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The Neglect of Scientific Method.

THE address by Sir William Pope, at Goldsmiths' Hall on Nov. 13, the sixth of the annual Norman Lockyer lectures instituted by the British Science Guild,* must be accounted one of the most weighty of recent scientific pronouncements, as well as most opportune, in its bearing upon two subjects of special interest at the moment —the extension of the Dyestuffs Act and the school-leaving age. It is to be hoped that, without delay, the printed lecture may, in some way, be brought under the notice of every headmaster and of every member of Parliament; as the girls to-day are even more victimised than are the boys at school and college by the imposition of a burden of inconsequent, undigested learning, headmistresses might also be induced to understand the implications of the address.

Sir William Pope does well to lay stress upon the fact, that modern man is in no appreciable degree the intellectual superior of his forerunners in the far fringe of historic time: he differs from them only in having other weapons. As he truly says, the forms of intellectual expression we recognise as the arts and literature, even moral philosophy, were worked out thousands of years ago, to the utmost limit of the capacity of the human mind. No convulsive revolutionary change could affect our outlook, our powers and our achievements, except the discovery and exercise of some unsuspected faculty of our intelligence. Such a faculty is now to be recognised as operating in the background in the modern development of the natural sciences *by experimental study*, wherein we may see a most wonderful fulfilment of Shelley's far-seeing foresight:

> A mighty Power, which is as darkness,
> Is risen out of earth and from the sky
> Is showered and, from within the air,
> Bursts, like eclipse which had been gathered up,
> Into the pores of sunlight.

The Power is no longer "as darkness" but a sublime light. The intensive work which has been done in science, largely during the last fifty years, has launched us, says Sir William Pope, well beyond the shore of a new era in the world's history, an era which may be described as the scientific age. Unfortunately, the process is in no way understood even by the superior politician, let alone the public. The words science and scientific as yet have no properly defined meaning in the public mind; even in scientific journals they

* "Science and Modern Industry." By Sir William J. Pope. Pp. 16. (London: British Science Guild, 1930.) 1*s*.

are often inconsistently used and rarely with forethought. We have no right to confine the word science to any particular branch of knowledge; moreover, all exact and logical users of knowledge and experience are entitled to be spoken of as scientific. The modern advance, in all fields, is due to our considered application of knowledge and our constant verification of whatever conclusion we may draw: only the verified is science. Much that so passes at the moment is mere speculation. In days gone by, conclusions were based upon first principles, without verification.

The great Helmholtz tells us, in his biography, how the philosophers, in his early days, regarded the introduction of experimental verification as unnecessary; in fact, as almost an insult to their dignity. Our use of the Latin word science, in place of knowledge, as if it meant something different and peculiar, is at the root of the difficulty: as a people, we cannot suffer Latin; much as we use it in our spoken language, we seem rarely to grasp the full meaning of Latin words. Until we study English, we never shall—unfortunately, this subject is still all but unknown in the schools; whatever stopped the way in the past, 'science' now crowds it out! Much of Sir William Pope's address is devoted to a criticism of the general literary ignorance of young people coming up to the university from the schools. He also complains bitterly of the neglect of modern languages. Being himself gifted with most remarkable linguistic ability, no one has greater right to speak upon the subject.

That a leading professor at a leading university should so speak out is a more than welcome sign that, at last, we are beginning to appreciate the danger of our position—that at last we see that the vicious circle in which youth is forced to revolve must in some way be broken and teaching made the free and considered practice of the greatest of all arts—an art nothing short of sacred. Research will soon be its own executioner, if we do not bring under effective consideration the methods of training used in school and university leading up to such work. What is now done is mainly by way of compensating for the absence of a proper educational foundation upon which a scientific superstructure may be built. The present situation is farcical. Trained at school and, say at Oxford, up to the end of his third year, to remain ignorant of method, suddenly the student is called upon to study 'the methods of research'—usually by working out an additional example after a well-known rule: in the main, he merely raises his value as an artificer. The art of logical inquiry and study—scientific method—should be inculcated from the cradle upwards: it is not to be learnt from the conventional 'research'.

This is really the meaning to be read into Sir William's address: and Brutus is an honourable man. He is a man who has shown supreme general business ability, having recently passed through the high City office of Prime Warden of the Goldsmiths' Company with great distinction. He is therefore a double first. His complaint is that most of the men in business and the politicians—I suppose he would say without exception—have no scientific training: they are empiricists, members of a class who have done in late years and are doing to-day, with alarming efficiency, everything possible to wreck our national fortunes. It is in the hands of such men that the fate of our dyestuff industry rests: theirs not to reason why, the decision is likely to be one taken without any intrusion of scientific method; the more as the industry is pre-eminently scientific, in origin and development.

In fact, our era is not yet to be spoken of as 'scientific', whatever the Norman Lockyer lecturer may assert. So few among us have any use for scientific method that the vast mass perish for want of such knowledge. Knowledge we have—a vast knowledge: only the knowledge how to use knowledge profitably is wanting among us. Our great present need is to appreciate the depth of our ignorance, especially in education.

Sir William Pope in and by his address sounds the trumpet call for action in the universities; it behoves the few who are alive to our educational peril to be up and doing, in remedy of his indictment. The headmasters will not move—they have not the courage nor any leader; the schools examining bodies will be opposed to all action; the public always leaves school to 'mother'. A colossal burden of responsibility rests upon the few at the universities who are aware of the straits into which education has drifted, through entire lack of scientific control, left as it has been in bureaucratic, unpractical hands. The universities, whatever may be said, *are* the prime source of all evil as well as of the little good in the prevailing chaos of teaching: they must cure themselves, in the first instance. Educationally they are unco-ordinated. We *must* exorcise the competitive lust that is within us, to the extent that we cease from treating education as if it were a branch of sport and our schools racing stables. In some way, we *must* take the money out of the examination purse and put 'morality' into its

place. In some way, education must be made real and of general avail—not the entirely fortuitous, inhibitory process it now too often is.

So little scientific is our era, that the chief use we have made of our great knowledge has been to squander natural resources in a blind and selfish pursuit of wealth. Industry, to-day, is entirely inconsiderate of the future. We cannot continue at present rates. The solution of the nitrogen problem by Crookes has brought us nearer to destitution rather than saved us, as the blind worshippers of mechanical success assert it has, by hastening the rate of depletion of irreplaceable phosphatic stores. We can clearly foresee in phosphorus the limiting essential factor to the world's progress:

Ohne Phosphor kein gemixte Pickles

stands written upon the wall. If we have any regard for the future, without loss of time we must learn to submit ourselves to scientific control. Unless we overcome the demagogue, there will be no health in us.

Sir Norman Lockyer, I am sure, would indeed have been more than satisfied to hear an address delivered in his memory such as that just given under the auspices of the Guild he founded. Never has the existence of the Guild been so fully justified; still, it cannot rest content with talk, however eloquent. The red flag of revolt must now go forward; the time for mercy to the incompetent is over.

HENRY E. ARMSTRONG.

Persia and the Persians.

A History of Persia. By Brig.-General Sir Percy Sykes. Third edition with Supplementary Essays. Vol. 1. Pp. xxxix + 563 + 15 plates. Vol. 2. Pp. xx + 616 + 16 plates. (London: Macmillan and Co., Ltd., 1930.) 2 vols., 42*s*. net.

LORD CURZON'S classic work on Persia, published in 1892, went out-of-print a few years later, and was never reprinted. Sir Percy Sykes made his debut in Persia in the following year, and but for interludes in South Africa and Turkestan was, until December 1918, on duty in that country as a consular official, representing His Majesty's Government and the Government of India. He has travelled very extensively, and to good purpose: he has written four other books on various aspects of life and manners in Persia, and is unquestionably the leading authority in Britain on the matters dealt with in the present work. That he should have found time, in the midst of his travels and official labours, to compile this history (the first edition was published in 1915) is a tribute to his versatility and to his pertinacious industry, for to write a standard historical work in a consulate in a remote provincial town on the borders of Central Asia is a task at which few men would persevere. That a third edition should be called for within fifteen years is a tribute to the widespread interest displayed by the English-speaking world in Oriental history.

"Official duty", said Lord Rosebery in 1898, "is only a very small part of public duty, and public work is by no means incompatible with other professions and other callings." The great historians of the East in the English language have with few exceptions been soldiers and administrators, who have been at pains to follow the precept of Habakkuk and to read as they ran. Sir Percy Sykes is the worthy successor in the field of Middle Eastern history of such men as Malcolm, Morier, Rawlinson, and Curzon.

The history of Persia is of unique importance to the student of past times, for, thanks to the discoveries of the last century, it constitutes a longer and more continuous record than that of any other country or nation. A few salient facts, as disclosed by the work under review, of special interest to readers of NATURE, relating to ethnography and to the Persian people and their contributions to the progress of the human race, are worth mentioning.

In no eastern country is 'national' sentiment stronger: yet in no country has there been a greater admixture of extraneous elements. Persia has in the last two thousand years been overrun repeatedly by foreign invaders—by Arabs in the seventh century, by Mongols in the thirteenth, by Turks in the seventeenth, by Afghans in the tenth, and Russians in the nineteenth; at least six different racial strains are apparent amongst the population to-day, and as many languages are currently spoken, namely, Arabic in the south-west, Baluch (Brahui) in the south-east, Kurdish in the west, Turkish almost everywhere except in the centre, to which must be added the Tajik of the Caspian provinces, and Luri—which has strong affinities to the ancient Pehlevi tongue—in the south-west. Yet the Persian kingdom has had a continuous and unbroken existence since the dawn of history, and has extended at different times to Cairo and Delhi, to Samarkand and to the Hijaz.

The extensive conquests made by the armies of successive rulers entailed further great admixture of blood, for the Persian soldiery were wont to

bring back strange wives, and slaves not a few. Yet the Persian racial traits were far less impaired than were, for example, those of the Greeks, amongst whom, as W. G. Clarke points out ("Peloponnesus", p. 328), Miltiades, Thucydides, and Demosthenes were notoriously of mixed race, and contemporary arts and crafts, which reached their highest development in the ancient world within the confines of Persia, as the forthcoming International Exhibition of Persian Art in Burlington House will show, retained all the characteristics of the soil that gave them birth.

The Persian plateau, alternately frozen by bitter winds and scorched by a pitiless sun, is one of the most ancient land surfaces of the Old World: it may yet prove to have been one of the cradles of the human race, and it has incontestably been shown to be one of the most ancient of civilisations. Its fauna and flora have little affinity with those of India, but are closely allied to those of Europe; some indeed hold that it is to Persia that we owe the prototypes of the vine and the genus *Prunus*, and several other trees now widely spread over the world.

Arduous but not intolerable climatic conditions, and the predominance over considerable areas of limestone formations, have probably played on the Persian plateau an important part in forming and fixing types of human beings, animals, and plants alike, but this interesting subject has as yet not, so far as the reviewer is aware, formed the subject of systematic inquiry or informed speculation.

Persia may well have been the home of astronomy, ere Nineveh was built, as it was of the most philosophical of ancient beliefs—which Zoroaster reduced to a system: it gave birth to kings such as Cyrus and Darius, to poets such as Firdausi, Hafiz, and Sadi, and to doctors such as Avicenna. Yet Persia, in more modern times, was the first of eastern nations to associate itself with international agreements such as those relating to posts and telegraphs; it was the first eastern power to take an active and useful part in the deliberations of the League of Nations, the first to take European advisers into the service of the State, and the first, also, to dispense with them. These matters, and much else, are dealt with fully in this closely packed and well-written work, which, up to and including Chapter lxxxiv., will for this generation be the standard work on the history of the country, to the study of which for forty years Sir Percy Sykes has devoted his talents.

A. T. W.

Bacteriology and Medicine.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 5. By W. Bulloch, S. L. Cummins, F. W. Eurich, J. T. Duncan, A. Fleming, S. R. Gloyne, W. Fletcher, A. Stanley Griffith, R. T. Hewlett, J. C. G. Ledingham, J. A. W. McCluskie, A. D. McEwen, J. McIntosh, F. C. Minett, E. Muir, C. C. Okell, R. St. John-Brooks, A. W. Stableforth, W. H. Tytler, L. E. H. Whitby. Pp. 506. (London: H.M. Stationery Office, 1930.) 21*s.* net.

THIS volume deals with glanders, melioidosis, diphtheria, tuberculosis, Johne's disease, leprosy, Malta fever, anthrax, and a few other less important diseases.

The short historical notes which appear at the beginning of several of the chapters are written by Prof. Bulloch, and this at once guarantees their accuracy and their interest. In the chapter on glanders he pays very just tribute to the work of Löffler. He writes: "Four years after Löffler's first paper with Schutz he published another (Löffler, 1886), in which he gave a masterly account of the bacteriology of glanders and practically without an error. Little has really been added to the pure bacteriology of glanders since Löffler gave us his account." An examination of the whole chapter, written by F. C. Minett, amply confirms this statement. There is really nothing new, nothing which has not been written over and over again in various text-books. The chapter is an account, and really a very good account, of the facts we have known for a very long time about this disease.

The short chapter on melioidosis caused by *B. Whitmori* is well written, and as it comes from the pen of William Fletcher it naturally emphasises many facts brought out by his own work. Bacteriologists generally, but particularly those working abroad, will welcome this chapter. It is a very valuable contribution.

Chapter iii., on *C. diphtheria* and diphtheroid organisms, is by Dr. Hewlett. It is stated in the introduction by Dr. Hewlett that in this article he has in a large measure epitomised the work published in 1923 by the Medical Research Council in its monograph on "Diphtheria". It is a very good epitome, and gives in a very readable form all the main facts which are of value in connexion with these bacteria. In regard to the laboratory diagnosis, there are some very pertinent remarks on p. 101—remarks which are very much needed in these days when the laboratory is so often regarded

as a mere diagnostic institution. As Hewlett says, "The only justification for awaiting a laboratory report is when the presumption is, on the whole, against diphtheria". The portion of this chapter dealing with the diphtheroid organisms and the avirulent strains of *C. diphtheria* gives a very accurate account of the present position of these organisms in relation to diphtheria.

Chapter iv., on tuberculosis, is, in our opinion, easily the best chapter in this volume. Dr. Griffith and those who have been associated with him in the production of this chapter are to be heartily congratulated. Naturally, the portions written by Dr. Stanley Griffith stand out as the work of a man who has devoted the greater part of his medical life to a careful study of the pathology and bacteriology of tuberculosis. It is marked by very many original observations. The author is not merely satisfied to give the opinions of other workers, but his discussion of their observations and their deductions brand this chapter as the work of a man not merely of keen observation but also of real critical power. We feel sure it will stand out as one of the very best summaries, and true critical summaries, on tuberculosis which have been published.

S. R. Gloyne deals with the distribution of tubercle bacilli and their resistance to destruction, and W. H. Tytler with allergy and immunity. The former part is interesting from the public health point of view, but somewhat indefinite; the latter is a very useful and valuable contribution. It gives all the main facts as to immunisation by living and dead bacteria and bacterial products. Naturally, the author does not commit himself to definite conclusions, but he gives an accurate report on experimental results and discusses them with great fairness. The treatment by tuberculin is dealt with by Dr. Fleming, the preparation and standardisation of tuberculin by Dr. Okell, chemotherapy in tuberculosis by Prof. Cumming, and the laboratory diagnosis by Prof. McIntosh and Dr. Whitby.

There is a short but interesting chapter on "Tuberculosis in Cold-Blooded Animals" by Dr. Stanley Griffith.

Johne's disease is discussed in Chapter vi. by Mr. A. W. Stableforth. This is a record of all the main facts in relation to the bacteriology and morbid anatomy of this disease, well put together but lacking in any originality or critical discussion.

Leprosy is dealt with in Chapter vii. by Dr. Ernest Muir. One expects from a writer who has had a wide practical experience with leprosy, and has done a great deal of experimental work both in relation to its bacteriology and its treatment, a very full account of the pathological and bacteriological aspects of this disease. The author certainly does not fail us. His facts are well marshalled, and though he gives the views of almost all the workers on the subject, he is careful to draw conclusions only from facts which have been fully established. Thus, reviewing the work which has been done on the cultivation *in vitro* of *B. leprœ*, he does not criticise adversely the statements of the various experimenters, but he gives careful notes for guidance, notes which, had they been followed, would have prevented some of the writers from drawing their erroneous conclusions.

Chapter viii., on the non-pathogenic acid-fast bacilli, by R. St. John-Brooks, is useful as an addendum to the chapters on tuberculosis, Johne's disease, and leprosy.

Dr. J. T. Duncan and L. E. H. Whitby contribute Chapter ix., on the Brucella Group. On this group a considerable amount of experimental work has recently been done, and the writers have done full justice to it. To those who wish a very good account not only of the pathology and bacteriology but of the chemotherapy, prevention, etc., of the diseases due especially to the *B. melitensis* and paramelitensis, we commend this chapter. The relation of *B. abortus* in the milk of cows to undulant fever is dealt with and all the relevant facts noted. This is a very useful article to the bacteriologist and the public health officer.

Chapter x., on *B. anthracis*, is by Dr. F. W. Eurich and R. T. Hewlett. This is simply a statement of known facts. The article does not call for special comment. It is a useful summary, dealing with the bacteriology, the pathology, and serum therapy of the disease. In the portion dealing with practical diagnosis, the estimation of the opsonic index, it is said, may prove useful in the hands of one who has acquired the necessary skill. One wonders how many times the opsonic index has been found useful in the diagnosis of anthrax.

In Chapter xi., R. St. John-Brooks writes on the non-pathogenic spore-bearing aerobic bacteria. This naturally follows the chapter on anthrax. It is a compilation of views of various authors and leaves the reader rather confused than otherwise. In the classification, the writer claims to follow Ford and his co-workers. It is difficult to see any reason why this classification was followed at all, if, as is the case, it was not followed completely. There is nothing in the chapter to indicate any reason for this. To take one example—the Cohœrens-simplex

group ; the writer gives three organisms, whereas Ford gives five. If the three were considered the only important ones and some mention made of them in the later text, one could have understood the omission, but they are not mentioned. If the whole classification had been omitted—for it serves no useful purpose in this article—the chapter would have been improved.

Chapter xii., on tularæmia, and Chapter xiii., on Bartonella and allied diseases, are useful additions which had necessarily to be included in some part of the series.

Throughout the volume the nomenclature is irregular, and we think it would have been wise either to adopt the recent American method throughout or not at all. Thus we find *Brucella melitensis*, *Corynebacterium diphtheriæ* alongside *Bacillus mallei* and *Bacillus tuberculosis*.

Taken on the whole, the volume is good, but scarcely up to the standard of the ones previously issued. With the exception of the chapters specially noted in the review, we do not think that by the issue of this volume any valuable addition has been made to bacteriological libraries.

J. M. BEATTIE.

German Work on Silicates.

Veröffentlichungen aus dem Kaiser Wilhelm-Institut für Silikatforschung in Berlin-Dahlem. Herausgegeben von Prof. Dr. Wilhelm Eitel. Band 3. Pp. 134. (Braunschweig : Friedr. Vieweg und Sohn A.-G., 1930.) 36 gold marks.

EDITED by Dr. W. Eitel, director of the Kaiser Wilhelm Institute for Silicate Research in Berlin, the third volume of publications issued from the Institute comprises a collection of twelve papers and reports, eight of which have previously appeared in various German technical journals during 1929. Among the contributors are W. M. Cohn, B. Lange, E. Kordes, and C. Gottfried, each of whom is concerned (alone or in conjunction with a fellow-worker) in two or more of the articles.

W. M. Cohn is responsible for two papers, the first being an illustrated account of a new self-registering apparatus for determining the thermal expansion of solid bodies. By the use of this contrivance, the expansion curves of solid rods can be obtained photographically up to temperatures beyond 800° C., so that even small effects, such as those representing transformation points, can be clearly perceived. Cohn's other paper relates to the expansion behaviour of new stoneware bodies, studied with the aid of the appliance described in his first paper. Results are cited indicating that a new stoneware body has been produced which possesses very low expansion values, the expansion being fairly regular. By altering the composition of the body, it is possible to produce various expansion values between those of silica glass and ordinary ceramic bodies.

B. Lange discusses the coloration and origin of gold ruby glass : with W. Heller the same author describes tellurium - platinum thermo - elements which permit very accurate determinations of low temperatures over small ranges (20° to 40°, 0° to 40°, and with certain conditions from −75° to +90°) ; a tellurium-bismuth thermo-element is also referred to. Lange and W. Cousins discuss the molecular condition of fused sulphur. Lange and H. Möhl discuss the application of sedimentation analysis (of Wiegner-Lorenz) and of depolarisation methods to ceramic analysis, citing experimental results obtained with various clays and kaolins.

E. Kordes contributes a somewhat lengthy paper on the lowering of vapour pressure in concentrated solutions of two volatile components ; in collaboration with E. Klever, the results of calorimetric investigations on dehydrated kaolin are reported. Kordes and F. Raaz present a paper on boiling diagrams of binary high-boiling liquid mixtures (of mercury and cadmium, and of the chlorides of sodium and potassium, respectively), the measurements of vapour pressures or boiling points being carried out by the spiral method devised by O. Ruff.

C. Gottfried gives a short (second) paper on minerals of the Adamello group, dealing with hornblende from a special material found in the Val di Dois ; jointly with E. Lubberger he contributes a short article on antimonite.

G. Trömel is the author of the remaining paper, in which silicates (or rather alumino-silicates) of the type of nepheline and anorthite are discussed at considerable length, including an account of results obtained from X-ray examinations and by the substitution of soda for lime (and vice versa) in such alumino-silicates, and also the results of substituting certain rare earth oxides for alumina in similar compositions. Some interesting deductions are drawn from the results obtained.

Fixed to the inside of the back cover as an appendix is a copy of the sixth part of the fifth year of *Schriften der Königsberger Gelehrten Gesellschaft*, consisting of a paper by W. Skaliks on some double combinations of alkaline carbonates with carbonates of alkaline earths.

While it may be admitted that several articles in the volume under consideration would scarcely

appeal to most readers of even scientific literature, others present features capable of useful application, and the whole volume constitutes an important record of high-class research. Such a miscellaneous assortment of papers does not provide an easy task for a reviewer, but it is hoped that sufficient indications have been given to enable readers interested to appreciate the real value of the work.

Impedance Networks.

Transmission Networks and Wave Filters. By T. E. Shea. Pp. xvii + 470. (London: Chapman and Hall, Ltd., 1930.) 32*s.* net.

THE study of impedance networks has acquired much importance during the past decade, as a result very largely of the pioneer work of G. A. Campbell on wave-filters. The literature of the subject has hitherto been scattered through the pages of patent specifications and technical journals, particularly the Bell System technical journal; the present very thorough account, which is particularly complete in its treatment of wave filters, will therefore be of the highest value to electricians. Although wave-filters have hitherto been used mainly in their practical applications to telephony, telegraphy, and wireless transmission, the precision with which they can be made to suppress some frequency bands while admitting others may render them of service in some branches of pure research.

Part I. deals with general principles, such as impedance-matching and the determination of iterative and image impedances—properties of asymmetric networks which correspond to the characteristic impedance of a uniform cable; propagation constants, the real part of which determines the attenuation of oscillations transmitted through the filter chain, while the imaginary part determines their phase change or velocity of propagation; and equivalences between various types of impedance combinations. Part II. deals with wave filters, as distinct from artificial lines for imitating cables, from retardation lines for producing progressive phase-change, and from attenuation equalisers for correcting distortion in telephony. It discusses the criteria for determining the 'cut-off frequencies' at the edges of the suppressed and transmitted frequency bands; the principal types of filter, particularly the 'constant-K' in which the product of the series and shunt impedances in each filter section is constant for all frequencies; the design of band-pass, low-pass, and high-pass filters; and the evaluation of the reflection losses which arise when a filter is not terminated by matched impedances.

