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Medical Research in Great Britain.[1]

PRIOR to 1913, relatively little had been done to foster or subsidise medical research in the United Kingdom. It is true that in almost all the universities there were one or two exhibitions or scholarships, but on such a small pecuniary scale that they could only be regarded as temporary stepping-stones for a select few who had, or imagined they had, a *flair* for original investigation. For scholarships of greater value the pioneer was the Grocers' Company, which by its benefactions enabled many men to adopt research careers in which they afterwards attained great distinction. In the present century, three great benefactions, by private individuals, have been given to Great Britain. Lord Iveagh gave 250,000*l.* to be associated with the Lister Institute; Mr. Carnegie gave several millions to further university education in Scotland, and Sir Otto Beit gave more than a quarter of a million pounds to found a series of fellowships in medical research.

While the Governments of other countries supported research financially, that of Great Britain was excessively penurious, and it was not until 1913, when the demands for an increase of medical knowledge had become clamant, that in connexion with the National Insurance Act the Medical Research Committee came into being, under the chairmanship of the late Lord Moulton. Two bodies were founded, one properly called the Medical Research Committee consisting of ten members, of whom seven were professed scientific men; the other—the Advisory Council—consisting of forty-two representatives of the various universities and learned medical bodies of Great Britain. It was intended to act in a consultative capacity, but in practice rarely or never did so. The duties of the Medical Research Committee were to frame schemes of research and to see that they were carried out, and the Committee was entitled to disburse a matter of 50,000*l.* annually, which sum was calculated at the rate of one penny in respect of each insured person in Great Britain. The Committee met under the chairmanship of Lord Moulton, and very early a secretary was appointed in the person of Dr. (now Sir) Walter Fletcher, who had been previously known as a physiologist but especially as senior tutor of Trinity College, Cambridge, and as a man of affairs. The subsequent history and results of the Medical Research Committee must always be associated with him as the driving force behind the Committee.

From an early date Lord Moulton advocated that the income of the Committee should be spent in two

[1] Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1922-1923. Pp. 143. (London: H.M. Stationery Office, 1923.) 3*s.* 6*d.* net.

ways, one in a central research institute in London to which the highest ability for research should be attracted in four departments, namely, applied physiology, bacteriology, pharmacology, and statistics. The other part of the scheme provided for the payment, part or whole, of a number of workers in other institutes in London or in the provinces. With these ends in view, a number of research schemes were prepared dealing with subjects of public health interest which in the opinion of the Committee demanded rapid solution. These schemes were being converted into action when the great War broke out in 1914. The Medical Research Committee at once placed the whole of its resources at the service of the Army, and throughout the War devoted itself whole-heartedly for the good of the country. It started great schemes of research on various war problems and pressed into its service almost every available worker who could usefully be employed at home or abroad. It enabled many men to work undisturbed by annoying military regulations, and it is not too much to say that, mainly through the efforts of the Medical Research Committee, we emerged at the end of the War with a reputation for research in medical war problems as high as that of any other country. The nation owes, indeed, a great if inadequately recognised debt to the labours of the civilian workers under the Medical Research Committee.

With the end of the War, a return was made to a pre-War state. The central research institute, which had been purchased at Hampstead, was prepared for the reception of the different research departments. By this time the Committee had acquired an increased reputation and a vastly increased power of controlling medical research by virtue of its increased income. It passed away from its previous close association with the public health government departments, and rightly or wrongly established itself under the ægis of the Privy Council. It was renamed the Medical Research Council. Lord Moulton had been succeeded by the Hon. Waldorf Astor, and he in turn by Viscount Goschen. In 1919–20 a grant-in-aid of 125,000*l.* was voted by Parliament for the expenditure of the Council, and in 1920–21 this amounted to 130,000*l.* The Council also took under its wing the Industrial Fatigue Research Board with its income, and also the grants made to the Board of Control of England and Wales and the General Control Board of Scotland. Other financial arrangements have been made by the Council, so that within ten years it may be said that the Medical Research Council has become the leading power in medical research in the British Isles in much the same sense as the Rockefeller Institute dominates the United States.

While it is a truism that medical research requires money, it is equally true that money cannot buy the highest types of medical research. Research and original investigation of the highest kind are the work of the individual, and first-class researchers occur sporadically but a few times in a generation. The other workers are for the great part mediocre, and much that is called research consists in a confirmation of work done as well or even better by predecessors. An attempt is frequently made to overcome the absence of prime workers by harnessing ordinary workers in teams, although this is very rarely a complete success, for it is found by experience that some of a team do not know how to work and some will not. With its Teutonic outlook, Rockefellerisation may work in the United States, but it is antagonistic to British instinct with its peculiar individualism. The real scientific researcher is rarely a self-seeker. History shows, in fact, that he is a peculiarly unworldly type and cannot be successfully "run" by a millionaire. Naturally the generous millionaire or the parsimonious government like to see a return for their money, and this very tendency it is which leads to a depreciation of the quality of the work which cannot be compensated by excessive quantity. We have carefully studied the recent report for the year 1922–23 of the Medical Research Council, which, although it contains a record of progress, contains no record of a first-class medical discovery. The principal medical discovery of the year—insulin—was made in Toronto, and relatively little has been added to the knowledge given us by the Canadian workers. In general, progress is being made which is set out in great detail in the report, but it may justly be said that in some places the report is verbose and almost meretricious and a good deal of it is neither inspiring nor inspired.

Agricultural Research at Rothamsted.

(1) *Manuring of Grass Land for Hay.* By Dr. Winifred E. Brenchley. (Rothamsted Monographs on Agricultural Science.) Pp. viii + 146. (London: Longmans, Green and Co., Ltd., 1924.) 12*s.* 6*d.* net.

(2) *The Micro-Organisms of the Soil.* By Sir E. John Russell and Members of the Biological Staff of the Rothamsted Experimental Station. (Rothamsted Monographs on Agricultural Science.) Pp. vii + 188. (London: Longmans, Green and Co., Ltd., 1923.) 7*s.* 6*d.* net.

(3) *Farm Soil and its Improvement.* By Sir John Russell. Pp. 126 + 37 plates. (London: Ernest Benn, Ltd., 1923.) 7*s.* 6*d.* net.

ONE of the most gratifying features of the scientific development in England during the present century has been the revivification of the Rothamsted

Experimental Station. The institution that was created and eventually endowed by Lawes has every right to be regarded as the first organised experimental station for agriculture, for Boussingault's famous farm at Bechelbronne, where field trials were carried out for some years before work began at Rothamsted, was a personal appanage of the professor rather than a whole-time centre of investigation. During the middle years of the last century, much of the pioneer work of agricultural science, whether as regards the soil, the function of fertilisers, or the broad principles of animal nutrition, emanated from Rothamsted, and it became the avowed example for the numerous experiment stations which were successively set up by other countries. But the agricultural pilgrim who visited Rothamsted in the latter years of Lawes and Gilbert's reign left with some sense of disappointment. The classic plots were still there, maintained with the care and accuracy that had made the conclusions drawn from them of permanent value; the plots, too, were still fraught with lessons for the inquirer approaching them from a new point of view; but the station clearly lacked income to live alongside its rivals, the laboratory was out-of-date, and the outlook was rather towards the past than forward. However, by 1909, the British Government began to take a serious interest in agricultural research; Rothamsted was adopted into its scheme as the centre for plant and soil investigations, and it received successive grants-in-aid until its income is now more than 30,000*l.* a year. It has a farm of about 300 acres available for experiment, a range of entirely modern laboratories, and a staff of some thirty trained men and women, and it is again the best-equipped experimental station for its purposes in the world.

One of the duties of an experimental station is to make its results known, not merely to specialists but to that wider public which is directly concerned with agriculture, and particularly to the men who are engaged in teaching or advising the farmer. Rothamsted has always published through the recognised scientific channels — the Transactions and Proceedings of the Royal Society, the Journal of the Royal Agricultural Society, and latterly the *Journal of Agricultural Science*, contain the bulk of its papers; and this method certainly secures a wider dissemination of the work and greater certainty of reference than issue by means of an annual report. Some readier means of access is, however, needed by the teacher who wants to keep pace with research in his subject but is scarcely in a position to read all the original papers that appear. To that end Sir John Russell is preparing for publication a series of monographs on particular aspects of the work at Rothamsted, two of which are now before us—Dr. Brenchley's discussion of the long-continued experiments on the manuring of grass land for hay, and a volume dealing with the micro-organisms of the soil by Sir John Russell himself and some of his colleagues.

(1) *Place aux dames*—let us begin with Dr. Brenchley. The grass plots at Rothamsted, some twenty in number, were laid out in 1856 on a uniform piece of old park land, and the scheme of manuring then adopted for each has been continued unchanged down to the present day. The original herbage consisted of a varied mixture of species, some of which are encouraged and others repressed by the manurial treatment, either directly or by the operation of competition, with the result that the plots have taken on an extremely different aspect. The plots in June present the finest example that exists of applied ecology, of the creation of a vegetative association in response to certain well-defined factors. In some cases we can attempt an explanation, as of the abundance of leguminous plants on the plots receiving phosphoric acid and potash but no nitrogen, or the association of shallow rooting species with ammonium salts, while nitrate of soda, which is not retained by the surface soil, encourages deeper rooting species, but many problems remain for which no solution can be offered. Why should *Lathyrus sylvestris* sometimes overspread the nitrate of soda plot, or *Anthriscus sylvestris* and *Bromus mollis* assume such proportions on the plot receiving an extra quantity of the same fertiliser? There is an opportunity for more investigation which may furnish a clue to the baffling presences or absences of particular plants in Nature. It is not an easy problem, as experimenters have already found, for a very small depression in the "constitution" of a given plant may cause it to be crushed out in the competition provided by a mixed herbage.

Dr. Brenchley's book gives the facts, with a self-denying avoidance of hypothesis. One would, indeed, have been grateful for a little more guidance to general ideas, even if it were only by directing attention to particular associations common to a group of plots receiving analogous treatment. For example, the plots receiving ammonium salts and so developing an acid soil all generate a layer of peaty, partly decomposed vegetable matter on the surface, which disappears when lime is applied. Dr. Brenchley deals with the plots individually and then with the main species, explaining how each is encouraged or depressed by particular fertilisers. Thus her book will supply any one interested in the plots with the necessary material for more detailed study, and will also afford some guidance to the distant observer who is inquiring as to the reasons for the predominance of a particular species on the land under his care.

(2) The second monograph deals with the micro-organisms of the soil and begins with a stimulating

review by Sir John Russell of the soil population, the functions of the various groups, and the soil itself as a medium for life. Then follow chapters dealing with particular groups—the bacteria, protozoa, algæ, fungi, and the other invertebrate fauna. In these chapters the discussion is not confined to work done at Rothamsted, though that may bulk largely in the section. A general review is attempted so as to put the subject in its proper perspective, and to each section a fairly full bibliography is attempted. The book forms a valuable résumé of our knowledge in relation to this difficult but vividly interesting subject, all-important to agriculture not only because the capital value of our soils has been accumulated mainly by the bacteria they contained, but also because their fertility and capacity of utilising manures are also dependent upon its life, and the intensity and character of that life can be greatly affected by acts of cultivation. The book is by far the best general introduction to the biology of the soil that has yet appeared, and is indispensable both to the research worker in that particular field and to all serious students of agricultural science.

(3) The third book on our list belongs to a different category. It is a popular book intended for the young farmer who cannot obtain access to a regular course of instruction but is anxious to learn something of the scientific principles underlying the cultivation of soil and the growth of crops. It deals with soil, with systems of farming and cultivation viewed in relation to soil and climate, with soil fertility and the use of manures and of lime. The discussion is simple and non-technical, and is freely illustrated from the results of current experiments. Our only criticism would be that in his advice Sir John Russell is sometimes a little too oblivious of the economic factor. For example, Sir John shows us a photograph of a nice cabbage crop described as an "improvement on the old root-break." So Cobbett used to advise a hundred years ago, yet the crop has never established itself on any large scale. None the less, the book is an excellent example of popularisation, sound science conveyed in common-sense language for the lay reader: we need many such, could we get them, all written by men possessed of the lucidity and knowledge of the Director of Rothamsted.

Mathematical Biology.

Biomathematics: Being the Principles of Mathematics for Students of Biological Science. By Dr. W. M. Feldman. Pp. xix+398. (London: C. Griffin and Co., Ltd., 1923.) 21*s.* net.

"IN every particular Theory of Nature there can only be so much real Science as is vouched for by Mathematics." Since Kant wrote these words it has become increasingly true that mathematics is an indispensable weapon in the development of any science, and Dr. Feldman's treatise constitutes an attempt to supply a weapon, sufficiently powerful, to enable students of biological science to understand and to express biological laws in mathematical form. "It aims in the first instance, at affording the reader sufficient mathematical knowledge to follow intelligently the records of the more modern researches in the various fields of biological science. In addition, it is hoped that a mastery of the book will enable the laboratory investigator to make use of the principles of Mathematics for the purpose of co-ordinating his experimental results." In a brief but very interesting introduction, Sir William Bayliss insists that, when experimental results are expressed by a mathematical formula, empirical or otherwise, the experimenter should not be satisfied until he can attach some meaning to the constants involved. Until he does this, he cannot fully understand the processes which are going on.

So far as we know, this is the first work dealing with the application of mathematics to biology and the kindred sciences, and it is not surprising that the author has not been completely successful. In the mathematical treatment of biological, physiological, chemical, and physical problems he has been to a large extent successful, and many of his examples are very illuminating. The "Compound Interest Law" is exemplified in interesting problems of biology, physics, and chemistry, while the mathematical treatment of Guldberg and Waage's "Law of Mass Action" applied to various chemical problems is good. The chapter on the thermodynamic equations and their use in physiology is particularly well written.

The development of the mathematics is not so satisfactory; at some points, in an effort to make the operations more easily understood, the author has not really simplified matters. In a few of the mathematical developments the reader may feel that the author is not absolutely certain of the process; in the determination of the surface of a prolate spheroid there is a striking example of this. Commencing with a false formula, the author advances two steps and then puts down the correct result, without showing how he has obtained it. The expression for the surface should be $\int 2\pi y ds$ instead of $\int 2\pi y dx$. Less important slips occur in other cases, and these may be rather puzzling to the student.

The chapter on biometrics is a useful addition, and the subject, which is treated in an elementary way, will be easily understood by the non-statistical student. The simple processes of finding arithmetic means and probable errors are illustrated by a number of examples.

In statistics, frequencies are generally regarded as areas, but here they are first regarded as ordinates and then as areas. The method of least squares is described and correlation is treated very briefly.

For the research worker who wishes to fit curves to his experimental results, a chapter on the co-ordination of experimental results is given. The determination of the best curve, straight line, parabola, or logarithmic curve to fit the results is here explained.

