a veritable mine of information on epidemiological data of every kind and will, we are sure, prove a highly appreciated work of reference. Misspellings, particularly of proper names, are unfortunately rather numerous.

Airgraphics. By Alexander McAdie. Pp. 37 + 7 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1931.) 12*s.* 6*d.* net.

PROF. MCADIE has brought together a number of physical formulæ and conversion tables of interest to meteorologists. There are also diagrams showing various relationships such as that between temperature and height up to a height of about 25,000 metres in different latitudes in summer and winter. But the value of the work must surely be reduced by the absence of a table of contents and of both preface and index. The absence of a preface makes the task of the reviewer a difficult one, the exact purpose of the work being a matter of conjecture. Matters would not be so unsatisfactory if the diagrams were self-explanatory. Fig. 2 is entitled "Kilobar, Kilograd and Kilometer Scales"; there are three curves labelled "pressure", "density" and "temperature"; these words also appear against the horizontal axis, while "kilometers" appears against the vertical axis. The curve for temperature bears no resemblance to average or individual curves for temperature and height in the earth's atmosphere, which seems to negative the idea that the kilometres are heights. The meaning of the figure is a mystery.

The letterpress begins abruptly on an un-numbered page with a long quotation from Shaw's "Manual of Meteorology", followed by a few comments on this quotation. With the next page a comparatively consecutive narrative begins under the heading "Simplifying Symbols"; suggestions are made as to what symbols should be used in meteorology, and numerous conversion tables and physical formulæ follow. The title of the work is not a good clue to its contents, for whereas eighty per cent of it is occupied with these last items, there is no discussion of graphical methods of presenting upper air relationships and the graphs are its weakest feature. E. V. N.

Constitution of Atomic Nuclei and Radioactivity. By G. Gamow. (The International Series of Monographs on Physics.) Pp. viii + 114. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 10*s.* 6*d.* net.

MR. GAMOW leaves one with a curiously unsatisfied feeling, for in no instance has the quantum theory of the nucleus, his main theme, solved any of the problems encountered with the finality—fictitious, perhaps, but nevertheless apparent—that it has attached to so many other aspects of atoms. The lack of success increases as one moves inwards. Well away from the nucleus, the α-particles and nuclear β-particles and γ-rays are almost old friends with regular habits; the potential barrier which they have to traverse to gain their freedom is also fairly well understood in general terms; but the region within this where they have their origin, which can be studied mainly only by its essentially abnormal conduct when it disintegrates, is largely *terra incognita* still.

Mr. Gamow's book has three principal objects. First, it provides a summary of those results of experiment which are likely to be of the greatest significance in the development of the theory, which proceeds more or less concurrently. In this choice there is naturally a certain amount of individual opinion, but it is doubtful if the selection could have been made better. Evidently much more information is required to test the theory as far even as it has been taken, but it may be confidently expected that recent improvements in technique and the complete working out of the intrusion of optical spectroscopy will provide this before long. Secondly, it develops the initial ideas of Gamow, and of Gurney and Condon, on the properties of the potential barrier, particularly those which are connected with the Geiger-Nuttall law of α-particle ranges; and lastly, and it is here that it is specially important, it contains an examination of the relations likely to exist between the main types of nuclear radiations, both spontaneously and artificially excited, on certain hypotheses, the most fundamental of which is that the extra-nuclear quantum mechanics gives an indication of what may be expected to occur internally.

Mr. Gamow has had the assistance of Miss B. Swirles in the preparation of the English manuscript; the result is a well-written and interesting production, the main faults of which are the absence of an index and of references to other theoretical work.

Microbes and Ultramicrobes: an Account of Bacteria, Viruses and the Bacteriophage. By A. D. Gardner; with an Appendix by G. R. de Beer. (Methuen's Monographs on Biological Subjects.) Pp. viii + 120. (London: Methuen and Co. Ltd., 1931.) 3*s.* 6*d.* net.

DR. GARDNER has added another good biological book to this excellent series. He does not attempt to deal with the whole of microbiology but, after a rather scrappy chapter on the structure and functions of bacteria, he gives good and stimulating accounts of bacterial variation, the ultramicroscopic viruses and the bacteriophage, as up to date as any version of these moving topics can be and adapted for the general biologist as well as the technical specialist. There are a few mistakes; for example, distemper vaccine is not made in guinea-pigs (p. 65). Mr. de Beer adds an appendix pointing out the analogy between genes and viruses.

The Explanation of Animal Behaviour

By REX KNIGHT

PROF. LLOYD MORGAN long ago formulated the principle that "we should not regard any instance of animal behaviour as the outcome of higher mental processes, if it can adequately be interpreted as the outcome of mental processes which stand lower in the order of mental development". This principle is but a special application of the canon of parsimony, which must be obeyed in all scientific explanation ; and, when logically extended, it imposes upon us the duty of inquiring, in the first place, whether animal actions must be ascribed to any mental processes at all.

It happens, however, that, if we openly pursue this inquiry, we run the risk of being misunderstood ; for many people will wrongly suppose that in suggesting a non-mental explanation of animal behaviour, we are thereby questioning the existence of animal minds. In my much-discussed communication to the British Association at York, for example, I criticised the view that some animal actions cannot be accounted for unless we regard them as caused by the animal's mental experiences ; and, in effect, I suggested that the view is unjustified. This was my sole aim, and (since to question whether A is necessary to the explanation of B is not to question whether A exists) it did not imply that there are no animal minds. Moreover, to guard against misunderstanding, I was careful to state, both at the beginning and at the end of my paper, that it is probable, on evolutionary grounds, that animals have mental experiences corresponding to their neural organisation. Nevertheless, I was widely misunderstood, and the general discussion, which newspaper reports of my remarks has aroused, has mostly proceeded on the mistaken assumption that I questioned or denied the existence of animal minds.

Let it be clear, then, that when we inquire whether animal actions can be explained in non-mental terms, the question is not whether animals think, but whether their thoughts must be held to affect some of their actions. What we are asking is this : Even though there be animal minds, must we ascribe causal efficacy to them in order to explain how animals act ?

When the layman seeks to produce some animal action, which, in his view, cannot be explained in non-mental terms, he is apt to refer, first of all, to examples of the differentiation that animal behaviour often exhibits. He tells of the cat that will sleep only on one particular cushion, of the dog that attaches itself more to one person than to others, or of some other animal whose behaviour is differentiated. Sir Edward Headlam, for example, wrote to the *Times* (April 5) about a hunter that neighed whenever it saw a pink hunting-coat ; and in the same journal (Sept. 24) Mr. H. Boyd Collins told of a dog, which, when its master imperfectly simulated grief, acted in a way in which (so ran the suggestion) it would not have acted if the simulation had been complete. It is urged that in all these cases the animal 'knows', and that its behaviour must be ascribed to conscious discrimination.

This conclusion, however, is unwarranted. The fact that an animal responds differently to two different stimuli may not be due to the animal's having mentally distinguished between them. A wireless set will respond differently to different wave-lengths ; a flower will respond differently to light and to darkness ; a decapitated earthworm, confined in a T-shaped tube, will keep away from that branch of the T which gives it a mild electric shock ; and, if we put a drop of acid on a spinal frog, the brainless creature will scratch just the spot that we touch—and, if we increase the strength of the acid, it will scratch correspondingly harder. Since in none of these cases is there any question of mind, it is clearly illicit to argue that differentiation in behaviour must always be due to conscious discrimination.

A second group of actions, the explanation of which is said to require reference to animal minds, comprises those that are sometimes ascribed to animal memory. Under this head we hear of the cat that purrs when its mistress comes home after a holiday ; of the (authentic) elephant that deluged the man who had given it, six weeks before, a sandwich with much cayenne pepper ; and of the dogs, referred to by Miss Katherine Buck in the *Morning Post* (Sept. 9) whose death followed, and seemed to be caused by, the previous death of their mate or their master.

But 'memory' is an ambiguous word. We can remember what we did last Sunday, and this kind of memory does involve the mind and conscious recall. We can also remember how to skate or to swim, and here the mind need not enter at all—by saying that we 'remember' we mean merely that the results of certain past behaviour have been enregistered in our bodily system, or (in Pavlovian language) that certain of our inborn reflexes have been interlinked or otherwise conditioned by our environment. Now, no one will dispute that many animal actions are due to memory, in the second, non-mental sense. But can we be reasonably sure that, as Prof. Lloyd Morgan and Sir Arthur Thomson believe, animals enjoy conscious recall ? Even if we can be sure of this, are there any animal actions which must be attributed to conscious recall rather than to its physiological counterpart ? Clearly, the cat's purring on the return of its mistress demands no such explanation. It can be adequately accounted for by the purely physical traces which the cat's previous association with its mistress has left in its nervous system ; and the same may be said of the vindictive elephant. Nor does the death of a dog as the result of the death of its mate or its master need to be ascribed to any mental

experience. After all, a dog will not long survive the absence of food; and, granted that the food-stimulus is one that the dog innately needs, surely the stimuli provided by mate or master may become acquired or conditioned necessities. What affects the bereaved animal may be, not the recollection of past events, but just the absence of the mate or the master from its present environment.

A third group of animal actions, which, it is said, must be due to mental experiences, contains those that arise in connexion with animal learning. Animals, of course, can be trained. Sheep-dogs, horses, elephants, and other animals, are being trained every day; and, under experimental conditions, there has been (to mention only a few examples) the training of Möbius's pike, Yerkes's turtles, Sackett's porcupines, Thorndike's cats, and a large number of colonies of maze-threading rats. But, great as is the practical and theoretical value of animal training, does it anywhere provide us with facts that require the ascription of causal efficacy to animal minds? The training in each case seems clearly to consist in that modification, or conditioning, of the animal's inborn responses which does not demand explanation in other than physiological terms. It exhibits the gradual elimination of wrong responses (wrong in relation to the particular training concerned), and the organisation of right responses into larger and larger units. But it does not necessitate retrospection or any other experience in the animal's mind. There is no need to hold that Pavlov's dogs, when they salivated in response to the ringing of a bell, must have been consciously remembering those earlier occasions when the ringing of the bell had been accompanied by the giving of meat; and all other animal training, being but an extension of this simple case, is similarly explicable in non-mental terms.

Animals, however, do not learn only when they are trained by human beings. They also learn, as we say, 'on their own'. These two forms of learning are, to be sure, not radically different. In both the animal's learning consists in the changing of its behaviour under the influence of environment, and the only distinction between them is that in the first the environment is more controlled by man than it is in the second. Still, it is useful to separate the two forms, for it is when animals learn 'on their own' that the efficacy of their minds is said to be especially obvious.

Many British Association critics of my paper have brought forward examples of this kind of learning. The *Times* has published letters from Mr. C. H. Roberts, who described (Sept. 29) how a dog, finding no one at home to fill its water-bowl, carried the bowl to the house of a neighbour; from Mr. Gilbert Coleridge, who told (Sept. 23) how a pony learned to lift a gate off its hinges; and from Lieut.-Col. W. Bunbury, who gave an account (Sept. 21) of a Cairn terrier's feints. Moreover, both in the *Morning Post* (Sept. 6) and in the *Veterinary Record* (Oct. 1), Sir John Moore described how he fell one day in the hunting field and was hung up by the stirrup between his horse's legs, and how the horse stopped twenty or thirty yards from the fence and put its off hind-leg beside him.

Now, in all these cases we may accept the recorded facts without accepting the view, dogmatically laid down in each instance, that they can be due to nothing but animal reasoning. For my part, before accepting any such view, I should require to know much about each of the examples put forward—more facts about the reported occurrence, and about the past behaviour of the animal concerned. Nevertheless, I would say, even now, that the action of Sir John Moore's horse was not indisputably due, as he supposes, to "reason, memory, and other attributes of mind". The stopping of a horse, whose rider has become suspended between its legs, can quite well be explained in terms of reflexes; and I think a similar explanation would suffice in each of the other cases that have been brought forward.

If I seem here to be over-cautious in regard to the efficacy of animal minds, I have at least two reasons for my parsimony: first, there is abundant evidence that brainless animals can profit by experience—that even the naturally ganglionless starfish learns; secondly, my own observations of animal behaviour, both inside and outside the laboratory, have shown me how easy it is for animals to acquire an undeserved reputation for mental characteristics. In my Department in the University of Aberdeen, we have been making careful observations of animal learning under controlled, experimental conditions. In one of our experiments we observed the behaviour of cats learning to get out of a box which could be opened from the inside only by pulling a stirrup. Most of the cats did learn to pull the stirrup; and one in particular earned a great reputation for intelligence among visitors by the speed with which, after a time, it opened the box and got to the milk that was waiting outside. These casual visitors naturally supposed that the cat pulled the stirrup because it had consciously grasped the fact that its action would open the door. Such a supposition, however, must be discounted in view of the fact that, when the stirrup was moved, the cat still clawed the air in the place where it had been—and that, when placed beside milk outside the open box, the cat would often not touch it until it had needlessly run into the box and pulled the stirrup.

It seems, then, that, when we consider the main groups of animal actions which are said to be caused by animal minds, we find none which is clearly incapable of being explained in non-mental terms; and this was the view that I sought to express and to argue at York.

One word in conclusion. Some of my critics, notably Mr. Gilbert Coleridge (*Times*, Sept. 9) and Sir John Moore (*Veterinary Record*, Oct. 1), condemn the observation of animal behaviour under experimental conditions. In a scientific journal there is no need to rebut so perverse a

view ; but I would make just two comments upon it. First, under experimental conditions we can observe the genesis of any particular action, and so avoid those false inferences to which observation of the action by itself might naturally lead. Secondly, under experimental conditions we can compare the behaviour of normal animals with that of spinal or decerebrate preparations, and thus test such mistaken assumptions as that mind is required in order that an animal should respond differently to different stimuli, or be modified by its environment.

Sir John Leslie, 1766–1832

By Prof. D. F. FRASER-HARRIS

THE centenary occurs on November 3 of the death of Sir John Leslie, mathematician and physicist. Leslie was a native of the small town of Largo in Fife, where his father, a most intelligent man who had come from the neighbourhood of St. Andrews, was a cabinet-maker. Leslie's mother's name was Carstairs. When only thirteen years old, John was sent to the University of St. Andrews to study for the ministry of the Church of Scotland, but after six sessions there and one or two years at Edinburgh until 1787, he gave up the idea of the Church and devoted himself to the study of his favourite mathematics. His paper on "The Resolution of Indeterminate Problems" had the honour of being admitted to the *Transactions of the Royal Society of Edinburgh* when its author was as yet in his twenty-second year.

In 1793 appeared Leslie's translation of Buffon's "Natural History of Birds" in nine volumes which he had made for John Murray.

Unsuccessful as a candidate for a chair first at the University of St. Andrews and then at the University of Glasgow, Leslie retired to Largo, where he carried out these experiments which, when published in 1804 as "An Experimental Enquiry into the Nature and Properties of Heat", made his name famous throughout the world of science. In this now classical research, he employed his famous cube to study the relative absorptive and reflecting powers of a large number of materials. The 'differential thermometer' which he had devised some years earlier was now found exceedingly useful. This instrument has been described by an enthusiastic admirer as "one of the most beautiful and delicate that inductive genius ever devised as a help to experimental enquiry". The essay of 1804 won for Leslie the recognition of the Royal Society, the Rumford Medal of which was awarded him in 1805.

In the same year, Leslie was a candidate for the chair of mathematics in the University of Edinburgh, vacant through the translation of Playfair to that of natural philosophy. Leslie, whose testimonials included one from Sir Joseph Banks, was vastly better qualified in science than his only opponent, a minister of Edinburgh ; but the clergy, professing to see in his essay 'an infidel note' because he had quoted approvingly some remark of Hume on cause and effect, opposed in the most vehement manner his election to the chair. All intellectual Scotland was in a state of ferment ; the case was argued for two days before a court consisting of 180 members and by a majority of only 12 at midnight on the second day was Leslie acquitted of heresy (May 1805).

In 1809 Leslie published his "Elements of Geometry" which saw four editions. In the following year he succeeded in freezing water by artificial evaporation. A quantity of water was placed alongside some sulphuric acid in the receiver of an air-pump from which the air was rapidly removed. This diminution of pressure caused a vigorous evaporation from the water, the vapour being taken up by the acid as fast as it was produced. Leslie's evident joy at seeing the crystals of ice forming in the water has been testified to by an eye-witness. Leslie is therefore the 'father' of refrigerators and all manner of appliances for producing low temperatures. Most of the pieces of apparatus used in these researches were made by Leslie's own hands, and are now carefully preserved in the University of Edinburgh.

In spite of having made these fundamental discoveries in the science of heat, Leslie believed to the last in the objective existence of cold, and, in expressed opposition to Wells, held that dew was the result of "cold pulsations from the azure sky".

In 1819, on the death of Playfair, Leslie was elected to the more congenial chair of natural philosophy.

Clerk Maxwell has told us that Leslie was the first to give the correct explanation of the rise of liquid in a narrow tube by capillary attraction.

Leslie, who had travelled widely and read as widely, was in 1820 elected a *correspondant* of the Paris Academy of Sciences. He was the author of a large number of essays on mathematical and physical subjects, one of the most valuable of which was his "History of Mathematical and Physical Science during the Eighteenth Century" in the seventh edition of the "Encyclopædia Britannica".

Probably Leslie's most celebrated student was Thomas Carlyle, whose ticket, duly signed for the class of mathematics, may still be seen in the Carlyle House, Cheyne Row. Leslie had a high opinion of Carlyle's mathematical powers, and he helped him to his first appointment (1814) as teacher of mathematics in Annan Academy.

In 1832, on the recommendation of Brougham, Leslie was created a knight of the Guelphic Order by King William IV in the illustrious company of William Herschel, Charles Bell and David Brewster.

As a bachelor of frugal habits, Sir John had an income much in excess of his needs so that he was enabled to purchase the estate of Coates near

Largo, to which he used to retire in the long vacation.

In person Sir John Leslie was of short stature and very corpulent, with protruding upper teeth, of florid complexion and rather deaf. In spite of these defects, it was a weakness of his in middle life to imagine himself both young and handsome. In keeping with this purely personal opinion, he dyed his hair. Unfriendly observers have related that, as his knowledge of chemistry was not so intimate as that of physics, the colour turned out to be purple. Sir John at times could deal with a very substantial meal, for it is recorded that in some sort of dietetic contest, he ate two pounds of almonds and raisins at the close of dinner. Another of Sir John's failings was distrust of the medical profession, so that he succumbed to the results of a neglected chill brought on by a severe wetting and complicated by erysipelas on November 3, 1832.