Part III. is devoted to the transmission through impedance networks of transient impulses, such as telegraphic impulses, and gives *inter alia* an interesting analysis of the blurring caused in television by the fact that the width of the scanning aperture is not zero—a defect which can be remedied by the insertion of a suitably designed network. There are an excellent bibliography, numerical tables and graphs, a list of U.S. patents, and an index.

Although the wording of the book does not always strike an English reader as perfectly lucid, the author contrives to make his complicated subject clearly intelligible, and the mathematical treatment is simple and direct. The style in which the mathematical formulæ are set out suggests that they were originally typewritten with an ordinary typewriter, and leaves something to be desired. The choice of symbols is irritating: dashes, suffixes, and sub-suffixes appear and disappear like 'bats in a belfry', and the list of symbols on page xv omits the most puzzling of them. Nevertheless, as an intelligible exposition of subject matter which has not previously been summarised with anything approaching the present thoroughness, the book will be indispensable to all whom it concerns.

C. W. HUME.

Our Bookshelf.

Christ's Hospital: from a Boy's Point of View, 1864–1870. By the late Rev. W. M. Digues La Touche. Edited by his Brother. Pp. xii + 82 + 2 plates. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1928.) 3*s.* 6*d.* net.

THE appointment of Mr. Hamilton Fyfe as the head of a university in Canada and of Mr. Flecker as his successor recalls one's mind to the famous school which the one is leaving and the other taking over. The Blue Coat School has always held a special place in the affections of English people, partly from the picturesque dress to which the boys remain loyally and proudly attached, partly from its old situation in the heart of London, partly from the lustre which a long array of distinguished ex-scholars have shed upon it. What school would not shine brighter in the light of Charles Lamb and Samuel Taylor Coleridge? It has since 1902 been housed in the most magnificent group of buildings provided for any school in England, and its efficiency in education reached its highest point under the able direction of its late chief.

The little book before us gives a lively and interesting account of the school in its old home from the pen of an 'old boy' now dead, the Rev. W. M. Digues La Touche, a member of one of the many gifted Huguenot families who came over from France

after the revocation of the Edict of Nantes. His father was a Shropshire clergyman and he himself returned there in mid-life in the same capacity. But he had added many things to the equipment of the average parson, for he was an enthusiastic and accomplished draughtsman, an ardent geologist, and a musician capable of training and conducting the village band and choral society. Evidently Christ's Hospital had done well by him, even in the rough and barbarous days which he describes. It is so evident in all he says that a spice of roughness is no drawback to a sound and even enjoyable education. The book is a welcome addition to the large literature which has arisen from Blue Coat surroundings. Every 'old boy' would wish to have it, and to the general student of education it has more than local interest. One striking feature which must have reached its highest point here is the list of special and esoteric names applied to the various boys, objects, and actions familiar in the school. In this vocabulary we go from the 'Grecians' at the top, down to the 'Trades' of each ward who brought up the food from the kitchens and even the 'Cakes' left on the boy's person by the cheerfully accepted canings. Can one have a really intimate and effective home or school without some such affectionate jargon?

F. S. M.

Penrose's Annual: the Year's Progress in the Graphic Arts. Vol. 33, 1931. Edited by William Gamble. Pp. xix+172+72+98 plates. (London: Percy Lund, Humphries and Co., Ltd., 1930.) 8*s.* net.

THIS ponderous volume is considerably thicker than any of its predecessors, presumably because of the larger number of examples of work that it contains. Of these examples, some, so far as one can judge, are very fine; but of course when the merit of a piece of work consists in copying an original as nearly as possible, one cannot really judge of it in the absence of the original.

We are very glad to see that Mr. A. J. Newton sets the good example of illustrating the results of the Peridak process by a graduated device, not a picture. Here we get a full range of tones with a patch of sensible size for each. This is a process of definitely controlling the reduction by means of Farmer's solution, in such a manner that dots that are completely joined may be reduced to mere pin points without losing their opacity. The screen negative is etched in nine stages. This tendency to complexity of method is also manifest in colour work. Theoretically, three colours are sufficient. Then for some time we got accustomed to four. In this volume there are specimens of pictures in up to eight colours, and from the nature of the examples we cannot see the advantage of running from the simplicity of three, or at most four, up to the complexity so nearly rivalling the colour work done before the three-colour era.

Mr. C. T. Jacobi has this year selected the Cambridge University Press for his historical article. He traces its development from A.D. 1521, when John Siberch printed the first Cambridge book. Dr. A. Ruppel, the Director of the Gutenberg Museum in Mayence on the Rhine, contributes an illustrated article on the Museum, past, present, and future. The editor gives his usual review and notes, summarising the progress of the graphic arts during the third of a century.

Grundlagen der praktischen Optik: Analyse und Synthese optischer Systeme. Von Dr. M. Berek. Pp. vii+152. (Berlin und Leipzig: Walter de Gruyter und Co., 1930.) 13 gold marks.

A NUMBER of circumstances have combined to bring the importance of applied optics to the fore in recent years. Unfortunately, research into the range of validity of some of the more important theorems has tended to lag behind the immediate needs of manufacturers, while, conversely, the practical optician has failed to appreciate the help which the applied mathematician—with workshop experience—can provide.

Prof. Berek is in a position to render great service in this connexion, in that he combines a first-hand knowledge of industrial conditions (and limitations) with an academic outlook upon physical optics. His book contains a number of very elegant theorems relating to image formation and synthetic optical systems, which should prove of considerable value in the design of microscopes and ophthalmic instruments. The latter have already benefited greatly from the classical work of Prof. von Rohr: it is gratifying to find the subject so much alive.

This is not a book that can be honestly recommended to junior students; its place is more in the post-graduate laboratory of technical colleges and in the research department of firms concerned with optical apparatus of high precision.

F. I. G. R.

Physik: ein Lehrbuch für Studierende an den Universitäten und technischen Hochschulen. Von Prof. Wilhelm H. Westphal. Zweite Auflage. Pp. xvi+571. (Berlin: Julius Springer, 1930.) 19·80 gold marks.

IN the second edition of his book, Prof. Westphal has retained the desirable features which were referred to in noticing the first edition (NATURE, July 6, 1929, p. 18). In particular, the first chapter is excellent, with its introduction to causality and the essence of hypothesis. This is clearly the way in which a text-book of physics should begin, and yet such an opening is all too rare.

As regards the rest, compared with the general high level, the portion dealing with thermodynamics seems a little uninspired. Would it not be possible to cut adrift from convention and attack entropy boldly from the axiomatic point of view of Carathéodory? Fear of the examiner is probably less acute in the German university than elsewhere. Again (p. 519), Debye's T^3 law is given without comment: Schaefer's reasons for doubting its validity at the lowest temperatures—where it is usually taken for granted—should surely have been mentioned.

The author writes with unusual clarity: many English-speaking students would do well to improve their physics and their German by using this book.

Letters to the Editor.

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

The Ether and Relativity.

I OBVIOUSLY must not ask for space to discuss all the points raised in Sir Oliver Lodge's interesting letter in NATURE of Nov. 22, and so will attempt no reply to those parts of it which run counter to the ordinarily accepted theory of relativity. For I am sure nothing I could say would change his views here. But I am naturally distressed at his thinking I have quoted him with a " kind of unfairness ", and should be much more so, had I not an absolutely clear conscience and, as I think, the facts on my side.

In the part of my book to which Sir Oliver objects most, I explained how the hard facts of experiment left no room for the old material ether of the nineteenth century. (Sir Oliver explains in NATURE that he, too, has abandoned this old material ether.) I then quoted Sir Oliver's own words to the effect that many people prefer to call the ether ' space ', and his sentence, " The term used does not matter much ".

I took these last words to mean, not merely that the ether by any other name would smell as sweet to Sir Oliver, but also that he thought that ' space ' was really a very suitable name for the new ether. He now explains he was willing to call the ether ' space ', " for the sake of peace and agreement ". If I had thought it was only *qua* pacifist and not *qua* scientist that he was willing to call the ether ' space ', I naturally would not have quoted him as I did, and will, of course, if he wishes, delete the quotation from future editions of my book. But I did not know his reasons at the time, and so cannot feel that I acted unfairly in quoting his own words verbatim from an Encyclopædia article.

Against this, I seem to find Sir Oliver attributing things to me that, to the best of my belief, I did not say at all, as, for example, that a mathematician alone can hope to understand the universe. My own words were (p. 128) :

" No one except a mathematician need ever hope fully to understand those branches of science which try to unravel the fundamental nature of the universe —the theory of relativity, the theory of quanta and the wave-mechanics."

This I stick to, having had much experience of trying to explain these branches of science to non-mathematicians. In the same way, if the material universe had been created or designed on æsthetic lines—a possibility which others have contemplated besides Sir Oliver Lodge—then artists ought to be specially apt at these fundamental branches of science. I have noticed no such special aptitude on the part of my artist friends. Incidentally, I think this answers the question propounded in the News and Views columns of NATURE of Nov. 8, which was, in brief :—If the universe were fundamentally æsthetic, how could an æsthetic description of it possibly be given by the methods of physics ? Surely the answer is that if the objective universe were fundamentally æsthetic in its design, physics (defined as the science which explores the fundamental nature of the objective universe) would be very different from what it actually is ; it would be a *milieu* for artistic emotion and not for mathematical symbols. Of course, we may come to this yet, but if so, modern physics would seem rather to have lost the scent.

However, I am glad to be able to agree with much that Sir Oliver writes, including the quotations from Einstein which he seems to bring up as heavy artillery to give me the final *coup de grâce* :—" In this sense, therefore, there exists an ether ", and so on. On this I would comment that nothing in science seems to exist any more in the good old-fashioned sense—that is, without qualifications ; and modern physics always answers the question, " To be or not to be ? " by some hesitating compromise, ambiguity, or evasion. All this, to my mind, gives strong support to my main thesis.

J. H. JEANS.

Cleveland Lodge,
Dorking, Nov. 23.

Boric Acid in the Glaze of the Sealed Vases of Arezzo.

IT may be of interest to record a discovery I have made, with Dr. Grassini, which should prove of importance in the study of old ceramics, and also of the commerce and industries of the Romans of the first century after Christ. My researches upon the antiquity of the boric acid bearing ' lagoni ' and ' soffioni ' of Tuscany led me to examine the glaze of the famous Arezzo pottery (*vasi sigillati aretini*). These vases are among the most beautiful and important of the artistic works of the Romans of the first century before and after Christ.

The constitution of that marvellous coral-like glaze, so bright and thin, many attempts at the reproduction of which have been made and about which so many hypotheses have been advanced, has always been something of a mystery. Dr. F. Keller,[1] a German worker, was the first to suggest that boric acid might be a constituent of the glaze, upon the assumption, based on experimental evidence, that good glazes could be obtained (excellent, to quote the author) only by using borax. His conclusions were not generally accepted, even by those who saw the results of his attempts to reproduce the old glazes. The question was still open. Nevertheless, the opinion was widely held that, in the glaze of the Arezzo vases, boric acid could enter as a constituent, and in the " Storia della ceramica Greca ", by Pericle Ducati, it is stated : " In Arezzo's manufactories, the application of a brilliant glaze, colourless, composed of silicates, iron oxide, and perhaps of borax, is also to be noticed ". But no proof could be established ; the historians of chemistry affirming, on the other hand, that borax was unknown to the Greeks and to the Romans.

I therefore made up my mind to try an *experimentum crucis* by analysing chemically the glaze of the Arezzo vases. This was not easy, since it was necessary to get a quantity of fragments of no artistic value ; in addition, the glaze is only a thin layer, and it is difficult to detach it. Dr. A. Del Vita, the archæologist who, with his brother, so successfully attempted the revival in Arezzo of the famous Roman ceramic industry, came to my help by providing a good quantity of fragments from the potteries of " L(ucius ?) Titi ", and " Thirsus ", which were found during some trials made for research purpose, by Dr. De Vita, in an area situated under the walls of the northern side of Arezzo. Collaborating with Dr. R. Grassini, and in his private laboratory in Florence, the necessary analyses were carried out.

Accurate analyses of the glaze have led us to affirm with certainty that boric acid is found as a constituent part of the glaze, and not merely in occasional traces. It is, we think, the first time that boric acid has been certainly detected in products of that epoch :

it must be noted, on the other hand, that we have not found any boric acid in the glaze of Etruscan-Campanian fragments.

Prof. Xaver Landerer (born in Munich in 1809, died in Athens in 1883), of the University and Polytechnic of Athens, states that the Romans and Greeks were acquainted with boric acid, but I do not believe that his statements were based upon accurate analyses by himself or others. Whether the Romans extracted borax, mistaking it for other products, from Asia Minor or other places in the East, or whether they utilised, without knowing their nature, products of the actual 'lagoni', it is difficult to say. A detailed account of the present work, together with a full discussion of these questions, will appear elsewhere: we limit ourselves, for the time being, to recording the results of the present investigation, and expressing our thanks to those who are helping us in this difficult field. We would also urge the importance of extensive chemical and physico-chemical studies on the various ceramic, metallurgical, and similar products of antiquity, studies which, until now, have been very incomplete and fragmentary, and may throw new light upon so many vital questions.

R. NASINI.

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Roma.

[1] "Die rote römische Topferwaare mit besonderer Rücksicht auf ihre Glasur. Eine kunstgewerbliche Skizze." Von Dr. Franz Keller, Rektor der Gewerbschule in Speyer. (Heidelberg: Buchhandlung von Carl Gross; 1876.)

Embryology and Evolution.

PROF. MACBRIDE, in his brilliant review (NATURE, Oct. 25, p. 639) of the recent embryological works by Dürken, Schleip, and Przibram, raises questions which are so fundamental in modern biology that I venture in all humility to interpose a word. Although I have not yet had the opportunity of reading these books, much of their work is already familiar ground, and Prof. MacBride's clear exposition renders reference to the originals unnecessary so far as these general questions are concerned.

My friend Prof. MacBride appears to have surrendered to the charm of Driesch's 'entelechy' as a directive agency in embryological development. But surely Driesch's method is the dangerous one of argument by exclusion. He says in effect, no mechanistic hypothesis yet brought forward will explain all the phenomena of development, therefore there must be some non-material agency at work. This, however, is an 'explanation' which explains nothing in any scientific sense. If it were to be accepted as an explanation, there would be no further incentive to experimental embryology. This is, indeed, the view which Prof. MacBride himself formerly took of Driesch's philosophy (see NATURE, vol. 92, pp. 291, 400; 1913).

But are the possibilities of a mechanistic explanation of development exhausted? I venture to think otherwise. The issue is the more important, because various writers, such as Rádl and Uexküll, endeavour to use Driesch as a means of decrying 'Darwinism', that is, evolution. Prof. MacBride's question, "If there be such a thing as evolution", leads one to wonder whether in his mind also an adherence to vitalism may lead to a questioning of evolution itself. Rádl, in his anti-evolutionary bias, goes so far as to say ("The History of Biological Theories", p. 187), "It is almost universally, though tacitly, assumed in biological text-books that organisms must have had a polyphyletic origin". I can only plead ignorance of any such 'text-book'. Again, he tells us (p. 388) that Darwinism was "completely rejected" by Driesch.

Turning to Uexküll ("Theoretical Biology", 1926), we find such statements as these. On p. 112 it is stated that whenever a vestigial organ has been tested, some function peculiar to it has always been revealed, and "it is to be hoped that 'vestigial organs' will soon disappear into oblivion". Again (p. 114), the framework of the cell "is an absolutely perfect machine", and "in this respect, there is no such thing as evolution". The first contradictory fact that occurs to one is the extremely primitive nuclei and mitotic mechanism of such organisms as the blue-green Algæ. But again (p. 164), "Every living creature is, in principle, absolutely perfect". Such statements savour more of medieval theology than of modern science. In this book we find (p. 238) that it was Mendelism which "swept the whole theory (of Darwinism) away"!

As is well known, Driesch's argument rests on those types of embryos in which the cells, when separated in the early stages of cleavage, are each capable of producing a complete embryo of smaller size. He argues that no machine can perform such feats, and that therefore, in short, the behaviour of such embryos cannot have a mechanical explanation. But what man-made machine is divided up into similar compartments, each having within it its own controlling centre? When those centres (the nuclei) are equipotential and are all moreover totipotent, why should there be surprise when each cleavage segment begins to develop as the original egg with its single nucleus began to develop?

Prof. MacBride agrees that emissions from the nucleus control development. Then why invent an entelechy to control these emissions? Is not the relation of the nuclei to the cytoplasm, and of the cells to each other and to the environment, sufficient to account for such differentiation of cytoplasm as takes place in development? Surely the facts of regeneration, remarkable as they are, would seem to lose some of their terrors when it is recognised that all the nuclei of an organism are in general totipotent.

Both Rádl and Uexküll adhere to the old conceptions of Weismann regarding the differentiation of nuclei during ontogeny, but such a view has long been obsolete and, as Prof. MacBride points out, the nuclei are to be regarded as undifferentiated during development. I reached a similar conclusion many years ago ("The Mutation Factor in Evolution", p. 297; 1915) on the basis of such mutations as *Œnothera lata*, which have an extra chromosome in every cell. Many similar cases have been discovered since. Driesch ("Science and Philosophy of the Organism", 1908, p. 154) regards the cambium of higher plants as a similar "equipotential system with complex potencies". This indeed appears to be true, but, so far as I am aware, botanists have never yet felt the need for an entelechy in their explanation of its characteristic activity. In the process of secondary thickening in an ordinary woody stem, secondary medullary rays soon begin to appear. This is because the cambium cells on certain radii change their activity and produce parenchyma cells instead of xylem and phloem. Has the entelechy changed its mind, or will it suffice to assume that with increasing diameter and circumference the altered spatial relationships between the tissues lead to a change in the activity of the cambial cells occupying certain positions?

The length to which such vitalistic conceptions can be carried is well exemplified by Uexküll, who, in his discussion of Mendelism, after adopting the current view that the chromosomes contain enzymes which in their turn initiate the development of

characters, makes the gratuitous assumption (l.c. p. 214) that these enzymes are themselves controlled by non-material impulses. We read (p. 216), "We may say that the genes are 'impulsive', but by that term we must not presume a physical energy, following the rule of causality; rather, we must understand the power to convert an extra-spatial and extra-temporal plan into a physical phenomenon". This seems pure mysticism, yet (p. 201) he accepts the usual conception that in Mendelian inheritance "a separation of the competing rudiments" takes place in germ cell maturation. What are these "competing rudiments" but material particles? After stating that Driesch "has proved that there is a framework present in the germ", Uexküll goes on to say (p. 209) that a framework is like a machine and cannot repair itself. It is important to point out that this also applies to the chromosomes. There is now clear evidence from various lines of observation and experiment that when a chromosome or a portion of one is lost it is never regenerated.

Prof. MacBride, in touching on the question of genes, states that Johannsen deplored "the damage and confusion of thought caused by the invention of the word 'gene'". There must be some further confusion of thought here, for it was Johannsen himself who invented the word gene ("Elemente der exakten Erblichkeitslehre", third edition, p. 165), as well as genotype and phænotype. We find it more rational to accept the conception of genes spatially arranged in the chromosomes and distributed by mitosis to every nucleus during ontogeny, thus leading to an orderly development, than to postulate an entelechy the ways of which are past finding out, or a bundle of memories which seems an even more uncertain basis on which to explain the phenomena of ontogeny and regeneration.

Since Prof. MacBride accepts the conception of emissions from the nuclei as controlling development, and since we know that the nuclei of each species of animal or plant have a definite and characteristic morphological collocation of materials making up the chromosomes, might we not ask him to consider the definiteness in every detail of the structure of these bodies, as a possible basis for the orderliness which we behold in the successive stages of embryological development. That the essential substances in the chromosomes are autocatalytic in nature, is a view frequently held, and it appears to furnish an adequate mechanistic basis for the phenomena of development.

We fully agree with Prof. MacBride that Schleip's conception of an ultra-microscopic crystalloidal structure in the cytoplasm will not suffice to explain the phenomena of development and regeneration, but we have already seen that the known organisation of the nucleus appears to be sufficient, working in a cytoplasmic matrix which is relatively undifferentiated from species to species. The recent work on species-hybrids shows that in those cases, such as *Antirrhinum*, where Mendelian behaviour results, there is no cytoplasmic difference involved; whereas in many other experimental cases, both in plants and animals, the less nearly related species have their characteristic cytoplasm, as well as differences in the germ nuclei. It appears clear that in species differentiation nuclear differences arise first and cytoplasmic differences afterwards, as the nuclear differences become more pronounced.

We are fully impressed by Spemann's conception of 'organisers' in embryonic development, based chiefly on the more recent embryonic grafting experiments. But we take it that this need not lead to the conception that the organisers have an entelechy which dominates over the entelechy of the part on which they are grafted.

It is interesting to note that both Driesch and Przibram regard the stiffening or solidifying of the cytoplasm of the animal egg as an important element affecting development. For Driesch it limits the activities of the entelechy, and for Przibram it leads to the formation of 'apoplasm' which is not fully alive. As regards plant embryogeny, however, the conditions of stiffening in the cytoplasm appear to be quite the reverse. The meristem of a growing root or stem is composed of undifferentiated cells which are filled with dense and apparently stiff cytoplasm. Differentiation of the stelar tissues only begins in the older region of the stem or root, where the cells have taken in quantities of water and developed vacuoles which ultimately coalesce to form a large watery chamber with a thin peripheral layer of cytoplasm. It appears true that such secondary meristems as the cambium retain dense cytoplasm or develop it before they begin to divide, but their derivatives show a progressive increase in water content, and therefore in one sense at least in liquidity. These products of the meristems are, of course, the cells which become differentiated tissue elements.

R. RUGGLES GATES.

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Strand, W.C.2.

To answer Prof. Gates fully would require a philosophical treatise, for which I am sure no room could be found in NATURE. I shall endeavour to deal with his principal points as briefly as I can.

Prof. Gates asserts that Driesch assumed an entelechy because the facts of development could be explained by no mechanical hypothesis so far put forward; but that the entelechy "explained nothing" and was "unscientific". These are serious accusations to bring against a biologist of the eminence of Prof. Driesch. Prof. Gates's statement of Driesch's argument is incorrect. What Driesch said was that no *possible* mechanical hypothesis would explain development: for all such hypotheses in the last resort resolve themselves into the assumption of a "fixed constellation of parts"—or, as I would put it, the juxtaposition in a fixed order of unlike molecules.

'Science' is only organised common sense, and if Driesch was driven to this conclusion by convincing logic, it is eminently 'scientific' on his part to say so. As to the entelechy explaining nothing, Prof. Gates should remember that *all explanation is comparison*—the ranging of less known with the better known. Prof. Gates does not believe that he himself is a mere mechanism; if he were, he could not carry out scientific reasoning. He knows that he possesses a personality which 'regulates' his bodily mechanism—and what Driesch's conclusion amounts to is that a rudimentary element of the same general nature exists in every organism. An eminently common-sense conclusion! For, as has been well said, the man who maintains that his brother or his cat is a mere mechanism, is either a fool or a 'physiologist'.

Prof. Gates agrees with me that nuclei are equipotential and that the nuclei control or 'organise' the cytoplasm, and these considerations, he thinks, afford a 'mechanical' explanation of development. On this point I shall only remark that it was precisely these considerations which led Driesch to his vitalistic hypothesis. I recommend Prof. Gates to re-read carefully "The Science and Philosophy of the Organism". The fact is that all so-called mechanical hypotheses of development surreptitiously introduce

vitalistic links into the chain of argument, but endeavour to cover them up by inventing technical names for them.