A number of arithmetical errors occur in examples, some of these in the earlier part of the book being rather serious. Signs are not always correct, and there are one or two errors in trigonometrical formulæ. In the printing some of the indices of powers have been lost and some have become suffixes. In some paragraphs a quantity may be represented by a small letter at the beginning and then later by a capital letter. The cause of the majority of the errors, especially the printer's errors, is undoubtedly careless proof-reading. A careful mathematician would have noticed most of the errors in the proofs. J. H.

Engines and Mechanical Vehicles.

(1) *Diesel Engines.* By Lacey H. Morrison. Pp. xiii + 598. (London: McGraw-Hill Publishing Co., Ltd., 1923.) 25*s.*

(2) *Mechanics of the Gasoline Engine.* By H. A. Huebotter. Pp. ix + 313. (London: McGraw-Hill Publishing Co., Ltd., 1923.) 20*s.*

(3) *Mechanical Road Transport.* By Charles Guthrie Conradi. (Reconstructive Technical Series.) Pp. xviii + 394 + 63 plates. (London: Macdonald and Evans, 1923.) 21*s.* net.

(1) MR. MORRISON, in writing of Diesel engines, has chosen a subject of peculiar interest at this particular time. A considerable proportion of sea-going tonnage now under construction is being fitted with internal combustion engines of this type, and the proportion grows as quarter of the year succeeds quarter. It is true that Mr. Morrison writes from the American point of view, and that America itself is taking but a modest share in this development: hence the author has not so large a field to draw on as would be the case in most other mechanical enterprises. A number of American central power stations have, however, been equipped with Diesel engines, and the author estimates that, in all, some 500,000 h.p. has been installed since the engine was first introduced into America.

The book is in no sense a scientific one; in fact at a first glance it resembles an attempt at a synoptic treatment of American manufacturers' catalogues. Work outside America receives less careful attention, and the introduction of the two-stroke cycle is attributed to one "Dungan Clerk."

The most interesting part of the book is, as it happens, the portion which has nothing to do with Diesel engines, namely, the excellent section dealing with airless injection. Airless injection—sometimes known as "solid injection"—has remarkable advantages over the Diesel method and there is reason to expect it to grow rapidly in favour. One reason for this lies in the fact that the engine will then operate with a much less compression pressure. In the author's opinion this is due to the different conditions in which the oil vaporises and to the difference in the heat loss during compression. His discussion of this point and of the method of action of the plug piston is a valuable contribution to what has previously been written on these topics.

(2) Mr. Huebotter's book also bears evidence to the recent growth in numbers and in aggregate power of the internal combustion engine. The author is proud of this growth, and claims that in the United States the total horse-power in the internal combustion engine is five times as great as that in steam power.

The object of the book is to apply the orthodox methods of machine design to the particular case of the "gasoline engine." That purpose is achieved in a very complete fashion, though it is a pity that temperatures are always given in Fahrenheit units and piston displacements solely in cubic inches and never in metric units. The author states, for example, that an automobile engine should normally develop 0·011 b.h.p. per cubic inch of piston displacement per 100 r.p.m. at the peak of the torque curve: this is equivalent to 10 b.h.p. per litre at 1500 r.p.m., and it is a pity to begin with units so little helpful to the final form in which most readers will desire to have it. The author also quotes—on p. 10—a rating formula of unfamiliar type and attributes it to "the Royal Automobile Club (Great Britain)"; actually the R.A.C. rating formula, adopted later by the British Treasury for taxation purposes, is much more simple.

The book will be of value to engine designers; a fair mathematical knowledge is assumed, but the explanations are full and clear. Little reference is made, however, to the practical bearing of recent research work on the engine.

(3) Mr. Conradi's book is one of the most useful contributions which have been made to the study of mechanical road transport. It is exceedingly comprehensive; its twelve chapters cover each aspect of the question, and no less than 100 pages at the end of the book are given up to reprinting as appendices the various Acts of Parliament, Statutory Rules and Orders, and even a list of all Government publications relating thereto.

Steam, electric, and petrol vehicles: all alike are studied and their chief types described, whether suited to run on rails or ordinary road surfaces. The author states that in England and Wales there are no less than 152,000 miles of ordinary main roads, of which between 11 and 12 per cent. are described as first class and 7 per cent. as second class, the rest apparently being beyond description; and judging from a comparison of road surfaces now and two years ago, the proportion in the third grade unfortunately shows every sign of growth. The author remarks that at the present time this country is "spending 50,000,000*l.* per annum on the roads, and getting apparently very little in return . . . the correct policy is to proceed as quickly as possible with the reconstruction of the roads and not to continue merely to repair them." We agree with the author's opinion, but we wonder whether in the meantime a close restriction of the type of transport permitted to use the roads may not be necessary in order to enable the renovation, or reconstruction, of the roads to compete with the rate at which deterioration is now proceeding.

Mr. Conradi's book will prove equally useful to road constructors and road users.

Popular Meteorology.

Weather Proverbs and Paradoxes. By Dr. W. J. Humphreys. Pp. viii + 125 + 16 plates. (Baltimore, Md.: Williams and Wilkins Co., 1923.) 1.50 dollars.

Making the Weather. By Prof. Alexander McAdie. Pp. 88. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1923.) 5*s.* net.

Meteorology. The Science of the Atmosphere. By Charles Fitzhugh Talman. (Popular Science Library, vol. 1.) Pp. 384. (New York: P. F. Collier and Son.)

MANY people have remarked on the limited extent to which the universal interest in weather finds expression in Great Britain in books or even in lectures which have that common human appeal connoted by the adjective popular—books or lectures which a person of ordinary education can read or listen to without effort and yet not without information. Only a few weeks ago it was remarked that in spite of the prodigious wealth of possible illustration of many kinds, more than a generation had passed since the weather had furnished the subject of the Christmas holiday lectures at the Royal Institution, when the late Sir James Dewar chose clouds as his topic. Doubtless something has to be allowed for the fact that, when the elders of the passing generation were young, forecasting by weather maps created such a sensation that both writers and readers have come to acquiesce in the nauseating situation that the study of weather is forecasting; and nothing else about weather can possibly be offered to a popular audience or the general reader.

The three books which form the subject of this review show that in America, where in spite of their modernity they have professors of meteorology, trees 3000 years old, and other aids to imagination, they have emancipated themselves from the thraldom of the forecasting idea and can find a fascination in many other aspects of the study of weather. The present reviewer has seen a number of people take up Prof. McAdie's little book and has not yet seen one of them lay it down until it was read through—not a great effort indeed, for there is not more than an hour's reading in it, but something that implies a marked difference from the type with which we are familiar in Great Britain.

Not that foretelling weather is ignored or neglected. The whole of the first part of Prof. Humphreys' book is devoted to providing physical explanations of weather proverbs which are mostly prognostic. The second part, however, deals with such paradoxes as "air pushed north goes east," "to cool air heat it," and so on. There is an abundance of paradoxical ideas to write about. In spite of the aggressive title of his book, Prof. McAdie, in his chapters on "Visibility *v.* Victory," dealing with the battle of Jutland, and "Fate and a Forecast," about the loss of the *Hampshire* with Lord Kitchener aboard, is not oblivious of forecasting; but he looks at it as an influence on life and death and not as an art to be explained and conveyed in a few pages.

Mr. Talman's book approaches more nearly to the conventional treatise, but it makes no attempt to enrol the reader among the professional staff of the U.S. Weather Bureau or to pelt him with formulæ. On the other hand, it brings out of the treasures of information of the Bureau library, of which Mr. Talman has been for many years the custodian, facts new and old that the man in the street would not think of looking for, and could not find for himself if he did. It is a series of very readable essays on all sides of meteorological work, the examination of the atmosphere from bottom to top: clouds, winds, storms, electricity, optics, acoustics, and the application of organised meteorology to agriculture, commerce, navigation of the sea and air, military meteorology with a somewhat sarcastic keynote, medical and physiological meteorology, finishing up with chapters on weather making and atmospheric byways. The illustrations are not all so good as the text; but with a meteorological work illustrations are always a difficulty.

All three are excellent gift books that one could take up at any time with the feeling of being in good company and neither in school nor purgatory.

Our Bookshelf.

Hydraulics: a Text-Book covering the Syllabuses of the B.Sc. (Eng.), A.M.Inst.C.E., and A.M.I.Mech.E. Examinations in this Subject. (Engineering Degree Series.) By E. H. Lewitt. Pp. viii+261. (London: Sir Isaac Pitman and Sons, Ltd., 1923.) 8*s.* 6*d.* net.

THIS can scarcely be considered as a serious contribution to the subject of hydraulics. It is rather a digest prepared for students who have not much time or else have not the desire to peruse a subject of study seriously but rather under compulsion of some examination. No doubt such works are of assistance in somewhat the same way that a slide rule is of help in arithmetical calculations, but it is doubtful wisdom to substitute the slide rule for that mental training which arises from a study of arithmetical processes.

So much first-class work on the flow of fluids through pipes has been done during the last fifteen years, and laws of dynamical similarity have been so well confirmed by experiment, that it is surprising to find the flow of fluids in pipes dealt with in a manner that, so far as it goes, is clear, but from the educational point of view—particularly that of a university student upon whom future developments will largely depend—is treated in a manner that explains how certain formulæ can be used to calculate certain quantities but entirely avoids any sound discussion of the fundamental principles underlying fluid flow. The author states that for water flowing in horizontal pipes Reynolds "found that for velocities below two feet per second the loss of head is proportional to the velocity, whilst above two feet per second it is proportional to the velocity squared." Students will be led entirely astray by this statement.

No mention is made of the diameter of the pipe to which the velocities given by Reynolds refer, and it would appear that the author is unaware of the variation of the critical velocity with temperature and diameter of pipe. It is rather doubtful if the author has referred to the original papers quoted in connexion with critical velocity. The treatment of turbines and centrifugal pumps is distinctly scanty.

The book is what might have been expected from a good student making a précis for examination purposes from existing works, and will accordingly be valuable to those students who are fond of taking their studies in tabloid form.

Guide to the Plymouth Aquarium. By E. W. Sexton. Pp. 165. (Plymouth: Marine Biological Association, 1924.) 1*s.*

THE Marine Biological Association has done a great service both to itself and to the public by the issue of this attractive guide-book to its aquarium. The main body of the book is devoted to a brief survey, in scientific sequence, of all the marine groups of animals. The important structural features of each group are succinctly stated in non-technical language and the more interesting points in their bionomics are briefly described. The common name, where one is available, is invariably given as well as the scientific name. In the first portion of the guide the contents of each of the exhibition tanks and cases in the aquarium are listed, some salient feature, such as colour, given, whereby they can be readily identified and a reference made to the fuller account in the other part of the book. Mrs. Sexton is to be congratulated on the successful accomplishment of her share of the work.

Of the illustrations it may be said at once that they are admirable habitus figures of the animals they depict. We do not know of a better drawing of a living Aplysia than the one given here. Miss Brightwell has an excellent eye for the *tout ensemble* of a species, and, in spite of the want of colour, naturalists familiar with the shore fauna will recognise in her drawings the peculiar traits of form and structure, often insignificant in themselves, by means of which the animals are readily recognised in the field. On the other hand, the artist is not so happy in her backgrounds and foregrounds. The black background of several of the drawings is not pleasing, and the sea-bottom over which several of the animals (cf. Aplysia) are shown to be crawling is not natural, and detracts considerably from the real merit of the drawing of the animal itself. The guide is excellently produced and profusely illustrated.

La Physique depuis vingt ans. Par Prof. P. Langevin. (Encyclopédie scientifique.) Pp. 455. (Paris: Gaston Doin, 1923.) 15 francs.

IN the nine chapters of this volume, Prof. Langevin has collected a number of addresses and reports bearing dates from 1903 to 1920. In the first three he discusses the development of the electron theory and its applications. Then follows a chapter, dated 1913, on the quantum theory. The latter half of the volume is concerned with the nature of the concepts of space and time and the theory of relativity. It would seem that the reports are printed in the form in which they were first presented with no attempt to revise them in the light of more recent knowledge. Thus the author provides an interesting historical picture of the development of physical ideas in the first twenty years of the present century. But the picture is in many respects incomplete, and the reader would have welcomed an additional chapter pointing out what modifications are necessary in the earlier addresses to bring them into line with the results of modern work. For example, the ether, the existence of which is so confidently assumed in the first chapter, would require an entirely fresh description to bring it into accord with the Einstein theory of relativity, even if the conception is not to be abandoned entirely.

Elements of the Theory of Infinite Processes. By Prof. Lloyd L. Smail. Pp. vii+339. (New York and London: McGraw-Hill Book Co., Inc., 1923.) 17*s.* 6*d.*

PROF. SMAIL'S book forms a very satisfactory introduction to the theory of infinite series and products, and includes a discussion of the simpler transcendental functions. It also contains chapters on infinite determinants and infinite continued fractions, subjects on which there is only a scanty literature in English. No systematic introduction to the theory of irrational numbers is given, however; without this the arithmetical concept of a limit cannot be put on to a logical basis. The aim of the book is to present the funda-

mental ideas at the basis of modern mathematical analysis. No attempt is made to go deeply into any particular aspect of the various subjects. Prof. Smail's book will be welcomed by University students reading for an honours course in mathematics, the only other systematic English treatise, Dr. Bromwich's "Infinite Series," being now out of print. It is unfortunate that the book has been issued at so high a price.

W. E. H. B.

Quantitative Chemical Analysis: Adapted for Use in the Laboratories of Colleges, of Technical Institutes, and of Analysts. By Dr. F. Clowes and J. B. Coleman. Twelfth edition. Pp. xxiv+576. (London: J. and A. Churchill, 1924.) 18*s.* net.

"CLOWES AND COLEMAN" is so well known that it is only necessary to state that the new edition will be found as useful as those of the past. There are a few points which might be suggested in the way of improvement. The method of weighing by vibrations is so superior to the zero method that it is now generally used, but the statement that "consecutive swings to the right and to the left must finally be equal in extent" (p. 9) is not satisfactory. The correct method should be explained. The methods used in the calibration of volumetric apparatus are also approximate only, but are suitable for elementary students. The analysis of industrial products is a special and valuable feature, but some of the newer methods (*e.g.* the reduction of nitrates by Devarda's alloy) are not given. The range of exercises is extensive, and the book may be recommended to students and analysts as an excellent introductory treatise and work of reference.

The Boys' Own Book of Science. By F. L. Darrow. Pp. x+331. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1923.) 10*s.* 6*d.* net.

AT a time when popular books on science over-emphasise the hypothetical and speculative, it is pleasing to find one in which chemistry is treated as an experimental science. The experiments are chosen for performance in the private laboratory, yet they are all instructive, deal with real problems, and in some cases, *e.g.* those with the electric furnace, call for considerable skill. The details are carefully given, and the reviewer, with memories of early failures, finds the pitfalls clearly marked. The dangerous character of a mixture of potassium permanganate and sulphuric acid should, however, have been mentioned on p. 21. The brief historical notices of famous chemists are sure to prove inspiring, and the book as a whole is written in an easy yet dignified style, which is most attractive. It should be a popular gift. The illustrations are excellent, and the only slip noticed was in the description of the experiment on the density of air on p. 60. In all cases the scientific value of the work is clearly in evidence.