A caricature of Leslie is to be found in the well-known "Kay's Portraits"; and a copy of the bust by S. Joseph has been placed in the National Portrait Gallery at Edinburgh.

Statistical Methods in Industry

THE conception of the ordinary business man, whether in England or the United States, of the function of statistics in industry is generally a vague one. To many the word means no more than lists of figures open to various interpretations, while few have realised that the essential element lies not in the figures but in the science of their analysis. Marketing, costing, advertising, adjusting output to anticipate fluctuations in prices and demand, and recently studies in industrial psychology, have become recognised fields for the statistician. But the link between the methods of statistical analysis and the problems of the engineer, that is to say, of the man who is concerned with the efficiency of methods of production and the quality of the thing produced, has up to the present been very little realised.

Yet when dealing with mass-production industry, the scientific method of investigation is essentially the statistical method. For whether the manufacturer is concerned with the diameter of a shaft, the strength of cotton thread or the resistance of electrical equipment, he cannot succeed in producing exactly the same article again and again; and any attempt to analyse this variation in order to locate and if possible remove some of its causes, must be based on statistical technique.

Dr. W. A. Shewhart, of the Bell Telephone Laboratories, who visited London in May to give three lectures at University College on the "Rôle of Statistical Theory in Industrial Standardization", is chairman of a committee on the development of statistical applications in engineering and manufacturing, sponsored jointly by the American Society of Mechanical Engineers and the American Society for Testing Materials. He has been largely responsible for the development of this work in the United States, and his presence in England provided just the opportunity that was needed to bring together men in different fields who had begun to realise the importance of this work in England. An immediate development resulted when the British Standards Institution called to a round table conference representatives from several engineering groups, societies and research institutes. At this meeting a small committee was appointed under the chairmanship of Mr. B. H. Wilsdon, of the Department of Scientific and Industrial Research, Building Research Station, to investigate the whole problem from the point of view of standardisation and specification. This Committee is preparing a report which will include a pamphlet intended to serve as an introduction to the subject for manufacturers and others faced with these problems. Similar action, it is understood, has been taken in Germany by the Deutscher Normenausschuss.

It is true, of course, that for a number of years individual firms have here and there made use of statistical theory in laying out efficient research programmes to improve the quality of production, or to establish sampling plans to reduce the cost of inspection; but there has been little contact between those interested on these lines. The practical worker has not fully realised the potentiality of the statistical tool, nor has he had any opportunity of discovering how similar problems have been dealt with in the research institutes or factories of other firms in the same field or in other industries. At the same time, the mathematical statistician has not understood the lines along which theory could be developed most helpfully.

Recently in Great Britain Dr. Egon S. Pearson, of the Department of Applied Statistics at University College, London, has taken a leading part in an attempt to bring together those different interests. Dr. Pearson has not only made important contributions to the theory involved in this new field of practical statistics, but also has had the advantage of making a close study of its application to large-scale American engineering problems; while at the York Meeting of the British Association he contributed a paper on statistical methods in the quality-control of output, which attracted a considerable amount of attention.

The Biometric Laboratory at University College, with its position in London and its long tradition as a workshop of statistical tools, would appear to be admirably placed as a centre for the development of education and research in this particular field.

Obituary

PROF. KARL, RITTER VON GOEBEL, For. Mem. R.S.

THE death occurred on October 9 of Geheimrat Prof. Karl, Ritter von Goebel, professor of botany in the University of Munich, president of the Bavarian Academy of Sciences, and foreign member of the Royal Societies of London and Edinburgh, the Linnæan Society, and leading academies of Europe and America. Von Goebel was without question the most prominent exponent of plant morphology of his time.

Two extreme aspects of biological science may be distinguished, and they are often pursued with but slight relation one to the other: namely, the morphological, which concentrates upon the form of the object studied, and the physiological, which concentrates on function. But neither of these can attain full success without the other. The best results will follow from some middle position. This is the key to the botanical work of von Goebel's life, as it was also to that of his great master, Hofmeister. Neither of these was a plant morphologist in the narrower sense of the formalist. Both tried to arrive at a knowledge of form through experimental study of the living plant. Both pursued organography, being impelled to fathom the problem: How does conformation come to be? The morphology of the present day is no longer formal and idealistic, but organographic. The change was due in the first instance to Hofmeister, Sachs, and Herbert Spencer; as von Goebel himself remarks in the preface to the first edition of his "Organographie", dated 1897. A general presentation of this newer aspect of the morphology of plants within the pages of a single book has been the work of von Goebel himself. The completion of the third and greatly extended edition of his treatise has almost coincided with its author's death.

This event may be held as closing a brilliant chapter in the history of botanical science. The period which it covers opened in 1847, when Hofmeister, by profession a bookseller and publisher in Leipzig, completed his comparative studies on mosses and ferns, and made his results public. He first brought to light the fact that a common life-history underlies the development of them all, with regularly alternating generations, one sexual the other neutral. He later extended his synthesis to include coniferous trees, thus drawing together seed-plants, ferns, and mosses into a common scheme.

Soon after the publication of these wonderful studies, Hofmeister was appointed directly from his place of business to the chair of botany in the University of Heidelberg, and afterwards went to Tübingen. Such happenings were without parallel in the rigid academic system of the time in Germany. Among the latest of the pupils of Hofmeister in Tübingen was young Goebel, who thus received at first-hand the stimulus of the greatest master of his time in plant morphology. Afterwards he became assistant to Sachs in Würzburg, and to de Bary in Strassburg: from both of these he derived experience and skill in physiological and cultural methods. Thus equipped, by education of a mind prone to quick perception and of unusual penetrating power, Goebel soon made his mark in research, and received academic promotion. His first chair was in Rostock: after a brief tenure he was posted thence to Marburg, and in 1891 he was finally appointed to the University of Munich, where he remained for life.

Von Goebel's contributions to botanical literature were extensive and varied. A complete list of them up to 1924 was included in the "Festschrift", published in 1925 in celebration of his seventieth birthday, as a double volume of *Flora*, a journal which he himself had edited since 1889. His writings range in time from 1877 to the day of his death, relating chiefly to bryophytes and vascular plants. They are based upon his own observations and collections, made during his extensive journeys to both eastern and western tropics, and particularly to Java, and the Buitenzorg garden. They deal not only with material collected in the open, but also include the results of his cultures within the Munich garden, over which he had official control. His experiments, summarised in his "Experimentelle Morphologie der Pflanzen" (Leipzig, 1908), were directed mainly towards a knowledge of causality, and particularly to the elucidation of the effect of environment upon symmetry. Such inquiries he seemed to prefer above those leading directly towards phyletic conclusions. Indeed he always appeared to feel some mistrust of phyletic argument, and to prefer to search deeper into the causality of those features which are too often used as mere counters in facile comparison by students of descent. In this preference he will always have the sympathy of those interested in phylogeny who wish for sound conclusions rather than immediate results.

In 1924 von Goebel published a volume in celebration of the centenary of the birth of his master, Hofmeister. A translation was published in 1925 by the Ray Society (vol. 111), and reviewed in NATURE for October 2, 1926. Nothing that he ever wrote is more self-revealing than this small book. The former student, himself a professor of more than forty years standing, who had travelled in all quarters of the world, and possessed an exceptional knowledge of plants whether growing in the open or as subjects of experiment, gives a truly philosophical analysis of his teacher's work in the light of a later generation. The book is not a mere appreciation, but a critical review. The author does not hesitate to expose points where Hofmeister's earlier position does not accord with later aspects of the science. As remarked by the reviewer in NATURE, this feature, associated with an unusually penetrating mind, makes von

Goebel's volume a most valuable addition to philosophical botany.

The production of von Goebel's "Organographie der Pflanzen", with its three progressive editions, has been a very great achievement. So large a book is in danger of suffering from the wealth of its material. When a work runs to more than 2,000 large pages, with above 2,000 illustrations, there is a risk of its becoming encyclopædic, and of its use being as a book of reference rather than a work to be read directly through. This may be but a confession of weakness in the user. As a summation of the living morphology of the time, critically stated, von Goebel's "Organography" stands unrivalled, whether as the achievement of a single brain, or as an epitome of the work of a long life of intense activity, and of unusual opportunity. Nothing like it has appeared before in the literature of botany.

Von Goebel has been a *persona grata* in his frequent visits to Great Britain. This was due partly to his own personality, partly to the character of his work, and partly it was a consequence of his command of the English language. His first introduction to British readers as a body was through his revision of the systematic section of Sachs's textbook, the translation of which was published by the Oxford University Press, under the title of "Outlines of Classification and Special Morphology of Plants" (1887). This was followed by the translation of the first edition of his "Organographie der Pflanzen" (1900–1905), both being edited by Sir Isaac Bayley Balfour. These books readily reached the hands of advanced British students: but for those engaged in morphological research von Goebel's more special writings have been for more than half a century indispensable: not only have they provided a wealth of new facts, but they have also been more influential than those of any other current writer in shaping the course of morphological inquiry.

Prof. von Goebel was born in 1855, at Billighem in Baden. He was tall and robust in figure, but with a face that suggested gentleness of character, combined with a dreamy expression of the eyes. He was, however, firm in his opinions, and resolute in their support. Nevertheless his manner in controversy was restrained, and tinged sometimes with humour. This came out particularly in his use of well-chosen classical quotations, applied so as to soften the otherwise keen point of an argument. He leaves behind the memory of a gracious personality, to whom the science of botany owes a supreme debt not only as a great observer, but also as a safe guide to correct channels of thought. F. O. B.

Mr. A. Chaston Chapman, F.R.S.

Chemistry sustained a severe loss in the death on October 17, at sixty-three years of age, of Alfred Chaston Chapman, one of the remaining chemists of a type that is disappearing. A consulting chemist and public analyst with a large and important practice, up to the last he was indefatigable in the pursuit of his scientific studies, and this in spite of the many calls on his time arising from the public duties and the many voluntary services he undertook.

Chapman received his training in chemistry at University College under Williamson, and remained in close touch with that College when Ramsay succeeded as professor. While quite young he started for himself as a consulting chemist, specialising in the fermentation industries, and soon acquired a position which was enhanced by his published work. An excellent organic chemist, he investigated the constituents of the essential oil of hops, some of them in great detail, such as humulene, and applied the same methods to the identification of a new hydrocarbon (spinacene) present in large quantity in certain fish liver oils. In the domain of general analytical work he contributed many useful processes; he was alive to the application of new chemical reagents and methods, to which he devoted a lecture to the Chemical Society, and in this connexion strongly advocated setting up chairs of analytical chemistry in the universities, on account of the range of discipline and chemical experience afforded by that subject.

Equally interested in life processes—he never ceased to marvel at the "wonderful laboratory of the yeast cell"—Chapman devoted much time to mycological and bacteriological work, evolving processes which required this technique. Some of this he described in special papers and an account of his views on the industrial uses of micro-organism will be found in his Cantor Lectures before the Royal Society of Arts. These studies led him to advocate with his usual cogency the setting up of an Institute for Industrial Microbiology, in which would be carried on systematic research and training, together with the formation of a collection of pure cultures. Although this has not materialised, his advice as a member of the Chemistry Research Board of the Department of Scientific and Industrial Research was valued in connexion with a start that is being made towards the fulfilment of some of these objects. In 1920 he was elected into the Royal Society.

Many institutions sought the advantage of Chapman's sound judgment of men and things. Thus he had held the offices of president of the Institute of Chemistry, of the Society of Public Analysts, of the Royal Microscopical Society, of the Institute of Brewing, and he was vice-president and benefactor of the Royal Institution. Of his assistance to Governmental committees, examples are his membership of the Royal Commission of Awards to Inventors, the scientific panel of the Board of Trade, Advisory Committee of the Imperial Institute, and the Forest Products and Chemistry Research Boards of the Department of Scientific and Industrial Research.

Among Chapman's activities was his interest in the antiquarian side of chemistry, and he delighted

to show to his friends and describe with detailed knowledge his library of books relating to the time when the Royal Society was founded and the succeeding century.

Chaston Chapman will be remembered as a cogent writer and exponent of his views, but his friends have to lament the loss of one whose striking and dignified figure, kindly humour and uniform graciousness endeared him to so many.

ROBERT ROBERTSON.

WE regret to announce the following deaths:

Prof. Louis Duparc, professor of mineralogy and petrography, analytical chemistry and toxicology at the University of Geneva, a foreign member of the Geological Society of London, known chiefly for his work in mineralogy, on October 21, aged sixty-six years.

Dr. Barton W. Evermann, director of the Museum and the Steinhart Aquarium of the California Academy of Sciences, who has published much work on ichthyology, especially with relation to the geographical distribution of fishes, on September 27, aged seventy-eight years.

Prof. K. K. Gedroiz, director of the Experimental Station of the Scientific Institute of Fertilisers, Moscow, a well known worker in soil science, on October 5.

News and Views

Diary of Societies

ANNOUNCEMENTS of meetings of scientific societies, and lists of papers to be read, have increased so greatly in recent years that it has become necessary to reconsider the claims which such particulars may reasonably make upon the space they have hitherto occupied in the "Diary of Societies" in NATURE. From the point of view of interest, it may be doubted whether weekly lists of meetings and papers running to three columns or more merit publication. In most cases fellows of societies receive such announcements direct, and the chief advantage of including the lists in our "Diary" is that fellows of other societies may see what is coming on, and may wish to attend meetings outside their own special societies. Several difficulties arise, however, even on this assumption. Meetings of scientific and technical societies are usually not open to visitors, and often a dozen or more papers may be announced in a list though only one or two papers may be actually read, the rest being read in title only.

Announcements and Reports

IF it is suggested that full lists of papers serve a useful purpose as indicating directions of scientific activity, then the question arises why such lists should be limited to London and some provincial centres. NATURE is an international organ of science, and might just as appropriately publish weekly lists of papers communicated to national scientific societies and academies outside Great Britain. Under "Societies and Academies", we record the proceedings of many such societies, giving short summaries of papers received, while our columns of "Research Items" direct attention to subjects of particular interest or importance. There is thus little justification for devoting excessive space to announcements of ordinary meetings and lists of papers, and we propose in future to include under the title of "Forthcoming Events" only special meetings, lectures, and discussions, or meetings at which single papers or topics having much the same character as that of lectures are being presented. In adopting this plan, we have in mind not only considerations of space but also the interests of the majority of the readers of NATURE abroad as well as at home; and we need scarcely add that any suggestions as to what might be usefully included or excluded from this new scheme, bearing these two points in mind, would be much appreciated.

The Shirley Institute

SOME anxiety regarding the future of the Shirley Institute was expressed at the annual meeting of the British Cotton Industry Research Association at Didsbury, Manchester, held on October 19. These misgivings were not about the ability of the Institute to continue to carry out fruitful investigations but about the necessary financial support. The Institute has a staff of two hundred, more than sixty of whom are university graduates, and Dr. R. H. Pickard expressed the opinion that the Institute could usefully employ at least twice as many people as at present on the investigation of scientific and technical problems to which the industry requires answers. The work on investigating current trade problems has grown to such an extent as to crowd out much of the fundamental research, and only one sixth of the work is now the long distance research upon which the future of the Association and the industry so largely depends. Financial arrangements made in connexion with the Rayon Department terminate next June and those for the Cotton Department in June 1934. With the exhaustion of the £1,000,000 fund, Government grants to the Association will in future come by annual vote and may accordingly be still further decreased through the need for public economy. The Institute costs about £65,000 a year to run and there is a deficit on the past year of £5,600, largely owing to a corresponding reduction in the Government grant. Only about £25,000 comes from the subscriptions of the 1,200 firms who are members of the Association and these subscriptions were described by the chairman, Mr. H. P. Greg, as ridiculously out of proportion to the size and importance of the cotton industry even in times of bad trade. Contributions of £10 from a firm with a capital of £100,000 or 50,000 spindles, or of £5 from a manufacturer with 1,000 looms are unworthy of the industry or of the results obtained.

Research and the Cotton Industry

THE actual results obtained in the scientific research carried out at the Shirley Institute are the property of the members subscribing and this undoubtedly handicaps the Association in propaganda work. Enough regarding the work, however, was revealed in general terms at the annual meeting to indicate the actual and potential value of the Institute to the industry. The staff has been in contact during the year with more than 90 per cent of the member firms. Results already obtained fully justify Mr. Greg's assertion that economy on research even in the days of bad trade is unwise and unprofitable, and that the Association is worthy of far more generous support by the industry. The number of problems already raised by members which cannot be attacked by the Institute is considerable and the diversion of effort from long-range or fundamental research to current trade problems is a serious threat to the future development and prosperity of the industry. These are matters in which the nation as a whole is vitally concerned, but it cannot be expected that the direct contribution of the State can be materially increased except *pari passu* with a fitting acceptance by the industry itself of its own financial responsibilities for research.

Archæological Studies in Mexico

A DECISION of the Supreme Court of Mexico, it is reported by Science Service (Washington, D.C.), is expected during the current month, which is of considerable moment for the future study of the archæology of Central America. The point at issue is the control by individual States of the archæological sites within their respective boundaries. For some years the Central Government, largely owing to the influence of Señor Gamio, himself an archæologist of note, has displayed commendable energy in the examination and excavation of the archæological sites of the country. Any decision which would hamper or disturb the organisation of systematic exploration would be unfortunate in the extreme. The arrangements for the season now opening are already complete; but work cannot go forward until the decision of the courts is known. It may be hoped that whatever the verdict, some *modus vivendi* will be attained to satisfy both local interests and any claims the Central Government may justly put forward on the ground of its superior facilities for organised research.

THE archæological activities which are delayed pending decision are considerable. At Monte Alban, where the now famous gold treasure was discovered in a tomb this year, an appropriation three times as large as that of last year is to be expended in the further excavation of the innumerable tombs on the site; while stratigraphical study is to be carried on with a view of correlation with Maya sites to the east, south and north. The exploration of a Zapotec fortress known as Quiengola, south of Monte Alban, is to be initiated; and further explorations are to be made in the tomb at Texmelincan, the remote area of Guerrero, from which part only of the contents, including a number of gold objects, was removed at the time of its discovery early this year. In the important Toltec city of Teotihuacan, near Mexico City, the excavation of the "Avenue of the Dead", the mile-long central axis of the city with its row of mounds, now known to be the platforms of temples, is to be continued. At Chichen Itzá, which may be considered the strategic point for at least one period of Mayan history, important work on the interior of the pyramid of the Temple of Kukulkan, the Bird Snake, will be carried further. This pyramid, 90 ft. high, is the highest in the city, and in last season's excavation was found to enclose a smaller pyramid. It is intended this year to explore this contained pyramid and search for other internal structures. This outline of impending excavation, brief as it is, will indicate the extent of the interests involved in the forthcoming decision, quite apart from any questions which may arise affecting the position of the numerous expeditions from the United States now operating in Mexico.