Prof. Gates admits that the cambium of the higher plants is an equipotential system, but says that no botanist as yet has postulated the existence of an entelechy. If Prof. Gates will read Prof. Bower's Bristol address to the British Association, he will encounter something suspiciously like the Drieschian entelechy.

I shall not follow Prof. Gates in his attack on Von Uexküll's "Theoretische Biologie", but will refer him to my review of that book which appeared in NATURE in July 1929.[1] Von Uexküll is one of our foremost comparative physiologists. His destructive criticism of the mechanistic position is, to my mind, unanswerable.

It is true, as Prof. Gates says, that Johannsen invented the word 'gene', but he lived to regret it, and his repudiation of it is contained in *Hereditas*, vol. 4 (1923), p. 133, to which I refer Prof. Gates.

Prof. Gates invites me to consider whether the conception of the chromosomes as composed of 'genes' which are 'autocatalysts' does not afford the explanation of development of which I am in search. The "orderly arrangement of genes" is a figment of the imagination; as Dürken has remarked, no one has ever seen 'genes' in a chromosome, which always appears when examined fresh to be a homogeneous rod of glutinous material. But if Prof. Gates were a zoologist instead of being a botanist, he would know that the assumption that 'genes' have anything to do with evolution leads to results, as in the case of *Drosophila*, that can only be described as farcical, and this assumption is repudiated by all those really conversant with the evidence for evolution.

The term 'autocatalysis' is a piece of bluff invented by the late Prof. Loeb to cover up a hole in the argument in his book, "The Mechanics of Living Matter". If we turn to the late Prof. Bayliss's book on enzyme action—and he is our foremost authority—we find a catalyst defined as something which causes a chemical action normally proceeding slowly to proceed quickly. All known chemical actions are inhibited by the accumulation of the products of the reaction. An 'autocatalytic' reaction, in which the products of the reaction accelerated it, must surely be a vitalistic one!

Prof. Gates has kindly and sympathetic concern about my 'salvation' as an evolutionist. Let me reassure him on this point; I am a thorough believer in evolution. I admit that statements of both Driesch and Uexküll give colour to his complaint that they repudiate evolution altogether. It was part of the object of my review to show that the concept of entelechy could be further analysed, and that entelechies could be brought into orderly relation to one another and fitted into a scheme of evolution.

E. W. MACBRIDE.

[1] "A Philosophy of Biology", NATURE, July 20, 1929.

Absorption of Sound at Oblique Incidence.

IN the issue of NATURE for Sept. 6, Dr. P. R. Heyl directs attention to a disagreement between theoretical conclusions concerning the absorption of sound by porous bodies at oblique angles of incidence.

The theories to which he refers are those given by Sir Joseph Larmor[1] and myself.[2] Dr. Heyl states that "For grazing incidence, Larmor finds that the absorption should be infinite, while Paris comes to the conclusion that it should be zero".

The disagreement is due to an unfortunate 'approximation' which occurs in Sir Joseph Larmor's calculation.[3] It is there shown that

$$\frac{u_1 - u_2}{u_1 + u_2} = \frac{k'}{k}\frac{a}{\cos\iota}, \quad . \quad . \quad . \quad (1)$$

where u_1 and u_2 are the particle velocities in the incident and reflected waves respectively, k'/k is the ratio of the wave-length in the incident sound to the wave-length in the pores, a is the proportion of the reflecting surface occupied by the pore openings, and ι is the angle of incidence. The 'degree of stifling of the sound' (that is, the coefficient of absorption) is stated to be "$(u_1^2 - u_2^2)/u_1^2$ or approximately $(u_1^2 - u_2^2)/\frac{1}{4}(u_1 + u_2)^2$" (an obvious misprint which occurs in the original paper is corrected). This leads to an absorption coefficient $(k'/k)4a/\cos\iota$ which increases with obliquity and tends to become infinite at grazing incidence—a result which is manifestly wrong, since for physical reasons the coefficient cannot in any circumstances be greater than unity. The source of trouble is in the approximation. From the equation (1) quoted above we have

$$\frac{u_2}{u_1} = \frac{\cos\iota - (k'/k)a}{\cos\iota + (k'/k)a}, \quad . \quad . \quad . \quad (2)$$

whence, without approximation, the absorption coefficient is

$$\frac{4(k'/k)a \,.\, \cos\iota}{\{\cos\iota + (k'/k)a\}^2}, \quad . \quad . \quad . \quad (3)$$

which tends to zero as grazing incidence is approached. It is clear from (3) that the so-called approximation consists in neglecting $(k'/k)a$ in comparison with $\cos\iota$ for all values of ι between 0 and $\pi/2$.

It appears therefore that when no approximation is made, Sir Joseph Larmor's results are in agreement with those given in my paper of 1927. In fact, the equation (1) which expresses the relation between the amplitudes of the incident and reflected waves has precisely the form of my equation[4] (3.4) deduced by the aid of 'acoustical admittance'.

It may be observed that $(k'/k)a = u/(p/a\rho)$ where u is the component of particle velocity normal to the reflecting surface, p is the pressure at this surface, a is the velocity of sound in air, and ρ is the density of air. This follows at once from equations on p. 234 of Sir Joseph Larmor's paper.[5] Hence $(k'/k)a = u/V$ where V is the particle velocity in a plane progressive wave in which the pressure is p. The possible values of $(k'/k)a$ therefore lie in the range zero to unity, that is, in the same range as the values of $\cos\iota$. Thus, from (2) we see that there are always values of ι for which u_2 is negligible compared with u_1, and for every value of $(k'/k)a$ there is a value of ι for which u_2 vanishes and the incident sound is totally absorbed.[6] The argument applies only to the ideal case when k' is real. For actual materials k' is expected to be complex, and then, as shown elsewhere, the absorption should be a maximum for some particular angle of incidence.

E. T. PARIS.

Shortlands, Kent, Nov. 10.

[1] *Proc. Camb. Phil. Soc.*, **26**, pp. 231-235; 1930.
[2] *Proc. Roy. Soc.*, A, **115**, pp. 407-419; 1927.
[3] P. 234, loc. cit.
[4] *Proc. Roy. Soc.*, A, **115**, p. 412.
[5] Cf. also Rayleigh, "Sci. Papers", vol. 6, p. 663.
[6] Cf. *Proc. Roy. Soc.*, A, **115**, p. 413.

Glucose and the Structure of the Cycloses.

THE cyclohexanols $C_6H_{12-n}(OH)_n$ and their methyl derivatives are of considerable interest from the point of view of biochemistry. It has been known for some time that these substances can, according to theory, exist in a great number of isomeric forms.[1] The following table shows the number of possible isomers

for various values of n, on the assumption of a plane ring structure for the cyclohexane nucleus:

TABLE I.

CYCLOHEXANOL ISOMERS (PLANE RING).

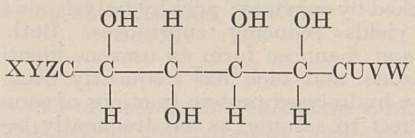
n.	Substitution.	Active (in pairs).	Inactive.	Totals.
1	1.	0	1	1
2	1.2.	2	1	3
..	1.3.	2	1	3
..	1.4.	0	2	2 8
3	1.2.3.	2	2	4
..	1.2.4.(1.2.5.)	8	0	8
..	1.3.5.	0	2	2 14
4	1.2.3.4.	8	2	10
..	1.3.5.6.	4	4	8
..	1.3.4.6.	4	3	7 25
5	1.2.3.4.5.	12	4	16 16
6	1.2.3.4.5.6.	2	7	9 9

The natural occurrence of the cycloses is summarised as follows: There are two inactive cyclohexanhexols, *i*-inositol and scyllitol, which are definitely known to occur. The monomethyl-*i*-inositols, bornesitol, mytilitol,[2] and sequoyitol,[3] and two dimethyl derivatives are also recorded. The two active inositols as such have been reported only in the racemic form in the berries of the mistletoe, but their methyl derivatives, quebrachitol and pinitol, are of more general occurrence.

The dextrorotatory pentol known as *d*-quercitol has been obtained from several sources and its lævorotatory diastereomer has been found in the leaves of *Gymnema sylvestre*. One active tetrol, betitol, the constitution of which has not yet been discussed, is reported to occur in the sugar beet.

While it cannot be said that the search for cycloses has been exhaustive, very considerable work has been done which would lead to their discovery.[4] It is therefore not unreasonable to suppose that at least a majority of the naturally occurring cycloses have been discovered. It remains then to explain the discrepancy between the seven known cycloses with four or more hydroxyl groups and the fifty which are theoretically possible.

In view of the widespread occurrence of these substances in Nature, one is tempted to look for some common function or property which will limit the number of cycloses which can occur. Without considering its plausibility, let us assume that in Nature the cycloses and their methyl derivatives have their origin in glucose, or at least are chemically closely connected with some substance which contains in its structure the configuration: *



Let us now determine which of the theoretical isomers of Table I. can give rise to the glucose configuration. In Table II. the number of isomers which satisfy this condition is compared with the number actually found in Nature. Of course, the monol, diols, triols, the 1.3.5.6 tetrols, and the 1.3.4.6 tetrols cannot contain the required arrangement of hydroxyls.

* We do not concern ourselves with the substitution of the end carbon atoms or with the sign of the activity. Thus the above formula might apply to *d*- or *l*-glucose, or to *d*- or *l*-gulose. This ambiguity does not have any bearing on the present argument.

TABLE II.

n.	Activity.	Theory.	Found.
4	inactive	0	..
..	dextro	1	1
..	lævo	1	..
5	inactive	1	..
..	dextro	3	1 †
..	lævo	3	1 †
6	inactive	3	2
..	dextro	1	1
..	lævo	1	1

† These are not antipodes, so that two models are represented.

We see from this table that of the fourteen cycloses required by the present theory, seven have been found. This agreement is surprisingly good when we remember that no account has been taken of the possible effect of the end groups in the formation of the ring. Any further condition can only reduce the number of isomers, so that the data in Table II. correspond to the maximum number of isomers consistent with the present assumption.

I am aware that the assumption of a puckered ring or a ring of any lower symmetry leads to a considerable increase in the number of possible isomers. Any criticism on this account is, however, equally well a criticism of most of the results of stereochemistry, and therefore need not be taken into account until circumstances warrant a more general view of the whole subject.

Of course, the theory that *i*-inositol is closely related physiologically to glucose is by no means new.[4] It provides an explanation of the association of glycosuria and inosituria in both pathological and experimental polyurias. Needham [5] has shown that inositol is synthesised in the embryonic development of the chick; and that in this case the maximum of the inositol–time curve can be nearly doubled by the injection of glucose at the beginning of the development. Needham [6] has also shown that the dogfish embryo synthesises scyllitol in a similar manner, although the effect of glucose still remains to be investigated.

It is important to note here that the present assumption is in agreement with the structure arrived at for *i*-inositol by S. and T. Posternak.[7]

A. L. PATTERSON.

Rockefeller Institute for Medical Research,
New York City, Oct. 10.

[1] L. Bouveault, *Bull. Soc. Chim. France* (3), **11**, 144; 1894.
[2] R. J. Daniel and W. Doran, *Biochem. J.*, **20**, 676; 1926. Specific references are only given for those substances not recorded in Beilstein (4th edition), vol. 6.
[3] E. C. Sherrard and E. F. Kurth, *J. Am. Chem. Soc.*, **51**, 3139; 1929.
[4] Cf. J. Needham, *Ergebn. d. Physiol.*, **25**, 1; 1926.
[5] J. Needham, *Biochem. J.*, **18**, 891 and 1371; 1924; also loc. cit.
[6] J. Needham, *ibid.*, **23**, 319; 1929.
[7] S. and T. Posternak, *Helv. Chem. Acta*, **12**, 1165; 1929.

A Relation between the Radial Velocities of Spiral Nebulæ and the Velocity of Dissolution of Matter.

IN a letter in NATURE of Nov. 8, p. 722, Prof. A. Haas proposes to relate the rate of expansion of the universe to the rate of 'disintegration' of matter by using Einstein's formula,

$$M = \frac{2}{\pi} R \text{ (gravitational units)} \quad . \quad . \quad (1)$$

and taking derivatives with respect to the time t.

Apart from the fact that this would give a negative velocity, that is, a contraction, the method itself seems to be illegitimate. Equation (1) is derived on the explicit assumption that R is not a function of t. When R is a function of t, (1) must be replaced by

$$\left(\frac{dR}{dt}\right)^2 + 1 = \tfrac{1}{3}R^2\lambda + \frac{4M}{3\pi R} \quad . \quad . \quad (2)$$

where λ is Einstein's cosmical constant.[1] From (2) and related equations Eddington [2] has shown that Einstein's universe is unstable, so that when once disturbed it will expand or contract even if the total mass remains constant. He has further shown that if the initial disturbance were a conversion of matter into radiation it would actually start a *contraction*.

Prof. Haas does not state whether he is considering the *proper* mass or the *relative* mass. The latter does not change when matter is converted into radiation. If the proper mass is to be understood, a relation of his proposed type might hold good, apparently, only if λ were to vary in a suitable manner with the total amount of matter present. I am not aware that such a possibility has ever been suggested.

W. H. McCREA.

Mathematical Department,
University of Edinburgh,
Nov. 10.

[1] Lemaître, *Annales de la Société Scientifique de Bruxelles*, **47** A, p. 49; 1927.
[2] *Mon. Not. Roy. Ast. Soc.*, **90**, p. 668; 1930.

A. HAAS deduces the equation:

$$v = 1{\cdot}1 \times 10^{-49} M,$$

where v represents 'cosmical velocity' and M the mass of the universe.[1] Taking $M = 1{\cdot}8 \times 10^{57}$ gm. he obtains $v = 2000$ km. per second and then says: "This value agrees well with the magnitude of the velocity with which the farthest spiral nebulæ appear to recede from us".

As against this, I find that according to more recent investigations the mass of the universe is considerably less than $1{\cdot}8 \times 10^{57}$ gm. According to A. S. Eddington[2] we may assume that $M = 2{\cdot}3 \times 10^{55}$ gm. If we insert this value we obtain only $v = 25$ km. per second.

In the near future the *Zeitschrift für Physik* will publish my paper: "Einige Folgerungen aus den neuesten Ansichten von E. C. Stoner und von E. A. Milne über das Innere der Sterne". In that article, among other subjects, I deal with the problem of the dissolution of matter, but from a totally different point of view from that of A. Haas.

WILHELM ANDERSON.

Tartu-Dorpat (Estonia),
Nov. 13.

[1] Arthur Haas, NATURE, **126**, p. 722; 1930.
[2] A. S. Eddington, *Mon. Not. Roy. Ast. Soc.*, **90**, p. 678; 1930.

Evidence for Quadripole Radiation.

THE $S \rightarrow D$ transitions which occur in the alkali spectra are forbidden by the ordinary selection rules for the azimuthal quantum number. As they are still observable in absorption, the question arises whether they are due to the action of external electric fields and are still a dipole radiation from a perturbed atom, or whether they are due to quadripole radiation. Rubinowicz has calculated the Zeeman selection rules for quadripole radiation; they differ from the ordinary rules in that the change in the magnetic quantum number may have the values ± 2 in addition to the ordinary ones 0, ± 1. The polarisation also is quite different.

I have observed the transverse Zeeman effect of the 4642·17-4641·58 potassium doublet, which is an $S \rightarrow D$ combination, and I have been able to show that its Zeeman pattern agrees with the predictions of Rubinowicz for quadripole radiation and not with those for dipole radiation. This transition is thus shown to arise from quadripole radiation.

Details will be published elsewhere.

EMILIO SEGRÈ.

Istituto Fisico della R. Università,
Roma, Nov. 7.

The Carbohydrate Complex of Serum Proteins and the Clinical Determination of 'Bound Sugar' in the Blood.

IN connexion with the reference to my work (Rimington: *Bioch. J.*, **23**, 430) upon the isolation of a carbohydrate complex from blood-serum proteins, made in an article in NATURE of Nov. 1, p. 704, it may be of interest to state that I have now extended these observations, with the consequence that I have somewhat modified my earlier conclusions.

The complex obtained from the proteins of horses' serum appears to be a *tri*saccharide structure (possibly polymerised) and not a *di*saccharide as originally suspected. This conclusion was announced to the Biochemical Society on May 17 of this year, and is to be found in the *Proceedings* of that Society published in *Chemistry and Industry*, May 23, 1930, p. 440.

Each molecule of glucosamine is associated with two molecules of mannose, thus giving a substance with the empirical formula $C_{18}H_{33}NO_{15}$ and containing 2·78 per cent nitrogen. A similar trisaccharide complex, which appears to be identical with that already described, has also been isolated from the mixed serum proteins of ox blood. All my preparations are optically inactive.

It is of interest that the nitrogenous impurity which was found to be present in the substance originally isolated proved to be histidine. For its complete removal prolonged and vigorous hydrolysis is required. Since the carbon and hydrogen content of histidine differs little from that of the sugar which was being isolated, the fact that its presence was unsuspected is capable of explanation.

More recently I have attempted to prepare sufficient of the so-called mucoid of blood serum to examine it for associated carbohydrate material. In view of Levene and Mori's recent findings in the case of ovomucoid (*J. Biol. Chem.*, **84**, 49), it seems possible that this protein of the serum, also, may prove to be carbohydrate containing.

Finally, I should like to add that the discovery of these complexes in serum albumin and globulin affords a satisfactory explanation of some of the contradictory observations of various authors upon the 'bound sugar' of the blood. Alkaline hydrolysis of the proteins leads to a non-reducing complex which is also unattacked by enzymes; acid hydrolysis, on the other hand, yields reducing substances. Both glucosamine and mannose form an osazone identical with glucosazone, and such has frequently been isolated from the hydrolysed protein fractions of serum, but it is incorrect to assume, as has frequently been done, that the protein sugar is thus proved to be glucose.

Certain quantitative discrepancies between the results of various authors can be similarly explained. Bierry and Rathery (*C. R. de la Soc. Biol.*, **83**, 1890) give the figures for the protein sugar of horse plasma as about 0·13 per cent; Dische (*Bioch. Z.*, **202**, 74) finds it to be about 0·22 per cent. The former authors deproteinised their solutions with a mercuric nitrate reagent, which also precipitates glucosamine, whilst

Dische's figure was arrived at when using phosphotungstic acid as the protein precipitant.

The 'bound sugar' of the blood may have a physiological significance (Glassmann; *Zeit. physiol. Chem.*, **150**, 16, and **158**, 113).

A further communication on this subject will be published shortly. CLAUDE RIMINGTON.

Biochemical Department,
Wool Industries Research Association,
Headingley, Leeds, Nov. 4.

Natural Selection Intensity as a Function of Mortality Rate.

IN NATURE of May 31, Prof. Salisbury points out that most of the mortality among higher plants occurs at the seedling stage, and concludes that natural selection is mainly confined to this stage. I believe, however, that this apparently obvious conclusion is fallacious, for the following reason:

Consider two pure lines A and B originally present in equal numbers, and with a common measurable character, normally distributed according to Gauss's law in each group. Let the standard deviations of the character be equal in each group, but its mean value in group A slightly larger than that in group B. Johanssen's beans furnish examples of this type of distribution. Now let selection act so as to kill off all individuals in which the character falls below a certain value. I think that this type of artificial selection furnishes a fair parallel to natural selection, in which chance commonly plays a larger part than heritable differences. Let x be the proportion of individuals eliminated to survivors, and $1+y$ the proportion of A to B among the survivors, so that x measures the intensity of competition, y that of selection.

Then when x is small y is roughly proportional to it. Thus when x increases from 10^{-4} to 10^{-1}, y increases 200 times. But when x is large y becomes proportional to $\sqrt{\log x}$. In consequence y only increases 9 times when x increases from 1 to 10^{12}, and is only doubled when x increases from 1 to 1800. In other words, when more than 50 per cent of the population is eliminated by natural selection, the additional number eliminated makes little difference to the intensity of selection. The theory, which I hope to publish shortly, has been extended to cover cases where the standard deviations differ, and also where populations consist of many genotypes. In general y changes its sign with x, but when x is large y never increases more rapidly than $\log x$.

Careful mathematical analysis seems to disclose the extraordinary subtlety of the natural selection principle, and merely verbal arguments concerning it are likely to conceal serious fallacies.

J. B. S. HALDANE.

John Innes Horticultural Institution,
Merton Park, London, S.W.19,
Nov. 1.

The Exit of *Leishmania infantum* from the Proboscis of *Phlebotomus perniciosus*.

SANDFLIES, *P. perniciosus*, infected with *Leishmania infantum* on a hamster, were allowed to feed on a solution of citrate by Hertig's method. This method consists of inserting the biting apparatus of living sandflies into a capillary in such a way that the mouth parts go through all the movements of piercing. In some species these movements in the Hertig apparatus are followed by activity of the pumping apparatus of the buccal cavity and pharynx which results in the ingestion of fluid. In the case of *P. perniciosus*, the mouth parts go through all the actions of piercing, but the insects seldom ingest fluid in the Hertig apparatus.

Fifteen sandflies from five to thirteen days after the infecting feed were placed in the Hertig apparatus. After an interval of one to three minutes, the sandflies were removed and the fluid in the capillary was examined. In six cases (9-10 days after the infecting feed) the fluid was found to contain flagellates. The number of flagellates found varied from one to hundreds, but in all cases the number recovered from the biting parts was very small as compared to the enormous numbers afterwards found in the dissected sandflies. In contrast to the flagellates from the midgut and œsophagus, which are very active, those recovered from the biting parts are sluggish and many of them quite motionless.

The above observations prove that *L. infantum* can leave the biting parts of *P. perniciosus* during the act of biting and enter a new host in the absence of any active interference on the part of the latter. We suggest that this accounts for the main peculiarity of Mediterranean kala-azar, that is, its relative frequency in infants less than twelve months of age.

S. ADLER.
O. THEODOR.

Kala-azar Commission of the Royal Society
and Hebrew University of Jerusalem.

Elements present in Animal Tissues.

IN a letter published in NATURE of Nov. 15, Mr. A. Chaston Chapman announces the interesting discovery of antimony in an animal. He refers also to the known presence of vanadium and arsenic in certain animal tissues. We purposely omitted from our letter to NATURE of Nov. 1 reference to a number of other elements which have previously been recorded as occurring in animal tissues but which have not up to the present been detected in our work, for reasons already given by one of us [1]. They are the following: Aluminium, zinc, boron, and silicon, from numerous animals; gold in mammals [2]; titanium in an ascidian [3]; bismuth [4] and tin [5] in human organs; vanadium, not only in ascidians, but also in a holothurian [6]. In addition, Dr. J. Needham has directed our attention to records of molybdenum [7] and uranium [8] in hens' eggs.

H. MUNRO FOX.
HUGH RAMAGE.

Nov. 25.

[1] H. Ramage, NATURE, **123**, 601; 1929.
[2] R. Berg, *Bioch. Zeit.*, **198**, 28; 1928.
[3] M. Azéme and H. Pied, *C.R. Ac. Sci.*, **190**, 1; 1930.
[4] T. Fairley and B. A. Burrell, *J. Soc. Chem. Ind.*, **37**, 155; 1918.
[5] E. Misk, *C.R. Ac. Sci.*, **176**, 138; 1923.
[6] A. H. Phillips, *Am. J. Sci.*, **46**, 473; 1918.
[7] W. R. Mankin, *Med. Jour. Aust.*, **2**, 87; 1928.
[8] W. B. S. Bishop, *ibid.*, **1**, 480; 1928.

English Equivalents of *Eigenfunktion* and *Eigenwert*.

MR. C. N. HINSHELWOOD suggests in NATURE of Oct. 18, p. 604, that the English equivalents of *eigenfunktion* and *eigenwert* should be *proper function* and *proper value*. Having shown how to develop the functions used by Schrödinger (see, for example, my paper in the *Phil. Mag.*, vol. 6, July 1928), may I again suggest from the nature of the Heaviside operator method disclosed that the terms to employ are *parametrals* and *parametral functions*.