L'Audition et ses variations. Par Dr. Marage. Pp. 262. (Paris: Chez l'auteur, 19 rue Cambon, 1923.) n.p.

THE work under notice is written mainly from the point of view of the physiologist or medical specialist. It covers a very wide field, and in consequence some portions receive only a slight treatment. The subject-matter of the book falls into twelve chapters, their topics being as follows: auditive acuteness; normal ears; auditive re-education, acoustical and clinical; deafness of various kinds; deaf mutes; auditive acuteness after cerebro-spinal meningitis; deafness through the War (this chapter is specially full with some guidance as to treatment recommended); buzzings in the ear; hearing horns; protection from loud sounds; telephonic audition; location of submarines and the threshold of audition. The thirteenth chapter is a bibliography of the author's works (more than eighty in number) from 1887 to 1923. The work has a number of tables, illustrations of apparatus, and graphs of vibrations.

E. H. B.

Diagnostic Methods: a Guide for History taking, Making of routine Physical Examinations and the usual Laboratory Tests necessary for Students in Clinical Pathology, Hospital Internes, and Practicing Physicians. By Prof. Herbert Thomas Brooks. Fourth edition. Pp. 109. (London: Henry Kimpton, 1923.) 8*s.* 6*d.* net.

THIS little book is limited mainly to laboratory methods, the descriptions of which are brief but clear. For the simpler pathological investigations most of the recommendations given are good; the Tallquist hæmoglobinometer, which is suggested "for rapid bedside work," is so inaccurate as to be quite useless. The more complicated tests, such as the Wassermann, Lange's colloidal gold, and the complement fixation for gonorrhœa, are best left entirely to the pathologist, since their use in unskilled hands is likely to be misleading to a dangerous degree. The book is too brief to be of value to students and too simple for the pathologist, but the practitioner will find in it real assistance in carrying out and interpreting the simpler pathological tests.

Éléments de la théorie électromagnétique de la lumière. Par Prof. Ludwik Silberstein. Traduit de l'anglais par Georges Matisse. Pp. vi+95. (Paris: Gauthier-Villars et Cie, 1923.) 6 francs.

THIS is a translation of the excellent booklet on the electromagnetic theory of light published by Dr. Silberstein in English a few years back and then noticed in NATURE (November 21, 1918, p. 225). It is derived ultimately from the author's Polish treatise on electricity and magnetism. The translator has added notes in explanation of some of the mathematical arguments and of the vectorial notation adopted by the author. Some appendices are omitted, but a special note has been added by the author on Poynting's vector.

S. B.

Populär-wissenschaftliche Vorlesungen. Von Prof. Dr. E. Mach. Fünfte vermehrte und durchgesehene Auflage. Pp. xii+628+7 Tafeln. (Leipzig: J. A. Barth, 1923.) Grundzahl: 10 marks.

THIS well-known classic appears, practically unaltered, in a fifth edition. We can only hope that the appearance of new editions indicates that the book is still alive, and is as popular and influential with the new generation as it was with the old.

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 Isotope Effect as a Means of identifying the Emitters of Band Spectra: Application to the Bands of the Metal Hydrides.

CERTAIN systems of bands obtained in zinc, cadmium, and mercury vapours are considered by Kratzer,[1] on account of the large spacing of the structure lines and the corresponding small moments of inertia, to be very probably due to hydrides of the respective elements. The same conclusion has been indicated in the case of copper by Frerichs,[2] who has recently measured the lines of several copper bands of this type under high dispersion.

A consideration of the magnitude of the isotope effects predicted by the quantum theory of band spectra for hydrides, as compared with oxides or other compounds, permits a definite decision in favour of the hydride origin of the above bands. The trustworthiness of the theory for the electronic bands has been tested by the writer on the BO and the SiN bands (see recent letter to NATURE). In the case of the BO bands, it was in fact the magnitude of the observed isotope effect which first definitely indicated that they were not due to BN, as formerly supposed.

Some numerical data will best illustrate the point here. A mixture of two isotopic molecules $A'B$ and $A''B$ should give a spectrum consisting of a set of bands of identical structure and arrangement for each. The *spacing of bands in a band system*, however, should be less for the heavier isotope in approximately the ratio (ρ) of the respective molecular vibration frequencies. Also, the *spacing of the lines in a given band* should be less in approximately the ratio ρ^2 for the heavier isotope. The quantities $100(1-\rho)$ and $100(1-\rho^2)$ are useful as determining the percentage differences in spacing. An approximate formula is: $(1-\rho^2) = 2(1-\rho) = m(M'-M'')/M(M+m)$, where M is the mean atomic weight of the isotopic element A, M′ and M″ are the individual atomic weights of the isotopes A' and A'', and m is the atomic weight of the other element B. Aston has shown that Cu consists of isotopes 63 and 65 in the ratio 2·5 : 1. For $Cu^{65}H$ *vs* $Cu^{63}H$, $(1-\rho) = 0{\cdot}024$ per cent.; for $Cu^{65}O$ *vs* $Cu^{63}O$, 0·31 per cent.; for $Cu^{65}I$ *vs* $Cu^{63}I$, 1·03 per cent. For $(Cu^{65})_2$ *vs* $Cu^{63}Cu^{65}$ or $Cu^{63}Cu^{65}$ *vs* $(Cu^{63})_2$, $(1-\rho) = 0{\cdot}79$ per cent.; for $(Cu^{65})_2$ *vs* $(Cu^{63})_2$, 1.59 per cent. It will be noted that for a heavy isotopic element (M large), $(1-\rho)$ is nearly proportional to the atomic weight m of the other element in the compound.

Let us apply these considerations to the Cu bands. Each band has two branches, the head occurring on the positive (R) branch. Frerichs noted an apparent doublet structure in the negative (P) branch of three of the bands, and was able to measure the separation of the components for some of the lines. Frerichs states that although a considerable isotope effect might be expected in the band spectrum of a Cu compound, the Cu bands show a structure analogous to that of the CN bands, for the emitter of which no isotopes come into consideration. As a matter of fact, however, the separation of the apparent doublets appears to agree within experimental error with the isotope effect predicted by the theory[3] for CuH. This is shown in the following table. Furthermore, the observed *absence* of doublets on the R branch at the same values of the rotational quantum number where they are *present* on the P branch is contrary to what is found in true doublet series of the CN type. It is, however, to be expected if the doublets are due to the isotope effect. In the table m denotes the series number of the doubled line, (ν_0-ν) its distance (in wave-number units) from the null-line (ν_0) of the band to which it belongs, and $\Delta\nu$ the doublet separation. The isotope effect is purely rotational for the λ4280 band, where n' and n, the initial and final vibrational quantum numbers, are both zero, and $\Delta\nu_{calc.} = (1-\rho^2)(\nu_0-\nu)$. For the λ4328 band ($n'$ and $n=1$), the isotope effect includes a small vibrational contribution[4] (0·06 units).

λ4280 Band.				λ4328 Band.			
m.	$\nu_0-\nu$.	$\Delta\nu_{calc.}$	$\Delta\nu_{obs.}$	m.	$\nu_0-\nu$.	$\Delta\nu_{calc.}$	$\Delta\nu_{obs.}$
..				..			
R +25	313	0·15	..				
R +26	352	0·17	..	+27	383	0·25	..
..				..			
..				..			
P −22	804	0·39	0·31	−17	539	0·32	0·23
P −23	861	0·42	0·29	−18	588	0·34	0·25
P −24	920	0·45	0·45	−19	639	0·37	0·26
P −25	981	0·47	0·44	−20	691	0·40	0·22
P −26	1043	0·51	0·68	−21	746	0·42	0·45
P −27	1107	0·53	0·56	..			
P −28	1172	0·57	0·60	..			
..				..			

Some of the Zn, Cd, and Hg bands[5] have been measured with nearly as great accuracy as the Cu bands, but the data contain no evidence of isotope effects. This can be accounted for only if the bands are of hydride origin, since the predicted effects are of the same order of magnitude as for the Cu bands. Some values of $(1-\rho)$ are: 0·024 per cent. for CuH; 0·046 per cent. for $Zn^{68}H$ *vs* $Zn^{64}H$; 0·024 per cent. for CdH, assuming $M'-M''=6$; and 0·007 per cent. for HgH, assuming $M'-M''=6$; for HgO, 0·11 per cent.[6] The isotope effect should be 10 or 15 times as great for an oxide or a nitride as for a hydride, and could not have escaped detection.[7]

The definite establishment of CuH as the emitter of the Cu bands of large spacing makes it extremely probable that the similar bands of Ag, Au, and Al are also due to hydrides.[8] Mg and Ca hydrides are well known as emitters of band spectra. Other metals also give bands of large spacing which are likewise probably due to hydrides. Thus metal hydrides appear to constitute an important group of emitters of band spectra.[9] It seems probable that most of the bands of *small* line spacing given by metals are oxide (perhaps sometimes nitride) bands.

[1] *Ann. der Physik*, 71, 102 (1923).

[2] *Zeit. für Physik*, 20, 170 (1923). Similar but less accurate and complete data have been obtained by Bengtsson, *Zeit. für Physik*, 20, 229 (1923).

[3] Frerichs gives no data on relative intensities of the doublet components, so that this point cannot be checked here.

[4] Of the other bands measured by Frerichs, three should show larger isotope effects than λλ4280 and 4328. Of these λ4380 was so weak that it could be measured only with a wide slit, while in the case of λλ4650 and 4690 the "lines appear broadened and unsharp due to the continuous background, making measurement difficult"; however, an apparent doubling of the lines from $m=-12$ on was noted (but not measured) in the case of λ4650.

[5] Hg, Liese, *Zeit. wiss. Phot.* 11, 349 (1913). Zn, Hulthén, *Compt. rend.* 173, 524 (1921). Cd, Hulthén and Bengtsson, *Compt. rend.*, 175, 123 (1922). The results are given to tenths of a wave-number unit.

[6] Zn has isotopes 64, 66, 68, 70, according to Dempster; Hg, (197-200), 202, 204, according to Aston; Cd undoubtedly has several isotopes, although they have not yet been determined experimentally.

[7] A possible doubt in the case of Hg is pretty well allayed by the similarity of the bands to those of Zu and Cd.

[8] For references, see Kayser's "Handbuch der Spektroskopie."

[9] Probably both diatomic and triatomic hydrides occur as emitters. The HCu bands have a simple structure very similar to that of the HCl absorption bands. The MgH_2 bands (cf. Sommerfeld, "Atombau," 3rd edit. p. 544) are more complex, and are closely analogous to the OH_2 bands.

In connexion with the Cu, Zn, Cd, and Hg bands, it should be mentioned that it has been assumed above that the *electronic* isotope effect is exceedingly small, as in line spectra; the assumption is evidently justified by the facts.

ROBERT S. MULLIKEN,
National Research Fellow.
Jefferson Physical Laboratory,
Harvard University,
Cambridge, Mass.

The Properties of Dielectrics.

As more general interest is now being taken in dielectric actions, it may be useful to give some conclusions derived from a long study of them.

Dielectrics are said to have capacity and resistance, or its reciprocal, conductance. In the highest class of dielectrics, if leakage is prevented, the resistance is so high that the loss of energy is negligible, and the capacity is practically constant, whether measured by single charges or discharges, or in an alternating field. When, however, the resistance is lower the capacity

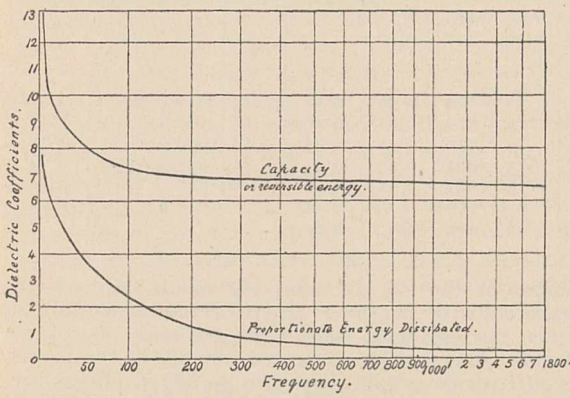


FIG. 1.—Values of capacity and the corresponding losses at frequencies from 4 to 1800 in celluloid at 16° C.

and conductance are larger, and also the loss in alternating fields, the longer the time of charge.

Now capacity is energy reversibly stored at unit potential difference, and both resistance and the so-called "dielectric hysteresis" are energy dissipated or lost. Much simplification results from thinking of dielectric actions in these two terms.

After examining the actions in a number of diverse dielectrics both in steady and alternating fields, the latter at frequencies of from 1 per second upwards, the actions in clear thin sheets of celluloid were selected as typical, and investigations were planned to exhibit their characteristics.

In the first place, the energy circulating in the circuit was measured, at a steady potential and at a similar (R.M.S.) alternating P.D. over a range of frequencies of from 1 to 2000. A voltmeter reading multiplied by an ammeter reading gives this. The energy dissipated was also measured in both fields and at the different frequencies by a sensitive electrostatic wattmeter.

If, then, I = current and E = potential difference,

$$IE^2 - D^2 = R^2.$$

Where D = energy dissipated and R = reversible energy, R is therefore proportionate to the pure charge and discharge at each frequency. Knowing the dimensions of the dielectric, the pure specific inductive capacity or dielectric coefficient was calculated for each frequency, and is plotted with the corresponding dissipated energy in the logarithmic diagram Fig. 1.

The dielectric coefficients fall from more than 12 at 4 ~ to about 8 at 50 ~ and to about 7 at 200 ~. At 1000 ~ the dielectric coefficient is 6·66 and at 2000 ~ is 6·56. Thus above 1000 ~ the capacity is nearly constant. According to ordinary acceptance a figure a little below 6·56 would be taken as the dielectric constant of celluloid. Large numbers of the dielectric coefficients quoted in works of reference have been so found, and without first deducting the energy dissipated, as is done above. The curve of energy dissipated is of the same general form as that giving the capacities, predicating an intimate relation, though the proportion of energy dissipated grows larger as the frequency is lower.

Now when chosen for these experiments it had already been found that such celluloid held about 2 per cent. of moisture, most of which could be driven off by careful drying at 100° C., and that when exposed to the atmosphere this quantity of moisture would be reabsorbed in about twenty-four hours.

In the second set of experiments the aim was to extract the moisture to the fullest extent, by heat and vacuum drying, and then to make measurements in the drying vessel without exposing the dielectric to the atmosphere even for a moment.

Now the ordinary resistance of the celluloid is about 2×10^{10} ohms per cm. cube at room temperature, and it can be electrified by friction, though the charge soon disappears. By drying, this resistance was increased about 100 times, while the alternating loss at 8 ~ was reduced more than 25 times. Simultaneously the dielectric coefficient corresponding to the capacity, which with the celluloid undried was 10 at 8 ~, and fell at 200 ~ to 6·8, now only varied 2 per cent. between these two frequencies. When a small allowance was made for the trace of moisture evidently still remaining, the dielectric coefficient was found to be about 4·8, and to be practically constant at all frequencies. (See Fig. 1.) In fact it appeared that the true dielectric constant had been found, characteristic of the chemical composition of the substance itself.