The Horniman Museum and Library

THE late Mr. Emslie J. Horniman has bequeathed a sum of £10,000, free of duty, to the London County Council, for the purpose of providing an extension to the Horniman Museum, Forest Hill. The Museum was built by the late Mr. John E. Horniman, father of the testator, and before it was opened to the public he presented it and its contents, in 1901, to the London County Council. As is usual, and perhaps inevitable, in museums, the collections have since outgrown the accommodation, with the result that cases have become overcrowded, and progress has been hampered. This is more especially so with the collections dealing with the material culture of backward peoples. The provision of additional space will enable the present exhibited series to be opened out and extended, thus furthering that educational arrangement of the collections which has been the constant aim of the Museum authorities. It may be noted that Mr. Horniman's interest in the Museum has been shown in many ways, notably in the provision, in 1912, of an extension for the purposes of a lecture hall and library.

UNDER Dr. H. S. Harrison, who was appointed curator in 1904, the collections have been built up continuously with the view of the function of the Museum as providing material for the study of the development of the arts and crafts of primitive races and the natural history of man and animals. The educational value of the Museum collections has been much enhanced by the excellent series of handbooks, prepared by the staff, which deal, in a scientific spirit, but in not too technical a manner, with the developmental aspect of the collections, illustrating such topics as fire-making, transport, tools from the stone age to the steel age, and the like. The enlightened policy of the education authority for London in promoting lectures on the

Museum collections and related subjects, which teachers are encouraged to attend, has given the Horniman Museum a unique place among the educational facilities of London.

The Royal College of Physicians and Preventive Medicine

IN his Harveian oration delivered before the Royal College of Physicians of London on October 18, Sir George Newman, chief medical officer of the Ministry of Health, discussed the debt of preventive medicine to Harvey and the College. He showed first of all that Harvey's discovery of the circulation of the blood led directly to the conception of physiological balance elaborated by Claude Bernard, who formulated the synthetic principle that all the vital functions of the body establish jointly a constant and stable internal environment for the organism living in a variable external environment. Subsequent discoveries proved that physical health and mental capacity depend upon a mutual contribution of nutrition, hormones, nervous regulation and oxygenation of the circulating blood, and that these factors act in the prevention of disease. The application of the Harveian method and spirit to the study of the cause and control of infective disease and artificial immunity was then considered. Sir George maintained that throughout its history the Royal College of Physicians, with which Harvey was so closely connected, has been the foster-mother of sound medical practice and has cultivated the Renaissance spirit of true learning and inquiry. The preventive work of the College is illustrated by its participation in the pharmacopoeias published between 1618 and 1851, after which year this duty was transferred to the General Medical Council by the Medical Act of 1858; its recommendations drawn up in 1720 for the prevention of plague; its petition to Parliament in 1725 which led to the suppression of gin shops and the restriction of private retail sales; its constant advocacy of vaccination; the introduction of registration of the causes of death and the nomenclature of disease in 1837; and the creation in conjunction with the Royal College of Surgeons of a diploma of public health and afterwards of a similar diploma in tropical medicine and hygiene. In conclusion, Sir George dealt with the development of a communal medical service and emphasised the necessity of mutual co-ordination between all channels and means of medical activity.

Chaucer and Contemporary Medicine

AT a meeting of the Osler Club on October 21, Dr. J. D. Rolleston read a paper on "Chaucer and Medieval Medicine", which he commenced by a quotation from the modern version of some of the "Canterbury Tales" published in 1700 by Dryden, who after describing Chaucer as the father of English poetry continues: "He is a perpetual fountain of good sense, learned in all sciences and therefore speaks properly on all subjects. . . . Chaucer followed Nature everywhere, but was never so bold as to go beyond her." Although a few references to Chaucer are to be found in the works of some British medical historians, no essay dealing with the allusions to contemporary medicine in his works has hitherto been published, if one may judge from the absence of any entry in the Surgeon-General's Catalogue relating to Chaucer, in striking contrast with medical articles on Shakespeare or Goethe or even Dante and Byron. Dr. Rolleston, however, maintained that not only in the "Canterbury Tales", including the lengthy prose discourses of Melibeus and the Parson, as well as in Troilus and Criseyde, but also in many of the minor poems, there is much to interest the medical reader as well as delight the literary student. After a brief sketch of Chaucer's life, during which the poet became acquainted with all ranks of society, including men of science and learning, Dr. Rolleston dealt with the passages of medical interest in his works under the four headings, the medical profession in Chaucer's time, prevalent medical doctrines, diseases and their treatment, and miscellaneous topics.

Monument to Ernest Solvay

ON October 16 in the presence of the King of the Belgians and the Duke of Brabant, a monument was unveiled in Brussels to Ernest Solvay, the eminent chemist, philanthropist and publicist. Solvay was born at Rebecq in Brabant on April 16, 1838, and died in Brussels on May 26, 1922. The foundation of all his success in chemical industry and his immense wealth was his discovery of the ammonia-soda process. To the unfortunate Nicholas Leblanc (1753–1806), whose statue stands in front of the Conservatoire des Arts et Métiers in Paris, the world owed the first successful process for manufacturing artificial soda, and by 1863, the year in which Solvay took out his patent, the world production of soda was about 300,000 tons a year. The Solvay process, after the many initial difficulties had been overcome, proved far more economical than the Leblanc process, and by 1914 there were some twenty-three works in various parts of the world engaged in the Solvay ammonia-soda process, capable of producing about 2,000,000 tons of soda ash a year. Mr. Runciman, President of the Board of Trade, in a speech delivered on October 20, when dealing with the question of trade recovery, said that "one first-class invention is worth fifty Acts of Parliament". To that class of invention Solvay's belongs.

Trevithick Centenary

THE centenary of the death of Richard Trevithick occurs next April and steps have been taken by the Newcomen Society to commemorate Trevithick's life and work. In response to an invitation sent out by the Society, there was a large gathering of representatives of engineering institutions from many parts of Great Britain at a meeting to discuss the matter held at the Institution of Civil Engineers on October 20, and a committee was formed to deal with the commemoration as an international affair. The president-elect of the Institution of Civil Engineers is to be asked to be chairman of the committee and Mr. H. W. Dickinson, honorary secretary of the

Newcomen Society was elected secretary. The committee has been asked to consider the questions of memorial services in Westminster Abbey, where there is a window to Trevithick, and at Dartford Church, in the grounds of which he was buried; a memorial lecture; the placing of tablets at Euston, where his engine "Catch-me-who-can" ran, on the site of his birthplace and at Penydarran, South Wales. It is also proposed to publish a memorial volume containing a good account of his life and work; no such work is at present available.

The Electric Grid

PROF. E. W. MARCHANT gave his presidential address to the Institution of Electrical Engineers on October 20. After discussing training and research he dwelt on the importance of some of the applications of psychology which enable men most suitable for special kinds of work to be chosen. For example, in direction-finding work in the Navy, it has been found possible to pick out men who can tell with high accuracy the direction from which a sound comes. Prof. Marchant went on to speak of the electric grid in Great Britain which has been in course of construction for the last four or five years and will be completed in a few months. The original eight year programme has been cut down by two years. The next stage in the development of electricity is the trading stage. Assuming that progress proceeds as rapidly as during the development of the grid, Great Britain will soon be completely electrified. Prof. Marchant divided the supply of electricity into three stages, generation, transmission and distribution. So far as generation is concerned, the range of possible improvements is now small. Similarly, great improvements have been made in the technical design of transmission lines. It is the final stage of the problem, namely, the distribution and utilisation of electrical energy, which offers the greatest scope. To do this successfully, there must be a great demand and the public must be educated so as to be ready to take full advantage of electricity for all kinds of purposes. He mentioned that in Germany electrical laboratories have been installed at small cost by manufacturers in all schools. These are equipped with electrical apparatus so as to familiarise the children with electrical heaters, cookers, kettles, irons, etc.

Meteorological Effects during the Total Solar Eclipse

DR. C. F. BROOKS, of the U.S. Weather Bureau, has given a brief preliminary account (*Bull. Am. Meteorological Soc.*, Aug.–Sept. 1932, vol. 13, pp. 159–160) of the co-operative effort made in the United States and eastern Canada to determine the effects upon the atmosphere of the total eclipse of the sun on August 31 last. The programme of meteorological observations was determined largely by the Blue Hill Observatory of Harvard University, but the scheme was carried out with the aid of many public bodies and private individuals. Special measurements were made of the radiation from sun and sky; conditions in the upper atmosphere were measured by meteorographs carried by aeroplanes and captive balloons; numerous ordinary meteorological observations were carried out by the regular observers of the U.S. Weather Bureau and by a large number of auxiliary voluntary observers.

THE large mass of observational material obtained in this way has still to be examined and discussed; Dr. Brooks mentions, however, a few interesting facts that have already come to light. He suggests that the cloudy skies that spoiled the view of the eclipse for so many and interfered with the work of the astronomers, were far from being a drawback for the meteorological work. There were clouds at five different levels in parts of New England, and these included both stratiform and cumuliform clouds. Generally speaking, the cumulus clouds, which half covered the sky locally just before the eclipse, disappeared during the eclipse, as the cutting off of the main heat supply for the surface layers of the atmosphere checked convection, but the stratiform clouds higher up in some instances developed rapidly, so as to cause the sky to become completely overcast. Upward-flowing mountain breezes generally ceased, but, doubtless owing to the short duration of the period of reduced radiation, katabatic winds did not develop. The fall of temperature near the ground varied greatly, mainly owing to the changing amount of cloud: it ranged from 2° F. to 11° F., the latter figure representing the combination of two favourable factors—absence of cloud and sandiness of the soil, with its concomitant low specific heat. The publication of the more complete discussion of the observations will be awaited with interest by meteorologists.

Elm Disease and its Distribution

FOR the fifth year in succession the Forestry Commissioners have had a survey made on the status of the elm disease (*Graphium ulmi*). First observed on the Continent in 1919, and in England in 1927, the disease is now common throughout western and northern Europe, and more recently its occurrence has been noted on a few trees so far away as Ohio in the United States. In England between 1927 and 1931 it increased steadily both as regards the number of outbreaks and the damaging effect on the trees. The most notable feature in this year's survey is the reduced virulence of attack in nearly every area visited. It is quite impossible to say whether this diminution is merely a temporary check in the progress of the disease or the first sign of recovery. Elm bark beetles have long been suspected as being the principal means by which the disease is spread and this has now been proved to be the case. A great deal of work has been carried out in Holland on the relative resistance to attack of the various species of elms. So far only certain Asiatic species have proved immune and for the most part these are small trees unlikely to take the place of the English elm. All kinds of elms ordinarily planted in England appear to be susceptible; but, judging from the investigations conducted in Holland, there is some foundation for the hope that completely resistant forms of the common species may yet become available.

Recent Acquisitions at the Natural History Museum

THE Entomological Department of the British Museum (Natural History) has recently acquired the collection of the economically important Thysanoptera, or thrips, formed by Dr. R. S. Bagnall, comprising more than 17,000 specimens, of which about 430 are types and 750 paratypes. Some 8000 insects of various orders, but mainly Diptera, have been collected for the Department in the High Tatra Mountains in Poland and Czechoslovakia by Miss D. Aubertin and Miss E. Trewavas. The King of the Hedjaz, Nejd, and its Dependencies has presented to the Geological Department the collection of fossils made by Mr. H. St. J. Philby on his recent remarkable journey in Central Arabia. It includes invertebrates from the Jurassic rocks of the Tuwaiq plateau and the Cretaceous rocks of the Arma plateau, near Riyadh, the Wahabi capital. From the area south of the Gulf of Bahrein, invertebrates of Miocene age, closely resembling those of contemporaneous rocks in the Persian oilfields, were obtained; while freshwater shells found in abundance at several localities in the middle of the great Rub' al Khali Desert show that rivers or lakes existed recently in that now arid region. The Government Geologist of the Anglo-Egyptian Sudan has presented a series of shells of Lower Tertiary age preserved in a remarkable kind of flint; these are the first fossils, other than a few plant remains, to be found in that territory. A large selection of material from the meteorite craters discovered in 1931 near Henbury, Central Australia, has been acquired for the Department of Minerals from the Kyancutta Museum, South Australia. This includes 172 pieces of meteoric iron with a total weight of 604 lb. The largest piece of 292 lb. was found in contact with three other masses (total weight 440 lb.) at a depth of 7 feet in the smallest of the thirteen craters. This is the only meteorite that has ever been excavated from inside a meteorite crater.

Additions to the Botanical Collections

MISS E. HOMBERSLEY has given to the Department of Botany of the Natural History Museum 882 paintings of British flowering plants by Miss Ellen Hawkins, who died in 1864. The paintings are of considerable merit and are accompanied by descriptions, written on the opposite page of the double sheet, which give interesting details and information. Miss Hawkins wrote the botanical appendix to Robertson's "Handbook to the Peak" (1854). Mr. Reginald Cory has presented the original manuscript and drawings of the "Tabular Distribution of the Vegetable Kingdom" by John Stuart, third Earl of Bute. The Department already possesses many plants purchased at the Earl of Bute's sale in 1794. Prof. John Percival has presented a set of all the known species of *Ægilops*. Prof. Percival's knowledge of this difficult genus of grasses makes the set of special value. Among the purchases there is a further set of H. J. Schlieben's Tanganyika plants and 668 Brazilian and Mexican plants collected by Y. Mexia and 248 drawings of liverworts (Jubuleæ) by Fr. Verdoorn.

Epidemic Diseases in Residential Schools

THERE has been since August a slight rise (which was anticipated) in the incidence of an epidemic disease of the nervous system named poliomyelitis (an infection which may sometimes result in 'infant paralysis'), though up to the present the cases have as a whole appeared singly and widely scattered. The Ministry of Health has, however, received certain inquiries as to the wisdom or expediency of closing residential schools in which such isolated cases may have occurred. The Ministry of Health is definitely of the opinion that the balance of advantage is in favour of not closing a residential school in which poliomyelitis has appeared. If the school be closed, any potential infectiousness of the disease is more widely distributed, and passes beyond such means of supervision and control as are furnished in a well-equipped residential school conducted on hygienic lines.

Co-operation of Scientific Societies

MANCHESTER chemical societies have initiated a form of co-operation which should prove of considerable value both to their members and to local industry generally. The Manchester and district sections of the Institute of Chemistry, the Society of Chemical Industry, the Society of Dyers and Colourists, the Oil and Colour Chemists' Association and the Institute of Rubber Industry, together with the Manchester Literary and Philosophical Society, have established a Joint Advisory Committee, consisting of the honorary secretaries (or other representative) of the societies concerned, in order that problems of mutual interest can be discussed and common plans arranged, and to provide a means whereby Manchester chemical opinion can be ascertained and expressed. The Committee has already published a card calendar of meetings, both scientific and social, of the participating societies, and a booklet which gives lists of officers as well as syllabuses and other information concerning the session's activities. The Chemical Society, not being organised in local sections, does not participate directly in the scheme, but—as is indicated in the booklet—fellows of that society may, under a co-operative arrangement, read papers on pure chemistry before the local section of the Society of Chemical Industry. Members of one society are cordially invited to attend meetings of any other society; hence by the promotion of personal contact and by the provision of facilities for discussion and joint action, Manchester chemists are effecting a consolidation of their own interests as well as providing an interesting experiment which will probably be found worthy of wider application. The Association of Secretaries of Technical Societies in Glasgow has also issued a programme of the meetings of the chemical and engineering societies in that city.

Musk Rat Menace

THE Trustees of the British Museum had under consideration at their meeting at the Natural History Museum on October 22 the serious position in the

country in relation to the musk rat menace, and particularly to the fact that now that the keeping of musk rats is prohibited except under the strictest regulations against their escape, the musk rat farmers have turned their attention to the coypu or nutria, an aquatic South American rodent. The latter animal is as large as a beaver, but has a tapering tail; it lives in burrows, and its fur is brown, soft and dense. The Trustees decided to recommend to the authorities concerned that the nutria should, like the musk rat, be scheduled as an animal the import of which is prohibited and which shall be kept only under licence.

Bartholomew Diaz off Cape Colony

MR. S. A. MUMFORD, of Tresta, Farley, Salisbury, Wilts., has written stating that the voyage of Bartholomew Diaz, when he touched the south coast of Cape Colony, is usually quoted as having taken place between August 1486 and December 1487, whereas in our "Calendar of Geographical Discovery" (NATURE, vol. 129, p. 177, Jan. 30, 1932), a note on the voyage appears under the date Feb. 3, 1488. The date given in our columns is based on a marginal note, probably by Christopher Columbus himself, on folio 13 of a copy of Pierre D'Ailly's "Imago Mundi", which fixes Diaz's return to Lisbon in the month of December 1488. The writer says he was present at Diaz's interview with the King of Portugal when the explorer's chart was shown and discussed. The "Imago Mundi" is at present in the Colombina at Seville.

Announcements

THE De Morgan medal of the London Mathematical Society, which is awarded triennially, has this year been awarded to Bertrand Russell in recognition of his mathematical work. The medal will be presented at the annual general meeting of the Society which will be held at Burlington House, Piccadilly, London, W.1, on November 10, at 5 P.M.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 24, the following Council was elected: *President:* Sir E. A. Sharpey-Schafer; *Vice-Presidents:* Prof. J. H. Ashworth; Dr. A. Logan Turner; Dr. J. B. Clark; Prof. James Ritchie; Sir Thomas Holland; The Hon. Lord Sands; *General Secretary:* Prof. R. A. Sampson; *Secretaries to Ordinary Meetings:* Prof. C. G. Darwin and Prof. F. A. E. Crew; *Treasurer:* Dr. James Watt; *Curator of Library and Museum:* Prof. D'Arcy W. Thompson; *Councillors:* Dr. Murray Macgregor; Dr. A. Crichton Mitchell; Prof. P. T. Herring; Prof. James P. Kendall; Prof. T. M. MacRobert; Prof. Godfrey H. Thomson; Dr. Malcolm Wilson; Prof. E. B. Bailey; Prof. J. C. Brash; Prof. A. J. Clark; Prof. A. G. Ogilvie; Prof. E. M. Wedderburn.