A. PRESS.

New York, Nov. 3.

Intense Magnetic Fields and Low Temperature Research.*

By Sir ERNEST RUTHERFORD, O.M., P.R.S.

EXPERIENCE has shown that the encouragement of research by minor grants for special apparatus and material is in reasonable measure provided for by the Government grant to the Royal Society, supplemented from the Society's own research funds. The grants to individual investigators from such sources are usually small but suffice to assist materially important researches of a limited scope. The situation, however, is very different when we consider large scale investigations of a pioneering character, which may require considerable financial support extending over a period of years in order to provide the necessary apparatus and technical assistance to bring the investigation to a definite conclusion. Few of our universities or other scientific institutions are sufficiently well endowed to support large scale researches of this kind, even when the research appears of marked promise and when the idea and the man are forthcoming. In considering the best method of utilising the balance of the Society's present resources, the Council of the Royal Society has decided that it can best help the advance of science by assisting major researches of this character, and, after careful consideration, was impressed with the fundamental importance of the researches at present being carried on by Dr. P. Kapitza, at Cambridge, and the need for continuing this work on a more permanent basis.

It may be helpful at this stage to give a brief history of the origin and development of the work on which Dr. Kapitza has been engaged for the past eight years. Trained as an electrical engineer, Dr. Kapitza was lecturer in physics in the Petrograd Polytechnical Institute from 1918 until 1921. In 1921 he came to England and commenced research work in the Cavendish Laboratory, Cambridge. In 1922 he began experiments to test the possibility of obtaining intense magnetic fields by sending very strong currents through a coil for such a short interval that the heating effect in the coil is restricted to a permissible value. With the assistance of a grant from the Department of Scientific and Industrial Research, special accumulators were constructed to give the necessary intense currents for a short interval of about $\frac{1}{50}$ sec. In this way, fields up to 200,000 gauss were obtained, and it was found practicable to carry out experiments by this method, for example, on the Zeeman effect and on the deflection of α-particles.

In order to carry these experiments still further, it was necessary to have a method of obtaining currents still larger and more under control. For this purpose, a generator of special design was constructed which gives, on short circuit, a current of about 70,000 amperes. The heavy current from the generator is passed for about one-hundredth of a second through a coil and is then broken by means of a specially designed automatic break. The Department of Scientific and Industrial Research gave a very substantial grant for the construction of this apparatus, while Sir William Pope kindly provided a temporary laboratory to install the plant and to carry out the experiments. In 1926 the laboratory was opened formally by the late Lord Balfour, then Lord President of the Council, who had throughout taken an active interest in promoting these large scale experiments. This pioneering investigation, which was carried out in connexion with the Cavendish Laboratory, was only made possible by the generous and bold support of the Department of Scientific and Industrial Research, which, up to the present, has defrayed the complete cost of the apparatus and of the subsequent investigations.

One of the chief difficulties in these experiments has been to construct a coil strong enough to withstand the enormous disrupting forces which arise when a large current is passed through it. A number of coils have been constructed which give magnetic fields of between 300,000 and 400,000 gauss over a volume of about 3 c.c. There appears to be no inherent difficulty why fields of the order of 1 million gauss should not be obtained, when called for, by this method. As the current through the coil only lasts for about $\frac{1}{100}$ sec., oscillograph methods are used to determine the strength of the current and magnetic field and to follow the changes in the properties of the material under investigation. There is no special difficulty in conducting experiments with these momentary fields. In fact, a single photograph, obtained in $\frac{1}{100}$ sec., may give a complete quantitative record of the magnetic effects produced in a material over a wide range of magnetic field.

The application of these new methods of producing intense magnetic fields opens up a wide field of research where all magnetic properties can be examined in fields ten to thirty times greater than those hitherto available by the use of electromagnets.

As soon as the apparatus was in working order, experiments were begun to investigate the change of resistance of crystals of bismuth in these intense magnetic fields from atmospheric temperature to that of liquid air. This was followed by an extensive investigation of the behaviour of a large number of metals under corresponding conditions. In general, it was found that the change of resistance was at first approximately proportional to the square of the magnetic field, but above a certain critical field, which varied from metal to metal, the change of resistance tended to become linear. On the basis of these new results, Dr. Kapitza has suggested a new way of looking at the phenomena which underlie the electrical conductivity of metals and its variation with temperature. Preliminary experiments have also been made on the action of these strong fields on the paramagnetism and diamagnetism of certain substances, while a new and sensitive apparatus has been constructed to study magnetostriction effects. An

* Excerpts from the presidential address to the Royal Society delivered at the anniversary meeting on Dec. 1.

account of the apparatus and the experimental methods, together with the results of some of these investigations, has been published by Dr. Kapitza in the *Proceedings* of the Royal Society.

Magnetic phenomena are shown in their simplest form at very low temperatures when the complications due to the motion of the atoms and molecules are largely avoided. In order to obtain temperatures still lower than that of liquid air, a liquid hydrogen plant has been installed during the present year, and is now in working order. Preliminary arrangements have been made to install a liquid helium plant when this is required for the investigations.

The grant given by the Department of Scientific and Industrial Research for carrying out these researches expires in a few years, while the laboratory temporarily lent for the purpose of these experiments is now required by the Chemical Department of the University. The Department of Scientific and Industrial Research, by its broad-minded and far-seeing action, has done a great service to science in thus supporting, through their initial stages, investigations having no obvious or immediate application in practice or industry. Their support for an indefinite period, however, could scarcely be part of the Department's policy. On the other hand, it appeared to the Council of the Royal Society that investigations of this kind, in which new fields of knowledge are being opened up by new methods, had a peculiarly strong claim for support from those funds which the Society was holding ready for the furtherance of fundamental researches in pure science.

The Council of the Royal Society, in addition to appointing Dr. Kapitza to a Messel professorship, has therefore agreed to offer the University of Cambridge the sum of £15,000 for the building of a suitable laboratory within the next three years, provided the University was prepared to offer an appropriate site and to defray the running expenses of the new laboratory. If the University of Cambridge concurs with these proposals, the Royal Society will thus have been instrumental in founding a new and up-to-date laboratory, primarily designed for carrying out researches in intense magnetic fields, but at the same time providing the essentials of a modern cryogenic laboratory for the study of magnetic and other effects at the lowest attainable temperatures.

The name of the new laboratory at Cambridge has not yet been settled, but it would be appropriate if it indicated the connexion with the Royal Society and with the late Dr. Ludwig Mond, whose bequest furnished the income from which the cost of the laboratory will be defrayed. It should be noted that among the purposes indicated in the will of Dr. Mond for the use of his bequest was " erecting new laboratories ".

It will be remembered that, thirty years ago, Great Britain was pre-eminent in the study of effects produced on matter by the low temperature produced with the aid of liquid hydrogen. It will be recalled that the late Sir James Dewar, with the technical assistance of Mr. Lennox, first produced liquid hydrogen in quantity in the laboratories of the Royal Institution in 1898, and in 1899 the first solid hydrogen was obtained. It was so early as 1893 that Dewar devised the vacuum flask which has proved to be of such fundamental importance in the technique of low temperatures and has so greatly simplified the handling of liquid gases. It is of interest to note that it was decided in 1902 to construct a liquid hydrogen plant, of capacity of about five litres of liquid hydrogen per hour, as a British Government exhibit to the St. Louis Exposition in 1904. This plant was placed in the competent hands of Mr. (now Sir) Joseph Petavel, and I well remember the interest of his demonstrations of the properties of liquid hydrogen at that Exhibition. Some time later, a small liquid hydrogen plant was installed by Dr. M. W. Travers, in the laboratory of the late Sir William Ramsay at University College, London.

In the meantime, an efficient cryogenic laboratory had been established at Leyden, under the direction of the late Prof. Kamerlingh Onnes. His success in liquefying helium and also the wide range and importance of the investigations carried out on the effects of low temperatures on the properties of matter are well known. It was only a few years ago that Prof. W. H. Keesom, who followed Onnes in the charge of this laboratory, was successful in producing solid helium.

A few years ago, owing to the energy and enthusiasm of Prof. J. C. McLennan, liquid hydrogen and helium plants were installed in the University of Toronto, and have proved their utility in a number of important researches. In recent years modern equipment for the liquefaction of hydrogen and helium has been installed in the Reichsanstalt, Berlin, by Dr. W. Meissner, and very valuable results have been already obtained. Dr. Franz Simon, of the University of Berlin, obtains the temperature of liquid helium by an ingenious method involving the use of liquid hydrogen and the absorption of helium gas by charcoal.

I am sure it will be gratifying to the Society to know that we may soon expect to have an up-to-date cryogenic laboratory on a small scale in Great Britain. I believe that it is in helping such important schemes of research that the Society can best utilise any research funds which it already possesses or which may become available in the near future. It not infrequently happens that a promising line of research or the development of a new method may be held up or abandoned because of the difficulty of obtaining adequate financial support. In some important directions, advance can only be made with the help of technical assistance in the construction and use of special apparatus, in some cases on an almost engineering scale.

It is by the encouragement and support of such major researches, especially in their initial stages, that the Society can be of great service in helping the advance of fundamental science in Great Britain. Along such general lines, it is not difficult to foresee that the Society will exert an ever-increasing influence on the progress of science and thus promote still further the original intentions of its founders.

Scientific Research and the Imperial Conference, 1930.

THE Imperial Conference of 1926 was distinguished by the lofty conceptions of the part which scientific research should take in the development of the British Commonwealth of Nations. Though it had been generally anticipated that economic questions would be the main issues at the Imperial Conference of 1930, many scientific workers and others who recognise the importance of science in economic affairs have been disappointed in what they consider the inadequate attention given to scientific research at this Conference. Fortunately, much more has been accomplished than has been reported in the public Press, and it is important that this fact should be realised and appreciated.

The two sections of the Conference most closely concerned with scientific matters were the Research Committee and the conference on standardisation, and it is noteworthy that the committee under Lord Parmoor provided the first occasion on which the responsible heads of the national industrial research bodies within the British Commonwealth of Nations met in a body to discuss their problems individually and collectively. Thus were met together Dr. F. E. Smith (Great Britain), Dr. H. M. Tory (Canada), Dr. A. C. D. Rivett (Australia), Dr. E. Marsden (New Zealand), Dr. P. J. du Toit (South Africa), Mr. J. Dulanty (Irish Free State), and Sir E. H. Pascoe (Director, Geological Survey of India), in addition to representatives from the British Ministry of Agriculture and Fisheries, Empire Marketing Board, and Imperial Institute.

Taking into account the existence of vigorous and well-organised national research bodies in Great Britain and the Dominions, it was not to be expected that the Research Committee would recommend the creation of still more forms of organisation. Its main task was to examine broadly the Imperial aspects of existing programmes of research, machinery for administration and consultation, training of research workers, and other questions; and to decide what further action could be taken to stimulate progress on the foundations laid down in previous Conferences and by direct communications.

In times of economic difficulty, efforts are made to lop off what are considered to be the less useful branches of activity, and Governments as well as commercial concerns are apt to regard research activities in this light. It was well, therefore, that the Research Committee, as one of its first recommendations, pointed out that the present severe economic depression should be regarded as a reason not for curtailment but for expansion of expenditure on research. In this connexion, it is only necessary to cite the valuable work in Australia on the influence of a supplementary protein diet in wool production, and in New Zealand on grassland problems, to realise the progress being made under the ægis of the respective national research bodies on problems of direct economic importance.

Agricultural research occupies a major position in the programmes of research in the Dominions, and it was natural that the committee should consider the results of the Imperial Agricultural Research Conference of 1927 and the work of the Imperial Agricultural Bureaux which were an outcome of that Conference. Both the details of the work being carried out by the bureaux and the manner of their establishment—financed from a common Empire fund and controlled by a council of nominees of the Governments of the British Commonwealth—were commended by the Research Committee. Following somewhat along the lines of the Imperial Institutes of Entomology and Mycology, these new bureaux deal with soils, animal nutrition, animal health, animal genetics, herbage and other farm crops, plant genetics, fruit production, and agricultural parasitology, and are gradually being recognised by research workers as trustworthy sources of information on the research aspects of the sciences concerned.

The research grants policy of the Empire Marketing Board was of special interest, since the Board is perhaps in the best position to draw together those interested in problems affecting the British Commonwealth as a whole, and to facilitate researches into these common problems by team work between two or more Dominions. Another phase of co-operative investigation which concerned the committee was the possibility of an interchange between the national research organisations of schemes of research, showing particularly the objectives and location of work of different lines of investigation. By this means, it is hoped that any unnecessary duplication will be reduced, and that economy of effort may be effected by definite collaboration in problems of mutual interest. This tendency to explore the possibilities of inter-Dominion action was clearly shown in relation to projects for investigation into the mineral resources and wool production of the Empire. In both cases, the benefit of a common line of action was realised and steps were taken to define the objectives and general procedure.

While in Great Britain, the directors of the Dominion research organisations visited many of the laboratories of industrial research associations and made a careful examination of the work of the Department of Scientific and Industrial Research on such subjects as fuel, preservation and transport of food, building, radio, river pollution, and the national laboratories for physical and chemical research at Teddington. The discussion in committee of research on these subjects was in many cases assisted by the presence of the directors of the laboratories concerned, and it was clear that the interchange of ideas by personal contact was likely to be reflected in the programmes of research both in Great Britain and in the Dominions. The deliberations on scientific research at the Imperial Conference of 1930 may indeed be summed up as a consolidation of the more spectacular achievements of the Conference of 1926.

Since most of the Dominion research organisations

are closely concerned with the movement for industrial standardisation and simplification in their respective countries, the overseas delegates on research matters also attended the conference on standardisation. This conference dealt with the two main questions of fundamental standards and industrial standardisation.

The deliberations on fundamental standards of mass, length, etc., had as an objective the securing of uniform fundamental standards within the British Commonwealth of Nations, and it is pleasing to observe that a considerable measure of progress has been made towards this objective. Hitherto no guide to common procedure has been available, and there has been a tendency among the nations of the British Commonwealth for minute but serious errors to arise through lack of regular intercomparison of local standards, such as the pound, yard, ohm, volt, etc. The conference, however, after recommending that there should be uniformity between the standards for all units of measurement of common use in the British Commonwealth of Nations, clearly indicated the procedure by which that uniformity may be established and maintained. Briefly, this involves a periodic reverification of the Dominion reference standards for each primary unit with the corresponding standards in Great Britain.

The position of industrial standardisation within the British Commonwealth was a much more involved question than that of fundamental standards, since the issues at stake are closely related to the complex economic and political affairs of the Commonwealth.

At this, the first Imperial Conference on the subject, the oral exchange of views was valuable in showing the present position of industrial standardisation in each part of the Commonwealth and the directions in which the movement was spreading. Though considerable attention was given to such questions as uniformity of industrial specifications within the Commonwealth, consultation and modification of draft specifications, adherence to standards, and the relation of Governments to the local standardisation authorities, it must be admitted that there is a great deal still to be done if the subtle but potentially great force of industrial standardisation and simplification is to exert its maximum influence on Imperial trade developments. A. S. F.

Obituary.

MR. EMILE GARCKE.

MR. EMILE GARCKE, one of the pioneers of the electrical industry, died on Nov. 14, at the age of seventy-four years. He was born in Germany in 1856, and came to England when he was very young. He became naturalised in 1880. In 1883 he was appointed secretary to the Brush Engineering Co., and four years later became the managing director. He was specially interested in the continental export trade of the company. In 1900 he began to study the question of industrial co-partnership, and in 1926 he initiated the co-partnership scheme of the Brush Co., which is operating very successfully. He was chairman of the council of the Industrial Co-partnership Association.

Mr. Garcke founded the electrical section of the London Chamber of Commerce and became its chairman. He is, perhaps, best known in connexion with the work he did as a director of the British Electric Traction Co., which owns electric tramway systems all over the country. He founded and became chairman of the Tramways and Light Railways Association. His commercial interests were very widely spread, and his life was a very busy one, as he was prominently associated with the legislation, finance, promotion, and organisation of many electrical undertakings. He was a member of the Institution of Electrical Engineers for more than forty years, and recently presented a very interesting portrait of André Marie Ampère to the Institution. He was also a fellow of the Royal Statistical Society and was a member of the Institute of Actuaries. In 1896 he founded "Garcke's Manual of Electrical Undertakings", which was an immediate success. He was chairman of the Electrical Press, Ltd., which publishes several technical journals.

In private life, Mr. Garcke was of a lovable and retiring nature. He was intensely interested in philosophy and loved nothing better than to discuss it with his friends. In 1929 he published a book which he called "Individual Understanding, a Layman's Approach to Practical Philosophy". In this he discusses the whole philosophy of life. He is not afraid to lay his inmost thoughts bare when he thinks that by so doing he will help others. In his opinion, the waste of material and mental energy by the human race due to a lack of mutual confidence, sympathy, and veracity is lamentable. He strongly believed that Nature is not against us, but is on our side in beneficent partnership. For every man the outstanding problem is to make the best use of his limited freedom of choice. He leaves a widow and one son, Mr. Sidney Garcke, who is a well-known company director.

WE regret to announce the following deaths:

Prof. C. Eykman, professor of hygiene in the University of Utrecht, who shared the Nobel Prize for medicine for 1929 with Sir F. Gowland Hopkins for discoveries in connexion with vitamins, aged seventy-two years.

Dr. Nathaniel O. Howard, forest pathologist of the U.S. Department of Agriculture, stationed at Brown University, who was known for his studies of the fungous diseases of forest and woody ornamental plants, on Sept. 14, aged fifty years.

Prof. C. E. Moss, professor of botany in the University of the Witwatersrand, Johannesburg, on Nov. 11, aged fifty-eight years.

Capt. O. Sverdrup, commander of the *Fram* and a well-known arctic explorer, on Nov. 26, aged seventy-six years.

News and Views.

ADMIRABLE sentiments were expressed by the Prime Minister when proposing the toast of 'The Royal Society' at the anniversary dinner on Monday last. Readers of NATURE must be familiar with, and possibly weary of, our continual insistence upon the use of scientific knowledge in the service of the State and of scientific method in administration. It is encouraging, therefore, to find Mr. Ramsay MacDonald expressing himself in entire sympathy with the view that public administration without science may be little more than a collection of words and phrases which can never lead a nation to security and prosperity. We are glad to record the words in which he stated this conviction: "The Royal Society", Mr. MacDonald said, "has stood pre-eminently for experimental knowledge, for the testing of every dogma whenever a competent witness arose to bring that dogma to the bar of reason and experiment. Until in our public life we can catch up the same spirit, the same rationality, the same conception of how truth is to be discovered and reality reached, and those who are engaged in public work and in government acquire the same frame of mind and adopt the same methods that the scientists adopt in their laboratories, government will be feeble, uncertain, and misleading. I make bold to offer the claim that science does not merely deal with the conception of the universe, with biochemistry, or with the conception of human nature, but that when science has claimed its full field, in all its width and length, it will claim to deal with governments and with administrations, and will assault and attack successfully those tremendously interesting and intricate problems of how to handle great masses of men, not by rule of thumb, not by the passing emotions of the day, but by a careful study of the permanent psychologies, emotions, leanings, and allurements of the human mind."

Now that Mr. MacDonald is himself a fellow of the Royal Society and has publicly declared his belief in the application of the methods of scientific inquiry to government, we may perhaps expect to see the principle put into practice more clearly than it is usually. The position of the dyestuffs industry, for example, might be considered on the Baconian plan of collecting facts and arriving at conclusions from them, instead of being decided upon political grounds. Attention might also be given, as was pointed out in a leading article in NATURE of Nov. 22, to the ethnology, social anthropology, and customs of the Indian peoples in connexion with the Round Table Conference now sitting in London. These are two opportunities which present themselves for consideration in the light of ascertained knowledge; and we may perhaps now hope that the Prime Minister will take advantage of them. In science, the test of a principle is the fulfilment of a prediction based upon it, and when we see that standard applied to political promises there will be more faith in democratic government than exists in most scientific circles to-day.

IN a letter addressed to the Prime Minister jointly by fifteen professors of chemistry in British universities, a strong case for reconsideration of the Government's decision to allow the Dyestuffs (Import Regulation) Act to lapse is cogently presented. The point of view is industrial as well as educational, for so closely is organic chemical research linked to the prosperity of organic chemical industry that it is impossible to consider one except in relation to the other. Moreover, the dyestuffs industry, which was the first industrial result of the development of organic chemistry into a systematic science, provided the experience and remains the pivot for the development of other branches of synthetic chemical industry; in no other branch of industry has there been such a clear repercussion between the art of the manufacturer and the science of the schools. The signatories are just those persons who are best qualified to express an opinion on the support which organic chemical industry affords to the advance of chemical knowledge, and they have declared that the existence of flourishing schools of organic research in the universities is indeed dependent on the demands made by the industry for the services of their students. Further, they insist that the salvation of many great industries of national importance depends on the application of scientific methods. They claim that the best training school for the future technologists and administrators of many of these industries is the organic chemical laboratory. Hence anything which tends to check the growth of the schools of organic chemistry is a blow at the future of a great many industries besides those most obviously or immediately concerned.

PRESENTING the report of the Council at the annual general meeting of the British Association of Chemists at Liverpool on Nov. 22, the general seecretary, Mr. C. B. Woodley, showed that there has been a steady advance in every department of the Association's established activities. Mr. H. T. F. Rhodes referred to the position of the dyestuffs industry, remarking that the Council of the Association has not yet definitely decided what action should be taken, but that it desired to assist the Government so as to ensure that the dyestuffs industry should not suffer as a result of the lapsing of the Dyestuffs (Import Regulations) Act of 1920. He said that the future of the organic chemical industry, and consequently the supply of adequately trained organic chemists, depends upon an efficient dyestuffs industry; if it suffers, the efficiency of all industries depending upon organic chemistry will suffer. Allusion was again made to this important matter in Mr. F. Scholefield's presidential address. It is obviously impossible, said the president, for any individual or group of individuals not in full possession of all the facts to arrive at any decision as to the extent to which it may be desirable to protect the industry against foreign competition, or if it is necessary to protect the industry at all. There is no doubt, however, that a successful dyestuffs industry is the very backbone of the whole organic chemical industry, and that the research carried on in organic chemistry is very largely applied to dyestuffs. This has naturally

stimulated interest in applied organic chemistry, and has resulted in improved facilities for training organic chemists and in the attraction of suitable recruits to the ranks of the profession of chemistry.

MR. SCHOLEFIELD, continuing his presidential address to the British Association of Chemists, criticised chemical training in Great Britain, alleging that "the newer universities are showing a tendency to model themselves on Oxford and Cambridge, and to be too keen on purely academic studies", whilst an investigation into technical education on the Continent, and particularly in Russia, shows that excellent work is being done. The Association should advocate an extension of the course to at least four years, the universal adoption of the metric system, and a bridging of the gulf between industry and academic institutions. At the annual dinner, when the Lord Mayor of Liverpool spoke of the city's long association with chemical industry, anxious reference was once again made to the lapse of the Dyestuffs Act; the speaker on this occasion was Mr. C. S. Garland, who feared injury not only to the industry but also to the profession of chemistry. Dr. E. F. Armstrong declared that Europe is going through a crisis equalled only by that which resulted from the Napoleonic wars. Great Britain has not yet adjusted herself to the new conditions. As a result of the War we shall have to adopt the policy, adopted by other countries, of being self-contained and self-sufficient. The future of Great Britain, and indeed of the world, he said, is in the hands of the chemist; the chemist cannot and must not fail, for the price of failure in the modern world is death.