Thus by intensive drying all the actions which have been so puzzling in dielectrics were comparatively speaking wiped out, leaving only the fundamental capacity action outstanding, and this remaining capacity was found to change little with change of temperature like the refractive index, though the eliminated actions all had large temperature coefficients. This latter point seems to coincide with the fact that the vapour pressure of water has a high temperature coefficient.

A third set of experiments were now planned in which an endeavour was made to find the percentages of moisture present corresponding to the effects found.

It is impossible to weigh dried celluloid in the open air as it reabsorbs moisture too quickly. A glass chamber was therefore constructed with a tight-fitting door at one end, and arrangements for arm-holes at the side, to which oil-silk sleeves were attached. Using rubber gloves, and the sleeves being held tightly round the wrists by rubber bands, it was possible to manipulate inside. The chamber was large enough to take a chemical balance and other things needed, and was connected with the outside by highly insulating leads. It was kept dry by large trays of calcium chloride. It had also a narrow slit through which dielectrics could be introduced, without disturbing the air inside.

A sheet of celluloid, aged by previous drying and exposure, was now well dried again at 100° C. in a current of dried air. It was then transferred to the dry chamber between a pair of hot glass sheets, and weighed. It was next put in a container with mercury electrodes (all my work has been done with such electrodes), and the capacity, the alternating

loss at 8 ~, and the loss in a steady field (the reciprocal of the ordinary resistance) were measured at the same potential differences, steady, and R.M.S. alternating. The dielectric was now taken out, wiped free of mercury, and an extra centigram having been put in the weight pan, was put in the balance while a little outside air was admitted. The extra centigram weight of moisture was soon reabsorbed. The dielectric was then put back in the container, and a fresh set of measurements were made. The procedure was repeated until the dielectric had reabsorbed nearly its usual quota of moisture.

The results are plotted in Fig. 2. The ordinates represent energy, taking 10^{-15} of a watt as unity to avoid decimals. The upper abscissæ show the weight of the dielectric at each weighing, and the lower the amount of moisture reabsorbed at each experiment.

Remembering that in the second set of experiments, where the drying was carried further, a final and invariable dielectric constant of 4·8 was found, a line to represent this value is ruled in the diagram. I have ventured to call this the "Maxwell Constant" for a substance. Ordinates for the equivalent dielectric coefficients are placed on the right of Fig. 2.

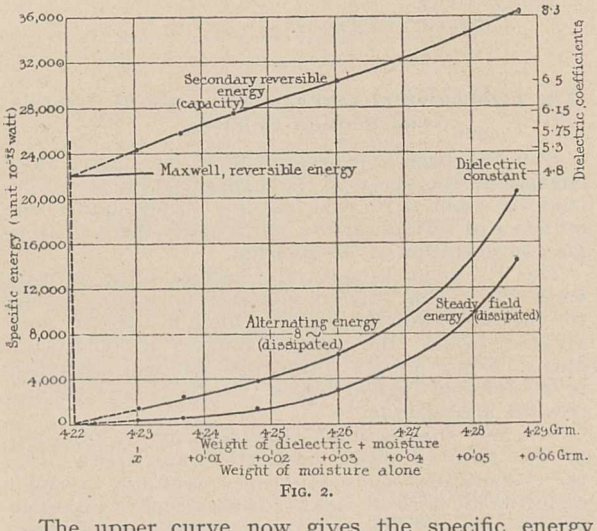


FIG. 2.

The upper curve now gives the specific energy reversibly stored, and the equivalent pure dielectric coefficient for each amount of moisture in the dielectric. It is nearly a rising straight line, though turning up slightly for the higher proportions of moisture. This line produced backwards cuts the "Maxwell line." From this point drop a perpendicular to cut the abscissæ. The second curve shows the specific energy dissipated in the same alternating field at 8 ~ for each amount of moisture present. The third curve gives the energy dissipated in a steady field (the reciprocal of the ordinary specific resistance). If now these two curves are also prolonged backwards like the capacity curve, they cut the abscissæ substantially at the same point as the perpendicular.

Now there was a certain amount of moisture still left in the dielectric. It seems a fair inference that any action due to it would be proportionately the same. Consequently the amount of water still present was about 1 centigram, or about 1/420 of the weight of the dielectric. The presumption then is that if all this remaining moisture could have been extracted, no alternating loss or dielectric hysteresis would have remained; that the ordinary resistance would have been substantially infinite; finally, that the capacity would be the same at all ordinary frequencies and characteristic of the substance.

If the so-called "dielectric hysteresis" had been due to any action on the molecules of the dielectric, it seemed certain this would be independent of small traces of moisture, and the curve of alternating losses would have become flatter and would have cut the ordinates above the origin. No trace of such an effect of recognisable magnitude could, however, be found.

Actions of the above kind cannot be explained on the basis that water in dielectrics has a dielectric coefficient of about 80. Such moisture must usually exist in an ionised state; in fact, we are apparently dealing with solid solutions of electrolytic type. An important new element, however, seems to enter in, that apparently the surface tension of the dielectrics usually opposes a strong barrier to ions leaving the dielectric, and thus in a steady field they tend to accumulate near the surfaces. This slows down the action owing to their mutual repulsion. This is apparently the cause of the slowing down of the action with time, which has been so much studied formerly without much further light having been thrown on it. It should be mentioned that the above experiments were not carried out until there were strong reasons for the view that the actions in all dielectrics were of the same nature though differing widely in range. (See a paper by the writer in Journal of the Physical Society, 1916.)

These experiments and the above views were put forward in a series of three oral lectures at the Institution of Electrical Engineers in 1919, and an epitome of the conclusions arrived at will be found in the Journal of the Institution for February 1919 under the head Institution Notes. Otherwise the work has not yet been published, as the writer is engaged in putting it into book form and carrying it further.

It may be interesting to state that with about 1/500th part of moisture present in the dielectric, such a large deflexion on the sensitive electrostatic wattmeter can be obtained that a change of 1/200th part in this moisture would be seen readily. Consequently an amount of moisture present so low as 1/100,000th part in a dielectric would produce a measurable effect. Ions must therefore have very active electrical charges.

There is another aspect of the subject which has been much neglected hitherto. Boltzmann fifty years ago showed that there is a complementary effect to capacity, namely, actual attraction. When we speak of capacities, it would be much clearer for many purposes to talk in terms of attractions. For both kinds of capacity referred to above, there are corresponding attractions between the field and the molecules of the dielectric on one hand, and the ions of moisture on the other. In such attractions we are approaching the boundaries of chemical combination.

In the past, effort has been naturally directed to the study of the higher class of dielectrics, but the effects of electric fields on matter, from those discussed above downwards, until we come to ordinary electrolytes, seem to be all of much the same character, except that the relative proportions of the various actions vary widely.[1] The substances which come within this category, and in which the actions are of electrolytic type, include more than nine-tenths of those we come in contact with in Nature, including vegetable and animal life. Of the effects of electric fields on all these almost infinite varieties of matter scarcely any data are known at present except some general ideas of their electric resistance, the most complicated and unilluminating of the factors involved.

G. L. ADDENBROOKE.

35 Holland Villas Road, Kensington, W.,
March 10.

[1] See Proc. Roy. Soc., Varley, 1871, Hopkinson, 1893.

The "Bleeding" of Cut Trees in Spring.

ON Saturday, March 15, at noon, several twigs were torn off a sycamore but no "bleeding" took place at the time or so far as I know on Sunday, but on Monday morning at 8.30 (say 44 hours after the injury) what were at first taken to be raindrops were visible on each of the 8 or 10 wounded surfaces. As there had been no rain and the liquid was slightly sweet, it was evidently sap, but the strange part is that it happened so long after the injury and that it was not repeated to-day (Tuesday), 72 hours afterwards.

The only explanation appears to be the fact that on Monday up to the time of the "bleeding" taking place the sky was overcast, but when it was going on the sun was shining brightly on the wounded surfaces.

Did the sunshine stimulate the flow of sap and so start the "bleeding"? As a matter of fact it was shining when the twigs were broken off, but no "bleeding" then took place.

A drop fell from each injured surface, say, once in each 3 or 5 minutes (not timed), and the total amount of sap estimated by the marks of the residue left after evaporation on a glass roof beneath the tree was, say, 1 or 2 fluid ounces from the 8 or 10 exposed surfaces. C. W. FOLKARD.

30 Eyot Gardens, London, W.6,
March 18.

MR. C. W. FOLKARD raises a topic of general interest, which is perhaps worth brief discussion, as though the phenomena are well known they raise many problems which are still very obscure. He asks whether the sunlight upon the twigs stimulates the flow of sap; probably all that can safely be said in reply is that the sap flow is chiefly due to root activity and that the sunlight may well be effective by raising the temperature of the soil.

There are many points that are puzzling in connexion with the flow of sap; besides sycamore the birch shows the same phenomenon, but Dr. J. Parkin, with whom the writer is in correspondence on the subject, states that he has not noticed its occurrence in other common English trees. The vine of course is a noted example of a greenhouse plant showing the phenomenon; during last year many gallons of sap were collected from vines in Leeds, in order to enable a complete examination to be made of the substances present in solution in the sap.

It happens that at present Mr. T. Swarbrick has been making observations upon the natural healing of woody branches cut each month, and as a result it is possible to give from his notes some precise data as to the date upon which bleeding in sycamores was noticed. On February 12, sycamore branches were cut and no bleeding from them occurred. On March 4, with snow on the ground and on the branches, the branches began to drip immediately they were cut. These cuts were still bleeding on March 11, when fresh cuts on other branches produced so marked a flow that the earlier cuts were re-examined. The branches cut on February 12 did not bleed at all, so that in the intervening weeks the cut surfaces had blocked. On March 12, 500 c.c. of liquid were collected from a few cut branches. This liquid contained no reducing sugars before inversion, but polarimetric observations before and after inversion show that it contains some 1·3 per cent. of cane sugar. The juice has very faint catalase and oxidase reaction, but an exceedingly vigorous peroxidase reaction; it also contains diastase capable of hydrolysing starch solution under antiseptic conditions.

The same two enzymes, peroxidase and catalase, have been found in vine sap by Mr. Wormall (Dept. of Physiology, Leeds, unpublished observation) and in the "wood-sap" of healthy trees by E. Ph. Votchal (Moscow, 1916, J.C.S. Abstr., vol. 126, i., 251, 1924).

In view of the cold weather during this period, March 4-11, in Leeds (snow on the ground and hard frosts nearly every night) it is difficult to account for this sudden activity of exudation.

Furthermore, the metabolic machinery is not readily pictured by which cane sugar, without any reducing sugar, becomes suddenly available in the sap in the wood of a tree which stores much starch in the parenchyma surrounding the wood vessels. Cane sugar without any reducing hexoses is not usually expected from starch, and furthermore, at the temperatures existing at this time, a rapid hydrolysis of starch would scarcely be expected. It is significant, however, that Prof. Lewis and his colleagues have directed attention to the fact that fundamental changes in the carbohydrate metabolism of the leaf seem to occur in the spring in N. America, and to be independent of temperature and of altitude (NATURE, February 2, p. 175). J. H. PRIESTLEY.

Botany Dept.,
University of Leeds.

The Production of Large, Clear, Cubical Crystals of Sodium Chloride.

FOR the past four years the writers have been engaged in the study of the crystallisation of sodium chloride from saturated natural brines under the influence of various factors, particularly the hydrogen-ion concentration of the solution.

The P_H value of natural Cheshire brine is from 6·9 to 7·1. This value is increased on boiling, owing to the liberation of carbon dioxide. From such alkaline brines, the salt crystallises in octahedral forms. From an acid brine, the salt will crystallise in the form of regular cubes. In both cases the salt is white and opaque.

We find that sodium chloride may be obtained in the form of clear, perfectly transparent cubes by evaporating acidified brine containing a small quantity of a lead salt. Thus, brine containing 0·1 per cent. H_2SO_4 and 0·1 per cent. lead nitrate, and maintained at 75° C. in a silica pan, will, in about twelve hours, yield a crop of brilliantly clear cubes, mostly of about 6 mm. diameter. Analysis shows that the crystals formed from brine containing varying amounts of acid and lead always contain about 270 parts of lead per million.

Individual cubes may be selected, and, by suspension in the mother liquor, may be grown by slow crystallisation to form clear cubes of 30 mm. diameter or more. We find, further, that the concentration of lead and acid must exceed certain minimum values before such cubes will form. The minimum acidity is 0·02 per cent. H_2SO_4; the minimum lead concentration is 0·006 per cent. Pb″. We have successfully used many acids as the source of hydrogen-ion—for example, mineral acids, and lactic, citric, and tartaric acids. Similarly, any source of lead appears to be a satisfactory source of "catalyst"—for example, lead sheet, lead oxides, and lead salts.

These clear cubes closely resemble natural rock salt. Both kinds of crystal were examined by the National Physical Laboratory in October 1921, their report showing that the refractive indices for the lines *c*, *d*, *f*, and *g′* are identical. An X-ray examination by Prof. W. L. Bragg revealed no difference between the internal structure of the two kinds of salt.

The work has been frequently interrupted for more

pressing industrial duties, but the numerous results and photographs are being summarised for publication at a later date. Meanwhile, the basis of the method is made available for workers who wish to prepare large, clear cubes of sodium chloride for optical or other purposes.

W. E. GIBBS.
W. CLAYTON.

Research Department,
The Salt Union, Limited,
Runcorn, Cheshire.

Relation between the Potential Gradient and the Number of Large Ions in the Atmosphere.

IN making some tests recently with an apparatus designed for the observation of large ions in the atmosphere, I have found evidence of a close connexion between the concentration of large ions and the magnitude of the atmospheric potential gradient. When conditions are not quite steady the two quantities frequently vary simultaneously in the

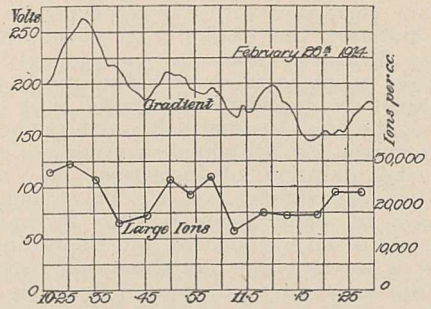


FIG. 1.

same fashion, large values of one being accompanied by large values of the other. The curves in Figs. 1 and 2, each representing about one hour's observations, show examples of this correspondence. The connexion is not always so well marked, as large and irregular fluctuations in the potential gradient are often unaccompanied by any notable change in the concentration of large ions. There is nearly always, however, a general resemblance between the curves obtained, and in a number of cases, peaks even more sharply defined than those of Fig. 2 have been found to coincide. The figures for the concentration of large ions refer to ions of one sign only. No great difference has so far been found between the numbers of positive and negative ions, except on one occasion during heavy rain, when the potential gradient was negative and negative ions were present in considerable excess. The values given for the potential gradient are not absolute values with reference to a plane surface.