PROF. E. N. DA. C. ANDRADE will give four lectures at the Royal Institution on Tuesdays at 5.15 P.M. beginning November 1 on "Rays and Radiations". The course is an experiment in the treatment of a branch of modern physical science on the lines of the popular Christmas Lectures to juveniles, but Prof. Andrade will address himself on this occasion to the grown-ups. He will talk and show experiments on the gamma and ultra-violet radiations, X-rays, infra-red rays, and the particle radiations which have been used in the investigation of the inner structure of the atom. Prof. Lancelot Hogben will give three lectures, also on Tuesdays at 5.15 P.M., beginning November 29, on "Colour Change in Animals". The mechanism of colour change in such a well-known example as the chameleon will be discussed, and compared with that in other animals subject to colour changes, such as the frog, the salamander and certain fishes.

THE Council of the Institution of Civil Engineers has awarded the Indian Premium for the session 1931–32 to Sir Bernard D'O. Darley (Bahawalpur, Punjab), and the Webb Prize for the session to Mr. B. G. White (London) for papers read and discussed at ordinary meetings of the Institution. The following awards for the session have been made for "Selected Engineering Papers", published without discussion:—A Telford Gold Medal to Dr. J. F. Baker (Abbots Langley); Telford Premiums to Mr. William Muirhead (London), Mr. E. B. Cocks (London), Dr. James Orr (Glasgow), Dr. W. J. Walker (Johannesburg), and Mr. W. C. Ash (Vizagapatam, India); and a Crampton Prize to Mr. L. St. C. Rundlett (Rangoon, Burma). Awards have also been made for papers read at students' meetings in London, or by students before meetings of local associations, as follows:—The James Forrest Medal and a Miller Prize to Mr. D. J. Anderson (Glasgow), and Miller Prizes to Messrs. A. C. L. Browne (London), C. W. Scott (London), A. J. P. Pashler (Birmingham), W. D. McFadyean (London), Granville Berry (London), P. J. Stuckey (Cardiff), W. H. Morgan (Newcastle), R. R. W. Grigson (London), E. A. Turner (London), and Frank Breakwell (London).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A University lecturer and a University demonstrator in biochemistry at the University of Cambridge—The Professor, School of Biochemistry, Cambridge (Nov. 9). A junior assistant and guide-lecturer at the City of Birmingham Museum and Art Gallery—The Keeper (Nov. 11). An Armourers and Brasiers research fellow in metallurgy of the Royal Society—The Assistant Secretary, The Royal Society, Burlington House, W.1 (Nov. 14). A lecturer and tutor in hygiene in the Department of Education at the University of Bristol—The Secretary and Registrar (Nov. 19).

ERRATUM.—Letter on "Possible Existence of Multiply Charged Particles of Mass One" by Dr. M. Delbrück in NATURE for October 22: p. 627, col. 1, line 33, for "an α-particle is stable . . ." read "a particle in the α-particle is stable. . . ."

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.*]

Bast-Sap in Plants

IN 1858 Th. Hartig directed attention to the fact that many trees yield drops of sap when their bark is punctured in summer and autumn. This sap issuing from the inner layers of the bast was said to include small quantities of nitrogenous substances with large quantities of various kinds of sugar. Obviously its motion and constitution might yield some information on the transport problem of organic substances. We found the most abundant flow when the puncture reaches the inner layers of the bast; deepening the puncture so as to reach the wood, causes the sap exuded to be instantly drawn in by the tensile water in the vessels. Hence the exuded sap is not driven out by root-pressure through the outer xylem. The exuding sap is transmitted by the sieve-tubes as we demonstrated by forcing a solution of potassium ferrocyanide into the puncture and afterwards tracing its path by means of ferric chloride.

In a stem of a young specimen of *Fraxinus excelsior* about 12 cm. in diameter all the seven or eight layers of soft bast transmitted the solution to some extent, while the inner layers transmitted it most readily. A pressure of 3 atm. drove the solution 3·5 cm. in 30 min. We have observed the flow of bast-sap in forty to fifty species of trees and in several herbaceous forms during June, July, August and September. All specimens of the same species in the same locality do not exude bast-sap simultaneously. The amounts exuded are variable. In active specimens the flow from a slit 1 mm. long continues for 30–45 min. and yields 0·1–0·2 c.c. Active flow from one puncture inhibits or reduces the flow from closely neighbouring punctures, and the amounts delivered from similar punctures at the same level, even when not influenced by neighbouring punctures, are not uniform.

Small quantities of proteins and glucose associated with considerable amounts of sucrose were found in the sap; the presence of tannin, an oxidase and a chromogen is also indicated. The sap is extruded by the turgor of a closed system in the bast (probably the sieve-tubes), and the flow only ceases when that pressure becomes negligible. Freezing point determinations give a measure of this pressure. Unexpectedly high pressures were observed ranging from 13 to 35 atm. The forces moving the sap through the bast and forcing it through the punctures are very high. Very different pressures have been observed in the same specimen on different occasions; but so far, it has always been found that the osmotic pressure of sap issuing from a higher level is greater than that coming from a lower one. Osmotic pressure gradients of 2·2–8·9 atm. per metre have been observed in the bast of *Fraxinus excelsior*.

Lateral motion is inconsiderable compared to longitudinal movement, hence from the amount exuded through a puncture of known size under the pressures available we obtain some idea of the ease with which the sap moves longitudinally in the bast. The gradient of pressure is presumably maintained by the production of carbohydrates in the leaves and their removal by condensation into products of growth (activity of the cambium) and materials of storage (sucrose, starch, etc., deposited in the bast-parenchyma, starch-sheath, cortex and medullary rays).

The difference in osmotic pressure above and below in the intact plant is available for forcing the solvent, water, of the less concentrated solutions below into the wood, thus creating a mass-movement of the solution downwards through the bast. These and other observations seem to us to support Münch's theory of mass-movement of organic substances in the bast, and probably bring into line the results of Mason's and Maskell's investigations.

HENRY H. DIXON.
M. W. GIBBON.

School of Botany,
Trinity College,
Oct. 1.

Stability of the Liquid Carbon Dioxide in the Ocean

IN NATURE of July 2, p. 26, Dr. Wattenberg of Berlin presented some objections to my paper "On the Field of Stability of Liquid Carbon Dioxide in the Biosphere".[1]

It is a pity that Dr. Wattenberg in formulating his criticism used, apparently, only the short notice of my paper which recently appeared in NATURE [2] and not the paper itself. Had he read my original paper he would have saved himself from misunderstanding of my point of view.

The water of the ocean, like the water of all the deep continental water-basins, is heterogeneous as to its baric properties, presenting a substance which cannot be reproduced by experiment since it has the properties of a specifically planetary phenomenon. In the ocean the water itself is subjected to pressures which can exceed 1000 atm./cm.^{2} and at the same time the dissolved gases in the same water (which are in an innate connexion with the troposphere) are subjected to pressures which can not exceed 1–2 atm./cm.^{2} In the thermodynamical conditions of the ocean's water all the carbon dioxide masses which are isolated (completely or partly) from the troposphere (that is, from the gases dissolved in the oceanic water), must exist in a special state of phases:

$$\text{liquid } CO_2 \rightleftarrows \text{gaseous } CO_2,$$

because the temperatures and the pressure of sea-water remain mostly below the critical point and above the critical pressure of carbon dioxide.

Marine organisms must have accommodated themselves throughout geological time to the specific state of carbon dioxide in the ocean. They have to obtain a special organisation in this respect.

I have indicated in my paper the following three examples among many of such accommodations:

1. The accommodation of plankton organisms in connexion with the low confines of their habitation.

2. The oxygen glands of deep-sea fishes in connexion with their respiration.

3. The conditions of life of micro-organisms in the bottom sediments of the ocean. The chemical processes in such sediments are regulated by micro-organisms. They are subject to changes under the influence of liquid carbonic dioxide, the possibility of existence of which in living environments cannot be denied.

The same peculiarities of carbon dioxide must influence many inorganic processes such as exhalations of gaseous carbonic dioxide in the gaseous and mineral springs on the sea-bottom.

The peculiar character of carbon dioxide in the ocean in comparison with its behaviour on the earth's surface must be taken into consideration in all conclusions concerning the state of the gaseous solutions in the ocean. There certainly must exist a lower limit than the gaseous solution of carbon dioxide in sea-water and therefore we must expect to find at greater depths only ions or hydrates of carbonic acids.

For further discussion on this subject reference must be made to my paper already cited. I have also discussed the subject in my lecture "Oceanography and Geochemistry" delivered in the Mineralogical Institute at Göttingen, which is to be published in the *Tschermaks Mineralog. u. Petrographische Mitteilungen*.

Further study in the same field of research has been made by Prof. V. Chlopin, who has published his results in the *Comptes Rendus* of the Academy of Sciences, Leningrad, mentioned before. Prof. V. G. Chlopin has shown that in the same conditions, which have been demonstrated by me for carbon dioxide in sea-water, the inert gases (argon, krypton, xenon) must give hydrates, which are soluble in sea-water. Apparently the geochemistry of the inert gases offers here a new and promising ground for research.

W. VERNADSKY.

Biogeochemical Laboratory
of the Academy of Science of U.S.S.R.,
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[1] *C.R. Acad. Sci. Leningrad*, 289–295; 1931.
[2] NATURE, **129**, 607, April 23, 1932.

Bead-Corona on Radio Antenna

DURING the period February–March 1932, of exceptionally dry atmospheric conditions, a curious high frequency – high tension – phenomenon was observed on several days on the antenna of the Hilversum (Holland) broadcasting station (λ = about 300 m., aerial power 15–20 kw.).

The aerial consists of five horizontal wires, strung between two metal masts sixty metres in height, and is connected at both sides to insulators fastened to two spreaders. There are five downleads, connected to the central part of the aerial wires.

On February 14, at 20.00, a corona was observed on the antenna, and this corona caused an acoustical effect such that the modulation of the emission could clearly be heard up to a distance of approximately 800 m. A reduction of the antenna power from 20 kw. to 12 kw. caused the phenomenon to disappear.

Again, on March 7, at 17.00, when the antenna power was raised from 7 kw. to 20 kw., the corona on the antenna reappeared. It consisted of slowly moving luminous spheres of about 10 cm. diameter. They first appeared at one end of an outer wire, they slowly moved, following the wires towards the downleads and disappeared at a distance of about 15 m. from their origin. Several of these luminous spheres were observed to occur simultaneously with a mutual distance of 0·5 m., so that the phenomenon made the impression of a string of beads, moving towards the centre with a speed of the order of 1 m./sec.

The phenomenon usually started at an outer wire, and when this was covered with beads over a length of about 15 m., also the second, the third and the fourth wire gradually developed the beads in a similar way. The colour of the beads varied from yellow to a light blue and pink. The sound emitted by this corona (corresponding to the modulation of the transmitter) was very distinct and could be heard up to a distance of 1–1·5 kilometres, so that a big crowd gathered round the gate of the station, listening in astonishment to the voice of a preacher, directly from the heavens.

The modulation was also plainly visible in the glittering of the emitted light. On that day again the phenomenon disappeared with the reduction of the antenna power from 20 kw. to about 10 kw. At 19.00 an increase of the aerial power caused the corona to reappear.

The same phenomenon was again observed on March 9, 10, 11, 12, and 13. Since March 16 the corona has not occurred.

BALTH. VAN DER POL.

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N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Holland,
Sept. 9.

Influence of Impurities on the Transformation Point of Liquid Allotropic Modifications

RECENT investigations dealing with the properties of liquid nitrobenzene, in the neighbourhood of the melting point, are yielding discordant results. Wolfke and Mazur,[1] in a carefully purified specimen, observe discontinuities at 9·5° C.; this temperature, they suggest, represents the transformation point of two distinct modifications of liquid nitrobenzene. Stewart,[2] using X-rays, confirms the assumption. Massy, Warren, and Wolfenden,[3] Newton Friend,[4] and Piekara [5] were unable to discover any discontinuities. The interesting question arises as to how far these discrepancies may be accounted for by assuming slight impurities to have been present in the samples used.

When two diluted solution phases co-exist, we have the well-known equation

$$\frac{L}{\vartheta}d\vartheta = \frac{x_2 - x_1}{x_1} R\vartheta dx_1$$

where L stands for the heat of transformation from phase (1) to phase (2), R is the gas constant (both per gm. mol.), x_1 and x_2 are the molecular concentrations in phases (1) and (2), and ϑ denotes the absolute temperature of transformation (see, for example, Van der Waals' "Lehrbuch der Thermodynamik", vol. 2, p. 80); the pressure is here assumed to remain constant. For the difference $\Delta\vartheta$ of the transformation points of the pure substance and that of the solution, we accordingly obtain

$$\Delta\vartheta = \frac{d\vartheta}{dx_1} x_1 = \frac{R\vartheta^2}{L}(x_2 - x_1).$$

That the allotropic modifications have unequal dissolving power is a common occurrence; the dielectric constant, which influences the dissolving power, increases nearly fourfold when we pass from nitrobenzene II to nitrobenzene I; thus x_1 and x_2 may be assumed unequal. Since the heat of transformation L for nitrobenzene ((1) $\rightarrow$ (2)) is exceptionally small (0·14 cal. per gm.), the effect of slight impurities may be to depress the transformation point below the freezing point; the liquid phase, nitrobenzene II, permanent below 9·5° C., would then disappear.

If μ denotes the integral molecular concentration of the solution and α the ratio x_2/x_1, then the term $x_2 - x_1$ varies, during the transformation (1)⟶(2), from the value $\mu(\alpha - 1)$ to $\mu\left(1 - \frac{1}{\alpha}\right)$. The phase (2) appears at the temperature

$$\vartheta + \frac{R\vartheta^2}{L}\mu(\alpha - 1);$$

the phase (1), however, does not disappear entirely until the temperature

$$\vartheta + \frac{R\vartheta^2}{L}\mu\left(1 - \frac{1}{\alpha}\right)$$

is reached. In the case of nitrobenzene we may probably admit that $\alpha < 1$.

In Fig. 1 are shown the probable coexistence lines

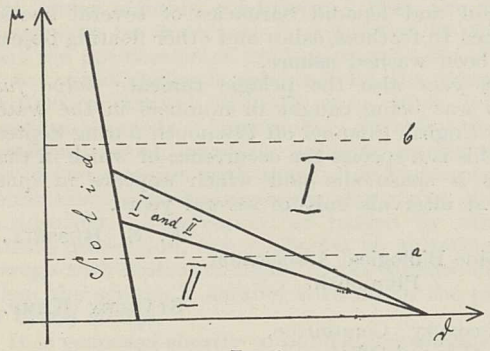

FIG. 1.

of the various phases of nitrobenzene. The dotted line *a* corresponds to Mazur's numerical data, the line *b* expresses results which would be found with samples of a less degree of purity.

STANISŁAW DOBIŃSKI.

Physical Laboratory, Jagellonian University,
Cracow, Poland, Aug. 10.

[1] Mazur, NATURE, **126**, 993; 1930: Wolfke and Mazur, NATURE **127**, 741; 1931: Mazur, NATURE, **127**, 893; 1931.
[2] G. W. Stewart, *Phys. Rev.*, **39**, 176; 1932.
[3] Massy, Warren, Wolfenden. *J.C.S.*, **91**; 1932.
[4] J. Newton Friend, NATURE, **129**, 471; 1932.
[5] A. Piekara, NATURE, **130**, 93; 1932.

Proof of Stability of Poiseuille's Flow

IN some recent papers[1] it is shown that there exists an absolute analogy concerning the question of stability of

(1*a*) disturbances being symmetric about the axis, of P.'s flow (= steady flow through a straight pipe of uniform circular section).	(1*b*) two dimensional disturbances of the steady flow between two parallel planes, the velocity being a linear function of the distance y from the axis.
(2*a*) three dimensional disturbances of P.'s flow.	(2*b*) two dimensional disturbances of the steady flow between two parallel planes, the velocity being a parabolic function of the distance y from the axis.

It was, therefore, concluded that the investigation of (2*b*) would elucidate also the question of stability of (2*a*). To make the investigation of (2*b*) possible, the problem was divided into four parts according to the following scheme:

(1) α small, αR large	(2) α large, αR large
(3) α small, αR small	(4) α large, αR small

$\alpha = 2\pi/\lambda$ being determined by the wave-length, λ, of the disturbance (R = Reynolds's number). Since in the limit of vanishing viscosity (that is, $\alpha R \to \infty$) there exists the solution $\alpha = c = \theta$, $\psi = 1 - y^2$, which can be regarded as representing a degenerate oscillation of the undisturbed flow, the most important case will be α small, αR large.

It was possible to integrate the problem approximately by dividing the stream function ψ into an even and an odd part, by reducing the differential equation of the fourth order to a differential equation of the second order and by complex (Laplace) integration of the latter equation, expanding asymptotically the particular solutions, parameter and argument both being large. The even part gives the following transcendental equation for $c = \beta/\alpha$: $e^{(1+i)z} = i$, z being $\left[\sqrt{c} - (1-c)\,ln\,\frac{1+\sqrt{c}}{\sqrt{1-c}}\right]\sqrt{\frac{\alpha R}{2}}$, that is, when c is small, $z = \frac{1}{3}c^{3/2}(2\alpha R)^{1/2}$.

The roots are in this limit

$$c = \left[\frac{3\pi}{2}\left(2n + \frac{1}{2}\right)\right]^{2/3} \Big/ (\alpha R)^{1/3} \cdot \frac{\sqrt{3} + i}{2}.$$

Since something similar is true for the odd part and also for α large, αR large, the absolute stability of Poiseuille's flow is established.

The detailed proofs and a discussion of the streamlines of the disturbed motion will be given in a paper to appear in the *Ann. d. Phys.*

TH. SEXL.

Institute for
Theoretical Physics,
University of Vienna.

[1] *Ann d. Phys.* (4) **83**, 835; **84**, 807, 1927; **87**, 570; 1928.