THE twenty-eighth annual report of the Imperial Cancer Research Fund contains an interesting summary of the year's work; full accounts will appear in the Ninth Scientific Report, which is to be issued immediately. A good deal of energy has, naturally, gone to the study of the tumours of fowls which can be transmitted from one bird to another without the intervention of living cells, and three distinct histological types of tumour of this sort are under investigation. The possibility of transmitting mammalian tumours by cell-free preparations has been re-examined in the light of the experience with bird tumours, without finding any certain evidence that living cells can ever be dispensed with. The question whether one tumour renders an animal resistant to the development of a second tumour still remains unsettled. A careful examination by modern methods of the innervation of the skin and of tumours developing therefrom in the mouse has failed to confirm the suggestion that tumours have nerves of their own, though it is of course possible that this may sometimes occur. Chromosome studies of tumour cells have also been resumed, partly from the point of view that irregular distribution during mitosis may underlie some of the abnormalities of cancer cells, and partly with the ideas of heritable changes in genes which a contemplation of the fixity of type of any one tumour throughout its history must suggest. The whole report gives an encouraging account of the solid, steady progress made by Dr. J. A. Murray and his colleagues.

AMONG the foreign men of science who either visited or settled in England during the eighteenth century, few were better known than Jan Ingenhousz, whose trough for comparing the thermal conductivities of metal rods has figured in innumerable textbooks. Ingenhousz, who was born on Dec. 8, 1730, two hundred years ago, was Dutch by birth and a doctor by profession, and it was his desire to acquaint himself with the method of inoculation for smallpox which first brought him to England. From England he went to Vienna to inoculate the Austrian Royal family, and then travelled in Italy, France, and Germany. Returning to England in 1779, he spent the remainder of his life in the congenial society of his scientific friends, enjoying, as he said, "that felicity which a free and independent man finds in the pursuit of knowledge and wisdom, in the society and friendly intercourse of those who have distinguished themselves by learning". A friend and correspondent of many, he was elected a fellow of the Royal Society, twice delivered the Bakerian lecture, and wrote on electricity, chemistry, magnetism, and other subjects. Ingenhousz died at Bowood, the seat of the Marquis of Lansdowne, on Sept. 7, 1799.

ON Dec. 7 occurs the centenary of the birth of the eminent Italian mathematician, Luigi Cremona. Born and educated at Pavia, Cremona in his eighteenth year joined the Italian volunteers, during the rising against the Austrians, and was present at the defence of Venice. Resuming his studies, he graduated at Pavia, where Brioschi was among his teachers, and afterwards taught mathematics at Cremona and Milan. In 1860 he became professor of higher geometry in the University of Bologna, in 1866 was transferred to Milan, and in 1873 became professor in the University of Rome and director of the School for Engineers. During thirty years of arduous work he reorganised the whole mathematical instruction of Italy, and was as ardent a politician as man of science. His writings include his "Graphic Statics", translated into English by Sir Hudson Beare, his "Introduction to a Geometrical Theory of Plain Curves", and "Elements of Projective Geometry". He became a Senator of Italy in 1879, and in 1898 was made Minister of Public Education. A member of many scientific societies, including the Paris Academy of Sciences and the Royal Society, he was well known among British mathematicians. He attended the tercentenary celebrations of the University of Edinburgh, and was the guest of Chrystal, who, in a note appended to an obituary of Cremona and referred to in NATURE of Aug. 27, 1903, p. 392, recalled the dinner given by Lord McLaren, when seated around the table were Cremona, Hermite, Picard, Helmholtz, Cayley, Sylvester, Kelvin, Stokes, Salmon, and Rayleigh.

MR. J. BRADLEY, Wallasey Grammar School, Cheshire, referring to the review by Prof. H. Dingle in NATURE of Nov. 22 of Sir James Jeans's "The

Mysterious Universe", sends us the following apposite quotation from an address by Ernst Mach, delivered at the anniversary meeting of the Imperial Academy of Sciences, at Vienna, on May 25, 1882, entitled, "The Economical Nature of Physical Enquiry" ("Popular Scientific Lectures", by Ernst Mach. Open Court Publishing Company): "What those ideas are with which we shall comprehend the world when the closed circuit of physical and psychological facts shall lie complete before us, (that circuit of which we now see only two disjoined parts), cannot be foreseen at the outset of the work. The men will be found who will see what is right and will have the courage, instead of wandering in the intricate paths of logical and historical accident, to enter on the straight ways to the heights from which the mighty stream of facts can be surveyed. Whether the notion which we now call matter will continue to have a scientific significance beyond the crude purposes of common life, we do not know. But we certainly shall wonder how colours and tones which were such innermost parts of us could suddenly get lost in our physical world of atoms; how we could be suddenly surprised that something which outside us simply clicked and beat, in our heads should make light and music; and how we could ask whether matter can feel, that is to say, whether a mental symbol for a group of sensations can feel?"

MR. HERBERT MORRISON, Minister of Transport, proposing the toast of the Institution of Professional Civil Servants at the annual dinner on Nov. 27, paid an encouraging tribute to the work of the technical and professional people engaged in various departments of the Civil Service. These include research workers and observers of many types; civil, electrical, mechanical, naval, and aeronautical engineers; surveyors, architects, valuers, medical men, and others with professional qualifications carrying on the work of the State. Mr. Morrison said he has "a special affection for the technical and professional officers in the public service", and he appreciates their readiness "to make their political chiefs understand the technical effects of the problems with which they have to deal". The difficulty in the past has often been for an officer in charge of a scientific or technical department to have direct access to a Minister, but we believe this condition of things is changing, and Mr. Morrison is evidently desirous himself of being provided with as full knowledge as possible of the technical aspects of problems which it is his duty to champion in the public arena.

SIR RICHARD REDMAYNE, in responding to the toast of the Institution of Professional Civil Servants, referred to the importance of the problem of transport in connexion with the distribution of everyday commodities and the aid which scientific men and technologists can give the administrator in solving it. He said: "In my view, what is required to be done is to mobilise more fully, in the interests of the community, the scientific knowledge and the technical experience possessed by such classes as those who form the membership of the Institution. The difficulties in which we as a nation now find ourselves are not, if Mr. Morrison will allow me to say so, entirely soluble by political methods. When all is said, the expert, and under this term I, of course, include the scientist, is largely the architect of modern civilisation and should be given a status in the community worthy of his attainments. If the Royal Commission, now sitting, do nothing more than recognise this fundamental truth and make the necessary recommendations in regard to the Civil Service, we, in the Institution, would be well content with our efforts in that direction".

FOR the third time since the great disaster of 1923, Japan has been visited by a destructive earthquake. The Tazima earthquake of May 23, 1925, and the Tango earthquake of Mar. 7, 1927, both on the Japan Sea side of the Main Island, were responsible for the losses of 428 and 3017 lives respectively. The centre of activity has now returned to the Pacific coast, and at 4.3 A.M. on Nov. 26 (7.3 P.M. on Nov. 25, G.M.T.) a severe earthquake caused much loss of life and property in the Izu peninsula and on the west side of Suruga Bay. According to the official estimate of the following day, 245 persons were killed, the towns that suffered most being Shizuoken and Mishima, while great damage is reported at Numazu, Hakone, and other places in the Izu peninsula. The shock was felt as far as Fukui, about 170 miles from the epicentre, which, according to Prof. Imamura, is believed to be slightly to the east of the centre of the peninsula. It was recorded at Kew at 7 h. 15 m. 40 s. P.M. on Nov. 25, but the movement there was less than that on Mar. 7, 1927, or even on Aug. 5, 1927, and May 27, 1928. The Izu peninsula, which lies between the two deep depressions of Sagami Bay and Suruga Bay, has felt at least ten destructive earthquakes since the beginning of the Japanese seismic record in 416. Its eastern coast near Ito was the seat of 3684 slight shocks in the spring of the present year (NATURE, Aug. 30, 1930, vol. 126, p. 326). It is perhaps worthy of notice that, while the epicentre of the Tango earthquake lies 11 miles to the east of that of the Tazima earthquake, the epicentre of the recent shock is only a few miles to the west of that of the great Kwanto earthquake of 1923.

IT seems now to be quite satisfactorily settled that Louis Aimé Augustin Le Prince was actually the first to make cinematograph pictures and to show them by methods and apparatus strictly comparable with those in common use to-day. Le Prince was born at Metz in 1842, but he lived for about nineteen years in Leeds and five years in the United States. He was last seen entering a train for Paris on Sept. 16, 1890. From then, he and his luggage and papers disappeared completely, and exhaustive inquiries have never led to any clue being discovered. In 1886 he applied for an American patent, and in January 1888 for a British patent, which included punched holes fitting on the pins of the guide rollers. In 1888 he took pictures at the rate of 12 and at 20 a second, in Leeds, and showed them successfully. A memorial tablet to Le Prince will be unveiled by the Lord

Mayor of Leeds on Dec. 9, on the site of his workshop. It is also proposed, if sufficient funds are available, to publish a pamphlet giving full details of Le Prince's work in cinematography, and also that of other pioneers. There is already a considerable list of subscribers, but more funds are needed. Cheques or postal orders made payable to "Le Prince Memorial", and crossed "Midland Bank, Leeds", may be sent to the hon. treasurer, Mr. John H. Horsman, 31 Wesley Road, Armley, Leeds, or to the hon. secretary, Mr. E. Kilburn Scott, Conway Hall, Red Lion Square, London, W.C.1.

THE annual general meeting of the Newcomen Society was held at Caxton Hall on Nov. 27, when Mr. C. E. Greener was elected president in succession to Mr. L. St. L. Pendred. There are 259 individual members and 58 institutions now on the roll of the Society, of which 67 members and 25 institutions are in the United States. Seven papers were read during the session 1929–30; during the summer meeting at Liverpool the Society took part in the centenary celebrations of the Liverpool and Manchester Railway, and it was also represented at the jubilee meeting of the American Society of Mechanical Engineers and at the unveiling of the monument erected to mark the site of the Allegheny Portage Railroad constructed in 1834 to link together the eastern and western division of the canal system from Harrisburg to Pittsburg. Through the Council, the Society has given its adhesion to the International Congress of the History of Science and Technology to be held in London in June–July 1931.

AT the same meeting on Nov. 27 of the Newcomen Society, Mr. Rhys Jenkins read a paper on "Fire-extinguishing Engines in England, 1625–1725", the former year being that in which a patent was granted to Roger Jones by James I., and the latter being the year of Newsham's second patent. At Roger Jones's request, the patent was issued in the name of his brother John, a London merchant, who in his travels abroad had found out the plan of making a portable pumping apparatus. With the aid of the invention, so the patent ran, ten men could quench a fire with more ease than five hundred men with buckets and ladders, and its value had been shown on the occasion "of a fire latelie happened in the dwelling house of James Demetrius, Brewer in St. Katherines neare the Tower of London". Illustrating his remarks by means of the writings of Besson, 1587; Lucar, 1590; Zeising, 1612–14; de Caus, 1615; Bate, 1634; Fuller, 1662; and others, Mr. Jenkins gave a sketch of the development of the hand fire-engine, which reached a certain degree of perfection by the efforts of Richard Newsham, of Cloth Fair, London, engineer, one of whose engines can be seen in the Science Museum. It was remarked of Newsham by a writer in the *London Magazine* for 1752 that in his engines he gave "a nobler present to his country than if he had added provinces to Great Britain". These early fire pumps could throw a jet of water a considerable height, but their usefulness always depended on the rapidity with which water could be conveyed to them, which was generally done with buckets.

ACCORDING to a dispatch from its Beirut correspondent which appears in the *Times* of Nov. 27, a chair in archæology has been founded in the American University of Beirut through the munificence of a Syrian woman who wishes to remain unknown. The first occupant of the chair will be Dr. Ingholdt, the Danish archæologist, the appointment in the first instance being for a period of five years. Under the terms of his appointment, Dr. Ingholdt will lecture during one semester in each year and will spend the second semester in excavation at Hama, on the Orontes, on behalf of the Carlsberg Foundation. Dr. Ingholdt, who is a gold medallist of the University of Copenhagen, is an authority on Aramaic inscriptions and papyri of pre-Christian times and on Aramaic dialects. His discoveries of a few years ago in Palmyrene tombs attracted no little attention at the time. Although archæological studies have been actively prosecuted in Beirut for some time past, especially by the French Fathers of the Université de St. Joseph, who publish a journal of much interest to students of early Syrian culture, the facilities for instruction and training which will now be available in Syria itself will prove without doubt of great assistance in the advancement of such studies in an area which, notwithstanding its interest, has scarcely received adequate attention.

AT a meeting of the Optical Society, on Nov. 13, Mr. D. M. Smith, of the British Non-ferrous Metals Research Association, demonstrated the use of the spectrograph in metallurgical analysis. Messrs. H. Buckley and F. J. C. Brookes, of the Photometry Department, National Physical Laboratory, showed a new type of spectrophotometer in which there are no moving optical media. Two light sources, consisting of gas-filled tungsten lamps each behind ground glass, are used. The ground glasses are used as secondary light sources of high uniform brightness (up to 400 candles per square inch). The photometric scale of the instrument is in terms of the voltage intensity relation of one of the light sources at a standard wave-length in conjunction with rotating sector discs of known transmission. The voltage intensity relation at other wave-lengths is deducible from that at the standard wave-length by simple computation. Special provision is made whereby the wave-length scale of the instrument is not affected by mechanical alteration in slit width. The Maxwellian method of view is utilised. The precision of the instrument is high, the average deviation from the mean of determinations of spectral transmission throughout most of the spectrum being about 0·5 per cent.

EXCELLENT and novel methods of lighting streets and buildings have recently made rapid progress in many towns in Germany. When electric light was first used, the main object was efficiency. The sole object of the lamps was to give light. Then came the time when old chandeliers, lanterns, and brackets were introduced, some of which were good and others very bad reproductions of 'period forms' with electric bulbs instead of candles. Now, especially in Germany, the designers of illuminating fittings have

recognised that the shapes of the lamps can be made interesting and decorative. In a series of papers on modern lighting, the first of which appeared in the *Electrical Review* for Oct. 24, A. B. Read gives many illustrations of the modern methods of lighting used by German electricians. He compares the lighting of the dining-rooms in our giant liners with the decorative lighting of the new North German Lloyd *Bremen*. British shipping companies still adhere to 'period' decoration similar to that used in many large hotels. In the *Bremen* the lighting forms a prominent decorative feature. The continuous alabaster lighting of the first class dining-hall and the huge ceiling fitting in the ballroom are admirably designed. Neat tubular wall brackets, corner lights, large decorative fixtures, and even the small bunk lights all show a breaking away from tradition. In London we see too often shops competing with their neighbours by means of projecting signs and flickering lights of every conceivable kind. There are also in some places huge signs with colossal letters straddling over windows and other architectural features and quite spoiling well proportioned buildings. In many towns on the Continent the names over the shops are made luminous at night and a high standard of lettering is used. The orderliness of the signs adds dignity to the streets and is very impressive.

THE Astor expedition to the Galapagos Islands, an account of which appears in the August number of the *Bulletin* of the New York Zoological Society, is the latest of several recent expeditions to this wonderful group. The explorers reached farther inland on Indefatigable Island than former travellers and attained a height of 2100 feet, but the main observations have to do with the fauna of the islands, which is distinctive. The islands boast two flightless sea-birds, the Galapagos penguin and a flightless cormorant (*Nannopterum harrisi*), a species which is gradually disappearing. The same fate hangs over many of the inhabitants—the great tortoises, the land iguana, the peculiar fur seal (*Arctocephalus philippi*), and others. This is due partly to the use made of some for food and oil, and partly to the introduction on some of the islands of pigs, dogs, cats, and rats, all of which are now abundant in a wild state, and have seriously affected the native fauna. The recommendations are made that all surviving species of tortoises, as well as the penguin and flightless cormorant, should be protected; that sealing should be prohibited; that the land iguana should be introduced to such islands as are free from pigs and dogs; and that pests should be destroyed. It is wise advice (notwithstanding that it so often comes from an expedition which has freely satisfied its own needs), and it would be well for science if the Ecuadorian Government could be convinced of its necessity and supported in carrying it out.

AN excellent photograph of a school of the false killer whale (*Pseudorca crassidens*) stranded near Kayts, Ceylon, in 1929, appears in the Report of the Colombo Museum for that year. Extraordinary interest attaches to this occurrence, following upon the strandings of large numbers, first in the Dornoch Firth in Scotland and later near Cape Town, of a species regarded as on the verge of extinction. It is strange, therefore, that the only reference in the text of the Report to the stranding of the false killers is a bare record—not even mentioning the numbers of whales observed—of the preparation of 12 skulls and 2 complete skeletons. The Museum itself becomes more and more appreciated, judging by the increase in the number of visitors (now about 800,000 a year) and the greater use made of the collections by teachers and school classes. A new wing is now being built to relieve congestion amongst the exhibits.

AT a general meeting of the members of the Royal Institution held on Dec. 1, Lord Eustace Percy was elected president of the Institution in succession to the late Duke of Northumberland. Lord Eustace, who is a younger brother of the late Duke, was president of the Board of Education in 1924–29 and this year is president of Section L (Educational Science) of the British Association.

AN international celebration and exhibition to mark the three-hundredth anniversary of the first recognised use of cinchona by Europeans will be held at the Wellcome Historical Medical Museum, 54 Wigmore Street, Cavendish Square, London, W.1, on Dec. 8 and 10. Addresses will be given by the Marquis de Merry del Val, Ambassador for Spain; Archbishop Goodier, formerly Archbishop of Bombay; Sir David Prain, formerly Director of the Royal Botanic Gardens, Kew, and Sir Humphry Rolleston, Regius professor of physic in the University of Cambridge. An extensive collection of exhibits has been arranged to illustrate the history of cinchona, the addition of which to the world's materia medica has, for three hundred years, proved itself to be of incalculable value, especially in tropical regions. An article on the history of cinchona and its introduction to India and other countries appeared in NATURE of Nov. 29, p. 850.

THE annual Congress and Exhibition of the British Institute of Radiology was held at the Central Hall, Westminster, on Dec. 3–5. The Mackenzie Davidson Medal of the Institute was awarded to Prof. G. P. Thomson, of the Imperial College of Science and Technology, and the Silvanus Thompson Medal to Dr. A. E. Barclay, lecturer in medical radiology and electrology in the University of Cambridge, who delivered the respective memorial lectures during the Congress.

DR. BRONISLAW MALINOWSKI, professor of anthropology in the University of London (London School of Economics), has been awarded the Rivers Memorial Medal of the Royal Anthropological Institute, in recognition of his distinguished field work in anthropology. Prof. Malinowski, who graduated at Cracow, did research work at the British Museum and the London School of Economics from 1910 onwards, went with the Robert Mond Anthropological Expedition to New Guinea and North-west Melanesia in 1914, returning to Australia in 1918 and to Europe in 1920. Among his numerous publications may be

mentioned "The Family among the Australian Aborigines", "Argonauts of the Eastern Pacific", "Crime and Custom in Savage Society", "Sex and Repression in Savage Society", and "The Sexual Life of Savages in North-west Melanesia".

THE Royal Anthropological Institute has created a class of associates with the object of bringing its facilities for study and research within the reach of the younger workers in anthropological subjects. Associates must be less than twenty-six years of age, they will pay an annual subscription of one guinea only, will receive the Institute's monthly publication (*Man*), and will have access to the library and ordinary meetings.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A graduate in engineering at the Oxford City Technical School and Municipal Secondary School—The Principal, City Technical School, Oxford (Dec. 8). A chief assistant in the Physico-therapy Department of St. Thomas's Hospital—The Secretary, St. Thomas's Hospital, S.E.1 (Dec. 9). A principal of the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (Dec. 13). A full-time teacher in the Department of Chemistry of West Ham Municipal College—The Principal, West Ham Municipal College, Romford Road, Stratford, E.15 (Dec. 13). An assistant bacteriologist and pathologist, an assistant and a junior assistant, each in the Bacteriological and Pathological Laboratory of the Staffs County Council—The Clerk of the County Council, County Buildings, Stafford (Dec. 13). A pathologist at the Royal Devon and Exeter Hospital, Exeter—The Secretary and Manager, Royal Devon and Exeter Hospital, Exeter (Dec. 31). An assistant in the Natural History Department of the Royal Scottish Museum—The Director, Royal Scottish Museum, Edinburgh (Jan. 17). An instructor for evening classes in engineering drawing at the Kingston-upon-Thames Technical College and School of Art—The Principal, Technical College and School of Art, Kingston-upon-Thames.

Our Astronomical Column.

Ancient Eclipses in Scotland.—Mr. L. MacLellan Mann writes with reference to his claim of having identified a record on stone of the eclipse of B.C. 2983 Mar. 28 (see NATURE, Nov. 8, p. 743). As regards the time of day at which the eclipse occurred, he notes that the 0·6 day (about 2.30 P.M. Greenwich) found by the writer of the note in NATURE, is in good agreement with the value 0·63 found by C. Schoch, and with the value 0·66 which Mr. Mann obtains from the record on the stone; he notes that this may be the end of the eclipse. He states that he obtained the year by his interpretation of the system of wheel-like markings on the stone, which he takes to be cycles of years.

Referring to the cycle of 1805 years, Mr. Mann claims that this was probably known in ancient times; M. Oppert, the discoverer of the cycle, made a similar claim, but most astronomers hesitated to accept it. Mr. Mann makes an evident mistake when he speaks of the related cycle of 100 saroses: there is no such cycle—the greatest possible number of returns of an eclipse in the saros cycle is about 84; further, the eclipses at the beginning of a series would be visible in regions near one of the terrestrial poles, while those at the end would be visible near the opposite pole. Some thirty returns, or not many more, would suffice to carry the region of visibility away from a given latitude. Mr. Mann states that his investigations of these old stone records have occupied him for some twenty-five years, and he promises to make his results accessible to students at an early date.

Light-variation of Eros.—A note from Leningrad in *Astr. Nach.*, No. 5748, dated at the end of October, notes that M. Zessewitsch detected a light-variation in Eros with an amplitude of 1 magnitude and a period of 0·105 days, or $2^h\ 31^m$. In February 1901 a light-range of a magnitude was also noted, but the period was then given as $5^h\ 16^m$, slightly more than twice the period now announced. The $5^h\ 16^m$ period, however, included two unequal maxima, so that the period now found may be half the complete period. The variation was noticed in 1903, but appeared to be absent in 1907. The study of the light-variation is a suitable one for amateurs to undertake. The attention of the large observatories will be chiefly taken up in photographs for position, for the deduction of the solar parallax and the mass of the moon.

The Kepler Tercentenary.—It is noted in *Astr. Nachr.*, No. 5744, that at the celebrations in memory of the death of Kepler that took place at Regensburg on Sept. 24 and 25, two minor planets were given names that would commemorate the event. Planet 927, discovered in 1920, was named *Ratisbona*; while planet 1134, discovered last year, was named *Kepler*. Both these planets were found at Königstuhl by Prof. M. Wolf. The use of a masculine name for 1134 is justified by its small perihelion distance; the usual rule is that the names should be feminine, but exceptions are made in the case of the Trojans, and those (like Eros) that come fairly near the earth.

Astronomical Equipment.—The new catalogue of astronomical instruments and observatory equipment issued by Messrs. Cooke, Troughton and Simms, Ltd., is a beautifully illustrated volume which will be of interest to all concerned with observational work in astronomy, whether they are in need of additional facilities or not. The catalogue includes four main sections, dealing respectively with object glasses and general telescopic accessories, telescope mountings, transit instruments, and observatory domes, each of which is prefaced by a short note on the general subject of the section. These notes—particularly the first, on the adjustment, care, and use of telescope objectives—will be found very valuable by the working astronomer of limited experience. The telescopic accessories which are described are, in addition to eyepieces, mainly photographic, spectroscopic, and micrometrical. The spectroscopic instruments mentioned are not numerous, but a note of general application in the introduction states that although the catalogue includes only instruments of general interest and use, others required to meet special and unusual needs can also be supplied. The fine quality of the work produced by this firm and its predecessors is well known, and a historical note at the beginning of the catalogue reminds the reader of the original work of the separate firms of Troughton, Simms and Cooke, photographs of some of the more important instruments of which are given.