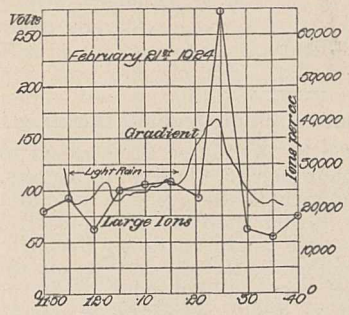


FIG. 2.

The connexion between the large ions and the earth's field is further made clear by bringing together the results of daily observations (Fig. 3). In computing the mean daily values, observations made during rain or when violent fluctuations were occurring were disregarded. The correspondence is fairly close, and might perhaps have been closer had the observations been taken at the same time each day.

The effect of the large ions on the potential gradient is probably not a direct one. A large number of these ions implies a small number of the more mobile small ions, and therefore an increased resistance in the lower layers of the atmosphere and a steepening in the potential gradient. The question arises as to whether all observations of potential gradient made

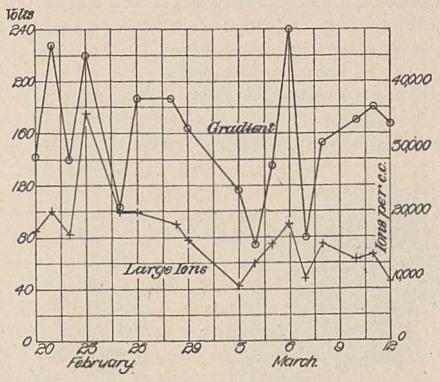


FIG. 3.

in the neighbourhood of cities are not affected in this way—certainly the highest absolute values are reported from regions where high values of atmospheric nucleation are to be expected.

These observations are being continued and will be reported later at greater length.

J. J. NOLAN.
University College, Dublin,
March 13.

The Golgi Apparatus in the Avian Oocyte.

IT is remarkable that, although so much work has been done on the oogenesis of the bird, the Golgi apparatus has never been described in the avian oocyte, so far as I am aware. In his monumental work published in the *Archives de Biologie* in 1914, Dr. Modeste Van Durme failed to find any Golgi apparatus, although he used some of the Golgi apparatus osmic techniques. Working with Dr. Da Fano's cobalt-silver-nitrate technique on the ovary of the fowl, I have succeeded in demonstrating the apparatus. As I believe this to be the first demonstration of the apparatus in the oocyte of a bird, and on account of its remarkable and, in many ways, unique characters, I claim the hospitality of your columns for a short preliminary account.

The Golgi apparatus in the ovarian oocytes of the fowl comprises two distinct sets of structures which I will call, for convenience, type 1 and type 2. In the oocytes surrounded by a follicle one cell thick the apparatus of type 1 appears as an excentric sphere with ring-shaped elements, heavily impregnated by the silver, studded over its surface. This apparatus is situated between the nucleus and the yolk-body of Balbiani, at what will be the vegetative pole of the cell (Fig. 1, GA_1).

When in some cases the yolk-body of Balbiani and the nucleus touch, this apparatus is found in the angle between the two and touching both. It is peculiar in that it is separate from the yolk-body of Balbiani, which is generally considered to represent the centrosphere. It may measure as much as 1/32 mm. in diameter and is probably the largest Golgi apparatus ever described in an animal cell. I am not at present able to give a final opinion as to the relations of this apparatus and the yolk-body of Balbiani to the centrosome, but by removing the silver and staining in iron hæmatoxylin after having drawn marked cells, I found that a darkly staining diploid body could

often be distinguished in the region previously occupied by the apparatus. This diploid body occurring in the middle of the Golgi apparatus certainly has every appearance of being a true centrosome.

The apparatus of type 2 consists of twisted and branched rod-shaped elements which, in the oocytes surrounded by a single layered follicle, are chiefly at the animal pole of the cell, being scattered in the peripheral cytoplasm in this region and often partly aggregated into a loose irregular mass close to the nuclear membrane (Fig. 1, GA_2). The difference of position and shape in the oocytes at this stage between the two types of apparatus is very constant. Both these types of apparatus fragment and become scattered throughout the cell in the form of fine granules which impregnate with the silver.

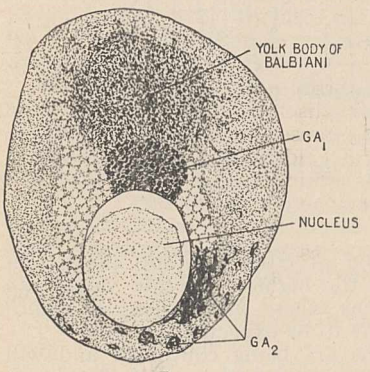


FIG. 1.

For some time after the apparatus of type 1 has fragmented, that of type 2 can be seen in intact pieces scattered in the peripheral cytoplasm. Indeed, it increases considerably in amount and becomes scattered throughout the entire periphery of the cell in the form of many small spherical or ovate reticular masses closely resembling those to be seen in the follicle cells. They have every appearance of being intruded into the oocyte from the follicle cells, it being possible to distinguish the various stages in the process: the apparatus in a follicle cell first enlarges somewhat, then breaks into two and passes through the membrane into the periphery of the egg, where it lies opposite the follicle cell (Fig. 2, GA_2,

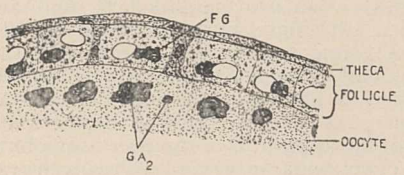


FIG. 2.

apparatus from follicle in oocyte; FG, Golgi apparatus in follicle cell). This process of intrusion ceases at the time when the follicle becomes many-layered, and by the time the zona pellucida has commenced to form, all the apparatus in the egg has fragmented.

At present I am driven to the conclusion that the apparatus of type 1 represents the true Golgi apparatus of the oocyte, and that that of type 2 has been intruded from the follicle cells. I hope shortly to publish a more complete account of my work.

F. W. ROGERS BRAMBELL.

Department of Zoology,
Trinity College, Dublin.

Sunshine and Health in Different Lands.

AT a time when the importance of sunlight—particularly of the ultra-violet constituent—to health is being emphasised by the medical faculty in Great Britain, perhaps it may be permitted to a layman, and climatologist, to point out that there is some need of co-ordinating the various aspects of a question which is not the same in all climates and thermal belts of the globe. A wealth of bio-climatic evidence indicates that it is possible to have too much, as well as too little, sunshine, and that there is such a thing, in the matter of sunshine as in other meteorological elements, as an optimum above which some countries rise, below which others fall, those most likely to hit the happy line lying between the 40th and 50th parallels of latitude. There is a widespread belief that in England we experience too little sunshine; but when it is considered that the climate of England takes a very high rank among the salubrious climates of the earth, it seems unlikely that the deficiency below the optimum of such a vital element as sunshine can be very serious, except, of course, in the smoke-laden industrial districts in winter, which are deprived of the allowance *natural to the climate at that season*.

To take another aspect of the question. We are insistently being told that direct sunshine exerts a powerful destructive effect upon germs of disease. Very well then! the fact must be co-ordinated with another fact, namely, that it is precisely in hot sunny climates that many species of pathogenic organism acquire such deadly virulence, particularly those which are correlated with the appalling fecundity of insect life in the tropics. It would appear a necessary deduction that the question of benefit from direct sunshine is so far subordinate that it must always be considered separately with respect to each of the great thermal belts of the globe which are determined by latitudinal variations in the intensity and duration of insolation, or sunshine, itself. In polar climates, for example, living organisms have to adapt themselves to a continuous winter night of several months, and the testimony of explorers is to the effect that these cold regions are intrinsically salubrious to man. Yet people in the great cities of England languish from light-starvation because during the short days of winter they are robbed by smoke of a certain natural allowance of sunlight, which in conjunction with the large summer allowance would be ample for the needs of health. Hence in the study of this sunlight element of climate, the importance of which is at last being fully realised, the best results are likely to accrue if a wide geographical point of view is adopted, to which the varying local aspects of the subject can be related.

L. C. W. BONACINA.

27 Tanza Road,
Hampstead, London, N.W.3,
March 16.

Apparatus for measuring Photographic Densities.

IN NATURE of March 8, Dr. Slater Price refers to two new types of photometric density measurers. Therein he strongly advocates the use of a selenium cell for such purposes, rather than the photo-electric cell containing one of the alkali metals. Recently Dr. Toy and Mr. Rawling kindly allowed me to see their density measurer, referred to by Dr. Price, in which a selenium cell is used. After being accustomed to use a density measurer containing a photo-electric cell, which has perfect steadiness, and entire absence of lag, it was at once evident that the lag of the selenium cell is a most serious drawback, and makes accurate measurement both slower and more difficult.

In favour of the selenium cell it may be urged that it is readily obtainable commercially, whereas the photo-electric cell had—up to now—generally to be made by oneself in the laboratory. Also, that the selenium cell passes a larger current, and thus necessitates a less delicate galvanometer. As photo-electric cells are now to be made commercially, the first objection is removed. Secondly, if a quick-period electrometer is used with a high-resistance leak (pure xylene plus a few per cent. of pure alcohol in a capillary

tube is satisfactory), no trouble is experienced in measuring currents of the order of 10^{-9} amperes, and maintaining a very quick period instrument.

Finally, Dr. Price refers to an accuracy of less than 1 per cent. as being possible with the selenium cell apparatus. With the photo-electric cell apparatus $\frac{1}{10}$ of 1 per cent. can easily be obtained, but such great accuracy is largely rendered valueless for many photometric purposes, because it seems impossible so to develop any plate, which has been uniformly exposed, that the resulting density will be uniform all over within, say, 5 per cent. (0·02 on the usual logarithmic density scale). If any photographic plate maker would take up this question, and produce a plate, and method of development, whereby really uniform densities could be obtained, he would be doing a very great service, since photographic photometry seems, at present, limited only by this cause.

G. M. B. Dobson.

Clarendon Laboratory, Oxford,
March 15.

The Phosphorescence of Fused Transparent Silica.

May I add a few observations on this phenomenon to those recorded by Messrs. Chapman and Davies in their letter to Nature of March 1? From time to time during the last four years or so, after running silica discharge tubes containing helium, I have noticed a fairly bright and very persistent greenish phosphorescence. Supposing that this effect must be well known, at least to those using silica discharge tubes, I made no special experiments at the time in connexion with it, but the following recent observations suggested by the above letter may be of some interest.

(1) A silica tube containing hydrogen at rather low pressure, which had not been run for nearly four months, showed the phosphorescence quite distinctly on being exposed to the hot air blast from a blowpipe flame. It could be observed in all parts of the apparatus, even in those remote from the direct discharge, as, for example, a large bulb connected to the side of the H-shaped discharge tube.

(2) The phosphorescence having been destroyed by heating the tube to redness, it was at once restored when the tube was again run, if only for a second. But in the case of such a brief "exposure" as this it appeared only in the capillary, and faded away in about ten seconds. Several minutes' running was necessary to develop the phosphorescence in the farthest parts of the apparatus.

(3) With uncondensed and condensed discharges the distribution of the phosphorescence was markedly different. Whereas in the former case it was much brighter in the capillary than in the side tubes (the uprights of the H), in the latter case it was only slightly brighter in the capillary. There is, of course, a considerable difference in the distribution of the luminosity of the discharge in the two cases, a difference which is chiefly due to the high intensity of the Balmer series in the capillary when the uncondensed discharge is employed. Another point which may be significant is that the ends of the side tubes opposite to the electrodes (and farthest from them) showed brighter phosphorescence than the neighbouring sides.

(4) Another silica tube containing pure helium at much higher pressure (probably 1 cm. or more) was examined. A fairly heavy uncondensed discharge failed to develop the phosphorescence after twenty minutes' run, but it appeared after about a minute with a condensed discharge. The length of the spark-gap, *i.e.* the disruptiveness of the discharge, did not appear to matter much. A curious feature was that one of the side tubes glowed more brightly than the other, and the former also showed the Balmer lines more strongly, although in both cases these were of low absolute intensity. Unfortunately it was not found possible to alter the relative strengths of the Balmer series in the two limbs, but the observation gains in significance when considered in conjunction with the absence of phosphorescence after passing an uncondensed discharge, since in the latter case no hydrogen was visible.

These observations, so far as they go, would appear to indicate that the phosphorescence is due to the ultra-violet radiations (constituting the "Lyman" series) of atomic hydrogen. These, it may be noted, lying as they do between λλ1216 and 912, are well within the absorption band of quartz, the centre of which is in the neighbourhood of λ1030, and might therefore be expected to produce some such effect. Whether the radiating atoms in question are those which have been absorbed by the silica or merely those in the path of the discharge cannot be definitely ascertained from the present observations, neither does the experimental evidence adduced by Messrs. Chapman and Davies in support of the former view appear quite conclusive. For example, the effects both of liquid air and of heating are similar to those observed for many phosphorescent substances in the case of which there is no likelihood of any absorption of gas. The question should not be difficult to settle, however, by suitably devised experiments.

W. E. Curtis.

King's College, Strand,
London, W.C.2.

Fractional Crystallisation of Common Lead.

By fractional crystallisation of common lead, specimens were obtained which had different densities (Nature, August 25, 1923). The densities given in that preliminary announcement were relative and not absolute. The absolute densities of two of the specimens were then determined; the same pieces of metal and also a piece of Stas lead were afterwards converted into lead sulphate in order to ascertain the relative atomic weights. The fact that I had to give up the work at this stage will serve as my justification for publishing the results without submitting them to further proof.

	Common Lead.		
Density at 20·49° C. (Wt. of 1 c.c. *in vacuo*) . . .	11·358	..	11·327
Relative atomic weights .	207·07	207·15	207·19

Obviously the differences are so small that they must be confirmed before being accepted. Although the above results are not consistent with the theory that common lead is a mixture of 206 and 208, the end-products of the uranium and thorium disintegration series, it is nevertheless noteworthy that the two fractions fall on the periodic atomic volume curve of the elements. The freezing-points of the two fractions were identical, thereby excluding the possibility that the differences might be due to bismuth impurity in one case and thallium in the other.

The discrepancy between the preliminary and the final values which Richards and Craig (J. Amer. Chem. Soc., 1923, 1155) obtained for the atomic weight of gallium, namely, 70·1 and 69·7 respectively, may be due to a real change in the atomic weight of the material brought about in the course of the fractional crystallisation of the metal which was introduced as a method of purification after the preliminary values had been obtained.

R. H. Atkinson.

Goldsmiths' Metallurgical Laboratory,
University Chemical Laboratory,
Cambridge, March 10.