Science Teaching in Schools

IN his letter to NATURE of October 1 Mr. Shearcroft accepts the gloomy picture of the state of science teaching in schools with which we are becoming familiar. He writes as a teacher of science, but there are many other teachers of science who will not agree with him. Writing with the authority of the Committee of the Science Masters' Association I wish to put on record our opinion, shared we are certain by most of our members, that the science teaching in the schools of to-day is making an important and valuable contribution to the educational development of our young people and is helping them towards an understanding of their future surroundings which they would not obtain without it. We make no extravagant claims, but we do claim that we are giving those who leave the schools some insight into the method of separating the important from the unimportant, the true from the false, and we ask for a more just appreciation of the contribution of the science teacher to the intellectual make-up of the pupils in the schools.

The Science Masters' Association exists for the advancement of science teaching in schools and

endeavours to deal with the situation as it exists. Is it not futile to talk of the "curse of useless external examinations" so long as employers ask for a definite proof that a pupil leaving school and seeking a post has shown some capability of achievement? The example of an apparent encouragement of a narrow specialisation in physics quoted by Mr. Shearcroft unfortunately exists, and the Association is emphatically opposed to the possibility of a pass in physics on an examination of this restricted nature. But it is fair to point out that of the eight examining bodies, three only accept this inadequate section of 'Sound, Light and Heat', and two of these offer alternatives which give scope for a wider treatment of the subject. Moreover, it does not necessarily follow that because pupils may be examined in 'Sound, Light and Heat' therefore schools are unable to include a fuller treatment of physics in their curriculum; nor need a teacher feel his work is under a curse because only a part of it is examined.

The widening of examination syllabuses is continually taking place and much is being done to bring together the school teacher and the university teacher for the discussion of the problems arising out of these syllabuses. Each examining body has a method by which teachers are able to make their views known, and the tendency is all in the direction of fitting the examinations to the work of the schools and so of preserving to the teachers a free hand in the development of their subjects. The professional associations, the interests of which are not confined to economics, are closely identified with these consultations, and the Science Masters' Association is very frequently consulted on both general and more detailed questions relating to science. The Board of Education's Secondary Schools Examination Council, containing representatives of the universities, teachers and education authorities, reviews all the examinations periodically.

The Science Masters' Association is anxious for progress—witness the enthusiastic reception given to the address of our president, Dr. C. Norwood, at the annual meeting in January last—and will welcome any practical projects for the furtherance of its objects. Both teachers and examining bodies may be assumed to be actively interested in the welfare of the pupils in the schools, and, whilst purely destructive criticism of their work is easy, it is not usually very helpful.

T. HARTLEY,
(Chairman, Science Masters' Association).

Pelagic Animals off the South-West Coasts of the British Isles

THE occurrence of the skeleton of the floating siphonophore *Velella spirans* on our south-western shores is of common occurrence. But it is only occasionally that the living animal is driven ashore in large numbers. Although this is probably largely a wind effect it is of interest to put these invasions on record for future reference, for its presence may be an indication either of wind drift of surface water or of increased inflow of Atlantic water; in either of these circumstances it is desirable to know what other plankton animals showed unusual abundance.

Of previous records we have in the Plymouth Marine Fauna, March and October, 1903, at Looe; Jan., 1916, at Plymouth and on Cornish coast; and Jan., 1921, at Bude; and in NATURE for July 26, 1924, there is a record by Herdman of its occurrence at Port Erin. One of us also remembers its occurrence in large quantities at Newquay in January, 1922, which was probably due to prevalent southerly winds.

This summer *Velella* has again arrived in large numbers. In the second week in September large specimens were being washed up on the Fistral Beach at Newquay, Cornwall, and their presence was recorded about the same time at Padstow.

In the south-west of Ireland great numbers of fresh specimens were seen in August on the Kerry shores of the Kenmare estuary and with them were found shells of the pelagic mollusc, *Ianthina*, with the soft parts decomposing. Miss M. Delap informs us that in Valentia Harbour enormous swarms of *Velella* have been seen this year. *Ianthina* has been plentiful and lepadid barnacles of several species, attached to feathers, ashes and other floating objects, have been washed ashore.

This year also the pelagic tunicate *Salpa fusiformis* was being caught in numbers in the waters of the English Channel off Plymouth during September; this is a species the occurrence of which in these waters is spasmodic and which appears in quantities at intervals only of several years.

F. S. RUSSELL.

Marine Biological Association,
Plymouth.

STANLEY KEMP.

"Discovery" Committee,
Colonial Office,
Sept. 23.

Bacterial Enzymes in the Purification of Sewage

FROM experiments carried out at the London School of Hygiene and Tropical Medicine, in connexion with the programme of the Water Pollution Research Board of the Department of Scientific and Industrial Research, we have come to the conclusion that the purification of sewage is essentially a matter of bacterial enzymes—whether associated with living or dead bacterial cells appears to be immaterial—and mainly of oxidation-reduction enzymes. Although not excluding from some part in the process such agencies as colloidal flocculation, sedimentation and adsorption, or ruling out the possibility of some step in the purification being due to the agency of other enzymes such as proteases, lipases and carbohydrases, we nevertheless believe that the essential step in the purification of sewage is due to the agency of the bacterial oxidation-reduction enzymes.

We have shown that the uptake of oxygen by crude sewage will not take place if the latter be first sterilised by heat or by filtration, provided that sterility is maintained throughout the period of test. If, however, a small seeding of crude sewage or a small inoculum of certain bacteria be introduced into the sterile sewage a rapid uptake of oxygen results. If the seeding be first boiled no oxygen uptake follows. Certain other bacteria do not bring about the absorption of oxygen when introduced into sterile crude sewage in small numbers but if large concentrations of these organisms, washed free from contaminating media, be introduced vigorous oxygen uptake results, although the organisms do not appear to multiply. The necessary controls give negative results. That bacterial enzymes can effect the absorption of oxygen in the presence of crude sewage independently of the growth of the organism can

be shown by treating a suspension of washed *Pseudomonas fluorescens* cells with formaldehyde so that the suspension is sterile whilst its indophenol oxidase and the dehydrogenases remain active. If such a suspension be introduced into sterile sewage, uptake of oxygen results although no living bacterium can be demonstrated to be present at any time throughout the experiment.

We have further shown that sewage sludge (whether this be taken from the sedimentation tank or the humus tank) or activated sludge is enzymatically active, possessing both oxidases and dehydrogenases. Crude sewage itself, even when sterilised, acts as a substrate for the sludge dehydrogenases, whereas a good sewage effluent acts in the reverse manner, namely, as a hydrogen acceptor in the presence of the sludge and under suitable conditions. That the oxidase appears to be important is supported by the fact that the purification of crude sewage in the presence of activated sludge is inhibited by the presence of *M*/1000 potassium cyanide even when vigorous aeration proceeds. Experiments with five per cent urethane, which similarly inhibits purification of sewage on aeration with sludge, tend to support the contention that dehydrogenases play a part in sewage purification. Purification, as judged by nitrite or nitrate production, is not effected by agitating crude sewage with activated sludge in the absence of air or when the sewage is aerated with air in the presence of boiled sludge.

It is proposed shortly to publish elsewhere some of the experimental evidence in support of our tentative thesis, namely, that the most important factor in sewage purification is a series of catalysed oxidation-reduction reactions determined by bacterial enzymes, present in either living or dead bacterial cells, or liberated by them into the fluid of the reacting system.

W. R. WOOLDRIDGE.
A. F. B. STANDFAST.

London School of Hygiene
and Tropical Medicine,
Keppel St., W.C.1,
Oct. 4.

Light as a Factor in Reproductive Periodicity

IN a letter to NATURE[1] I observed that the culture of diatoms in polarised light would be an interesting piece of research. Later, I placed a culture in a small tube in the path of light from a Nicol prism, and a similar tube using the same culture medium, in ordinary daylight: at night, light from the sky was admitted as in the day. The rate and prolificacy of reproduction were approximately the same. It appears from this that it is the length of the period of exposure, and the intensity of the light which are the chief factors; the polarisation of the light is of little importance. In this case it looks as though reproduction at night has no connexion with lunar periodicity.

To find the effect of the period of exposure to light, I then started nine culture experiments, using the same medium, and inoculated them with a pure culture of *Nitzschia paradoxa*. Three of them were exposed to day light, three to night light, and three to light from both day and night skies. These experiments were begun on August 14 and discontinued on September 1. The first quarter of the moon was on August 9, and the third quarter on August 24, so that the cultures exposed to the night sky were illuminated by a period of maximum polarisation.[2] To make the periods of exposure comparative, the day and night cultures had twelve hours each in the light, the cover which permitted access of light being changed at 8 A.M. and 8 P.M.

The results obtained were as follows:

Culture (*a*)—night light—216 hours.
Culture (*b*)—night light and day light—432 hours.
Culture (*c*)—day light—216 hours.

In cultures (*a*) no reproduction took place, no brown film spread over the bottom of the Petri dishes, and no mass of individuals could be seen with the microscope. In the cultures (*b*) reproduction occurred to the greatest extent, the brown film of diatoms spreading over the bottom of the dishes in a shorter time and in greater numbers than in either of the other two cases. In cultures (*c*) reproduction occurred, but the visible brown film appeared later, and the number of individuals was obviously less than in case (*b*), which had twice the time of exposure.

From these results it appears that the light 'ration' is very important to diatoms: moonlight alone is insufficient to stimulate reproduction, and photosynthesis must take place. The fact that food is an important factor as well as light in reproduction[3] is as true of these minute cryptogams as it is of birds and mammals.

Furthermore, it seems that polarised light promotes the hydrolysis of starch in the presence of the enzyme diastase.[4] This probably explains the asexual reproduction of diatoms at night. In the daytime photosynthesis takes place, ultra-violet light being the active component of sunlight, and starch is deposited round the pyrenoids of the cells. At night hydrolysis takes place, polarised light, in the absence of ultra-violet light, being the active component of moonlight, and this breaking down of starch is conducive to reproduction. It is quite reasonable to believe that this hydrolysis supplies the energy which stimulates the division of the nucleus.

GRAHAM PHILIP.

128, Westbourne Avenue, Hull.
Oct. 8

[1] Philip, NATURE, **129**, 655, April 30, 1932.
[2] Fox, NATURE, **130**, 23, July 2, 1932.
[3] Bissonnette, NATURE, **129**, 612, April 23, 1932.
[4] Semmens, NATURE, **130**, 243, Aug. 13, 1932.

Constitution of Cholesterol

IT is not too much to say that work published this month[1] has resolved all dubieties in regard to the main outlines of the molecular structure of the sterols and bile acids, and unquestionably the Wieland-Dane formula is correct. In addition to the change in the position of the hydroxyl group which was mentioned in my letter of October 8 a further modification of current views is necessary in order to make the pieces of the puzzle fit together. Lithobilianic acid and *iso*lithobilianic acid must be stereoisomerides and not structural isomerides as usually assumed and the seat of this persistent type of isomerism is doubtless C–8 of Wieland-Dane's formula. Thus in a *cis*-series we have lithobilianic acid, dihydrocholesterol, the Abderhalden–Diels dibasic acid; and in a *trans*-series, coprosterol and *iso*lithobilianic acid. Interchange of the isomerides

occurs when a carbonyl group is attached to positions 8 or 9 as in deoxybilianic acid and ketostadenic acid. Stereoisomerism also arises as the result of the disposition of groups round position 5.

Only a minor point of the Wieland-Dane formula remains doubtful, and that is the site chosen for the methyl group in the position common to ring II (bile acids) and ring IV. On biogenetic grounds the other point of fusion of these rings would appear to be preferable, the methyl wandering in that case into a *para*-position in certain reactions in the ergosterol series.

As a corollary to the above the paper mentioned in my earlier letter has been withdrawn.

R. ROBINSON.

Dyson Perrins Laboratory,
Oxford. Oct. 12.

[1] Tschesche, *Annalen*, **498**, 185; 1932. Wieland, Dane and Schönberg, *Z. physiol. Chem.*, **211**, 261; 1932. Wieland, Dane and Maiweg, *ibid*, 164.

A New Principle of Time Observation, especially for Determination of Longitude

A MAIN difficulty of accurate time determination is the personal equation of the observer. Although the term 'personal equation' suggests that any trained observer would have a fixed personality, such is not found to be the case; and two observers will differ by different amounts in varying circumstances.

Nowadays personality in time observation is to a considerable degree overcome by the 'moving wire micrometer' with which the transit instruments of observatories are generally equipped. I have heard the statement that by this means the personality of several observers is reduced to fall within 0·02 seconds of time. Experience at the Dehra Dun Observatory, where regular time observations have been in progress for the past six years by means of a transit fitted with a moving wire micrometer (hand-driven), scarcely justifies this; and I should say that the results of the several regular time observers scarcely fall within 0·04 seconds of time.

In field observations the differences are apt to be even greater, for the observer is then subjected to much greater changes of conditions than he is likely to encounter in an established observatory. For the study of the figure of the earth, longitude observations must be made at numerous field stations, and the results are apt to be marred by any personal error which is considerable and yet not constant and determinable.

Some six months ago the idea occurred to me to vary the nature of the observation, as now indicated. Instead of attempting to time the instant of a star crossing a wire in the eyepiece of a telescope by depressing a tappet and thereby making a record on a chronograph, or, with the moving wire micrometer, striving to keep the star intersected for a considerable time during which contacts cause a record on a chronograph, I proposed the following plan. The telescope is fitted with a form of shutter which is operated by the clock. This shutter obscures the star to be observed except for brief periods, controlled by the clock. The duration of the exposure should not exceed the period of persistence on the retina, say 0·07 second; and it has been found convenient to have exposures at intervals of three seconds. The eyepiece is provided with a fixed scale, appropriate to the magnification of the telescope—that on which trials have been made was divided to 0·1 mm. The observation consists in estimating the position of the star on the scale at each exposure. The star appears stationary at each exposure, and the observation is merely the reading of a scale. I cannot see that there is room for personality in the mean of a considerable number of readings well distributed over the scale. The observation is not trying to the observer.

Putting this idea into practice has offered a good many difficulties in an observatory remote from scientific supplies. Apart from the glass scale, kindly obtained for me by Sir Gerald Lenox Conyngham and sent out by air mail, I have had to contrive the other requirements from raw materials. I will not enter further into details than to say that a shutter was first placed in front of the object glass but was soon replaced by a narrow strip close to the glass scale and actuated by an electro-magnet controlled by the clock. Owing to the monsoon, clear skies have been very rare and the observations so far obtained are not sufficiently numerous to warrant final conclusions; but the results do not appear to suggest systematic error.

The application of the method to the prismatic astrolabe and to ordinary theodolites has also been considered, and seems quite feasible. As the method does not require a chronograph it offers considerable advantages for field work in difficult country where lightness of equipment is important, and if further observations confirm its precision it will also be useful for time determination in observatories.

J. DE GRAAFF HUNTER.

Survey of India,
Geodetic Branch Office,
Dehra Dun, Sept. 14.

Variations of Latitude and Great Earthquakes

THE beautiful Japanese chart of variation of latitude which accompanies Prof. Nagaoka's communication to NATURE of October 8 starts many inquiries. The motion was within six feet of swing until upset by the Mindanao earthquake, which started an annual wobble of double that amount. This may throw light on the gyroscopic causes of wobble.

Linked with this inquiry, involving the equatorial protuberance, is the uniformity of rotation. Beside checks on it by moon and planets, which can scarcely be very minute, there is the pendulum check. For that a metal pendulum cannot suffice, for the internal flow of cold metal is so slow that it takes centuries for oxidisable products to reach the surface. Only a stone pendulum can serve the question; for that a beryl cut between the axes of contraction and expansion will give a pendulum independent of temperature.

The elevation of the observing station is also involved, and partly settled by sea level. But there is no uniformity in sea level, as ocean flow will not immediately equalise rainfall and evaporation of the ocean. Suppose twenty feet of water piled up at Karachi by Indus flow; for that to equalise with the dry heat evaporation of the South Arabian Sea, it would make a slope of an inch in five miles; and, if flow varies as gradient, that would take most of a year to reach Aden. This suggests that ocean level may be twenty feet higher permanently at Karachi above Aden. It is only possible to suggest inquiry on these interlinked questions; to find solutions is a task of the future.

FLINDERS PETRIE.

Gaza, Palestine.

Research Items

Totemism among the Karadjeri.—The totemic system and social organisation of the Karadjeri tribe, which inhabits territory around Lagrange Bay, north-western Australia, is described by Mr. Ralph Piddington in *Oceania*, vol. 2, pt. 4. Although the tribe has long been under the influence of the white man, certain elements of the totemic system, such as the increase ceremonies and their associated mythology, retain the more important features of their original elements. Increase ceremonies are associated primarily with the districts in which the ceremonies are held rather than with the individual members of the totems. Not all species have their increase centres located in Karadjeri territory, but all important natural species have increase centres somewhere. There are certain prescribed forms for the ritual, though these are not so circumscribed as among the Aranda. The ceremonies are usually performed once a year only, and, if the species appears at one season only, generally just before it becomes plentiful. If the ceremony is associated with perennial foods, it may be performed at any time. Instructions to the species to become plentiful are uttered by the performers as they carry out the ritual, the districts in which it should become plentiful being named in succession. The places named are those in which the species are actually found. At many of the increase ceremonies decorations are worn, such as powdered charcoal, red ochre, white mud, white down, and blood from a human being, taken from the fore-arm by a pointed bone from a wallaby's leg, at a ceremony of which no woman should be a witness.

Ancient Hindu Temples in Burma.—The history and cult of the only Hindu temple in Burma now extant, the Nat-Hlaung temple, Pagan, is discussed by Nihar Ranjar Ray in a communication to the *Indian Antiquary* for September. It would appear that the temple was built not for housing figures of the Buddha, but for statues of deities inferior to him—Hindu figures of the different incarnations of Viṣṇu. According to tradition the temple was founded by king Taung Thugyi (A.D. 931–964); but more probably, and in accordance with another tradition, it was founded by Anaorahta, who flourished in the last half of the eleventh century, even though he was an ardent adherent of the southern Sinhalese school of Buddhism, under the influence of the Brahmanas, who were prominent at the Pagan court. The figure of the main deity of the temple once stood in a niche in a square obelisk in the centre of the interior; but after lying on the floor for long it was removed, and is now in Berlin. It was a seated image of Viṣṇu, of which the lotus throne rests on the bird Garuda posed ready to fly. The god is elaborately ornamented from head to ankles. The bird differs from other representations in Burma. It shows a short stunted human bust resting on two heavy rounded feet. A peculiar feature of the figures of the ten niches on the outer walls of the temple, is that of the seven which still remain, only four are avatars of Viṣṇu, while of the other three, one is identified as the image of Sûrya. It is of the south Indian variety. In the Vedas Sûrya is identified with the sun and is intimately related with Viṣṇu. The idea that Viṣṇu is the sun appears in the worship of the sun as Sûrya-Nârâyaṇa.