Research Items.

The Greenland Shaman.—Dr. William Thalbitzer records in the *Journal des Américanistes*, N.S., vol. 22, fasc. 1, observations on the character of the shaman and his beliefs relating to the world and the soul, made at Ammassalik, the most northerly settlement on the eastern coast of Greenland. Near the settlement were about 500 pagan Eskimo, living in villages. Each group had its shaman (*angakkok*). These had no temporal power but considerable moral and religious authority. The shaman gave spirit manifestations almost nightly in one of the houses by the light of a single lamp, all other lights being extinguished. He conversed with the spirits in a sacred and mystical language, consisting of archaic words not fully understood by the spectators. Only the elect became shamans—dreamers and visionaries of an hysterical temperament. They were selected by the shaman to become his pupils and receive instruction in the mountains. The course of instruction lasted for from five to ten years, and the pupil received instruction not from one alone but from several shamans. In the course of instruction the pupil was devoured by the spirit of a bear but came to life again; he entered into communion with the spirits of the dead, spirits of metamorphosed animals, and the spirits of the other world. When he had learned from these their names, they became his allies and he could summon them to do his bidding. When he had thus become the master of all knowledge, he took up the functions of a shaman, one of these being the power of inflicting evil on a man's enemies or protecting him from their attacks. Each shaman had from ten to fifteen allied spirits. The shamans were thoroughly sincere in their belief in their powers and the manifestations of the spirits.

The Monozoic Cestode *Archigetes*.—L. W. Wiśniewski, in *Mem. Acad. Polonaise Sci. et Lettres*, Series B, Sci. Nat., vol. 2, 1930, gives an account of the anatomy, biology, and systematics of the cestode genus *Archigetes*, three species of which were studied. The adult *Archigetes* is regarded as a neotenic procercoid and this is the final stage of the life-history. The host, an aquatic oligochaete—for example, some species of *Limnodrilus* or of *Tubifex*—becomes infected by swallowing the egg containing a fully developed oncosphere which is not ciliated or free-swimming. The oncosphere issues from the operculate egg in the intestine of the host, penetrates the gut-wall, and lies in the body cavity, where it grows to sexual maturity, causing a swelling of the body and eventually a rupture of the body wall so that the parasite escapes to the exterior. Its tissues decompose and the eggs fall into the mud. The oncosphere, which has three pairs of hooks—a larger median and two lateral pairs—develops in about 40 days and may live enclosed in the egg-shell for 70-80 days. The egg-shell is formed from the secretion of the yolk-cells. In the young stages the cells of the developing oncosphere lie loose, there is no epithelium; the cells are surrounded by a membrane. The author describes the anatomy and histology of the adult worm. An account of the early stages of *Archigetes* is given by I. Motomura in *Annot. Zool. Japon.*, vol. 12, 1929, who states that the development so far as the oncosphere is carried on in the uterus of the parent.

Demanian Vessels in Nematodes.—N. A. Cobb (*Jour. Washington Acad. Sci.*, June 1930) describes in nematodes of the genus *Oncholaimus* a remarkable system of vessels which he terms the demanian vessels—after de Man, who first discovered these tubular organs. The complicated double system of vessels is connected with the middle or posterior part of the intestine and with the uterus. The two ducts are confluent and discharge their contents through pores in the body wall near the base of the tail. The vessels are not present in young females; they come into existence at the last moult. In adult females the vessels elaborate a copious sticky secretion, insoluble in water; and the author, after examining the possible functions of this material, suggests that it is utilised during agglomeration and copulation, and also presumably to protect and preserve the batches of eggs after deposition. The demanian organs seem to occur in mud-inhabiting Oncholaims, that is those of stagnant habit, and to be absent in those which live in more thoroughly oxygenated water.

Habits and Development of the Synentognathi.—Mr. C. M. Breeder's notes on the fishes belonging to the families Belonidæ and Exocœtidæ from the Dry Tortugas are very interesting (Year Book 28, Carnegie Institution of Washington, pp. 279-282). The young of the four species of *Strongylura* are highly differentiated and specialised in various ways, the proportional development of the beak proceeding in decidedly different directions in each. The post-larvæ here are almost entirely confined to the drifting *Sargassum*. Older, but still young, fish occur in schools, usually of one species and of one size, and stay close to the shores, circulating about so that a given school may appear every two or three hours at a given place, in the meantime being replaced by other schools of different species or of different-sized individuals. Three species belonging to the Exocœtidæ were specially studied, *Paraxocœtus mesogaster* being much the most abundant. Its young, of only a few millimetres in length, when the wings are too short for flight, so closely resemble their parents as to be recognisable at sight with their simple blue and silver colouring. These occupy the clear spaces between the drifts of *Sargassum*. On the other hand, the young of *Cypselurus fuscatus* are markedly different from their parents and show a series of patterns and colour changes which resemble the floating *Sargassum* and debris in which they are found. Associated with the habitat is a difference in the possession of barbels in the young *Cypselurus* and not in *Paraxocœtus*. The barbels seem to be used in poking about in the weed. The Exocœtids, especially the young, are found to be very important as food for other fishes and for sea-birds.

Types of Gabb's Californian Fossil Pelecypods.—R. B. Stewart's revision and rectification of Gabb's work on the Cretaceous and Tertiary fossils of California (published in 1864 and 1869 by the California Geological Survey) has now been completed by the issue of the part relating to the Pelecypoda or Lamellibranchia (*Acad. Nat. Sci. Philad.*: Special Publication, No. 3). The first part, relating to the Gastropoda, appeared in 1926 and attention was directed to it in NATURE of Feb. 12, 1927, p. 255, and the lines on which the reviser proceeded were then indicated. The same methods have been adopted in the present part, with some amplification of the information concerning the strata containing the fossils, but as a whole it is of far greater importance to systematists generally. For the first time, we believe, in an American work of this importance, Pelseneer's classification of the group Pelecypoda, as set forth in Lankester's "Treatise on Zoology" (vol. 5), has been employed in lieu of Dall's; whilst in the matter of nomenclature, the International Rules of Zoological Nomenclature have been applied even when opposed to the reviser's own ideas, and the need for teaching students of palæontology the rudiments of those rules pointed out. To all this has gone

an immense amount of research work, which has been most thoroughly and carefully carried out, to the great benefit of all subsequent investigators, although doubtless some *emendanda* will reveal themselves as time goes on. Certain new names have had to be created: thus there are seven new genera and twenty-five new subgenera proposed, some of the latter being for the reception of old friends. The illustrations on the 17 plates are, as before, from photographs taken and retouched by Miss Helen Wichester: and excellent they are. Some additions and corrections to the part on the gastropods have been appended to the introductory chapters, while an "Index to Genera and West Coast Species and to Genera of the paper on the Gastropods" concludes this indispensable work.

Flora of Yucatan.—This work by P. C. Standley (*Field Museum of Nat. Hist.*, Chicago. Bot. Series, vol. 3, No. 3; 1930) treats of the Mexican portion of the Yucatan Peninsula. The whole area of 55,000 sq. miles is low-lying and composed of a sheet of porous and friable limestone rock with a striking absence of permanent surface streams. In the dry region of the northern plains there are few large trees, and where not under cultivation the land is covered with scrub, a few cacti being plentiful, with occasional palms. The central undulating part of the Peninsula, which has a heavier rainfall, has extensive low forests, whilst the forests of Campeche and Quintana Roo yield many valuable woods and other produce, including logwood, mahogany, cacao, sarsaparilla, and rubber. The sharply differentiated geological and physiographical features of Yucatan are reflected in the flora, which is radically different from that of other parts of Mexico and Central America. Its proximity to Cuba and similarity in geological conditions account for the many plants common to both countries. The number of native plants listed comprises 557 genera and 1068 species, the best represented families being the Leguminosæ (119 sp.), Compositæ (86 sp.), Euphorbiaceæ (69 sp.), and Gramineæ (68 sp.). The degree of endemism is notably high for a continental area, embracing 17 per cent of the native flora. Of the Euphorbias 39 per cent are endemic, whilst three genera of the Rubiaceæ and Compositæ are confined to the Peninsula. The species enumerated include naturalised and cultivated plants, whilst an account is given of botanical exploration of the Peninsula—far from complete—together with a list of vernacular names and a bibliography.

Pre-Cambrian Formations of Western Australia.—The Annual Progress Report of the Geological Survey of Western Australia for 1929 is notable in containing a valuable summary of the present state of knowledge of the Pre-Cambrian rocks of that terrain, accompanied by a clearly drawn geological map. The Yilgarn Series are predominantly of sedimentary parentage; they are invaded by greenstones which in turn are followed by granites. In the Kalgoorlie Series, greenstones with intermediate and acid lavas and pyroclasts are the characteristic members. A later series of metamorphosed basic and ultrabasic rocks, known as the "younger greenstones", invades the "older greenstones". The Mosquito Creek Series has been regarded as younger than the Kalgoorlie greenstones. It consists in the main of sediments that are less profoundly metamorphosed than those of the Yilgarn Series. The Government Geologist, Mr. T. Blatchford, however, thinks that some of the rocks mapped as Mosquito Creek may be Yilgarn or Kalgoorlie, while others may even be Nullagine. The Nullagine Series is not yet definitely known to be Pre-Cambrian, in the Kimberley district; it may be Lower Cambrian. A large part of the State is shown as consisting of granites and gneisses. It is probable that these are of several ages. The goldfields granites cut the Yilgarn, Kalgoorlie, and Mosquito Creek series, but the marginal gneisses are themselves cut by dykes which are indistinguishable from those of Kalgoorlie age.

Relations between Sunspot and Earthquake Frequency.—Messrs. T. Takayama and T. Suzuki have studied the relations between sunspot activity and the frequency of destructive earthquakes in Japan (*Earthq. Res. Inst. Bull.*, vol. 8, pp. 364-374; 1930). In the whole Japanese area they are unable to detect any relation, but considering Omori's three seismic zones separately, they find that, in the inner or Japan Sea zone, destructive earthquakes are more frequent near the sunspot maxima, in the outer or Pacific zone near the sunspot minima, while in the inland zone between them there is no definite relation.

Surface Drift Currents in the North Sea.—Mr. J. B. Tait, in "Surface Water Drift in the Northern and Middle Areas of the North Sea and in the Faroe-Shetland Channel" (*Fisheries, Scotland, Sci. Invest.*, 1930, No. 2), reports upon the drift of 4825 bottles which were liberated in batches from numerous widespread points in order to determine the drift of surface waters in this area during each of the five years 1910–14. Of these bottles, weighted to float just awash, 1096 were recovered, mostly stranded on the east coast of Britain and on the shores of the Continent between Texel and the North Cape. The results suggest that more water from the Atlantic enters the North Sea between Shetland and Norway than through the channels between Shetland and the mainland of Scotland, and indicate that almost two-thirds of the distance between Shetland and Norway is occupied by water moving southward into the North Sea. A stream of surface water from the Atlantic in the direction of the channel between the Shetlands and Orkneys appears to have its progress barred on occasions by a north-flowing surface current from the Moray Firth to Shetland, causing the former stream to divide, part turning north to flow west of the Shetlands and part turning south between Fair Isle and Orkney. The results also suggest that the general current system in the northern part of the North Sea is subject to irregularities. The author mentions the lack of close correlation between the drift of these bottles and wind, such as is met with in the southern part of the North Sea and in the English Channel.

Map Revision by Air Photographs.—With the view of investigating the value of air photography compared with ground work in the revision of large scale maps, the Ordinance Survey chose an area near Brighton to be photographed on a scale of about 1 to 7500 with a 50 per cent overlap in consecutive negatives. The photographs were compared with corresponding field traces which were marked to show where alterations had occurred. Revisers then visited these places and put in the detail by the usual ground methods. Three types of country were included in the experimental area, open down, suburban districts with much new building, and closely built town. The results are summarised in a leaflet of the Ordinance Survey (Report on the Experimental Revision of the 1/2500 Ordinance Survey Plans with the aid of Photographs taken from the Air, No. 2, 1928–30). The method was found to be uneconomical in open down lands and in suburban areas of rapid growth. On the other hand, in closely built areas it effects substantial economies compared with ground work, although the completeness of the revision is liable to suffer since certain features are

missed, notably wire fences and internal divisions between houses. These would have to be put in by ground work if required.

Flashing Afterglow in Discharge Tube.—Mr. V. Dumert, 22 Fortis Green Road, East Finchley, sends us a letter describing flashing phenomena in a discharge tube similar to those described by Mr. Braddick in NATURE of Nov. 8, p. 725. The discharge tube was a burnt-out carbon filament lamp, made presumably of soda glass since it showed green luminescence. A continuous afterglow was followed by an intermittent flashing when the glass of the lamp was touched. A valve amplifier, connected between the metal cup and an external electrode of copper foil, gave no sound during the continuous afterglow; then a rushing sound which stopped abruptly at each flash. The phenomenon suggests that the conditions in a discharge tube may be considerably affected by charges on the inside and outside of the glass walls. An effect which is doubtless due to such charges is sometimes observed with heavy discharges run through capillary tubes with moderate voltages; for example, the hydrogen discharge tubes used as a source of light in ultra-violet spectrum work. The tube refuses to run steadily unless an earthed coating of metal foil is closely wound about the capillary.

Emission of Radiation from Excited Surfaces.—It is known, from the experiments of Prof. O. W. Richardson and others, that the inelastic reflection of an electron from a metal surface involves characteristically the transfer of a definite amount of energy from the electron to the surface. The surface appears to have quantised energy levels, and so it might be expected that an excited surface would emit radiations corresponding to transitions between pairs of these. A search for radiation of this type is described by Dr. E. Rudberg in the *Proceedings of the Royal Society* for November, a number of substances being bombarded which would be expected to emit line radiation from this effect in the visible or quartz ultra-violet regions. The experiments were entirely negative, the only lines obtained being attributable to impurities in the vacuum apparatus; and from a discussion of other results on the energy levels of the surfaces, Dr. Rudberg concludes that this result, which applies in the first instance only to the lower possible energy losses of the surfaces, is probably general, that is, that the rearrangement of the disturbed surface takes place without emission of radiation.

Ozone in the Earth's Atmosphere.—Dr. G. M. B. Dobson has contributed a paper to the November number of the *Proceedings of the Royal Society*, in which, after giving an account of further detailed observations on the ozone of the air, which conclude the original programme of work proposed five years ago, he summarises the results which have been obtained, and discusses the remaining outstanding problems. Dr. Dobson considers that the two fundamental points which need to be decided are, first, the nature of the agents forming and destroying the ozone, and secondly, the nature of the connexion between the ozone high in the atmosphere and the meteorological conditions much lower down. He expresses the opinion that the chief ozone-forming agent is the corpuscular radiation from the sun—including the action of electric fields which may be set up by this in the air—at least, near the poles, and possibly over the whole world; the destruction of ozone is attributed to the action of solar radiation of wave-lengths between 3300 A. and 2200 A., and to thermal decomposition, the amount of the latter being rather sensitive to the temperature. Dr. Dobson expresses no definite opinion on the second question, but gives, as the most probable ways in which a connexion could be brought about, transport of large masses of the atmosphere over the surface of the earth, transport by vertical currents, and actual formation and decomposition of ozone over the areas in question, all of which are, however, somewhat unlikely for one reason or another. Dr. Dobson hopes to conduct future work with photoelectric spectrophotometers, instead of the photographic instruments which have been used up to the present. It should be mentioned that two recent papers by Prof. S. Chapman (in the *Philosophical Magazine* and the *Memoirs of the Royal Meteorological Society*) in which the kinetic aspects of the reactions occurring in the upper air are examined, emphasise the need for fairly accurate knowledge of the temperatures involved, and that these are now believed to be higher than was previously supposed.

A New Methylation Process.—The difficulties encountered in the exhaustive methylation of hydroxyl groups in complex compounds are well known. Since the methylated products have often proved extremely useful in the elucidation of structural problems in the investigation of carbohydrates and many other natural compounds, it is of interest to learn that Dr. M. Nierenstein, of Bristol, has described a new process of methylation which consists in replacing acetyl groups by methyl groups with the aid of diazomethane in the cold. This reagent needs careful handling as it is extremely poisonous. In the *Journal of the American Chemical Society*, vol. 52, p. 4012, some preliminary results are recorded. The reaction takes place in the presence of piperidine, one molecular proportion of which is used for every acetyl group replaced. An ethereal solution of diazomethane prepared from nitrosomethylurethane by a method described in a previous paper in the same journal (vol. 52, p. 1508) is distilled into an alcoholic solution of the acetylated hydroxy-compound to which the requisite amount of piperidine has previously been added. After standing for 24 hours the alcohol is removed and the residue refluxed with aqueous alkali. The piperidine is then extracted with ether and the methylated product is liberated with acid. The method has been successfully applied to the preparation of veratric acid, isovanillic acid, dimethyl β-resorcylic acid, monomethyl β-resorcyclic acid, and trimethyl gallic acid. Experiments on the methylation of penta-acetyl catechins, which by other methods give impure products, are in progress.

Atomic Weight of Rhenium.—Since the element rhenium is now being produced in Germany in considerable quantities, its atomic weight has been redetermined by O. Hönigschmid and R. Sachtleben in the Atomic Weight Laboratory at Munich (*Zeit. anorg. und allgem. Chemie*, **191**, 309; 1930). The authors have studied the reaction of rhenium which appeared suitable for an atomic weight determination, and found that the preparation of metallic rhenium from the disulphide by heating in a stream of hydrogen did not take place quantitatively, so that the value for the atomic weight determined by W. and I. Noddack appeared doubtful. By heating rhenium metal in a stream of chlorine there was formed a rhenium chloride which could be sublimed but was apparently not homogeneous. The analysis of silver perrhenate ($AgReO_4$), by precipitating with hydrobromic acid and weighing the silver bromide, proved to be a suitable method. The methods used in the preparation and analysis of the pure silver perrhenate are described. From seven determinations it was found that 51·82860 gm. $AgReO_4$ gave 27·17309 gm. AgBr, from which was derived the relation: $AgReO_4 : AgBr = 1·90735$, and the atomic weight of $186·31 \pm 0·02$ for rhenium.

Anniversary Meeting of the Royal Society.

SIR ERNEST RUTHERFORD completed his term of office as president of the Royal Society by a noteworthy address on the Society's policy for the promotion of research, before he presented the medals for 1930 at the anniversary meeting on Dec. 1.

Looking back over the years since the end of the War, Sir Ernest pointed out how the responsibilities and work of the Society have increased during that period. Between 1919 and 1923, the Society received bequests under the wills of Miss Agnes Foulerton, Dr. Rudolph Messel, and Dr. Ludwig Mond, and a notable benefaction from Sir Alfred Yarrow. Foulerton and Yarrow research professorships were in due course instituted, and regulations for the Messel and Mond funds were adopted, subject to periodical review, which provided for further professorships as the need and opportunity might arise.

The Council of the Royal Society has watched the effect of thus endowing research professorships and is satisfied that the experiment, in Sir Ernest's words, "has proved an unqualified success". The appointments have added materially to the strength of the research side of the universities where the Royal Society professors are working, and "have led to a marked increase in the research power of the nations". While it would be unwise to increase their number unduly in the near future, the Council has decided that the Messel and Mond funds can now be employed to the benefit of the whole body of science by supporting the work carried out in recent years by Dr. P. Kapitza, fellow of Trinity College, Cambridge, who has accordingly been appointed to a Messel professorship.

The funds held in trust by the Royal Society now amount to more than £600,000. Plans for the utilisation of the income from these funds have been carefully matured during the past ten years, for it was difficult to foresee the financial commitments of the Society due to its existing activities. The increased volume of publication after the War and the disproportionate increase of costs involved heavy expenditure, which the Council felt was justified in the interests of scientific research, but it has now been decided that the price of the Society's publications to outside subscribers must be increased. This will release a substantial sum which can be devoted to other purposes. It is now felt, however, that the time and opportunity have come to expend some of the accumulated income of the Society's trust funds, with the result that the sum of £15,000 has been offered to the University of Cambridge for the purpose of building a cryogenic laboratory for the continuance of Dr. Kapitza's researches on the magnetic properties of materials at very low temperatures. The circumstances of the offer and an outline of Dr. Kapitza's work are given in an extract from Sir Ernest Rutherford's address which appears elsewhere in this issue.

The Council's policy, Sir Ernest said, has been and will be to keep watch over the whole field of scientific activity, giving help where there is promise of important advances and where the right man is to hand. It is by the support of major fundamental researches, especially in their initial stages, that the Society can employ most effectively the research funds which it has at its disposal.

Sir Ernest Rutherford also referred to the institution of a new research fellowship, financed from the bequest of the late Mr. E. W. Smithson. The first award has been made to Dr. P. D. F. Murray. After a distinguished undergraduate career in the University of Sydney, Dr. Murray spent two years in research work in the Department of Comparative Anatomy at Oxford, and since 1926 has been lecturer in zoology at the University of Sydney. Nearly all his work has been in the field of experimental embryology, and he has investigated with conspicuous success the factors which determine the differentiation and shaping of the limbs and other parts of the body. Dr. Murray proposes to examine the cellular differentiation of the developing chick, which underlies the coarser morphology, and he will work in the first instance at the Strangeways Research Laboratory in Cambridge.

Sir Ernest Rutherford announced at the anniversary meeting that it has been decided to increase the number of candidates recommended annually for election to the Society from fifteen to seventeen. The Council reports that during the past year the Society received £8000 for general purposes under the will of Sir Dawson Williams and £500 for research under the will of Col. G. H. Leathem. In addition to the Messel research professorship and the Smithson research fellowship referred to above, the following research appointments were made during the past year, the subject of research being given in brackets: Foulerton Research Fellow, Dr. A. S. Parkes (physiology of reproduction); Mackinnon Research Student, Miss M. E. J. Chandler (fossil fruits and seeds of tertiary and quaternary age); Moseley Research Students, Mr. G. S. Adair (proteins of blood) and Dr. J. K. Roberts (exchange of energy between gas atoms and solid surfaces); Lawrence Research Student, Lieut.-Col. E. C. G. Maddock (tuberculosis); Tyndall Mining Research Student, Mr. A. G. R. Whitehouse (loss of salts from the body in sweating and the passage of water through the skin with and without sweating). Through the bequest of the late Mrs. Sollas, the capital of the Moseley Fund has been increased to more than twice its former value, so an additional studentship has been created; the two studentships will be awarded for work in physics or chemistry and for biological work bearing on pathology respectively. The Tropical Diseases Committee, with the aid of the Anonymous Bequest Fund, has instituted a research into kala-azar in Mediterranean countries, which is being conducted by Dr. Saul Adler, of the Hebrew University of Jerusalem. Grants amounting to £6002 have been allotted from the general fund by the Government Grant Committee, and ten grants, amounting to £1600, have been made from the Government Publication Grant.

We print below extracts from the remarks made by the president on the recipients' scientific work at the presentation of medals.

Presentation of Medals.

COPLEY MEDAL, AWARDED TO SIR WILLIAM BRAGG.