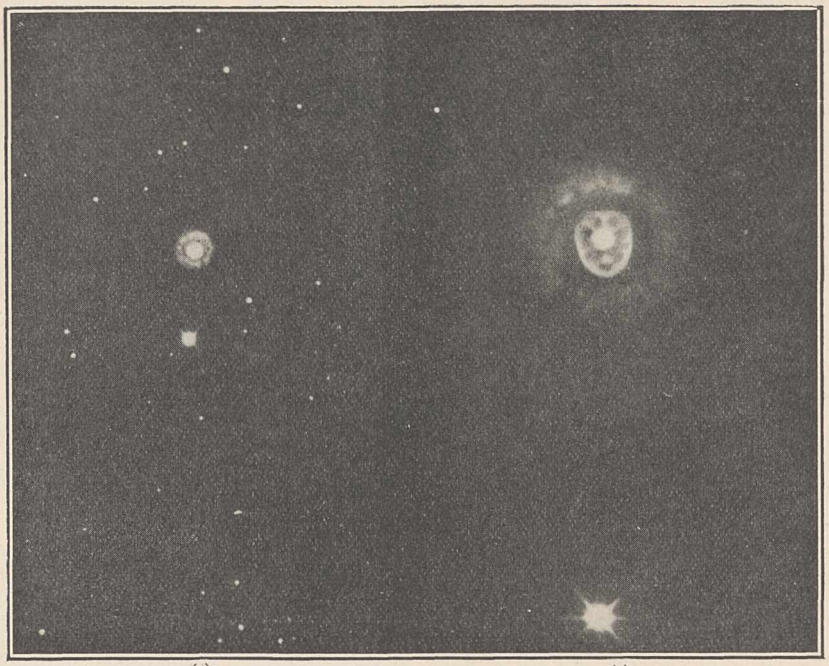
Astronomical Photographs.

WE directed attention some time ago to the excellent collection of astronomical photographs issued in various forms by the University of Chicago Press for the benefit particularly of lecturers and teachers. We have now received a complete set of card descriptions of one hundred of the photographs, specially selected "for the benefit of institutions or individuals desiring a small collection thoroughly representative of present astronomical science," and we take this opportunity of making known as widely as possible the admirable work which is in this way being done to popularise interest in astronomy.

FIG. 1.—Extended gaseous nebula in Cygnus. Photographed at the Yerkes Observatory.

The photographs, nearly all of which were taken at the Yerkes Observatory, are issued in the form of lantern slides, transparencies, and prints. The lantern slides, which are $4 \times 3\frac{1}{4}$ in. in size and are therefore unfortunately unsuitable for the ordinary carriers of British lanterns, are supplied at 75 cents each, but the total cost of the selected set of 100 slides is 62.50 dollars, involving a saving of approximately 12 dollars. Unmounted prints, matt or glossy, are 50 cents each; transparencies, which are made to order in five sizes, vary in price from 2 dollars for size 8 in. × 10 in. to 10 dollars for size 18 in. × 22 in. Card descriptions of the hundred selected photographs are 5 cents each, or 2.50 dollars for the set.

There is no need to emphasise the excellence of the illustrations themselves—the work of the Yerkes Observatory is too well known for that—and we can perhaps give the reproductions no higher praise than by saying that, so far as we can judge from the specimens we have seen, they are in every respect worthy of the originals. They cover the whole range of descriptive astronomy, and have evidently been chosen with the greatest care. The selected list of 100, for example, comprises various types of solar phenomena; the moon at various ages (including earth-shine on the moon, a total eclipse, and an occultation of Aldebaran); the whole of the planets, including trails of asteroids; a good selection of comets and a meteor-trail; star fields, showing conspicuous constellations, circumpolar and equatorial star-trails, variable, double and temporary stars; open and globular star clusters; nebulæ of all types—diffuse (bright and dark), planetary, annular and spiral; star clouds of the Milky Way; solar, stellar, nebular, and cometary spectra, showing the chief stellar types and the spectra of spectroscopic binaries and of a nova; and finally,



(1) (2)

FIG. 2.—Planetary nebula in Gemini. Photographed at the Mount Wilson Observatory. (1) Showing structure of outer ring; (2) showing inner structure.

views of the Yerkes Observatory and the chief instruments in use there. Portraits of about fifty astronomers are also included.

It will be realised from this summary that a very

FIG. 3.—Dark nebulæ in the Milky Way. Photographed at the Yerkes Observatory.

The upper picture shows very large curved marking with definite boundaries, and the lower shows an S-shaped marking, as well as several small dark spots south of it. Although formerly believed to be vacancies, these objects are now accepted by many astronomers as representing actually very faintly luminous or non-luminous masses.

wide field has been covered, and that the collection is truly representative. It becomes clear, however, on a careful examination of the catalogues, that the selectors have done their work more efficiently than a mere summary of the slides would indicate. The total number of illustrations issued now amounts to more than 800, and in making a selection of only 100, many extremely useful slides have had to be omitted. This disadvantage has been to a considerable extent overcome by selecting slides suitable for more than one purpose. For example, no slide intended to illustrate the determination of radial velocities is included, but there are two spectra of μ Orionis—a spectroscopic binary of which only one component yields a spectrum—which are perfectly suitable for the purpose. (These spectra, we may remark, will be useful also to advanced students, as providing an exercise in measurement.) Again, there is only one picture described as a "meteor-trail," but among the illustrations of nebulæ there is one which includes a meteor-trail also. We have no hesitation in saying that the lecturer or teacher who carefully studies these selected illustrations will find them to cover a much wider range than their number and titles would indicate.

The descriptions of the slides are clearly printed on cards 6 in. × 4 in. in size, and are each about 250 words in length. They are clear and simple, and not only point out the chief features of the slides they are intended to describe, but include also a considerable amount of interesting matter relating to the general types of the bodies to which they refer. More than half of the descriptive cards were written by Prof. Frost, about a quarter of them by Prof. Barrett, and a dozen or so by Prof. Barnard. It is inevitable, in view of the very rapid rate at which astronomy is now advancing, that some of the descriptions should be slightly out-of-date. Thus, for example, we are told that "the best estimates of the extent of the Milky Way place it at about 30,000 light-years." In view of Shapley's work, this is now at least doubtful. On the whole, matters of controversy have been avoided, though we note that the existence of "nebulium" is assumed. As the publishers point out, the descriptions, consisting of nearly 24,000 words, are equivalent to an octavo volume of about 70 pages. While they are not

FIG. 4.—Comet Brooks, October 23, 1911. Photographed at the Yerkes Observatory.

Although this comet was visible to the naked eye and had a tail 26° long, none of the details shown in the illustration could be seen either with the naked eye or with a telescope. The head of the comet was about 300,000 miles in diameter at the time when the photograph was taken.

recommended as a textbook, they would be in many respects the equivalent of such a book if they were accompanied by prints from the negatives which the slides represent. We give the following descriptions of two of the four illustrations which are here reproduced, in order to show their general character. These descriptions are quite typical, and give a true idea of the quality of the whole.

N 16. EXTENDED GASEOUS NEBULÆ IN CYGNUS.

Photographed by Prof. E. E. Barnard with the Bruce Telescope.

These two wonderful filamentary nebulæ are parts of a still larger ring, the fainter portions of which can be photographed, but probably have never been seen with the eye. They are sometimes called the "cirrus nebulæ" because of their resemblance to the cirrus clouds frequently seen in the sky. They are gaseous, composed of nebulium, hydrogen, and helium. They are of enormous size, each of the two brighter nebulæ being over a degree in length, and even the slenderest filaments must be hundreds of millions of miles in width.

It will be noticed that the nebula at the left of the slide lies along the line of separation of a region thick with stars from a region noticeably less dense in stars. It has not yet been possible to detect any motion of these filaments with respect to the stars, but probably it will ultimately be measured when photographs are available separated by a long period of years.

During this long exposure of nearly six hours, a meteor flashed across this part of the sky, and its impression was caught on the plate. It is brighter than some of the filaments of the nebulæ, but there could be no greater contrast in actual size or brightness, for the meteor was only a small pebble, or perhaps a grain of sand, burning itself out by friction in our atmosphere, and probably less than 100 miles away, while the nebula is several hundred light-years distant from us.

N 51. PLANETARY NEBULA IN GEMINI, N.G.C. 2392.

Photographed by Prof. E. E. Barnard.

Planetary nebulæ, of which there are only about 150 catalogued, are all apparently small in size, are rather dense, and in general have well-defined outlines resembling ellipsoidal shells, with a Wolf-Rayet star at the centre. They are uniformly gaseous, their inner parts containing helium, nebulium, and hydrogen; their outer parts, hydrogen only.

Since they have a tendency to lie in the plane of the Milky Way, they probably belong to our own system. One planetary nebula has been found to be distant 140 light-years, but the average distance is probably about 1000 light-years. From rather uncertain data some are found to be rotating about an axis with periods of from 600 to 14,000 years, their masses being three to one hundred times that of the sun, but with densities of about one-millionth that of our atmosphere.

The two photographs are of the same nebula, but taken with the 25-foot and the 100-foot focus, respectively, of the 60-inch reflector at Mount Wilson Observatory. The first is over-exposed in the centre in order to bring out the details of the faint outer ring, while the one of large scale shows the inner structure. The appearance of this nebula is unique, and bears little resemblance to that of other nebulæ.

The fact that planetary nebulæ have an average radial velocity of 24 miles per second discountenances the theory that they condense into the early types of stars, O and B, whose velocities are markedly less. The radial velocity of this nebula is 50 miles per second. It has been suggested that planetary nebulæ are the wrecks of ancient collisions among stars.

We hope that the effort which the publishers of these illustrations and descriptions are making to spread the knowledge of astronomy in so interesting a manner will meet with the success which it deserves. It will be understood that the work of distributing lantern slides and photographs, or descriptions of them, is not a matter of business with the Yerkes Observatory, as the proceeds from sales cannot do more than cover the cost of manufacture, quite apart from the time spent by scientific members of the staff of the Observatory in selecting the subjects, supervising the photographic work, and writing the descriptions.

Copies of an illustrated catalogue of the photographs made at the Yerkes Observatory, or of a selected list of one hundred slides, may be obtained from the University of Chicago Press, Chicago, Illinois, U.S.A.

Brain and Speech.

By TUDOR JONES, M.B.

AS the conclusions which Dr. Henry Head bases upon his extensive researches into the phenomena of aphasia are now approaching a comprehensive form,[1] the present is a convenient time to attempt a summary of his views. Fourteen years ago, in the light of his work on the part played by the brain cortex in sensation, it became clear that new tests must be devised before the clinical investigation of aphasia could produce any satisfactory result.

It is less necessary to describe here the elaborate series of tests which Dr. Head invented, every one of them new or used in a new way, than to direct attention to the principles which guided him in this important part of his work.[2] Foremost among these was the conception, which a study of his own work and that of Sherrington and his collaborators led Head to formulate, that cortical injury, so far from removing a strictly definable anatomical "centre," disturbs a highly organised act, the very variable *end-point* of a whole march of events occurring in the central nervous system. The effects of a destructive lesion of the brain cortex are all negative. They do not reveal the primitive elements out of which speech issues, nor do they break it up in accordance with our conceptual terms in describing it. What they do is to prevent, in part, the activity of a highly organised group of functions all at the cortical level. Head insists very strongly upon the negative characters of this interruption, distinguishing them from such positive effects as the spasticity of hemiplegia, which reveals the uncontrolled activity of neurons at a *different* level. Thus his first aim was to determine with the greatest possible accuracy what it was that the patient could not do, or could do only sometimes or with difficulty. The tests at length devised are not considered to be complete or incapable of improvement; but that they constitute in themselves a great advance in clinical method has been admitted even by those who, for the present, are unable to adopt Head's more theoretical conclusions.

This great gain is, however, less than that which must proceed from due observance of the principle itself: that what we must strive to ascertain is not the defect

[1] "Speech and Cerebral Localisation," by Henry Head, *Brain*, vol. xlvi. Part iv., 1923 (London: Macmillan and Co., Ltd.) 6s. net.

[2] A description of the tests appeared in *Brain*, vol. xliii., 1920.

in such conceptual terms as may occur to us or be forced upon us by an imperfect and misleading psychology; but the defect stated in cortical terms, in terms of the special function actually removed from the great chain of functions of which speech in all its forms is the last link. The terms "motor," "sensory," "emissive," "receptive" are conceptual no less than "apraxia," "agraphia," and all the train of Greek words which merely translate the plain English for various gross disabilities. Not in our terms, which describe only finished products of cortical activity, but in terms of purely cortical function, what absence of one or several acts leading to the formulation and expression of symbols can be discovered?

This is surely one of those rare questions, which have a certain power of illumination of their own apart from any answer which may be found for them. The complete answer is for the present an ideal involving an account of the innumerable integrations of the central nervous system and of their modes of action. Yet in defining so vast a problem, Dr. Head has concurrently swept aside the crude theories of the past half-century in regard to aphasia, and has carried us far towards a rational understanding of the functions of speech.[3]

After the outbreak of the War, Head was able to apply his tests to a class of patient vastly different from the aged aphasics of civilian practice with their arterial degeneration, diminished intellectual capacity and mental depression. Many "were extremely intelligent, willing and anxious to be examined thoroughly. As their wounds healed they were encouraged and cheered by the obvious improvement in their condition. They were euphoric rather than depressed." Moreover, while many vascular lesions tend to destroy the substance of the brain, the damage caused by gunshot wounds often tends to be most extensive superficially. One only of the cases upon which the research is based was a civilian, an intelligent woman, from whose brain an extra-cerebral tumour was removed by operation.

When Pierre Marie first attacked the "classical" presentation of the facts of aphasia, he attributed the "sensory aphasia" of Wernicke to a defect of general intelligence and of special intelligence of language. Head's first finding contradicts this view. A man who in general conversation is unable to express his thoughts or comprehend the full significance of words and phrases appears more stupid than others. His isolation from the sources of mental life diminishes his field of thought, and thus many aphasics gradually deteriorate. But "general intelligence" (the existence of which Hughlings Jackson denied) is not primarily affected. Behaviour suffers specifically. What cannot be done in one way can be done in another. "All my patients could choose some familiar object, colour, or geometrical figure, which corresponded to the one shown to them." No symbolic formulation intervenes necessarily between perception and such an act of choice. When a unilateral lesion of the brain disturbs the use of language, any act of mental expression which demands symbolic formulation tends to be defective, and the higher its propositional value the greater difficulty will it present. Any modification of the task which lessens the necessity for symbolic representation will render its performance easier.

It is remarkable how definitely Head's observations cut up the classical terminology and unmask its latent assumptions. Many patients who cannot name objects can choose them to oral as well as printed command. "Once the word has been presented to the patient, it calls up an image which corresponds to some object before him"; but he cannot himself reproduce the appropriate symbol on demand. The more abstract the symbol the greater the difficulty which its invocation affords. Colours are more difficult to name than objects—*i.e.* crude colours, not their varied shades. A patient failed to recall the name for "black," but was perfectly at home with the more concrete "what you do for the dead," and "dead," to which he shortened this phrase, served perfectly as a more accessible synonym. Moreover, we make use of many subtle symbolisms (how many?) besides those indicated on the conventional brain charts. "The short and long hands of the clock have acquired a significance which converts each of them into a direct symbol, and they are confused or wrongly used in many forms of aphasia." Galton's classical article described many highly individualised uses of such symbols. Patients who cannot make use of the conventional time nomenclature, either in words or by the peculiar symbolism of the clock itself, will describe events more concretely as "when we went there"; they recognise the passage of time intervals and are punctual for appointments.