The Inheritance of Goitre.—Various hypotheses have been put forward to explain the inheritance of goitre, which is well known to be endemic in regions where the soil waters have a low iodine content but to occur sporadically elsewhere. Dr. C. B. Davenport (Carnegie Inst. Publ. No. 428) has recently made an investigation of goitrous families in a mountain valley in western Maryland. The difficulty of drawing a line, particularly in women, between functional and pathological enlargement of the thyroid, introduces some uncertainty into the results. Since many individuals in goitrous regions escape the disease while some in other areas develop it, the threshold for iodine intake and the efficiency of the thyroid must vary in different families. Dr. Davenport has compiled a number of pedigrees, and from their analysis reaches the conclusion that for the appearance of goitre two genetic factors are necessary, one dominant and sex-linked, the other dominant but not sex-linked. This hypothesis accounts for the well-known excess of females with goitre, and also for various relationships found among the offspring when one or both parents are goitrous. How widely this hypothesis is applicable can be determined by testing it with other pedigrees.

X-Ray Analysis of Teeth.—The hardness of teeth, like that of bone, is due to the deposition, in the enamel and dentine, of a salt (or salts) of calcium and phosphorus. Previous X-ray investigations have indicated the probability that these elements are deposited in the form of apatite. J. Thewlis (*Brit. J. Radiology*, **5**, 353; 1932) has recently confirmed this conclusion, in an X-ray analysis of the enamel and dentine of both human and canine teeth. The rays are more heavily absorbed by the enamel than by the dentine, due to the greater proportion of organic matter in the latter. From density determinations it appears that there is about five per cent of organic matter in the enamel but forty per cent in the dentine. The human tooth contains slightly less than the canine. It was also found that the crystallites of the dentine, in both types of teeth, are randomly oriented: the enamel crystallites, however, have one direction in common but are otherwise randomly oriented. This direction makes an angle of 20° with the normal to the tooth surface in human teeth and is coincident with the normal in canine teeth. There is a possibility that the immunity of dogs' teeth to caries may be related to the arrangement of the crystals of apatite in the enamel. Thewlis's experiments failed to disclose the presence of any other crystalline constituent.

Cytology of Spinning Glands.—St. Wajda (*Bull. Internat. Acad. Polon. Sci. et Lettres*, No. 2, Bd. II., 1931) has investigated the cytology of the spinning glands of the larvæ of the trichopterous insect *Anabolia*, and has shown that, as in the spinning glands of other insects, the nucleolar substance plays an important part in the formation of the secretion which, he states, may be produced in four different ways. (1) The nucleolar material may be extruded from the nucleus into the basal part of the cell; there it stains with acid dyes more weakly than the nucleoli, and forms a sort of pro-secretion which later

breaks up into spherules, and these lie for a long time in the cell plasma, but later increase in size at the expense of the cytoplasm and are finally passed into the lumen of the gland. (2) The nucleolar substance may be expelled from the nucleus into the cytoplasm, where it lies in large vacuoles, and from this eosinophilous material small secretion particles pass from the cytoplasm into the lumen of the gland —in this case the secretion arises directly from the nucleolus. (3) Fragmentation of the nucleolus occurs, and the pieces lie each in a vacuole and become changed by swelling and pyrenolysis into the spinning substance. (4) Pieces of chromatin change from basophile to eosinophile and become transformed into the spinning material. The nucleolar substance therefore plays the most important part in the production of the spinning secretion, as is the case in other insect larvæ previously investigated, but there is no production of the secretion in the cell plasma such as takes place in the larvæ of Myrmeleonidæ and Hymenoptera. This may be correlated with the different chemical constitution of the secretion in the Trichoptera, which 'sets' under water.

Metabolism of Potatoes affected with Leaf-Roll.—Leaf-roll of potatoes is perhaps the most serious of the so-called degeneration diseases. It has been recognised for many years that the causal virus produces an accumulation of starch in the leaves and hinders its translocation to the tuber. The cause of this hindrance forms the subject of a very extensive study by E. Barton-Wright and A. M'Bain ("Studies in the Physiology of the Virus Diseases of the Potato : A Comparison of the Carbohydrate Metabolism of Normal with that of Leaf-Roll Potatoes". *Trans. Roy. Soc. Edin.*, vol. 57, Pt. II, No. 11, 1931–32). It was found that sucrose is the sugar of translocation in healthy plants, whilst carbohydrates are removed as hexose in leaf-roll potatoes. The seasonal variation of starch content in leaf-roll tubers has also been studied, and the bearing of these factors on tuber formation is discussed. Two varieties of potato have been used for the experiments—'Arran Victory', which is not much affected by leaf-roll, and 'President', which is attacked very severely by the disease.

'Tea Yellows' in Nyasaland.—A communication from the Department of Agriculture of the Nyasaland Protectorate (Bulletin No. 3, new series) records a successful piece of work on the etiology and control of the 'yellows' disease of the tea bush, which has troubled planters in Nyasaland for many years. This work, done by Dr. H. H. Storey, of the Agricultural Research Station Amani, Tanganyika, and Mr. H. Leach, mycologist to the Nyasaland Department of Agriculture, leaves little doubt that 'tea yellows' is a deficiency disease due to lack of sulphur in the soil and in the plant. An experiment, started in 1927, showed that the application of ammonium sulphate was very effective in restoring the health of severely diseased bushes, and this was followed up by a series of field tests with fertilisers containing sulphur and not containing sulphur, which showed that both prevention and cure are effected by the sulphate part of the fertilisers. Treatment with ground sulphur was also found beneficial. These results were corroborated by growing tea seedlings with their roots immersed in distilled water containing all the essential plant foods, and in solutions from which one of these plant foods was absent. The seedlings grown in the solution without sulphur developed the exact symptoms of 'yellows' disease even down to the scorching of the young leaves. Chemical analysis of leaves from diseased bushes showed a deficiency in sulphur, and mycological investigation indicated that the fungus *Rhizoctonia bataticola*, which is found on the roots of diseased plants, is not the causative agent, but invades the plant after its health has been sapped by the disease. The control measure now recommended is to apply ammonium sulphate or potassium sulphate in a minimum dressing of 1 oz. per old plant or $\frac{1}{2}$ oz. per new plant, or sulphur at the rate of $\frac{1}{4}$ oz. or $\frac{1}{8}$ oz., respectively. The use of kraal manure, which is rich in combined sulphur, is also advocated.

Swedish Topography.—A detailed study of the recent geology of the Stockholm region in its relation to the existing topography is contained in a paper by Prof. G. de Geer entitled "Stockholmstraktens Kvartärgeologi" (*Sveriges Geologiska Undersöknung*, Sev. Ba. 12). It is accompanied by a large-scale coloured geological map of the area showing the surface geology, and much of the paper consists of a discussion of the relations to one another and the sequence of the moraine strata. The morphology of the region is shown to be partly determined by shatter belts and this feature is particularly noticeable in the area lying to the south of the inlet joining Lake Mälar to the Baltic. This inlet, some forty metres deep, is bordered on its southern side by a horst rising comparatively steeply to sixty or even seventy metres. This horst, like the rest of the area, was once covered by Cambro-Silurian deposits. It was then faulted downwards and so its covering rocks were better preserved than in surrounding regions. Subsequent elevation then occurred and gave the present position. The paper is provided with summaries in English of several of its sections.

Scattering of X-Rays by Amorphous Media.—The *Physikalische Zeitschrift* for Aug. 15 contains two papers dealing with the scattering of X-rays by 'amorphous' media. In the first, by Mencke, the scattering is studied in the 'atomic' liquids mercury and gallium, and in carbon tetrachloride. A filtered beam of X-rays falls at a small angle on the liquid surface, and the scattered intensity shows periodic variations with angle. From these one may deduce the structure of the liquid as expressed by a curve showing the relative probability of various interatomic separations. The distribution is similar to that obtained by shaking up two marked balls in a lot of similar balls. The case of carbon tetrachloride is more complicated, and it appears that the scattering cannot be explained by assuming molecules oriented at random. In the other paper, by Ehrhardt, the shapes of the molecules (1,1) and (1,2) $C_2H_4Cl_2$ and (1,2) $C_2H_2Cl_2$ are studied by X-ray interference patterns obtained from the vapours. The results show the distortion of the 'tetrahedral' linkages when chlorine molecules are linked to carbon atoms, the atomic separations in the *cis* and *trans* forms of (1,2) $C_2H_2Cl_2$ and the structure of (1,2) $C_2H_4Cl_2$ as a rotational oscillation around a stable *trans* form. The paper is an interesting example of the application of X-rays to the structure of simple organic molecules.

Scattering of Light by Argon and Methane.—Rayleigh and others have found that the light scattered transversely when a beam of unpolarised light passes through argon is incompletely polarised.

The incompleteness is usually explained by assuming that the molecules behave as anisotropic electric dipole radiators, but it is also possible to explain it on the assumption of electric quadripole radiators or of magnetic dipoles. S. Parthasarathy has described (*Indian J. Phys.*, July) an experiment designed to test this point. The anisotropic dipole view alone requires that the light scattered in the plane of the electric vector from a beam of plane polarised light be unpolarised. The gases were illuminated with a plane polarised beam and the track was photographed through a double image prism by a lens of aperture *F*:1. A 48-hour exposure was required. The images showed that the light was unpolarised as required by the anisotropic dipole theory. A similar result was found for methane.

Free Organic Radicals.—Rice, Johnston and Evering (*J. Amer. Chem. Soc.*, Sept.) have presented experimental evidence for the decomposition of organic compounds into free radicals by heat. Paneth had previously shown that the vapour of lead tetraethyl, $Pb(C_2H_5)_4$, when mixed with an indifferent gas and passed through a heated tube, decomposed with the formation of free ethyl radicals, since the decomposed gas would remove lead mirrors from a colder part of the tube to form tetraethyl lead once more. The present authors show that a condensable gas such as steam or carbon dioxide may be substituted for the permanent gas, and that a great variety of organic compounds when heated in the range 800°–1000° decompose into free radicals, so that by removing the products rapidly from the furnace, the free radicals formed can be combined with many different metals. Acetone gives only methyl groups; propane gives 80 per cent methyl and 20 per cent ethyl; and butane gives 70 per cent methyl and 30 per cent ethyl. The half-life of the radicals so obtained is 1×10^{-3}–2×10^{-3} sec., as compared with 6×10^{-3} sec. obtained by Paneth and his co-workers. The rate of disappearance does not follow either a first order or a second order equation very well. The temperature coefficient of the decomposition into free radicals, in the case of acetone, was approximately the same as the temperature coefficient of the ordinary thermal decomposition.

Astronomical Topics

Astronomical Notes for November.—Venus and Jupiter are conspicuous morning stars. Venus is now more than a unit from the earth, but three quarters of the disc is illuminated. Mars is also a morning star, near Regulus on November 10; but it is still too distant for useful observation. Uranus is well placed for observation in Pisces, and is observable nearly all night.

Several occultations of stars by the moon are observable in London. A sixth magnitude star disappears at 9^h39^m P.M. on November 8. The Pleiades are occulted at the end of November 13 and beginning of November 14, but the moon is only 18 hours past full. Disappearances occur at 10^h30^m, 10^h53^m and 11^h4^m P.M. Re-appearances (at the dark limb) at 11^h22^m (angle 197°), 0^h6^m (angle 274°), and 0^h26^m (angle 241°). Regulus is occulted on the morning of November 21; disappearance 7^h51^m A.M.; re-appearance 8^h51^m (angle 274°). The angles are measured from north point through east.

A good display of the Leonid meteors is likely to occur this year, but it is impossible to predict what longitudes on earth will be most favoured; the most likely time of maximum is in daylight on November 16, but watch should be kept for two or three nights preceding and following this. The Astronomer Royal has requested the Directors of Kodaikanal and Helwan Observatories to telegraph to the B.B.C. if they see a rich shower. The B.B.C. will broadcast the telegrams if they arrive before the stations close down. The radiant (near Gamma Leonis) does not rise until nearly 11 P.M., so watch need not begin until then. Tempel's comet, associated with these meteors, may also be detected in November; search ephemerides are given in the B.A.A. Handbook for 1932 and (with shorter time intervals) in B.A.A. *Journal*, vol. 42, No. 10. The earth on November 16 is only half a million miles from the comet's orbit.

The minor planet Vesta is in opposition on November 22, and is visible in a binocular, being brighter than mag. 7. An accurate ephemeris is given in the B.A.A. Handbook for November; the following will probably suffice to find it:—

	R.A.	N. Decl.
Nov. 5	0^h 4^h $14{\cdot}8^m$	12° 42′
13	4 7·2	12 27
21	3 58·8	12 15
29	3 502·	12 8

Vesta is 5′ south of λ Tauri on the evening of November 22. Conveniently observable minima of Algol occur on November 3, 9^h P.M., November 6, 6^h P.M., November 23, 11^h P.M., November 26, 8^h P.M.

Radial Velocities of Stars, Nebulæ and Clusters.—Vol. 18 of the Lick Observatory Publications consists of a useful catalogue of radial velocities compiled by Joseph Haines Moore. All the results obtained at the Lick Observatory and at its southern station in Chile are included, also those at eighteen other observatories, systematic corrections being applied to all classes of observations for which their determination is possible. The results of the separate observatories are given for each star, also an adopted value with its estimated probable error. The stellar portion of the catalogue occupies 199 pages with an average of about thirty stars on each. Then follows a short catalogue of velocities of 133 gaseous nebulæ; these are all galactic objects except 18 in the Magellanic Clouds. Another list includes the results for 18 globular clusters, mainly obtained by V. M. Slipher at the Lowell Observatory. Finally there are radial velocities for ninety extra-galactic nebulæ, mainly obtained at the Lowell Observatory and at Mount Wilson. The spectral shift is expressed as radial velocity, but with a note that this is only done for uniformity with the rest of the catalogue, not asserting that this is its true interpretation. The velocities are nearly all positive; there are the well known exceptions of the Andromeda nebula and its two companions, also M. 33 and N.G.C. 6822. The largest recessional velocity is 19,700 km./sec. for a nebula in Leo, R.A. (1900) $10^h22{\cdot}0^m$ N.Decl. 10° 56′.

The Structure of Cellulose and Related Substances

THE discussion arranged by Section B (Chemistry) of the British Association on September 2, on the constitution of polysaccharides with special reference to fibres, was perhaps a happy example of what such discussions should be and disarms some of the criticism which has recently been levelled against the programmes of certain of the sections. The results of recent researches in this difficult but fascinating field were presented for the most part in a lucid manner which rendered them intelligible to scientific workers generally and not merely to specialists in this particular field. For this some credit must undoubtedly be given to the formal arrangement of the discussion; the gap left by Prof. M. Bergman, who was unable to be present, was well filled by Prof. L. Zechmeister.

Prof. W. N. Haworth opened the discussion with a survey of the development of our knowledge of the constitution of polysaccharides in which the fundamental contribution of the work of the Birmingham school in establishing the structure of the mono- and di-saccharides was emphasised. The structure of cellulose, for example, rests ultimately on the constitution assigned to the disaccharide cellobiose, and the mutual linking of β-glucopyranose residues in a chain through positions 1 and 4 of the glucose molecules is the fundamental principle of the modern cellulose structure. Recent work by Haworth and Machemer has indicated that information on the approximate length of the chains and as to whether they are open or closed can be obtained by a study of the fully methylated derivative of cellulose, obtained by methylation under very mild conditions in which no important degradation or decomposition of the macro-molecules occurs. Since if the macro-molecule is in the form of an endless chain, each glucose unit ultimately yields 2 : 3 : 6-trimethylglucose, while if the chain terminates one of the terminal groups yields a molecule of tetramethylglucose, and a quantitative separation of the tri- and tetramethylglucose is possible, the hydrolysis method can be used to determine the structure of the chain. The formation of 0·6 per cent of tetramethylglucose accordingly indicates a mean average length of about 100–200 glucose units for the terminated chains in cellulose. The average molecular weight of 30,000 thus indicated is in good agreement with values obtained from X-ray data and by the use of Svedberg's ultra-centrifuge method. Values obtained by this method for the chain length of a long series of cellodextrins are in excellent agreement with those obtained by viscosity measurements or by determination of the iodine value.

Prof. H. Staudinger then described the viscosity method of investigating the nature and size of the colloid particles of cellulose and related substances. An exhaustive study of synthetic polymeric substances of known constitution parallel with that of the 'polymer homologous' series of degradation products of cellulose showed that in sufficiently dilute solution the relation between their molecular length and viscosity in solution is expressed by the viscosity law :

$$\eta/c = K_m.M$$

where η is the specific viscosity, c, the concentration, K_m a characteristic constant for each polymer homologous series and M the molecular weight. In these solutions as in solutions of cellulose in Schweizer's reagent or of cellulose acetate or nitrate in organic media the colloid particles are the molecules themselves and do not have a micellar structure. The 'polymer homologous' series of degradation products of cellulose obey the same law and these methods lead by extrapolation to a molecular weight of 120,000 for cellulose in Schweizer's reagent, 750 glucose residues being combined in one molecule. The molecules are long threads which in one dimension are 500 times longer than in the other two. Viscosity relations also afford evidence of the presence of a 6-carbon atom ring in the glucose residues of cellulose.

Prof. L. Zechmeister's paper discussed the unexpected behaviour towards enzymes of polysaccharides of comparatively small chain-length (4–8 glucose units). Dr. Zechmeister suggested that in enzyme reactions the length of chain of the reacting molecule as well as the character of the groupings present is important. The field of investigation thus outlined is of the greater interest in view of Mr. W. T. Astbury's suggestion of the existence of a fundamental relation between protein chains and polysaccharide chains.