To the rapid advance of experimental physics in the last thirty years, Sir William Bragg has made conspicuous contributions by his pioneering researches in radioactivity, X-rays, and crystallography. He was the first to realise, in 1904, the characteristic difference to be expected in the nature of the absorption of the massive α-particle and the light β-particles expelled from radioactive substances. His experimental researches brought out clearly

the rectilinear path of the α-particles and their limited range of travel. In collaboration with his students, he examined in detail the variation of the ionisation of the α-particle along its path and its absorption by different kinds of matter. In his researches in X-rays and γ-rays, he was impressed by the difficulty that these high frequency radiations behaved like projected corpuscles—a difficulty which has only been in part resolved to-day. Following the discovery by Laue of the diffraction of X-rays by crystals, he was the first to develop a method for showing that ordinary X-radiation gave bright lines superimposed on a continuous spectrum. This reflection method of studying the spectrum of X-rays has proved of great importance to the development of knowledge. In the hands of Moseley, it supplied a means of showing that the atoms have all a similar structure and that their properties are defined by a whole number. In the hands of Sir William Bragg and his son, Prof. W. L. Bragg, it has provided a powerful tool for unravelling the structure of crystals. In this important development, which has added widely to our knowledge, Sir William Bragg has taken an active part, not only by his own researches but also by the direction of an important school of research on this subject at the Royal Institution.

Rumford Medal, awarded to Prof. P. Debye.

Prof. Debye introduced and developed a theory of the specific heats of solids which is of fundamental importance. By it, for the first time, the main phenomena relating to specific heats and their variation with temperature were quantitatively explained. He has made important contributions to the theory of the scattering and reflection of X-rays. Independently of Compton, he put forward the quantum theory of the change of frequency due to the scattering of X-rays—the Compton effect. He was one of the inventors of the powdered crystal method of X-ray crystal analysis. By his introduction of the idea of spatial quantisation and by his investigations relating to the electric and magnetic properties of molecules he did much to advance our understanding of radiation and molecular phenomena. In collaboration with Hückel, Debye has developed a theory to account for the properties of strong electrolytes which has many important applications.

Royal Medal, awarded to Prof. O. W. Richardson.

In his earlier work, Richardson laid the foundation of thermionics. He was the first to study in detail the escape of electrons from hot bodies in a vacuum and to give the correct interpretation of the phenomena. His work on photo-electric emission was also of fundamental importance, and in it many of the now generally accepted ideas relating to interaction between radiation and matter were suggested. Among many important contributions in other fields was the prediction and calculation of the gyromagnetic effect—the rotational torque accompanying the magnetisation of a rod. In addition, he has done important work on electron emission associated with chemical action. He and his students have contributed largely towards filling up the gap between the ultra-violet and X-ray spectra. His main work in recent years has related to the hydrogen molecule, and has afforded a detailed test of the new quantum mechanics when applied to one of the simplest structures for which the old quantum mechanics breaks down.

Royal Medal, awarded to Prof. J. E. Marr.

At a time when few believed it possible, Prof. Marr discerned a delicate time-scale in the Lower Palæozoic Rocks, chiefly in the Lake District and North Wales, and applied it to elucidating the development of life and earth-structure. After testing his results in Scandinavia and in Bohemia he was able to make further use of them in setting in order corresponding rocks in South Wales. He has worked out the structure, origin, and development of the mountains, lakes, and rivers in Lakeland and elsewhere in the north of England. His work in association with Dr. Harker on the metamorphism brought about by the great mass of granite of Shap Fell on the rocks into which it was injected has become classic, and has inspired the rapid advance now being made in kindred studies. Of recent years he has contributed largely to knowledge of the Cambridge district, and particularly of the Pleistocene deposits and their relation to early man there and in East Anglia generally.

Davy Medal, awarded to Prof. R. Robinson.

By his investigations of the chemistry of the alkaloids, Prof. Robinson has made notable additions to the knowledge of the structure of these complex substances, and by experiment extended by theoretical discussion he has strikingly indicated possible mechanisms of their formation in Nature. He has also carried out brilliant synthetical work in connexion with the colouring matters of flowers. His theoretical studies of the mechanism of organic reactions, in particular substitution in aromatic compounds, have led to results of great value in that they enable a very wide range of reactions to be considered from a common point of view.

Darwin Medal, awarded to Prof. Johannes Schmidt.

Dr. Johannes Schmidt is at the same time a distinguished oceanographer and a recognised research worker in genetics of animals and plants. The number and extent of the voyages in small research vessels which Dr. Schmidt has accomplished with success, his large and varied collections of the pelagic fauna and flora, and the remarkable series of observations made under his direction, on the physical and chemical phenomena of the sea, give him an undisputed place in the first rank of those scientific explorers whose labours have built up our knowledge of the oceans of the world. His researches on the life-history of the fresh-water eel and the discovery of its breeding places far out in the Atlantic are widely known. Dr. Schmidt's breeding experiments on the tropical fresh-water fish, *Lebistes*, carried out in the Carlsberg Physiological Laboratory at Copenhagen, are of much interest, whilst his investigations on the local races of the viviparous blenny (*Zoarces viviparus* L.) are of outstanding importance and originality.

Hughes Medal, awarded to Sir Venkata Raman.

Sir Venkata Raman is one of the leading authorities on optics, in particular on the phenomenon of the scattering of light. In this connexion, about three years ago he discovered that the light's colour could be changed by scattering. This had been predicted theoretically some time before, but in spite of search the change had not been found. The 'Raman effect' must rank among the best three or four discoveries in experimental physics of the last decade. It has proved, and will prove, an instrument of great power in the study of the theory of solids.

Polar Front Analysis.

FIVE years ago Dr. J. Bjerknes, of Bergen, Norway, visited the forecasting branch of the London Meteorological Office to demonstrate the methods of weather forecasting that had been developed by him and his colleagues. These methods had been arrived at in the first place because of a dearth of telegraphic reports from foreign countries during the War, which made it possible to progress only by securing more numerous local telegraphic reports giving an unusual wealth of information about conditions in Norway. Such a direction of development is contrary to that generally followed in synoptic meteorology in other countries, the natural course during the past few decades having been constantly to extend the network of stations to cover an increasingly large area, as it has been realised more and more that many weather phenomena can only be explained by tracing the past history of the wind currents involved during several days, which may involve the construction of 'trajectories' several thousand miles in length. Sir Napier Shaw has been prominent in these developments, and his "Life History of Surface Air Currents" is a notable landmark of progress on those lines. Nevertheless, as was shown by the French meteorologist Durand Gréville at a competition in weather forecasting held at Liège in 1905, it is equally true that many phenomena can be explained only by a very detailed study of local variations of wind and pressure in a portion of a single cyclonic depression, and this line of advance has not been followed nearly to the extent that it deserves.

Dr. Bjerknes has left as a memento of his visit to London a paper * which deals with three meteorological situations analysed by his 'polar-front' method, full use being made of the large number of autographic records of wind, pressure, temperature, etc., that are maintained in Great Britain. The spacial distribution of the masses of 'polar' and 'equatorial' air that according to the Norwegian school of meteorology are the fundamental elements of the cyclonic depressions of middle and high latitudes, and possibly even of tropical cyclones, is not the main subject matter of this paper, which is concerned rather with a demonstration of certain ways in which a 'front', that is, the line or band separating such different air masses, may be modified either by downward movement of air within the cold polar air mass or upward movement of air in a transitional band separating polar and equatorial air masses. Three cases covering the periods Mar. 30–April 1, 1925, Feb. 10–11, 1925, and Jan. 22–23, 1926, are analysed.

It is not possible in a short space to give more than an outline of the subject matter of the paper. As some of the ideas introduced are published here for the first time, the paper should be read by all who wish to follow the progress of this interesting school of meteorological thought. It is doubtful whether the pursuit of this method of analysis is likely to lead to an understanding of the causes of formation and maintenance of depressions, but it is none the less almost indispensable for explaining certain weather sequences, and as an aid to greater precision in making forecasts for periods up to about twenty-four hours ahead, and especially for periods of six or twelve hours ahead. The application to longer periods is normally impracticable, because the complexity of meteorological conditions makes it impossible to get much beyond a kind of extrapolation of tendencies revealed by a sequence of synoptic charts. The causes of acceleration or retardation of fronts, which last are so important in controlling the upward and downward motion of the air masses on either side of a front, are still obscure.

* Practical Examples of Polar-front Analysis over the British Isles in 1925–26, by Dr. J. Bjerknes. Meteorological Office Memoirs, No. 50. (London: H.M. Stationery Office, 1930.)

Body and Mind.

IN a paper read before Section J (Psychology) of the British Association at Bristol, Dr. H. Banister discussed the psychology of the tuberculous patient. He quoted various authorities who have attributed to tuberculosis a great variety of mental changes. The disease has been regarded by some to be stimulating to intellectual activity, even to the extent of producing the genius; others consider it to be the cause of neurasthenic syndromes, hysterical manifestations, certain types of psychosis, and homicidal tendencies. As his own view, Dr. Banister insisted that the mental mechanisms of tuberculous patients are the same as those of the healthy individual. Their apparently peculiar psychology is not dependent on tubercle infection; it is the ordinary reaction of the mind to the inhibitions, restrictions, and difficulties which inevitably accompany the disease, and is absent only in those who can readily adapt their outlook and their lives to the new and limiting circumstances. In some persons such adaptation, coupled with a tendency to day-dreaming which can be present during any chronic illness, may bring out the creative tendencies of the individual, expressed in literature and the arts. The state of undue exaltation and optimism often stated to be characteristic in phthisis, is very infrequent, and is simply a manifestation of the dissociation which might follow any severe mental stress.

Considering the effects of the mental attitude of the tuberculous, Dr. Banister stated dogmatically that the patient with a hopeful outlook has a far better chance of arresting the disease than the one who is constantly in a state of despair and anxiety. This points to an extremely important line of treatment. The patient must be encouraged to aim for a life of useful though limited activity, to beware of invaliding himself beyond the degree required, and to avoid anxiety and worry. This is not always easy for the rich; for those of limited means it is, in the home, almost impossible; but that it can be successful under suitable conditions is fully confirmed by the results obtained at Papworth Village Settlement.

A related topic was discussed in a paper before Section I (Physiology) of the Association by Mr. P. Watson-Williams, who referred to chronic toxæmia as a cause of mental disorder and alteration in character. He pointed out that chronic infections can give rise to mental changes and produce disorders of conduct resulting in the unfortunate victim being charged with misdemeanours or criminal actions. As a typical illustration, he cited the well-known character changes which often follow epidemic encephalitis in children. Of equal importance, but more readily overlooked, is toxic absorption from some focus of sepsis. The results of such toxæmia vary within wide limits, from a mild depression to a certifiable psychosis with suicidal tendencies.

While recognising that there must be convincing evidence before attributing misconduct to a toxic mental breakdown, Mr. Watson-Williams emphasised the necessity for expert medical examination to determine whether a delinquent should be dealt with in a hospital rather than before a magistrate.

Fishes from the *Dana* Expedition.

DR. C. TATE REGAN and Miss Ethelwynn Trewavas have described a large and unique collection of fishes in "The Fishes of the Families Stomiatidæ and Malacosteidæ" (The Danish *Dana* Expedition, 1920–22, in the North Atlantic and Gulf of Panama. Oceanographical Reports edited by the *Dana* Committee, No. 6).

The closely related families Astronesthidæ and Chauliodontidæ have already been dealt with, and the present work is a complete systematic revision of the Stomiatidæ and Malacosteidæ, except for the genus *Stomias*. The report is based on the *Dana* collection and on the specimens in the British Museum (Natural History), and in addition several type specimens have been examined from elsewhere. Four new genera, twelve new sub-genera, and seventy-three new species of the Stomiatidæ and four new species of the Malacosteidæ are here described, the new species exceeding in number those previously known. They are all oceanic and probably predaceous, mostly living at no great depth below the surface.

Of the nineteen genera described by Dr. Tate Regan and Miss Trewavas, all but one are known to occur in the North Atlantic. The presence of a barbel is general, and there are two series of photophores on each side of the lower part of the body and a single series on the tail. Behind the eye is a large organ with luminous surface which can be turned downwards and inwards into a pocket and so concealed. The authors suggest that the serial photophores possibly serve as recognition marks, enabling the members of a shoal to keep in touch with one another, and that the post-ocular luminous organ may give light for vision, but the use of the barbel in these fishes of the upper and middle layers of the ocean is more difficult to see. It is suggested that it may be sensory, perhaps receiving impressions that indicate the approach of other fishes, or, when very long and simple, may be tactile. The bulbs and swellings which often occur on the barbel are glandular, similar to the luminous organs on the body, and are probably also luminous, serving as lures. In some species, especially those belonging to the genus *Eustomias*, the form of the barbel is the chief distinguishing mark.

Very interesting changes are shown in some of the young stages of these fishes. In *Aristomias* in the family Malacosteidæ and *Eustomias* and *Idiacanthus* in the Stomiastidæ there are young specimens of the same species with juvenile characters which are as large or larger than those with the structure of the adults, indicating a rapid transition from one stage to another, possibly accompanied by a decrease in size.

University and Educational Intelligence.

CAMBRIDGE.—The Appointments Committee of the Faculty of Physics and Chemistry has appointed Dr. R. G. W. Norrish, of Emmanuel College, to be Humphrey Owen Jones lecturer in physical chemistry for three years.

The General Board recommends (1) that a professorship of geography be created as from Jan. 1, 1931, that the stipend attached to the professorship be £1200 a year, and that the present reader in geography, Mr. F. Debenham, be the first holder of the chair; (2) that a professorship of experimental psychology be created as from Jan. 1, 1931, that the stipend attached to the professorship be £1200 a year, and that the present reader in experimental psychology, Mr. F. C. Bartlett, be the first holder of the chair.

DURHAM.—Lord Londonderry has been appointed Chancellor of the University in succession to the late Duke of Northumberland.

EDINBURGH.—At a meeting of the University Court held on Nov. 24, it was resolved to proceed with ordinances founding a chair of psychology and a chair of geography in the University.

Dr. J. Duncan White was appointed as University lecturer in radiology in succession to Dr. J. M. Woodburn Morison.

Intimation was received of a bequest by Mrs. A. M. Cameron, widow of the late Surgeon Lieut.-Col. Lewis Cameron, the bequest to be for the constitution of a Lewis Cameron Fund for a prize in connexion with bacteriology or the diagnosis of disease, as the Court might from time to time decide.

On the recommendation of the Senatus, the Court resolved to institute a course of twenty-five lectures in acoustics in the Department of Natural Philosophy for students in music.

Having consulted the Senatus and the General Council, the Court concurred in a proposal of the Scottish Universities Entrance Board to adopt a regulation including natural science among the subjects of the Preliminary Examination.

ACCORDING to the Report of the Board of Management of the London School of Hygiene and Tropical Medicine, presented to the Court of Governors on Nov. 28, the financial situation of the School is satisfactory up to a point, the Court of the University having secured to the School an Exchequer grant for a term of years at the rate of £40,000 per annum. The School, however, has to supplement this by voluntary effort, not only to meet the cost of the present programme, but also to meet the cost of developments, especially in regard to industrial medicine and hygiene, which are already pressing for attention. The report on the work of the School during the first year of occupation of the premises, the gift of the Rockefeller Foundation, which were opened by the Prince of Wales in July 1929, stated that no less than 217 post-graduate students had attended the courses and a further 75 non-medical persons proceeding to the tropics had attended the lectures in tropical hygiene. Reference was also made to the assistance rendered by the Seamen's Hospital Society, and to the extension it has recently made to the Hospital for Tropical Diseases, which provides a valuable centre for the teaching of tropical medicine in association with the School. A beginning has been made with the teaching of industrial physiology and medical industrial psychology.

THE annual conference of the Geographical Association will be held on Dec. 31–Jan. 5 at the Imperial Institute, South Kensington, S.W.7, and the London School of Economics, Houghton Street, W.C.2, under the presidency of Mr. B. B. Dickinson, who will deliver his presidential address on Jan. 1. The programme includes a discussion and exhibition on school journeys, exhibition of maps showing agricultural distribution in Scotland (Mr. H. J. Wood), regional study of the Chod villages of south-west Bohemia (a Leplay House group), lantern lecture by Major R. W. G. Hingston on the 'tree-roof' of the Guiana forest and by Miss R. M. Fleming on regions of Russia, a paper on the distribution of houses in England and Wales as a population index (Dr. P. W. Bryan), a discussion for secondary school teachers of Mr. B. C. Wallis's paper on geography from the point of view of the examiner, and another for primary school teachers on geography and the extension of the school age. Reference is also made to the discussion on the teaching of geography arranged by the Conference of Educational Associations for Jan. 5 at University College, Gower Street, W.C.1. A publishers' exhibition of books and apparatus will be open upon Jan. 1–3. Information regarding the meeting of the Geographical Association can be obtained from the Clerk of the Association, Municipal High School of Commerce, Princess Street, Manchester.

Historic Natural Events.

Dec. 7, 1663. High Tide.—Pepys records that "last night was the greatest tide ever known in the Thames; all Whitehall was drowned".

Dec. 7, 1873. "Cattle-Show" Fog.—During the whole of the week beginning Dec. 7, the British Isles were under the influence of an anticyclone. Hard frosts and dense fogs occurred over the whole country. In London the fog was continuous throughout the week, which was that of the annual Cattle Show, and caused great inconvenience. It was followed by a great increase in the number of deaths from respiratory diseases.

Dec. 7, 1879. Great Cold in Central Europe.—December 1879 was the coldest month of the century in France and central Europe. The frost began on Nov. 22–25, and reached its greatest intensity on Dec. 7, when it extended over France, Switzerland, Italy, and even northern Africa, for snow fell in Tunis. At Montsouris, Paris, a temperature of −11° F. was recorded in the shade, and farther east, at Langres, −22° F. In Paris there were 75 days of frost, 33 in succession, and in France 50 persons died of cold. The Seine, Yonne, and Loire were frozen. There was heavy snow in Paris. The Dutch waterways were frozen for 54 days. On Dec. 8 the Zuider Zee became an ice lake. By way of contrast, the winter was not cold in Russia. A second period of cold came at the end of January, but February was very warm. The beginning of December was very cold in England and Scotland (see Dec. 4), but afterwards the cold was not excessive and the Thames was not frozen over.

Dec. 8-9, 1886. Storm and Low Barometer over Eastern Atlantic.—This storm was notable for its great extent, the low barometer in its centre, its duration, and the violence of its winds. It appeared off the west of Ireland on the evening of Dec. 7 and travelled due eastwards across the south of England. At Belfast on the afternoon of Dec. 8 the barometer fell to 27·38 inches (927·2 mb.), The average wind velocity reached 80 miles per hour at Fleetwood from 8.30 to 9.30 A.M. on Dec. 9, and exceeded 70 miles per hour from 8 A.M. to 4 P.M. The gale extended over the whole area from Stornoway to Corunna, more than 1100 miles. A sharp squall with thunder, lightning, and hail passed over London at 9 A.M. on Dec. 8. On the coasts no fewer than 217 vessels were recorded as lost or damaged, while two lifeboats were capsized near Fleetwood, with the loss of 27 lives.

Dec. 9-11, 1671. Glazed Frost in Somerset.—Although there was no ice on any water, the rain of these days in Somerset froze as it fell. An ash branch weighing three-quarters of a pound had 16 pounds of ice on it, the ice being five inches in circumference. Vast numbers of trees were destroyed by the weight of the ice.

Dec. 10, 1149. Severe Winter in England.—The winter of 1149–50 was very severe in England and the Netherlands. The Thames was frozen from Dec. 10 until Feb. 19, and was used as a highway for carriages and horses. The sea off Holland was frozen three miles from the shore. The winter caused a severe famine, and the whole year was very unfavourable.

Dec. 12, 1901. Snowstorm over England.—A deep barometric depression travelled eastward along the English Channel on Dec. 12–14, and during these three days strong north-easterly winds prevailed over the British Isles, while a violent snowstorm raged over most of England, especially the north Midlands. Enormous damage was done to telegraph wires, the north of England being isolated from London, while railway traffic was completely disorganised. Great drifts were formed in hilly districts, blocking roads and causing the loss of many sheep.

Dec. 13, 1795. Meteorite.—The controversy as to whether so-called 'thunder-bolts' ever actually fell from the sky was ended in 1795, when an aerolite was observed to fall on Dec. 13 at Wold Cottage, Thwing, near Scarborough. This aerolite, which weighs 56 lb., is now in the British Museum (Natural History).

Societies and Academies.

LONDON.

Mineralogical Society, Nov. 4.—Arthur Russell: An account of British mineral collectors and dealers in the seventeenth, eighteenth, and nineteenth centuries. A first instalment of a series of short biographies dealing with:—Nehemiah Grew, F.R.S. (1641–1712), William Borlase, F.R.S. (1696–1772); Rudolf Erich Raspe (1737–1794); and Philip Rashleigh, F.R.S. (1729–1811).—M. H. Hey: On cupriferous melanterite from the Skouriotissa mine, Cyprus. A crystallographic study of a well crystallised specimen from an ancient working (perhaps Roman) in the Skouriotissa mine, revealed a very peculiar habit tabular to $b(010)$, and the presence of the new forms $x(161)$, $y(231)$, $g(\bar{1}12)$, $q(\bar{1}02)$, and $\beta(150)$. A partial analysis shows the presence of 7·7 per cent $CuSO_4,7H_2O$.—C. E. Tilley: On the dolerite-chalk contact-zone of Scawt Hill, Co. Antrim. The production of basic alkali rocks by the assimilation of limestone by basaltic magma. (With chemical analyses by H. F. Harwood): Assimilation of limestone at the contact of a dolerite intrusion with the chalk at Scawt Hill gives rise to a hybrid zone built up of pyroxene-rich rocks (pyroxenites), titanaugite-melilite rocks, and basic rock-types bearing nepheline (theralite and nepheline-dolerite assemblages). The segregation of a basic alkali residuum is the complementary process in the precipitation of magnesia-rich pyroxene in the pyroxenites. Plagioclase is resorbed and gives place to a titaniferous lime-augite rich in alumina, melilite, and nepheline, while perovskite, aegirine, and wollastonite are other products in the hybrid zone.—Frank Smithson: A simple method of observing the magnetic properties of mineral grains. The tests are made with softened steel needles attached to the poles of a horse-shoe magnet, a strong field being obtained when the points are 1 mm. or so apart. The attraction is observed under the microscope.—M. H. Hey: On studies of the zeolites (1). General review. A short review of the general properties of the zeolites, with some suggestions on the interpretation of the available data, and a comparison of the zeolites with the clays, ultramarines, permutites, and 'artificial zeolites'.

Royal Meteorological Society, Nov. 19.—J. Edmund Clark, I. D. Margery, R. Marshall, and C. J. P. Cave: Report on the phenological observations in the British Isles, December 1928 to November 1929. A year of extreme conditions resulted in average results for 1929. Winter migrants, such as fieldfares and redwings, fled from usual haunts to avoid the cold, but reappeared as welcome guests in south Ireland and south-west England. Sharp spells of cold in April, May, and June neutralised the alarming number of queen wasps. In the table of flowering dates, all are late in England and Wales, though decreasingly so: from 17 to 14 days for the hazel and coltsfoot in February, to 1 and 2 days for the devil's bit scabious and ivy in early August and late September. That the determining factor was cold of continental type

spreading exceptionally in proportion to propinquity is well shown by the district values. Our earliest bird record, the song of the thrush, and the honey bee date for insects, tell the same tale. The exceptional nature of the March warmth and sunshine is best illustrated by the insects: on the average the queen wasp appears two days after blackthorn blooms; in 1929 ten days earlier. It was more than a month early in Scotland W., and the orange tip butterfly nearly as much in Scotland E. The year's results in farm and garden as to quantity and quality showed a small balance on the credit side, due chiefly to the superb September. But to drought in the south-east was due a shortage of hay and straw, while in the far north, late comparatively in its harvest-time, the October deluge played sad havoc.—**A. V. Williamson** and **K. G. T. Clark**: The variability of the annual rainfall of India. Variability is defined as the percentage departure—irrespective of sign—from normal annual rainfall which has occurred at a given station in half the years of the period 1890–1923. Two generalisations are submitted: (1) the lower the rainfall the greater variability tends to be; (2) rainfall is less reliable when it is characteristically concentrated than when it is well distributed in time. A map of India divided into zones by means of "lines of equal-variability" has been prepared.