Again, not only have sensory impressions to be "formulated" in terms of a symbolism which employs other forms of sensation besides hearing and vision, the whole forming an aptitude acquired laboriously in the lifetime of the individual, but also the relations between sensory impressions must be expressed in accordance with the same conventions. As Elliot Smith, approaching the question from morphology, has pointed out, man's immediate ancestors possessed high powers of discrimination before man developed speech and invented his symbolisms to register differences (relations) apparent to him. Like speech, this is a cortical function but earlier acquired. "A patient with his eyes closed may be able to point to the position of various objects in some familiar room with regard to himself, although he cannot formulate their relation to one another. He can say "The window is there, the fireplace there," but is unable to express the situation of the one with regard to the other. This makes it impossible to draw a ground plan, which demands somewhat complicated acts of symbolic formulation. Similarly illuminating disabilities arise among aphasics in their power to handle money with its complex symbolism. The primary significance of words, figures, and coins may be appreciated, but not their deeper significance in relation to one another. The processes of arithmetic have to be constantly reformulated in order that they may be correctly carried out.

It will be clear that the disorders of behaviour observed by Head involve a wide range of acts from mechanical acts up to exercises in formal logic; they manifest themselves most profoundly in the *use* of

[3] The "classical" localisation of cortical function was completed with Wernicke's localisation of a centre for "auditory images" in 1874. Despite Hughlings Jackson, the subject then entered upon a phase of complete sterility which lasted until Marie's "Revision of the Question of Aphasia" in 1906.

symbols, *i.e.* words, numbers, and analogous conventions. "The processes which underlie an act of speech run through the nervous system like a prairie fire from bush to bush; remove all inflammable material at any one point and the fire stops." Clearly, it is as reasonable to call the site at which there is discontinuity of the nervous mechanism a "speech centre" as it would be to call the place where the fire ceased a "fire centre." Most so-called "centres" in the nervous system are nodal foci, where central neural activities undergo integration and other changes in relation to one another. But the evidence laboriously collected by Head displaces from the classical "centres" all that it has been customary to regard as resident within them.

These anatomical sites are themselves not functional parts from which words or other acts spring ready formed; "there are no 'centres' for speaking, reading, writing, or other forms of behaviour comprised in the normal use of language." There are merely situations where the normal stream of neural activity may be interrupted with results which may or may not be characteristic. The view that there can be anything characteristic, in our purely linguistic terms, is set aside as an absurdity. We must learn to speak the language of the cortex itself before we can state its disorders in appropriate terms. Acts of symbolic formulation and expression "are built up on a level of integration superior to that of motion, and are of a higher order than sight or hearing." Consequently, the clinical manifestations cannot be classified as "motor," "visual," or "auditory" defects of speech. Head has given a death-blow to the classical theory of aphasia and has thrown the whole conception of "centres" into the melting-pot, for even motor "centres" in the cortex are not primary foci from which movements are initiated and determined, but rather "the means by which we are enabled to interfere with otherwise automatic acts."

We must now inquire what substitutes can be found for the "linguistic" terminology. The disorders of speech following cortical injury reveal themselves to us as disabilities of various kinds, associated with symbolic formulation and expression. The analysis of these disabilities made by the "classical" technique meant nothing. Do the more discriminating methods of Head bring us nearer to what I have ventured to call the language of the cortex itself? I have used this phrase because Head's argument does seem to me to discriminate between the disturbances of cortical function and the disturbances of speech which alone are subject to clinical investigation. It is the whole burden of his insistence that the diverse defects of speech do not reveal the elements out of which the use of language is built up. These elements are functions of the central nervous system. Neurologically, what is all-important is that we should move towards some understanding of these elements. Clinically, we are justified in grouping the manifestations of interrupted function in whatever way the facts determine, and Head has effected such a grouping himself, being able, further, to show a corresponding anatomical localisation. But the clinical and neurological demands must not be confused. It is to ward off such confusion that Head has taken up an attitude towards localisation that has mystified many of his opponents. He has given names to his groups (verbal, syntactical, semantic and nominal), and has assigned each group to an area of the cortex more or less definite.[4] Indeed, the facts appear to justify a greater definiteness than he is willing to claim. But he would have preferred to identify his groups by some purely conventional sign. Clinically the groups are clear cut.

There should be little difficulty in classifying an aphasic in accordance with Head's system without very minute investigation. There is something distinctive about each group, and the distinguishing characteristics are readily revealed by the application of Head's system of testing. But, if our work ended there, we should have only added a new (albeit a better) clinical convention to the study of aphasia. We should be no nearer to the elucidation of cortical function in regard to speech. The verbal aphasic has difficulty with verbal forms of expression. The structure of his words is abnormal. They may be so badly pronounced as to be scarcely recognisable; but they are applied correctly. The significance of words is retained, and the patient can appreciate jokes presented to him in pictures. He can play card games and draw plans. The syntactic has plenty of words but their production is ataxic. Comprehension of the meaning of words is always in excess of their use. The arhythmical character of spoken words extends to phrases, so that phrasal memory is defective, and conversation difficult or impossible. The order of terms in a simple phrase is often reversed, and pictures are "read" from right to left. Nominal defects show themselves as an inability to name things, which becomes more marked the more abstract the nature of the things. Relations cannot be identified by appropriate word labels. The patient fails to choose correctly to oral commands, and cannot draw a ground plan, although he knows where things are. He cannot play card games because they demand rapid and correct recognition of names and an ability to register a score; but chess, draughts, and dominoes may be played correctly. The semantic fails to recognise the full significance of words and phrases, apart from their verbal meaning. The "point" of a picture escapes him. He cannot play games or put picture-puzzles together. He cannot formulate a general conception of what he has been told or has read for himself. But he does not forget people or places; he can recall spontaneously events both recent and remote.

It is Head's thesis that there is nothing exclusive about the acts which are disordered by cortical injury. They imply highly integrated functional arrangements, developed originally for other simpler purposes. But with increasing aptitude the functional adaptations on which the use of language relies become engulfed in the automatic activities of the central nervous system. He has suggested a differential but nevertheless serial classification of functions involved in the simplest acts of speech, and in so doing has opened up the way for further investigation of a very promising kind. Neurology as well as clinical medicine, but above all psychology, is indebted to him for a great pioneer work.

[4] The localisation of cortical injuries in Head's cases was as follows: *Verbal defects*, the lower portion of the central convolutions and the parts beneath them; *syntactical*, an area above and below the superior temporal fissure; *nominal* and *semantic*, between the post central fissure and the occipital region, the latter the more postero-medial.

Obituary.

Dr. R. E. Froude, C.B., F.R.S.

ROBERT EDMUND FROUDE, who passed away at Cambridge on March 19 after a brief illness, came of a distinguished family. One of his uncles was the celebrated historian, James Anthony Froude, professor of modern history at Oxford, and author of many well-known historical works, while another uncle, Hurrell Froude, took a prominent part in the Oxford Tract movement. His father, the late William Froude, F.R.S., devoted a lifetime to research in ship propulsion, and was the pioneer of the system of testing the probable qualities of a proposed ship design by towing experiments in an "experiment tank" on a model hull carefully made to the exact proportions of the intended ship. Beaufoy, in the latter part of the eighteenth century, had carried out some interesting experiments on frictional resistance in the open water of the Greenland Dock (London), but it was William Froude who conceived and carried out the idea of having a large covered tank specially built in which ship models were tested for resistance. This tank was erected at Chelston Cross near Torquay about 1870, and it was there that the earliest work of this kind was carried out. How the system has spread may be gathered from the fact that in Great Britain alone six such tanks, for warship and merchant ship models, all much larger and more completely equipped than their prototype, are now built and fully occupied; while similar tanks exist in America, France, Italy, Germany, Austria, Holland, Russia, and Japan.

The system when first proposed was, like many other useful discoveries, looked upon complacently enough as a pleasant recreation for amateur enthusiasts, but the remarkable results obtained and the accurate forecasts of the power required to drive a proposed ship at a given speed, which could by this means be made, soon brought recognition of its value, and William Froude was in 1870 engaged by the Admiralty to test models of projected warship designs. In 1884 the Admiralty decided to build a larger (500 ft.) tank at Haslar (near Portsmouth), and when this tank was completed, Mr. R. E. Froude, who had received his early training in model experiment work under his father, became superintendent of that establishment. Here for more than thirty years (until 1919) Mr. Froude continued to carry on the work inaugurated by his father, and his notable contributions to the Transactions of the Institution of Naval Architects and other scientific societies bear evidence not only of his great skill as a scientific investigator, but of the practical lines upon which his research work was carried on. Hull forms and resistance were the principal branch of that work; but to propeller problems, so difficult of exact solution, he also devoted much time and thought; while wave motion and the rolling of ships were carefully investigated and yielded valuable results. The more notable papers which he contributed to the Transactions of the Institution of Naval Architects form the basis of all subsequent work, and have become classic examples of the best research in this branch of applied science.

Mr. R. E. Froude was born in Devonshire in 1846. All of his professional life was spent on the south coast, but after retiring under the age limit from his Admiralty post he moved to Cambridge, where he spent the remaining years of his life. He had always been an enthusiastic yachtsman, and was a frequent competitor in single-handed sailing matches in the Solent. His knowledge of ship design doubtless added to the interest which he took in this form of sport, though the art of successful yacht-building still conceals many secrets from the purely scientific investigator.

Mr. Froude was elected fellow of the Royal Society in 1895, and was awarded a C.B. in 1910 for the services he had rendered to the Admiralty. He served for many years on the Council of the Institution of Naval Architects, and was in 1905 elected an honorary vice-president of the Institution, to which he had made such valuable contributions.

Count Hilaire de Chardonnet.

The death of Count Hilaire de Chardonnet in Paris on March 12 will be regretted in the world of science. A career of consistent devotion to a scientific-technical ideal through a long life of eighty-four years, and closing without diminution of vital—even passionate—interest in his work, impresses the immediate sense of loss, which at once gives place to the pleasing recognition of so much positive achievement.

"Artificial silk" suffers from its name, but the wit of the age which has seen its birth and development to a staple textile is not equal to the discovery of a term free from any bar sinister. To Chardonnet belongs the peculiar honour of first transforming cellulose into a textile fibre rivalling the insect product which held the world for nearly 5000 years as the last expression of elegance and strength in this field of natural products. It must not be forgotten that a silk thread, with its diameter of 1/100 mm., represents a colloid of such structural quality that the unit thread has a tenacity represented by a breaking strain of 50 kilo. per square mm. of sectional area. The public which uses the artificial silk in immense quantity has little thought of its history, and perhaps even the corporate body of men of science are not quite sure as to how far its French pioneer is to be taken "au grand sérieux." A short account of his career and work may, therefore, be of interest to many readers of Nature.

Chardonnet had his formal training at the École Polytechnique. On leaving, he entered at once into research work, studying particularly the absorption of ultra-violet rays by normal and morbid tissues both vegetable and animal. Such contact with biology, at a time when Pasteur was publishing his important works on the silkworm, supplied the incident or accident which so often appears in directing the life-work of inventors. Chardonnet was attracted to the subject of silk and took it up on rigid scientific lines. Probably he dived back into ancient history and found that Réaumur in 1734, in a "Mémoire pour servir à l'histoire des insectes," gave a categorical forecast of artificial silk.

The stages of his life-work are a short story—1878–1884, researches ending in filing his *pli-cacheté* at the Academy containing a close description of the essential

features of the invention. In 1889 Chardonnet had a working exhibit of his process in the Exhibition of that year, sufficiently advanced to be a realisation. Following this, industrial capitalists of Besançon, the town where he was born on May 1, 1839, invited him to localise the industrial development of the matter, and on his consent found the necessary capital of three million francs for an industrial unit. The progress of the industry was chequered by reason of difficulties which chemists know only too well to be associated with the properties of the cellulose derivative involved, but the manufacturing company worked its way to a very considerable financial success towards the year 1900. At this time French and German competitors had been attracted to the subject, and, adopting the alternative cuprammonium solution, developed an industry by way of this rival process. Also at this period the now well-known viscose process had made its mark by a modest exhibit of products in the 1900 Paris Exhibition. The subsequent history of the competition between these three rival processes is common knowledge. Artificial silk at the present time is produced in excess of the world production of silkworm silk.

The career of Chardonnet does not appear to have been influenced by the success of rivals. He maintained his working connexion and his interest to the end, and within a few weeks of his death he filed a patent of improvement which involved the preparation of drawings by his own hand. The distinction of his work and personal elevation of character were duly recognised by his election to the Paris Academy of Sciences in 1918. In Great Britain recognition was marked by the award of the Perkin medal by the Society of Dyers and Colorists (1914). His work is another illuminating example of the French pioneer spirit: but its development, as in other cases, to its ultimate magnitude has been realised in other countries. This in no sense lessens the claims of the genial pioneer to recognition as such.

Mr. A. H. Jones.

ALBERT HUGH JONES, for many years one of the best-known and most highly esteemed of British entomologists, was born on November 24, 1840, his father being the vicar of Brecknock. He was educated, first at Croydon, and afterwards in France, where he acquired that intimate knowledge of the French language which served him so well on his many European tours. For fifty years he was on the staff of Drummond's well-known London bank, in which he held a very high position on his retirement in 1909.

Throughout his long life Mr. Jones was devoted to the study of the Order Lepidoptera, and from 1858 onwards he was a frequent attendant at the weekly "At Homes" of Mr. H. T. Stainton at Lewisham, then the great rendezvous of London entomologists, where he made the acquaintance of H. W. Bates and other prominent workers of that period. A few years afterwards we find him supplying his not very distant neighbour, Charles Darwin, with details of the comparative numbers of the sexes in bred families of moths, to be utilised in "The Descent of Man and Selection in Relation to Sex." Living as he did at Eltham, in one of the richest parts of the London district in Micro-Lepidoptera, he devoted many years of close attention to the British Tortrices, and contributed largely to our knowledge of this very interesting group of small moths.

It is, however, with the butterflies of Europe that the name of Albert Jones has been most closely associated in recent years. His chief interest from 1886 onwards was centred in these insects, and scarcely a year from that date passed without his making a trip to some productive Continental locality, the results of these expeditions appearing in the contemporary entomological magazines. He was the first English entomologist to visit more than one of these localities, and his last, and perhaps most successful and interesting, collecting expedition was undertaken in his seventy-fourth year, in company with his life-long friend Mr. W. G. Sheldon. These entomologists, after a flying visit to the Crimea and the Black Sea ports, spent a month in the early summer of 1914 at the Sarepta on the Volga, well known as the head-quarters of Russian butterflies, with great results, both travellers fortunately reaching home only a few days before the outbreak of war.