Dr. E. L. Hirst then discussed the question of the molecular structure of starch and its allied products glycogen and inulin. In starch the mutually linked glucose residues are united by α-glucosidic linkings in contrast with the β-glucosidic linkings of cellulose, while the α-linkings of starch do not readily give a straight chain pattern but favour the formation of interlocked aggregates of the macro-molecules, which in presence of water are hydrated with formation of micellar solutions. Recent work has shown that the differences between amylose and amylopectin do not depend on the phosphorus content. On careful acetylation and methylation the special characteristics of each modification are retained and since the purified and fractionated methylated derivatives both yielded 5 per cent of tetramethylglucose, the macro-molecules of amylose and amylopectin both consist of terminated chains of 24–30 glucose units (mean average mol. wt. 4000–5000) and the differences between amylose and amylopectin depend on hydration and interlocking of the macro-molecules and on micellar structure. Glycogen is built up on a plan similar to that of starch and differs from amylose in having a macro-molecule containing only 12–14 glucose residues in the chain. Similarly inulin has been found to consist of a terminated chain of about 30 fructofuranose residues mutually linked through positions 1 and 2, the macro-molecule probably terminating at one end in a reducing group. The corresponding molecular weight (about 5000) is in good agreement with estimates made by direct methods.

Prof. H. Mark gave a critical review of the bases upon which the accepted formula for cellulose rests, and showed how a combination of the chemical methods which had established the structure of cellobiose and the disaccharides, the application of X-ray methods, and the researches of Prof. Staudinger on the nature and size of molecules of colloidal substances had led to a picture of the cellulose molecule and of the arrangement of molecules in the fibre which in many respects may be considered as definitely established. From a detailed examination of X-ray data including data recently obtained by the

application of new methods Dr. Mark described the arrangement of the glucose units in the fibre and of groups of these chains associated as micellar bundles, the length of the chain being about 100–200 glucose residues, in agreement with the value obtained by the chemical methods of the Birmingham school.

The final paper by Mr. W. T. Astbury described the application of X-ray methods in the field of protein chemistry, where again the combination of the results of organic chemistry and physical methods has established the concept of long chain molecules. Protein fibres are built up of polypeptide chains in various states of extension whereas cellulose appears to be laid down in biological structures as fully extended chains. X-ray methods have as yet revealed only two proteins, the fibroin of natural silk and the β-keratin of stretched hair which are in a fully extended state. Since in natural processes the formation of cellulose and other polysaccharides seems to be effected through the intervention of proteins, it is possible that the protein chains may act as a pattern or framework upon which the sugar units are laid down as a preliminary step to their linking together in polysaccharide chains. It is an interesting point that the chief longitudinal spacings of muscle and of unstretched hair are almost equal to the length of a glucose residue as it occurs in cellulose and the fact that the crossed-cellulose chains of the wall of *Valonia ventricosa* are laid down according to a definite plan indicates that they have been built on a net-work pattern in the underlying protoplasmic layer.

Sixth International Congress of Genetics

NOTWITHSTANDING the small number of European delegates attending, the International Congress of Genetics held at Cornell University, Ithaca, New York, on August 24–31, was a marked success. This was mainly owing to the large amount of preparatory work undertaken by the Organisation Committee, the Executive Council and the Local Committee. Although many papers were not read in the absence of their authors, the programme was still overcrowded, and the volume of proceedings containing the abstracts of papers and descriptions of exhibits runs to more than four hundred pages. The exhibits alone would have furnished ample material for a busy week. Numerous laboratories in several buildings were devoted to exhibits, in which cytological demonstrations played a prominent part; but they included also living and dried specimens illustrating genetic experiments with fungi, liverworts, mosses, ferns, numerous cereals, economic and other plants, as well as collections of varieties of maize and vegetables and numerous floricultural exhibits. The animal exhibits included *Drosophilia* and *Sciara*, Lepidoptera, Orthoptera, bees, aphids, *Gammarus*, tunicates, echinoderms, molluscs, fishes, rats and mice, foxes, pigeons, guinea-pigs, and all the domestic animals, many of the latter as living specimens.

FIG. 1.—Genetic garden at the Sixth International Congress of Genetics, Ithaca

A unique feature of the Congress was the genetic garden (Fig. 1), contributed to by geneticists who had sent seeds from many parts of the world. Here were demonstrated and compared side by side the various forms, hybrids and mutations, of *Zea*, *Œnothera*, *Nicotiana*, *Primula*, *Antirrhinum*, *Pharbitis*, *Helianthus*, *Pisum*, etc. A special feature arranged by Prof. Emerson was the display of the numerous mutations of *Zea* in their proper order in the ten chromosomes, as determined by linkage investigations. A chart also showed the loci of more than eighty genes in maize.

The cytological demonstrations were so many that, although a hundred microscopes must have been in use, each exhibit could only be set up for one afternoon. The work on maize chromosomes by the Cornell group was the basis of excited discussions. The great detail of chromosome structure and behaviour observable in maize is in marked contrast to *Drosophila*, although here, too, numerous cases of visible translocations were demonstrated.

The morning sessions were devoted to general papers grouped under such topics as the nature and cause of mutations, the interrelations of cytology and genetics, the genetics of species hybrids and the contributions of genetics to the theory of organic evolution. On the afternoons of the last three days the Congress divided into six sections for the reading of a very large number of more specialised papers. The grouping of these was under such topics as general genetics, cytology, animal genetics, human genetics, methods and technique, and genetics and pathology. Numerous papers were concerned with *Drosophila* and a number bore on chromosome structure, especially in relation to crossing-over.

The presidential address by Prof. T. H. Morgan was on "The Rise of Genetics".

The evenings were taken up with informal group conferences on such subjects as the nature of the gene, poultry linkage work, mice, maize, size valuation, fish genetics and human genetics. Motion picture films were shown of the developing fowl blastoderm, living cells in mitosis and sexual reproduction in *Mucor*.

On the last day of this crowded week the Congress met at the New York Agricultural Experiment Station, Geneva, where the papers, exhibits and demonstrations related mainly to fruit and vegetable breeding and agricultural bacteriology. This was followed by excursions to New England and Canada, while others dispersed to see the solar eclipse of August 31.

The Congress must have been a great stimulus to everyone who took part in it, for it served to show that genetics is still a rapidly expanding field, with innumerable practical applications in plant and animal production and also with a widening basis in relation to general biological theory. Many papers showed how technical is becoming the investigation of the *Drosophila* mutations and the production of mutations in many organisms by X-rays. Perhaps the most general advance indicated since the last Congress in 1927 is the increasing intimacy of relationship demonstrated between chromosome structure and genetic behaviour.

The British delegates included Prof. Ruggles Gates and Prof. F. A. E. Crew, representing the Government, and Dr. R. A. Fisher, Prof. J. B. S. Haldane, Dr. C. C. Hurst, Dr. C. D. Darlington, Dr. Honor Fell and Dr. John Hammond.

Progress of Aeronautical Research*

THE Aeronautical Research Committee's report of the year's work reflects the general slowing up of all progress consequent upon the reduction of expenditure, in that there has been little new research undertaken, but a good deal of cleaning-up of outstanding detail has been accomplished.

New experimental apparatus has received a good deal of attention. At the National Physical Laboratory the new compressed air tunnel is in working order, and an early obsolete tunnel is being rebuilt with an elliptical cross section and a much higher speed. The R.A.E. has the new vertical free flight tunnel in operation. A modification giving an increase of speed in the new open jet tunnel, and a new high-speed water tank are both practically finished. A 24 ft. full scale tunnel is in hand, and should be working by the end of 1933.

The work on spinning has been collected and collated, and design rules for ease of recovery from, or for complete avoidance of, spinning, have been developed. An interesting sideline in these experiments has been the development of wing-tip parachutes, which can be released at will to act as brakes on the spinning machine. It is suggested that these will reduce the danger when carrying out spinning tests on new type machines, the properties of which in this respect have to be found by actual experiment.

Further research on 'buffeting'—an effect first brought into prominence by the failure of a German D.V.L. aircraft over Meopham—suggests a remedy which in cases appears to clash with that needed to cure spinning. Buffeting can be minimised by keeping the tail plane "in the lowest practicable position in relation to the wings", while for the avoidance of spinning it is necessary to raise the tail plane with respect to the fin and rudder. These contradictory requirements appear to indicate a disadvantage of the low-wing monoplane which has not previously been realised.

The problems of stability and control are adequately met by the development of various forms of slots and interceptors, and as a result of the intensive investigations upon these questions the report suggests that there is now sufficient information in existence to enable designers to achieve a sufficient degree of safety by "correctly shaping and arranging the wings and tail organs without using additional mechanisms on the wings". Similar remarks are made with regard to wing or tail flutter. Airscrew flutter is unfortunately not so completely understood, and further investigations into this are proposed.

Interference between various adjacent parts of an aeroplane has now been dealt with up to the stage at which it is possible to isolate the various causes and deal with them separately.

A new term, "spoiling drag", has been introduced to indicate an additional drag due to the rotary motion of the airscrew slip stream upon the bodies in it. Suggestions for counteracting it with radial vanes are offered, as the result of wind tunnel experiments.

Attention is directed to the very rapid increase of size of sea-going aircraft during the last few years and to the necessity of keeping pace with this in research, as many new problems due to increase of size are arising. For example, the change of hydrodynamic pressures on hull bottoms during take-off and alighting are giving rise to problems upon the elasticity of the material of the hull plating.

The effect of accelerations imposed upon the aircraft by gusts is now being taken up. Vertical gusts with velocities up to 30 ft. per second have been recorded under the edges of certain types of clouds, and there is reason to suppose that even larger ones may be found in stronger winds. Statistical recording accelerometers are being developed for use on aircraft operating over established air routes. On the theoretical side the effect of accelerations on the aerodynamical characteristics of the various parts of a machine is being investigated.

The position with regard to research on aero-engines is peculiar in that it appears that there is little scope for further radical improvement in the present weight of 1·5 lb./H.P. with a fuel consumption of 0·5 lb./B.H.P./H.P. Any further reductions could only be made at the expense of reliability and length of life, but attention to details, such as cooling methods, that allow the engine and aeroplane as a whole to have a better streamline form, will possibly result in an improved performance being obtained for the same power and weight of engine. It is suggested that there is a greater probability of reducing this drag by, say, 20 per cent, than of cutting down either weight or fuel consumption by a similar amount.

In theory, fuel economy is being hindered by unsatisfactory induction pipe distribution in multi-cylinder engines, and the absence of a control of fuel-air mixture production which automatically adjusts itself to changing air conditions. Direct injection of fuel into the cylinders would remove both of these weaknesses.

Work on compression-ignition engines is progressing both with engines and fuel. It has been decided that the two-stroke direct spray type holds

* The Aeronautical Research Committee Report for the Year 1931–32. H.M. Stationery Office, 2*s*. net.

out the best possibilities of success for aircraft work, and a new experimental unit is being built. Fuel oil has been found to respond to various doping mixtures, and a small addition of ethyl nitrate renders inferior oil superior to the highest grade when undoped.

The report appreciates the fact that there has been a considerable increase in the amount of research work done at the universities. Direct aeronautical research is now being carried out at Bristol, Cambridge, Glasgow, Imperial College (South Kensington), Manchester and Oxford.

University and Educational Intelligence

CAMBRIDGE.—Mr. N. Dean of Trinity Hall has been appointed University lecturer in estate management.

The Appointments Committee of the Faculty of Biology 'B' gives notice that it will shortly proceed to appoint a University lecturer and a University demonstrator in biochemistry. The duties will commence on January 1, 1933. Particulars as to stipend and duties may be obtained from Sir Frederick Gowland Hopkins, at the School of Biochemistry, to whom applications should be sent on or before November 9.

The degree of M.A. has been conferred on Prof. R. S. Hutton, of Clare College, Goldsmiths' professor of metallurgy.

In accordance with its usual practice, Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. The College also offers, as usual, dominion and colonial exhibitions to students of dominion and colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of £40, but their actual value is such sum (if any) not exceeding the titular value as the College Council may from time to time hold to be justified by the exhibitioner's financial circumstances. If it is made clear that the financial need of an exhibitioner cannot possibly be met by the payment to him of the full amount of his titular emolument, the Council has power, if funds are available, to award him an additional payment. Candidates for the research studentship and the exhibitions must apply through the principal authority of their university, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1933.

WALES.—At a meeting of the Court of Governors of the University College of Wales, Aberystwyth, held on October 19, it was reported that Sir Julien Cahn has promised to provide a sum of £3,000 a year for a period of seven years. This money will be utilised for large-scale experiments on the improvement of poor soils at the Welsh Plant Breeding Station. Principal Stuart-Jones has accepted the invitation of the Council to retain the principalship for another year. Prof. G. A. Schott, professor of mathematics, has been appointed vice-principal of the College.

OXFORD.—On October 18 a decree was passed by Congregation constituting a Committee for Ornithology with the duty of establishing and supervising an Institute of Ornithology. The functions of the Institute, the formation of which was foreshadowed by Dr. F. Homes Dudden, the previous Vice-Chancellor, in his valedictory address, will be to carry out research into problems of ornithology, with special reference to the numbers, distribution, movements, habits and economic status of British birds; to collect, co-ordinate and supply information on these subjects obtained from published sources and from field observers, and to publish the results of its work by means of printed papers, informal instruction, or lectures. The Institute will be independent of any single University department but will work in co-operation especially with the Departments of Zoology and Comparative Anatomy and of Rural Economy. The decree creating the Institute does not come into force until May 1, 1933, and it is one of the functions of the new Committee to select the staff.

THE Council of the Institution of Naval Architects has made the following awards: Parsons scholarship in marine engineering (1932), to Mr. Allan M. Baxter, of Messrs. G. and J. Weir, Cathcart, Glasgow; Denny scholarship in naval architecture to Mr. John R. White, of Macclesfield Grammar School, and the Denny scholarship in marine engineering to Mr. K. F. Leonard, of the Ealing County School, London; Duke of Northumberland prize (in connexion with the 1932 examinations for National Higher Certificates in naval architecture) to Mr. Norman Holey, of the Technical College, Sunderland.

THE superintendence of the work of rural school teachers in the United States of America forms the subject of two recent bulletins, Nos. 6 and 7 of 1932, of the Office of Education. These supplement the studies, recently noticed in these columns (see NATURE of Oct. 15, p. 589), of the present status of the rural school teachers themselves, and afford further evidence of the keen interest now taken in rural education in that country. In "The County Superintendent in the United States" by the professor of rural education, Cornell University, attention is directed to the magnitude and the difficulty of the work of this functionary. While recent improvements in means of communication must have facilitated the inspection of schools in sparsely populated tracts, the task which falls to the lot of the typical superintendent with 145 teachers in 55 schools under his jurisdiction is a formidable one. In addition to supervision he has to attend to problems of finance, buildings and their equipment, pupil classification and progress, curricula, consolidation and transportation, etc. The intrinsic difficulty of these problems is aggravated by the fact that he has to deal with many local boards. Only a minority have a supervisory assistant and only about half have clerical help. In more than half the States the superintendent is elected by popular vote and in these 43 per cent are women and the median salary is 1848 dollars. In the other States, where appointments are made by county boards or State officials, the percentage of women superintendents is 5–18 and the median salary ranges between 2259 and 2773 dollars. An improvement in the salary situation is necessary, we are told, in all the States if the rural schools are to attract and hold professional men and women of ability.

Calendar of Geographical Exploration

Nov. 2, 1841.—Afghanistan and Its Borders

Sir Alexander Burnes was assassinated while acting as political agent in Kabul. Burnes became an interpreter in Surat when only seventeen years of age and developed a keen interest in the history and geography of north-western India and the adjacent countries. In 1832, disguised as an Afghan, he started from Lahore, made his way across Afghanistan to Balkh, thence to Bukhara, Astrabad and Teheran, and across Persia to Bushire. In 1835 he returned to Afghanistan, taking with him John Wood. The latter explored the Kabul River, crossed the Hindu Kush mountains to the Oxus, and explored that river to one of its sources. He gathered much information about the nomad tribes of that region.

Nov. 3, 1924.—The Rio Negro and its Tributaries

Dr. Hamilton Rice made his first air survey in the 1924–25 expedition to the Rio Branco and Uraricoera. Rice's valuable work on the northern portion of the Amazon basin began in 1907, when he surveyed the Uaupes River to its junction with the Rio Negro. Further expeditions in 1912–13, 1917, 1919–20 and 1924–25 resulted in an accurate survey of the tributaries of the Rio Negro and of the river itself to Manaos.

Nov. 4, 1909.—Exploration of Persia

Sir Percy Sykes left Meshed on the second part of his sixth expedition into Persia. These six expeditions were of the utmost importance for the survey of Persia, and filled in many blank spaces on its map. Sykes's travels also threw new light on ancient geography; in this sixth, 1906–10, journey he discovered the site of ancient Nishapur and also of Kishmar a spot connected by legend with Zoroaster.

Societies and Academies

LONDON

Physical Society, Oct. 21.—F. Twyman: New apparatus for rapid spectrophotometry of liquids in the ultra-violet. A single exposure, usually of less than 20 sec., results in a set of spectra which embodies all that is necessary for plotting an absorption curve.—J. D. Stephenson: An experimental study of electrical discharge in gases at normal temperatures and pressures. By an investigation based on corona discharge it is shown that there is a fixed constant, the true breakdown strength of the gas, for all types of gas discharge at normal pressures.—G. A. Tomlinson: A new type of pendulum clock. A new method of taking accurately defined seconds signals from a pendulum is described, in which a photo-electric cell is used in conjunction with a special arrangement of multiple slits. This has been developed into a complete free-pendulum system, self-maintained *in vacuo* by means of electrostatic impulses and having a closely governed arc.—S. E. Williams: A photographic method of deriving optical constants of the metals. A grating consisting of alternate strips of glass and metal of known dimensions gives diffraction spectra the relative intensities of which depend on the optical properties of the metal and glass. An expression has been found for the relative intensities of the central reflected image and the first principal diffracted image in terms of the reflection coefficients for the metal and glass and the phase change on reflection from the metal surface. By means of a photometric method which is described, the intensity ratio has been measured for two or more gratings of different proportions cut on the one mirror, enabling the deduction of the reflection coefficients and the change of phase. This is done both for light plane polarised in, and perpendicularly to, the plane of incidence, and the approximate Drude formulæ are used to calculate the optical constants. Simultaneous measurements can be made at several wave-lengths if the grating is illuminated with light from a source having a suitable line spectrum.

PARIS

Academy of Sciences, Sept. 12 (vol. 195, pp. 525–532).—N. Saltykow: The complete integral of partial differential equations of the second order.—Pierre Marti: The possibility of determining the slope of the sea floor by means of acoustic sounding. When the sea floor is level the determination of the interval of time between the sound emission and the arrival of the echo gives the depth. If the sound is powerful, several echos are received and these are separated by equal intervals of time in the case of a horizontal sea floor, but if there is a slope, the intervals of time of the successive echos are not equal, and the exact comparison of these intervals can be used for determining the slope. A formula for this is given.—V. Hourcq: The age of the glauconitic limestones of the Antsalova region (Province of Maintirano), Madagascar. It is possible that the limestone represents only the lowest part of the Kimmeridge strata and that the greater part should be regarded as Tithonic.