PARIS.

Academy of Sciences, Nov. 3.—**Bigourdan**: The Technological Institute of I. Porro. Historical account of the astronomical equipment of this observatory.—**E. L. Bouvier**: The systematics of the Saturnioides of the family of Hemileuca.—**Georges Claude**: The utilisation of the thermal energy of the sea. An account of the laying an iron tube, 2 km. in length, in the Bay of Matanzas, for the purpose of extracting cold water from the sea floor, to be utilised by the Claude-Boucherot plan.—**C. Camichel, J. Leclerc du Sablon**, and **L. Escande**: Experiments on the pipes supplying water to the Miègebat power station.—**N. Achieser**: The polynomials of Tchebyscheff for two segments.—**Henri Dumas**: The generalisation of a theorem of Mandelbrojt.—**Mandelbrojt**: Some theorems on holomorph analytical functions limited in an infinite region.—**Jean Chazy**: The velocity of propagation of the Newtonian attraction.—**G. Wataghin**: The relations of indetermination in the theory of quanta.—**L. Goldstein**: The distribution of the electrons in the atom.—**Pan-Tcheng Kao**: The vibrations of piezoelectric quartz along the optic axis. Quartz possesses three fundamental frequencies related to the three axes, and this is not in contradiction with Curie's law.—**A. Dargenton**: The refraction of pencils of right lines.—**A. Couder**: Spectrograph with a non-inclined plate.—**R. Tréhin**: The absorption of aqueous solutions of hydrochloric acid in the ultra-violet.—**R. Zouckermann**: The phosphorescence phenomena presented by fused silica discharge tubes. The phenomena described are analogous with those described by Curie as resulting from the action of radium rays on various substances and by Wiedemann and Schmidt when studying the action of the cathode rays.—**J. Giuntini**: The compounds of tartaric acid and copper. Solutions of the copper tartrates were prepared by dissolving increasing proportions of precipitated copper hydroxide in tartaric acid and these were examined for rotatory power and dichroism. The discussion of the data from the point of view of formation of definite compounds is reserved for a later communication.—**E. Darmois** and **Jean Pierre Pérez**: The variation of the rotatory power of the camphorsulphonates in the presence of neutral salts.—**Jean Becquerel** and **W. J. de Haas**: The paramagnetic rotatory power of crystals of xenotime at very low temperatures and on the paramagnetic saturation. The temperatures were taken down to 4·2° abs. (liquid helium) with a magnetic field of 27,000 gauss. Under these conditions the paramagnetic saturation is almost complete. Curves have been obtained representing the rotations as functions of H/T, where H is the magnetic field and T the absolute temperature.—**H. A. Kramers**: Paramagnetic rotation in uniaxial crystals of the rare earths.—**Desmaroux** and **M. Mathieu**: The X-ray study of the gelatinisation of nitrocellulose.—**A. Kling** and **A. Lassieur**: The hydrogen exponent (pH) of water. In two earlier communications the authors have found by two independent methods a value 5·8 for the pH of water. This figure has been criticised on the ground that the experiments may have been vitiated by the presence of a trace of carbon dioxide in solution. An experiment is described in which the water used was directly distilled from a platinum vessel after addition of caustic soda, the distillation being carried out in a current of pure hydrogen. This water again gave a pH of 5·8 by a zero electrometric method, confirming the previous results.—**Al. Yakimach**: A complex compound of quadrivalent vanadium cyanide. The preparation of the compound $K_2V(CN)_6$ is described.—**Joseph Robin**: The migration of the amino groups in the arylamines derived from the diarylarylethinylcarbinols. The constitution of the compounds obtained.—**Paul Bruère**: The colorimetric micro-reactions of the glutenogen proteids and of the cellulose gels of the wheat grain.—**J. Beauverie** and **J. Treyve**: The survival and development of green plants during periods up to nearly two years in hermetically closed receivers.—**Fontaine**: The parallelism existing in fish between their resistance to variations of salinity and the independence of their interior medium.—**H. Laugier** and **Mlle. L. Lubinska**: Reflex excitability and refractory phenomena in the nerve centres.—**Georges Blanc** and **J. Caminopetros**: The sensibility of *Citillus citillus* to the Mediterranean kala-azar. This marmot is so sensitive to kala-azar infection that it is undoubtedly the best experimental animal for the study of this disease and its mode of transmission.—**J. Magrou** and **Mme. Magrou**: Action at a distance and the development of the egg of the sea urchin. New experiments.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 15, 1930.—**V. Ipatjev**: Cellulose from sugar. An analysis of the cellulose obtained by Prof. E. Schmidt, Munich, from monosaccharides.—**A. Čičibabin**: Acids in Baku petroleum.—**A. Karpinskij**: (1) Studies of problematic objects and phenomena: a study of the remnants of *Helicoprion*.—(2) A problematic fossil from the Palæozoic deposits of the northern Urals. A description and discussion of *Proamphibia problematica*, represented by a fossilised scaly skin.—(3) Grey cast-iron resembling in structure a piece of wood. Chemical, metallographic, and microscopic analyses of an object found in a furnace and representing a piece of cast-iron, with all the details of structure of wood.—**V. Chlopin** and **B. A. Nikitin**: The radium content of the petroliferous waters of the Grozny area. The concentration of radium in some samples was very high, namely, 1/28, 3/28, and 1/31.—**V. Vernadskij**: Radioactivity of petroliferous waters. The concentration of radium in natural waters must be connected with some biological processes on the surface of the earth.—**A. Grosse**: The X-ray spectrum of the element 91, ekatantalium (1), Series L.—**G. Pfeiffer**: A generalisation of Jacobi's method of the integration of complete systems of linear homogeneous equations.

Official Publications Received.

BRITISH.

Harper Adams Agricultural College, Newport, Shropshire. Pp. 96. (Newport.)

Journal of the Chemical Society. October. Pp. iv+2217-2401+x. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 47: A Study of Fungi found in Butter. By M. Grimes and V. C. E. Kennelly and H. A. Cummins. Pp. 549-569+plates 22-23. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s.

Indian Journal of Physics, Vol. 5, Part 3, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 14, Part 3. Conducted by Sir C. V. Raman. Pp. 237-383. (Calcutta.) 3 rupees; 4s.

Catalogue of Indian Insects. Part 19: Gyrinoidea. By Georg Ochs. Pp. 39. (Calcutta: Government of India Central Publication Branch.) 12 annas; 1s. 3d.

Bothalia: a Record of Contributions from the National Herbarium, Union of South Africa, Pretoria. Edited by Dr. I. B. Pole Evans. Vol. 3, Part 1. Pp. 156. (Pretoria.) 7s. 6d.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, October. Pp. 663-740+xli. (London.)

FOREIGN.

Det Kgl. Danske Videnskabernes Selskab. Mathematisk-fysiske Meddelelser, Band 11, Nr. 1: Radiometer Pressure and Coefficient of Accommodation. By Martin Knudsen. Pp. 75. (København: Andr. Fred. Høst and Son.) 3.60 kr.

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 71: Librationstheorie des restringierten Dreikörperproblems. Von Aurel Wintner. Pp. 639-667. (København.)

L'Observatoire de Genève, 1772-1830-1930. Par Raoul Gautier et Georges Tiercey. Pp. 172+26 planches. (Genève: Albert Kundig.)

U.S. Department of Agriculture. Technical Bulletin No. 176: The Citrus Rust Mite and its Control. By W. W. Yothers and Arthur C. Mason. Pp. 56. (Washington, D.C.: Government Printing Office.) 15 cents.

CATALOGUE.

Mercury Switches and Relays for Industrial and Laboratory Control. (List No. M. 1030.) Pp. 32. (London: Isenthal and Co., Ltd.)

Diary of Societies.

FRIDAY, DECEMBER 5.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Dr. G. Riddoch, Dr. A. B. Rosher, and others: Discussion on Intracranial Complications of Otitic Origin: Neurological and Pathological Investigation.

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

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—M. Fahmy: A Point of Analogy between the Equations of the Quantum Theory and Maxwell's Equations.—B. K. Johnson: Sources of Illumination for Ultra-violet Microscopy.—W. A. Wood: The Influence of the Crystal-orientation of the Cathode on that of an Electro-deposited Layer.—C. A. Kloss: Relations between the Fundamental Physical Constants.—Demonstration by Prof. G. B. Bryan of some Stroboscopic Effects.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—U. R. Evans: The Protection of Metals by Painting.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. W. E. S. Turner: Machinery and Methods of Manufacture of Sheet Glass.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. T. Callan: The Estimation of Minute Traces of Copper.—Dr. F. C. Wood: (*a*) The Reaction of Formaldehyde Derivatives with Cellulose; (*b*) The Formation of Cellulose Monomethylene Ether; (*c*) The Action of Grignard Reagent on Cellulose.—C. M. Whittaker: Some Notes on Viscose Dyeing.—J. M. Preston: A Skin Effect on Viscose Rayon.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) (Informal Meeting), at 7.—Discussion on The Camera for the Pictorialist.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—O. Howarth: The Metering of Three-Phase Supplies.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—R. L. Mayston: Oil Burning for Domestic Central Heating.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Dr. A. K. Wells: A Journey through South and West Africa, with special reference to Igneous Phenomena (Lecture).

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.—G. F. O'Riordan: Recent Developments in Chemical Engineering.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.

SATURDAY, DECEMBER 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir E. Denison Ross: Persia and the Persians (1): The Country and its History.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.—S. H. Russell: Foundries—and Foundries.

INSTITUTE OF BRITISH FOUNDRYMEN (Scottish Branch) (at Royal Technical College, Glasgow), at 4.—A. Harley: The Production of an Aluminium Alloy Casting.

BIOCHEMICAL SOCIETY (in Department of Physiology, London Hospital Medical College), at 5.—H. Chick and A. M. Copping: Observations on the Water Soluble B Vitamin Complex.—G. T. Calthrop and J. R. Marrack: Carotinæmia in Diabetes.—J. R. Marrack and F. Campbell Smith: Quantitative Aspects of Immunity Reactions.—Prof. C. Lovatt Evans, Chaio Tsai, and F. G. Young: The Influence of Adrenaline on Glycogen Distribution in the Cat.—Demonstrations:—F. Campbell Smith and E. R. Holiday: Photo-electric Spectrophotometry of the Ultra-violet using the Hydrogen Discharge Tube as the Source of Radiation.—J. R. Marrack and F. Campbell Smith: A Kataphoresis Apparatus.—K. S. Thompson: A Precipitin Reaction with Bee Stings.

INSTITUTE OF BRITISH FOUNDRYMEN (West Riding of Yorkshire Branch) (at Technical College, Bradford), at 6.30.—F. Griffiths: Some Aspects of Modern Foundry Practice.

MONDAY, DECEMBER 8.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—L. H. Gray: The Photoelectric Absorption of Gamma Rays.—L. G. Vedy: On the Rotation of Dielectrics in Electrostatic Fields and Related Phenomena.—*Papers to be communicated by title only*:—W. G. Welchman: On Elliptic Quartic Curves with Assigned Points and Chords.—Dr. S. Verblunsky: Note on Continuous Functionals.—A. Oppenheim: Note on some Linear Diophantine Inequalities.—Prof. C. G. Darwin: The Diamagnetism of the Free Electron.—Prof. J. B. S. Haldane: A Mathematical Theory of Natural and Artificial Selection. Parts VII., VIII.—G. de B. Robinson: On the Rotation Groups of Four Dimensions.—Prof. L. M. Milne-Thomson: On the Operational Solution of Linear Finite Difference Equations.—Dr. D. R. Hartree: The Propagation of Electromagnetic Waves in a Refracting Medium in a Magnetic Field.—H. R. Hassé: The Calculation of the van der Waal Forces for Hydrogen and Helium at Large Interatomic Distances.—Dr. G. S. Carter: Aquatic and Aerial Respiration in Animals.—Von Gottfried Fraenkel: Die Mechanik der Orientierung der Tiere im Raum.—G. C. Hirsch: The Theory of Fields of Restitution with Special Regard to the Phenomena of Secretion.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Prof. J. W. Gregory: The Earthquake off the Newfoundland Banks.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—H. C. Armitage: Machine Tools from the Manufacturing Users' Point of View.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. O. Gibbon, Lt.-Col. K. Edgcumbe, and others: Discussion on Impulse *versus* Synchronous Time Service.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (in University, Liverpool), at 7.—O. Howarth: The Metering of Three-phase Supplies.—J. Urmston: The Electrical High-pressure Testing of Cables and the Localisation of Faults.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.—S. G. Brown: Loud-speakers since their Conception with Gramophone Pick-ups and Wireless Recording Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at University, Birmingham), at 7.—D. B. Hoseason: The Cooling of Electrical Machines.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry—Leeds Area Section) (at Great Northern Hotel, Leeds), at 7.15.—Dr. W. J. S. Naunton: Antioxidants.

ROYAL SOCIETY OF ARTS, at 8.—Prof. C. R. Darling: Modern Domestic Scientific Appliances (Cantor Lectures) (3).

CHARTERED SURVEYORS' INSTITUTION, at 8.—A. T. A. Dobson: The Land Drainage Act, 1930.

TUESDAY, DECEMBER 9.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 5.—Discussion on The New Mercurial Diuretics and their Uses in Medicine.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. E. A. Milne: Stellar Structure and the Origin of Stellar Energy (2).

INSTITUTE OF MARINE ENGINEERS, at 6.—Dr. J. Tutin and A. C. Hardy: Modern Developments in Ship Design, with Special Reference to Propulsion.

INSTITUTE OF METALS (Swansea Section) (at University College, Swansea), at 6.15.—W. Andrews and H. Martin: Copper Welding.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—S. G. Brown: Loud-speakers since their Conception with Gramophone Pick-ups and Wireless Recording Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—Dr. J. J. Rudra and Prof. M. Walker: The Theory and Performance of Phase Advancers.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—P. G. Fairhurst: Paper.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.—Display of New Apparatus. Projection of Films.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (Burnley Section) (at Municipal Technical College, Burnley), at 7.15.—F. Harris: Survey in Making of Light Castings.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—E. V. Pannell: Light Alloy Piston Development.

INSTITUTE OF METALS (North-East Coast Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Prof. H. V. A. Briscoe: Properties of Coke.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—D. D. Hoseason: The Cooling of Electrical Machines.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. D. M. S. Watson: Endocrine Organs (Lecture).

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. N. H. M. Burke: Stigmata of Degeneration in relation to Mental Deficiency.

WEDNESDAY, DECEMBER 10.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—Dr. J. S. Owens: Atmospheric Pollution due to Combustion of Fuel, and Methods of its Prevention.

TEXTILE INSTITUTE (Midlands Section) (at Colleges of Art and Technology, Leicester), at 6.—W. Kershaw: Research in the Textile Industry.

TELEVISION SOCIETY (at University College), at 7.—T. Thorne Baker: Television in Natural Colours and the Fundamental Problems involved.

INSTITUTION OF AUTOMOBILE ENGINEERS (Leeds Centre) (at Metropole Hotel, Leeds), at 7.15.—Dr. H. E. Merritt: Trends in the Transmission.

BACUP TEXTILE SOCIETY (at Natural History Rooms, Bacup), at 7.30.—Dr. J. H. Kitson: Factory Hygiene.

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.30.—H. W. Taylor: Voltage Control of Large Alternators.

ROYAL SOCIETY OF ARTS, at 8.30.—A. L. B. Ashton: Persian Textiles.

EUGENICS SOCIETY (at Linnean Society), at 8.30.—Dr. M. Radford: Heredity in Education.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (jointly with Faraday Society).—D. J. Macnaughtan: The Determination of the Porosity of Electrodeposits.—D. J. Macnaughtan and R. A. F. Hammond: The Influence of Small Amounts of Chromic Acid and of Chromium Sulphate in the Electrodeposition of Nickel.—D. J. Macnaughtan and A. W. Hothersall: 'Stopping Off' Materials for Use in the Electrodeposition of Nickel.—S. Glasstone and J. B. Speakman: The Electrodeposition of Cobalt-Nickel Alloys.—W. J. Shutt and J. Stirrup: The Time Factor in Anodic Passivation of Metals.

THURSDAY, DECEMBER 11.

ROYAL SOCIETY, at 4.30.—Prof. J. Bordet: Les Théories des Bactériophages (Croonian Lecture) (*in English*).

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. N. Bailey: An Extension of Meissel's Expansions in Kapteyn Series, and Some Similar Expansions.—Dr. R. A. Fisher and J. Wishart: The Derivation of the Pattern Formulæ of Two-way Partitions from those of Simpler Patterns.—Prof. L. M. Milne-Thomson: Ten Figure Table of the Complete Elliptic Integrals K, K', E, E'.—V. C. Morton and Dorothy S. Meyler: Quadrics and Quadric Cones of a Set of Three Associated Steiner Trihedral Pairs.—R. F. Whitehead: Ramanujan's Approximation for e^{π}.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir John Russell: The Agricultural Development of the Empire (2): Conquest of the Drought.

CHEMICAL SOCIETY (at Imperial College of Science), at 5.30.—Prof. W. A. Bone: Fifty Years' Experimental Research upon the Influence of Steam on the Combustion of Carbonic Oxide (1880–1930) (Liversidge Lecture).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—D. R. Pye: The Origin and Development of Heavy Oil Aero-Engines.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Chemical Engineering Group) (in Chemical Department, University, Bristol), at 6.30.—S. Stephens: Modern Water Treatment.

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.—E. W. Causton: Types of Internal Combustion Engines.

INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7.—E. J. Dobbs: Plating.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour and Kinematograph Groups), at 7.—Kinematograph Group:—S. G. French: Some Kodacolor Films of the Italian Lakes.—Colour Group: Instantaneous Colour Photography. Some Comparative Tests of Bead and other Lantern Screens.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Section) (at University College, Dundee), at 7.30.—A. V. Reis: Electricity and Mining—a Story of Progress.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch) (Informal Meeting) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—J. Crichton and others: Discussion on Shipbuilding in Japan and Russia.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—T. H. Court and Dr. M. von Rohr: New Knowledge on Old Telescopes.—Mrs. E. Gifford: On Interpolating Refractive Indices.—H. Buckley: On the Determination of the Transmission Factors of Coloured Step Lenses.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—C. C. Hall: The Fabrication of Plant in Acid-Resisting Steels.

INSTITUTE OF METALS (London Section) (jointly with Institute of British Foundrymen) (at Chemical Society), at 8.—E. Player: Magnesium Alloy Castings.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Major G. Shanks: Demonstration on the Pathology of Epidemic Dropsy in Bengal.—Sir Aldo Castellani: Minor Tropical Diseases.

FRIDAY, DECEMBER 12.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department Lecture Room, Imperial College of Science and Technology), at 2.30.—The Purification of Waste Waters from Beet-Sugar Factories:—D. W. Cutler: Microbiological Aspects.—E. H. Richards: Biochemical Aspects.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30—A. Wigglesworth: India's Commercial Fibres.

ROYAL ASTRONOMICAL SOCIETY, at 5.—E. A. Kreiken: (*a*) On the Relation of Colour and Spectral Type in the Different Galactic Latitudes; (*b*) On the Axial Rotation of the Stars; (*c*) Some further Remarks on the Rotation of the Stars.—Prof. H. N. Russell and R. S. Dugan: Apsidal Motion in Y Cygni and other Stars.

MALACOLOGICAL SOCIETY (at Linnean Society), at 6.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—V. E. Pullin: X-Rays in Engineering Practice.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. J. Rees: Refractories for Boiler Furnaces.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—W. D. Oliphant: Laboratory Method as met with in Wireless Technique.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Literary and Philosophical Society, Manchester), at 7.—Short Papers.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Royal Institution, Liverpool), at 7.—A. W. C. Harrison: The Incorporation of Dry Pigments into the Medium.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with South Wales Section of Institute of Chemistry) (at Thomas' Café, Swansea), at 7.30.—Dr. P. M. Davison: The Structure of Molecules.

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Sir Henry George Lyons: Technical Museums and their Value to Engineers (Presidential Address).

INSTITUTE OF METALS (Sheffield Section) (in Non-Ferrous Section of Applied Science Department, University, Sheffield), at 7.30.—R. H. D. Barklie and A. E. Nicol: Studies in the Electrodeposition of Silver. Throwing Power. The Behaviour of Silver Anodes, with special reference to Blackening and its Prevention.

SATURDAY, DECEMBER 13.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir E. Denison Ross: Persia and the Persians (2): Art and Literature.

PUBLIC LECTURES.

SATURDAY, DECEMBER 6.

MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—Dr. Cyril Norwood: The Value of Exactness (Presidential Address).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Prehistoric Man in Minorca.

MONDAY, DECEMBER 8.

IMPERIAL COLLEGE, ROYAL SCHOOL OF MINES, at 5.30.—Dr. M. A. Hogan: Supports for Underground Workings in Coal Mines. (Succeeding Lectures on Dec. 9, 10, and 11.)

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Life of the Past (Swiney Lectures). (Succeeding Lectures on Dec. 10, 12, 15, 17, 19, Jan. 5, 7, 9, 12, 14, and 16.)

TUESDAY, DECEMBER 9.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: The Economic Geography of U.S.S.R.: Social and Economic Life.

WEDNESDAY, DECEMBER 10.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Sir Hubert Bond: The Prevention of Mental Illness.

ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street Extension of Regent Street Polytechnic, Little Titchfield Street), at 5.30.—Lord Raglan: Nilotic Tribes of the Anglo-Egyptian Sudan.

BELFAST MUSEUM AND ART GALLERY, at 8.—C. W. Harvey: Linen Damask: Historical Sketch.

THURSDAY, DECEMBER 11.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. Marie C. Stopes: Positive and Negative Control of Conception in its various Technical Aspects.

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at London School of Economics), at 6.—Dr. W. J. Pinard: Tests of Character.—C. B. Fox: Industrial Psychology applied to the Blind.

BIRKBECK COLLEGE (Celebration of Foundation), at 8.15.—Sir Josiah Stamp: The Responsibility of Knowledge (Foundation Oration).

FRIDAY, DECEMBER 12.

INSTITUTE OF INDUSTRIAL ADMINISTRATION (at Institute of Hygiene, 28 Portland Place), at 5.30.—A. S. Comyns Carr: Education for Management, to be followed by a discussion.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—H. Ll. Bassett: Nitrogen in Nature and Industry.

SATURDAY, DECEMBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Bird Life in and around London.

CONGRESSES AND EXHIBITION.

DECEMBER 5.

BRITISH INSTITUTE OF RADIOLOGY (at Central Hall, Westminster).

Friday, Dec. 5, 10.30 to 12.30.—Dr. H. A. Harris: The Growth of Bone as illustrated by Radiography.

Dr. D. Hunter: Changes in the Bones in Hyperparathyroidism and Hyperthyroidism.

At 4.30.—Dr. A. E. Barclay: The Danger of Specialisation (Silvanus Thompson Memorial Lecture).

DECEMBER 5.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).—The Utilisation of Trade Wastes.

Friday, Dec. 5, at 10.30 A.M.—Dr. D. J. Lloyd: The Problem of Tannery Waste.

O. Wans: The Use of Wood Waste for Heating and Generation of Power.

At 2.30.—E. B. Busenburg: The Utilisation of Waste Rubber.

Prof. J. W. Hinchley: The Recovery of Metal from Waste Materials.