Sept. 19 (vol. 195, pp. 533–548).—J. Cantacuzène and S. Longhin: The experimental transmission of human leprosy to the white rat.—Louis de Broglie: An analogy between Dirac's electron and the electromagnetic wave.—J. Fromaget and F. Bonelli: Materials from Angkor and some points of the stratigraphy and the geological structure of northern and eastern Cambodia.—A. Rivière: Contribution to the study of the Jurassic in the central Elbourz.—L. Clariond, N. Gouskov and E. Roch: The ancient series of the country of Skoura (Central Moroccan Haut-Atlas).—Pierre Marty and Pierre Bout: The discovery of a layer of fossil plants in the Pliocene formation of Perrier, near Issoire (Puy-de-Dôme).—Jean Caminopetros and B. Contos: The transmission of pustular fever to the guinea-pig.

Sept. 26 (vol. 195, pp. 549–564).—A. Caillon and R. de Fleury: Casting magnesium: use of a special sand. The addition of ammonium sulphate and powdered fluorspar to the sand used for moulds is recommended on the grounds of low cost for magnesium castings.—A. Rivière: The Cretaceous in the north of central Elbourz.—Jacques Fromaget: The Caledonian folds of the massif of Fan Si Pan (Tonkin).—Léon Grigorakis: The action of ether on the microplant parasites of animal tissue. Factors of virulence, vitality, degradation and mutation.—P. Cappe de Baillon: The thermal sensitiveness of the Phasmidæ.—A. Magnan and Ch. Perrilliat-Botonet: The relative weight of the motor muscles of the wings in insects—Jonesco-Mihaiesti, A. Tupa, B Wismer and G. Badenski: Acute pseudo-tabetic syndrome resulting from the experimental inoculation of the filtrate of inguinal lymphogranulome (Nicolas–Favre).

SYDNEY

Linnean Society of New South Wales, June 29.—C. Oke: Notes on Australian Coleoptera, with descriptions of new species (2). Two new genera and thirty-five new species belonging to various families are described. Probably the most interesting species described belongs to the family Rhysodidæ, and is the first of the Australian species to be recorded as a myrmecophile.—A. B. Walkom: Fossil plants from Mount Piddington and Clarence Siding, N.S.W. Specimens from Mount Piddington include *Cladophlebis australis*, *Thinnfeldia Feistmanteli*, possible flowers of *Williamsonia*, and one which may be *Phyllotheca robusta* Feistmantel. From Clarence Siding a fertile specimen of a fern (?) with very long narrow pinnæ and sori of the *Asterotheca* type is described as a new genus. These plants occur near the western margin of the Hawkesbury Series basin, and it is difficult to correlate the horizon since, near the coast, the sandstone series has a thickness of about a thousand feet, but near the western margin the thickness is only about three hundred feet.—H. L. Jensen: Contributions to our knowledge of the Actinomycetales. (3) Further observations on the genus *Micromonospora*. A description of sixty-seven strains of *Micromonospora* isolated from Australian soils. They are divided into four species-groups, one of which seems identical with '*Streptothrix*' *chalcæ* Foulerton; the other three are described as new species. These organisms seem to occur most abundantly in neutral to alkaline soils from districts with a low rainfall.—J. R. Malloch: Notes on Australian Diptera (31). Certain species of the genus *Prosena* (Tachinidæ) are described, three being new. A key is given for the identification of the species of *Prosena*.

Royal Society of New South Wales, Aug. 3.—A. R. Penfold: The chemistry of Western Australian sandalwood oil. Conclusive and confirmatory evidence was submitted that the oil from the roots and butts yielded the best quality of oil for commercial purposes and differed considerably in chemical composition from that obtained from the stickwood. The paper was accompanied by two comprehensive tables setting forth the chemical and physical characters of each individual sample of oil together with the alcoholic bodies obtained from each by treatment with phthalic anhydride in benzene solution on a boiling water bath for two hours, as well as the yields of santalenic acid and santalol allophanate. An examination of the oil obtained from a consignment of butts said to be a fair average of the raw material used in the production of commercial Australian sandalwood oil showed it to contain more than fifty per cent of B-santalol.—Alma G. Culey: Ripple-marks in the Narrabeen series along the coast of New South Wales. Numerous exposures of oscillation ripple-marks have been observed over a large vertical range and wide area in the Narrabeen series (lower Triassic), of New South Wales. The dimensions of the ripple-marks and their association with plant remains, worm-burrows, and sun-cracks, point to quiet deposition of the Narrabeen beds in a very shallow, subsiding, fresh-water lake. Comparison of quantitative diagrams, indicating the directions of the ripple-marks and present-day winds, suggests that the planetary wind systems of lower Triassic time were the same as those prevailing now. Hence one may deduce that the poles were in the same position then as now.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 481–523, July 15, 1932).—Marcus M. Rhoades: The genetic demonstration of double strand crossing-over in *Zea mays*.—Jack Schultz: The behaviour of vermilion-suppressor in mosaics. This factor in *Drosophila* depends on factors outside the mosaic tissues as does vermilion. Its effect seems to be exerted before the onset of pigment formation.—George C. Vaillant: Stratigraphical research in Central Mexico. Continuation of the American Museum of Natural History archæological work in the Valley of Mexico. It is concluded that the Teotihuacan culture was not derived from Valley groups of the Early periods, and a ceramic sequence of three periods is arranged. The Mazapan culture is dated as post-Teotihuacan and pre-Aztec.—David Davidson and Marston T. Bogert: Isovioluric acid (alloxan-6-oxime). Prepared by action of nitrous acid on isobarbituric acid. It is rearranged by acid, giving violuric acid and by reduction yields isouramil (5, 6-dihydroxycytosine).—Edward W. Washburn and Harold C. Urey: Concentration of the H^2 isotope of hydrogen by the fractional electrolysis of water. An experiment is in process at the Bureau of Standards. Meanwhile, spectrographic examination of the residues from the commercial hydrolysis of water showed there was increase in the abundance of H^2 relative to H^1.—Linus Pauling: The electronic structure of the normal nitrous oxide molecule. A recalculation of Plyler and Barker's data leads to a value of the moment of inertia which corresponds to a Lewis structure in which the nitrogen–nitrogen bond resonates between a double and triple bond and the nitrogen–oxygen bond between a single and double bond. The structure can be written N≡N=O.—Harvey Cushing: Further concerning a parasympathetic centre in the interbrain. (7) The effect of intraventricularly injected histamine. It has been objected to the observations recorded about a year ago that the effects after intraventricular injection of pituitrin and pilocarpine were due to impurities, probably histamine. Examination of the posterior lobe extract used showed it to be free from histamine. Further, intraventricular injection of histamine produces facial pallor rather than flushing.—(8) The comparative effects on gastric motility of intramuscular and intraventricular pituitrin, pilocarpine and histamine. Pituitrin and pilocarpine do not increase gastric acidity as does histamine. When given intraventricularly, both increase motility and lead to retrograde peristalsis and vomiting; intramuscularly, they inhibit gastric peristalsis, but there is also a delayed acceleration of peristalsis with pilocarpine. Intramuscular pituitrin seems to stimulate the thoracolumbar sympathetic apparatus; intraventricular pituitrin appears to have a contrary effect, essentially parasympathetic in character.—G. A. Miller: Orders for which there exist exactly four or five groups.—J. L. Walsh: On interpolation to harmonic functions by harmonic polynomials.—A. E. Currier: Partial differentiation in the large.—Chester Stock: Eocene land mammals on the Pacific coast. The Sespe formation in Southern California comprises sandstones, shales and conglomerate. Vertebrate remains in the Simi Valley region in the maroon and green clays and sandstones of the middle division of the Sespe formation include titanotheres, rhinoceroses, artiodactyls (*Protylopus*), rodents (*Paramys*) and others indicative of the Eocene age.

Forthcoming Events

TUESDAY, Nov. 1

CHADWICK PUBLIC LECTURE—(at the Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, W.1.).—Prof. Keilstra: "Hygiene in the Far East", at 5.15 P.M.

INSTITUTION OF CIVIL ENGINEERS—(Opening Meeting). Sir Murdoch Macdonald: Presidential Address, at 6 P.M.

WEDNESDAY, Nov. 2

INSTITUTION OF HEATING AND VENTILATING ENGINEERS—(at the Lecture Room, Home Office Industrial Museum, Horseferry Road, Westminster, S.W.1).—Mr. A. F. Dufton: "Radiant Heat", at 7 P.M. (open to non-members).

THURSDAY, Nov. 3

KING'S COLLEGE, LONDON.—Prof. Martin Knudsen: "Some Aspects of the Kinetic Theory of Gases", at 5.30 P.M. (succeeding lectures on Nov. 10 and 17).

UNIVERSITY OF LONDON—(Semon Lecture at the Royal Society of Medicine, 1, Wimpole Street, W.1).—Prof. Otto Kahler: "The Tonsil Problem", at 5 P.M.

FRIDAY, Nov. 4

INSTITUTION OF MECHANICAL ENGINEERS—(Thomas Hawksley Lecture).—The Right Hon. Lord Rutherford: "Atomic Projectiles and their Application", at 6 P.M.

BRITISH SCIENCE GUILD—(Alexander Pedler Lecture).—Prof. F. T. G. Hobday: "Animals as a National Asset and Responsibility", at Burton-on-Trent.

SATURDAY, Nov. 5

GEOLOGISTS' ASSOCIATION OF LONDON.—Special General Meeting in the Botany Theatre, University College, Gower Street, W.C.1, at 3 P.M.

ROYAL INSTITUTION.—Prof. E. N. da C. Andrade: "Rays and Radiations", at 5.15 P.M.

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1432 (T.3099): Single Crystals of Bismuth subjected to Alternating Torsional Stresses. By Dr. H. J. Gough and H. L. Cox. Pp. 25+4 plates. 1*s.* 6*d.* net. No. 1434 (T.3163 extd.): Hot Wire and Spark Shadowgraphs of the Airflow through an Airscrew. By H. C. H. Townend. Pp. 10+7 plates. 1*s.* 3*d.* net. (London: H.M. Stationery Office.)

Observations of Colour Temperatures of Stars made at the Royal Observatory, Greenwich, in the Years 1926–1932, under the direction of Sir Frank Dyson. Pp. iii+63. (London: H.M. Stationery Office.) 6*s.* net.

Annals of the Cape Observatory. Vol. 13, Part 3: Discussion of Observations of Occultations of Stars by the Moon, 1672–1908; being a revision of Newcomb's "Researches on the Motion of the Moon, Part 2". By Dr. H. Spencer Jones. Pp. 70. (London: H.M. Stationery Office.) 5*s.* net.

Proceedings of the Royal Society. Series A, Vol. 137, No. A833, September 1. Pp. 481–723. (London: Harrison and Sons, Ltd.) 12*s.*

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1459 (T.3220): Interference on Characteristics of Aerofoil in Wind Tunnel of Rectangular Section. By H. Glauert. Pp. 7+1 plate. (London: H. M. Stationery Office.) 6*d.* net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 429, September. Pp. 405–540+xviii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

The National Institute of Poultry Husbandry, Harper Adams Agricultural College, Newport, Shropshire. Bulletin No. 7: Mixed Protein Rations for Laying Hens and Breeders (Single Comb White Leghorns). By Raymond T. Parkhurst. Pp. 20. Bulletin No. 8: The Production of Table Ducklings: Barley Meal and Sussex Ground Oats for Rearing and Fattening Table Ducklings. By Violet K. Tallent. Pp. 20. (Newport.)

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1932–33. Pp. 372. (Manchester.)

Character and Personality: an International Quarterly for Psychodiagnosis and Allied Studies. Edited by Robert Saudek. Vol. 1, No. 1, September. Pp. 87. (London: George Allen and Unwin, Ltd.) 2*s.*

The Journal of the Quekett Microscopical Club. Edited by W. S. Warton. Ser. 2, Vol. 16, No. 98, September. Pp. 215–260+plates 5–10. (London: Williams and Norgate, Ltd.) 5*s.* net.

Brochure containing Lists of Recent Additions to the Library, Cabinets and Collections of Instruments of the Quekett Microscopical Club. Pp. 10. (London: Quekett Microscopical Club.) 1*s.*

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 5: The Geology of the Roundstone District, County Galway. By L. R. Wager. Pp. 45–72+5 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s.* 6*d.*

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1463 (T.3224): Acceleration of Aeroplanes in Vertical Air Currents, Part 1. By H. R. Fisher. Pp. 16+4 plates. 1*s.* net. No. 1456 (T.3198): Relation between Ground Contours, Atmospheric Turbulence, Wind Speed and Direction. By W. R. Morgans. Pp. 39+12 plates. 2*s.* 3*d.* net. No. 1464 (T.3216): Wind Tunnel Tests of Recommendations for Prevention of Wing Flutter. By B. Lockspeiser and C. Callen. Pp. 32+13 plates. 1*s.* 9*d.* net. No. 1469 (T.3234): Induced Flow through a Partially Choked Pipe. By H. Glauert, D. M. Hirst and A. S. Hartshorn. Pp. 15+4 plates. 1*s.* net. No. 1470 (T. 3249): Wind Tunnel Interference on Aerofoils. By H. Glauert. Pp. 11+4 plates. 9*d.* net. (London: H.M. Stationery Office.)

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections, 1931–32. Vol. 33. Pp. 51. (Leicester.)

OTHER COUNTRIES

Records of the Geological Survey of India. Vol. 66, Part 1. Pp. 179+24+2 plates. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s.*

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 121: Contributions to a Knowledge of the White Flies (*Aleurodidæ*) of Egypt (I). By Prof. Dr. H. Priesner and Mahmoud Hosny. Pp. 8+6 plates. 2 P.T. Bulletin No. 122: Sand-sowing in Growing Cotton. By Gadallah Aboul Ela. Pp. 12+2 plates. 5 P.T. (Cairo: Government Press.)

Ministry of Public Works, Egypt: Physical Department. Helwan Observatory Bulletin No. 35: Installation of the Schuster-Smith Magnetometer, and the Helwan Standard of Horizontal Intensity. By P. A. Curry. Pp. 11+2 plates. (Cairo: Government Press.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 11: Report on Archæological Research in the Foothills of the Pyrenees. By J. Townsend Russell. (Publication 3174.) Pp. 5+8 plates. (Washington, D.C.: Smithsonian Institution.)

Department of Science and Agriculture, Jamaica. Entomological Bulletin No. 6: Lecture delivered under the Auspices of the Citrus Producers' Association on the occasion of the Importation into Jamaica of a Parasite (*Eretmocerus serius*, Silv.) of the Citrus Black Fly (*Aleurocanthus Woglumi*, Ash.). By W. H. Edwards. Pp. ii+12. (Kingston, Jamaica: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 81, Art. 5: A New Trematode of the Genus Urotrema from Bats. By Joseph E. Alicata. (No. 2928.) Pp. 4. Vol. 81, Art. 8: The Fishes obtained by Lieut. H. C. Kellers of the United States Naval Eclipse Expedition of 1930, at Niuafoou Island, Tonga Group, in Oceania. By Henry W. Fowler. (No. 2931.) Pp. 9. Vol. 81, Art. 16: Notes on the Helminth Parasites of the Opossum (*Didelphis virginiana*) in Southeast Texas, with Descriptions of Four New Species. By Asa C. Chandler. (No. 2939.) Pp. 15. (Washington, D.C.: Government Printing Office.)

Canada: Department of Mines: Mines Branch. Gold in Canada. By A. H. A. Robinson. (No. 730.) Pp. vii+92. (Ottawa: F. A. Acland.) 20 cents.

Sveriges Geologiska Undersökning. Ser. Ba, Nr. 12: Kvartärgeologisk karta över Stockholmstraktens, Skala 1:50000. 5.00 kr. Stockholmstraktens Kvartärgeologi. Av Gerard de Geer. Beskrivning till kvartärgeologisk karta över Stockholmstraktens, Skala 1:50000. Bilaga med specialundersökningar; with English Explanations. Pp. 89. 3.00 kr. (Stockholm: P. A. Norstedt and Söner.)

Geological Survey of China. Soil Bulletin No. 4: Soil Survey of the Salachi Area, Suiyuan Province, China. By Robert L. Pendleton, L. C. Ch'ang, W. Chen and K. C. Hou. Pp. 42+8 plates. (Peiping.)

Bulletin of the American Museum of Natural History. Vol. 59, Art. 8: Fossil Sirenia of Florida and the Evolution of the Sirenia. By George Gaylord Simpson. Pp. 419–503. (New York City.)

Carnegie Institution of Washington. Publication No. 426: Gorillas in a Native Habitat. Report of the Joint Expedition of 1929–30 of Yale University and Carnegie Institution of Washington for Psychobiological Study of Mountain Gorillas (*Gorilla beringei*) in Parc National Albert, Belgian Congo, Africa. Pp. iv+66+22 plates. (Washington, D.C.: Carnegie Institution.)

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 14: April, May, June. 1932. By Ernest A. Hodgson. Pp. 227–244. (Ottawa: F. A. Acland.) 25 cents.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 7–8, Juillet–Août. Pp. 285–376. (Prague: Regia Societas Bohemica Scientiarum.)

Journal of the Indian Institute of Science. Vol. 15B, Part 3: Transients in Negative Series Circuits. By L. C. Verman. Pp. 33–42. 1·4 rupees. Vol. 15B, Part 4: Telephony as Carrier and One Side Band. By S. P. Chakravarti. Pp. 43–48. 1 rupee. (Bangalore.)

Journal of the University of Bombay. Vol. 1, Part 1, July. Pp. 243. (Bombay and London: Longmans, Green and Co., Ltd.) 3 rupees.

Geological Survey of Uganda. Memoir No. 2: The Geology of South-West Ankole and adjacent Territories with Special Reference to the Tin Deposits. By A. D. Combe; with an Appendix on the Petrology, by Dr. A. W. Groves. Pp. xiv+236+19 plates. (Entebbe: Government Printer.) 35*s.*

Ceylon. Part 4: Education, Science and Art (G.). Administration Report of the Marine Biologist for the Year 1931. By Dr. Joseph Pearson. Pp. 11. (Colombo: Government Record Office.) 10 cents.