Mr. Jones's genial presence will be greatly missed at the Entomological Society of London, at which he was a constant attendant from his election as a fellow in 1888. From 1904 to 1918 he held the onerous and responsible post of treasurer of the Society, and in the latter year, as well as in 1912, he was one of the vice-presidents. It is understood that his fine and almost complete collection of European butterflies, numbering more than 7000 specimens, will find a permanent home in the Oxford University Museum. J. J. W.

WE regret to record the death at the age of forty, on March 2, of Dr. Guy Alfred Wyon, lecturer in pathology in the University of Leeds. "M. J. S." has contributed an appreciation of life and work to the issue for March 15 of the *British Medical Journal*. Dr. Wyon graduated at the University of Edinburgh, and after some years in general practice and on service with the Royal Army Medical Corps during the War, he joined the staff of the Department of Applied Physiology and Hygiene of the Medical Research Council, and was engaged with the late Prof. Benjamin Moore in the study of trinitrotoluene poisoning. By a series of experiments, many on their own persons, they were able to show the mode of entrance to the body of the poison and to devise practical means of protection. Later Dr. Wyon rejoined the Army, being finally in charge of a mobile bacteriological laboratory. In 1920 he joined the staff of the Department of Pathology and Bacteriology of the University of Leeds, and while there interested himself in the chemistry of bacterial growth and in the application of chemical methods to the investigation of disease.

WE regret to announce the following deaths:

Prof. H. Carmichael, formerly professor of chemistry at Bowdoin College, Montana, on January 29, aged seventy-seven.

Dr. U. Grubenmann, honorary professor of mineralogy and petrography in the University of Zurich, aged seventy-four.

Current Topics and Events.

The perusal of a preliminary list of some of the exhibits to be shown in the Chemical Hall of the British Empire Exhibition gives the impression that chemical manufacturers of Great Britain are leaving no stone unturned to make their particular section a great success. The first list contains particulars of the nature of the goods to be displayed by thirty-one different firms, and further lists are promised which will doubtless include mention of exhibits from the Dominions overseas. Readers of Nature will probably take greater interest in the purely scientific exhibits that are to be displayed in the same building; they would, however, be well advised not to overlook the attractions of the industrial section, where, if many of the articles will be familiar to them, they will surely find some that are novel or suggestive. Such exhibits as insulin, to be shown by British Drug Houses, Ltd., saccharin and "stabilarsan," a new form of salvarsan, to be displayed by Boot's Pure Drug Co., Ltd., are certain to attract attention. Dyestuffs will be well represented, and in this connexion L. B. Holliday and Co., Ltd., are concentrating on a single exhibit which will "finally dispel the fallacy that British-made dyestuffs are inferior in fastness" to foreign-made descriptions. Peter Spence and Sons, Ltd., will show some striking specimens of alums, including one crystal weighing more than 200 lb., which took nearly four years to grow, and is believed to be the largest single artificial crystal in existence. Among many other features, there will be an attractive and instructive exhibit of chromium compounds by J. and J. White, Ltd.

In view of the fact that many overseas botanists may be expected to visit England this year in connexion with the British Empire Exhibition at Wembley, an Imperial Botanical Conference will be held at the Imperial College of Science and Technology on July 7-16. The arrangements for this conference are in the hands of an executive committee of which Sir David Prain is chairman, Dr. A. B. Rendle, treasurer, and Mr. F. T. Brooks, secretary. The preliminary programme shows that discussion will be arranged upon general topics likely to interest both home and overseas botanists. Thus the promotion of a botanical survey of the Empire is to be introduced by Dr. A. W. Hill, Mr. A. G. Tansley, and a number of overseas botanists are to discuss vegetation survey and training in field geology; Prof. R. H. Biffen introduces the subject of plant breeding, Prof. Percival the importance of selection. Plant physiology is represented by discussions upon cold storage of apples and crop physiology; under plant pathology tropical experience will be utilised in the discussion of sugar-cane mosaic, bud-rot of coco-nut, and brown bast of rubber, whilst the relations of plant pathology to genetics and to silviculture will be considered in separate discussions. Prof. J. B. Farmer will open a discussion upon the important question of interchange of staff and post-graduate students between overseas and home universities and the desirability of providing further facilities for botanical research within the tropics and Dominions. The programme outlined is certainly of great Imperial significance, and it is only to be regretted that the executive has not seen its way to bring some of these problems before a wider overseas audience in the conference halls at Wembley itself. Whilst the opportunities for meeting and discussion provided by the Conference will no doubt be welcomed by overseas botanists, there is no doubt that the occasion is peculiarly appropriate for the numerous home botanists, many of whom will be deprived of their usual annual opportunity for botanical "shop" with their colleagues by their inability to attend Section K at its distant rendezvous in Toronto. All such botanists will be very welcome at the Conference, and they are asked to notify Mr. F. T. Brooks, 31 Tenison Avenue, Cambridge, of their intention to be present. A subscription of one pound toward the expenses of organisation is being asked from those proposing to attend.

On March 26, Mr. Henry Woodall, jun., handed over the experimental gas plant presented by him to the University of Leeds as a memorial to his father, the late Sir Corbet Woodall. The plant, in the construction of which he has been generously helped by others interested in the memorial, adjoins the Department of Coal Gas and Fuel Industries. It is not merely a coal gas plant on a small scale. It is specially designed for the carbonisation of coal on a scale greater than is possible in the laboratory, but less than that of industrial practice. Thus by a control of conditions closer than is possible in manufacturing plant, it is hoped to study the mechanism of carbonisation in a way hitherto only attempted in the laboratory with its attendant limitations. For carbonisation there is a setting of two horizontal retorts by Gibbons, Ltd., and of two vertical retorts by Woodall Duckham, Ltd. These are designed so as to be run, if need be, singly, in series, or in parallel. The liquid products can be carefully collected and measured without the possibility of the reflux action of the ascension pipes. Heating arrangements permit of close control of temperature. A gas-fired boiler by Spencer-Bonecourt, Ltd., is provided for experiments in steaming. The design provides for wide variation of the conditions of time, temperature, and atmosphere, which influence the results of carbonisation. The gas obtained is drawn away by an exhauster and there is provided a complete train of condensers, tower scrubbers, purifier box and station meter with two 1000 cub. ft. gasholders for storage. It is proposed to embark at once upon a programme of experimental work.

The annual general meeting of the Chemical Society was held at Burlington House on March 27, Prof. W. P. Wynne, president, in the chair. In presenting the Longstaff medal to Prof. F. G. Donnan, the president referred to the very wide field covered by Prof. Donnan's important contributions to chemical science during the twenty-five years that had elapsed

since he first entered the lists of chemistry. These comprised three main divisions: (1) his investigations into the nature of colloid systems in the thermodynamical, electrical, and chemical aspects; (2) his work on the application of thermo-dynamic principles to chemical problems, and (3) his work in ionic chemistry, both on the purely electrical side and on the applications of the ionic theory to the mechanism of chemical change. The president stated that Prof. Donnan, by his own researches and by all those he had inspired, had established a position in British physical chemistry which is unrivalled. In receiving the medal, Prof. Donnan expressed his appreciation of the honour thus conferred upon him. The president then delivered an address entitled "Some Aspects of Russia's Contribution to Chemistry." A vote of thanks to the president for his address, proposed by Prof. H. E. Armstrong and seconded by Prof. H. B. Baker, was carried with acclamation. It was declared that the vacant places on the Council had been filled as follows: vice-presidents who had filled the office of president, Sir James J. Dobbie and Prof. W. H. Perkin; vice-presidents who had not filled the office of president, Mr. A. J. Greenaway and Prof. J. C. Philip; secretary, Prof. C. S. Gibson; ordinary members of council, Prof. D. R. Boyd, Dr. O. L. Brady, Dr. A. E. Dunstan, Mr. B. Lambert, Prof. T. S. Moore, and Prof. F. L. Pyman. At the informal dinner held the same evening at the Hotel Cecil there were present 260 fellows and guests.

ON Monday, March 17, Mr. Leon Gaster delivered an informal talk at the Institution of Electrical Engineers on the value of illuminating engineering to the electrical industry. The chief point which he sought to bring home was that recommendations affecting large sections of the community must be determined on scientific lines, and with due regard to the views of users of light as well as those by whom the light is furnished. For example, the requirements in a certain industry must be settled by conference with those engaged in it. Lighting conditions for schools must be decided with the help of educational authorities and in many cases other experts, such as medical men and architects, are needed. The idea that such requirements can be prescribed by makers of lamps and lighting appliances is erroneous. The public are being educated to demand scientific authority and will not accept without question the views of those concerned with the sale of light. Mr. Gaster quoted in support of this view a recent paper by Prof. E. F. Nichols explaining that in the United States it has been found wise to refer such problems to the National Research Council. In Great Britain there likewise exists machinery, such as the committee working under the Department for Scientific and Industrial Research, for the solution of such problems, and the electrical industry has everything to gain from the encouragement of genuine research on impartial and scientific lines.

DR. LANCELOT HOGBEN, of the University of Edinburgh, has been appointed Ray Lankester investigator at the Laboratory of the Marine Biological Association at Plymouth.

PROF. A. N. WHITEHEAD, who has been professor of applied mathematics at the Imperial College of Science and Technology, South Kensington, since 1914, has resigned his post and has accepted a chair in the faculty of philosophy at Harvard University.

THE Home Secretary has given notice that, in accordance with the Summer Time Act, 1922, Summer Time in Great Britain will begin this year at 2 o'clock, Greenwich Mean Time, on the morning of Sunday, April 13.

THE Secretary of State for the Colonies has approved the appointment of Dr. Stanley W. Kemp, Superintendent of the Zoological Survey of India, to be director of research on the *Discovery*. This vessel is being reconditioned in order to undertake research mainly into whaling, in the Dependencies of the Falkland Islands.

REFERRING to the article on acoustic depth sounding in NATURE of March 29, Sir Oliver Lodge writes: "As one who has had nothing to do with it, may I briefly comment on the remarkably ingenious and obviously practical sounding device so well described in your issue of to-day. Some one on the Admiralty Research Staff should surely be congratulated and thanked, in spite of his anonymity; and it is a welcome sign of international peace that such an invention—the outcome of much previous work—can be published."

PROF. J. A. FLEMING writes: "In your otherwise excellent account of the jubilee celebrations of the Physical Society, an error occurs in the abstract of my address on Friday, March 21 (NATURE, March 29, p. 466). Your report says that 'Guthrie himself showed in 1874 that red-hot iron loses negative more quickly than a positive charge.' This is the exact opposite of my correct statement at the meeting, namely, that in 1873 Guthrie discovered that a red-hot iron ball could not retain a charge of positive electricity but could retain a charge of negative electricity."

AT the meeting of the Faraday Society to be held on Monday, April 14, in the rooms of the Chemical Society, a report will be presented on an investigation of the chemical, physical, and explosive properties of Oppau ammonium sulphate-nitrate, by Sir Robert Robertson and Dr. G. Rotter, with appendices by Dr. H. H. Thomas, Mr. A. L. Hallimond, and Sir William Bragg. A short introduction by Sir Richard Threlfall will precede the report, giving briefly the conclusions of the Chemistry Research Board as to the causes of the Oppau explosion, which took place on September 21, 1921.

HIS ROYAL HIGHNESS PRINCE ARTHUR OF CONNAUGHT will be the principal guest at the official banquet of the Empire Mining and Metallurgical Congress to be held at the Guildhall by the courtesy of the City Corporation, on Thursday, June 5. The Lord Mayor and other distinguished guests will also be present, including official delegates from all parts of the Empire. The sessions of the Congress will be

held at the British Empire Exhibition on June 3, for which the various Conference Halls have been placed at the disposal of the convening bodies by the Exhibition authorities.

AT the annual general meeting of the Institution of Automobile Engineers, held on March 25, Dr. W. R. Ormandy was elected president for the session 1924–25. Messrs. L. H. Hounsfield, B. W. Shilson, H. Kerr Thomas, and C. Wheeler have been elected vice-presidents.

MR. J. H. THOMAS, Secretary of State for the Colonies, replying to a question in the House of Commons on Monday, March 31, stated that the Government had decided that in the scheme for the reorganisation of the Imperial Institute, the exhibition galleries of the Institute should be kept open. This decision had been made in view of representations and promises of financial support from certain Dominions, and of a very generous offer from Viscount Cowdray to contribute 5000*l.* a year towards the cost of the galleries. A Bill to give effect to this decision, and to the other recommendations of the Imperial Economic Conference regarding the Imperial Institute, is to be submitted to Parliament.

ENGINEER-CAPT. E. C. SMITH, R.N. (ret.), who is well known as a lecturer and writer on the history of engineering, has been appointed guide lecturer at the Science Museum, South Kensington, and took up his duties there on April 1. In the years 1921, 1922, Capt. Smith contributed to NATURE a weekly Calendar of Scientific and Industrial Pioneers which was much appreciated by many readers. Visitors to the Museum will be conducted around the various collections at 12 noon and 3 P.M. on each week-day according to a programme which will be varied from time to time. At present only the collections which are exhibited in the Old Buildings, Aeronautical Collection, and selected groups of the Science Collections, are available, but as galleries of the new Museum building are completed and occupied the conducted tours will be extended to these also.

NEARLY two years ago, the Society of Constructive Birth Control and Racial Progress appointed a special medical research committee "to consider critically the physiological and psychological reactions of various methods of control." The personnel of the Committee includes the medical vice-presidents of this Society and other medical and scientific members selected to represent various points of view. The members of the Committee are: Sir James Barr, Sir William Bayliss, Mr. Harold Chapple, Dr. Jane Hawthorne, Mr. Geo. Jones, Dr. Maude Kerslake, Sir W. Arbuthnot Lane, Sir John MacAlister, Sir Archdall Reid, Dr. Christopher Rolleston, Dr. D. Sommerville, Dr. Marie C. Stopes, Dr. H. M. Telling, Dr. Mather Thomson, and Mr. E. B. Turner. In accordance with the objects of its foundation, the Committee has considered a variety of current affairs concerning contraception, but its proceedings and minutes are strictly confidential and none of its deliberations are published, except about points which are specially passed for publication. At the last meeting of the Committee the following resolution was passed for publication in suitable quarters: "The Medical Research Committee of the Society for Constructive Birth Control and Racial Progress wishes to place on record its joint and several opinion that the methods now used at the Mothers' Clinic are the best known at the present time." Communications from any one desiring to bring matters for discussion before the Committee, or to present scientific results for its consideration, will be welcomed by the Hon. Secretary, C.B.C., 7 John Street, Adelphi, London, W.C.2.

Our Astronomical Column.

OCCULTATIONS OF ALDEBARAN.—This, the brightest star in Taurus, and situated in the group called the Hyades, will be hidden by the moon on four occasions during the present year, namely:

	Disappears.	Reappears.
April 8 . . .	8.47 P.M.	9.33 P.M.
June 29 . . .	3.20 P.M.	4.20 P.M.
August 23 . . .	4.7 A.M.	4.56 A.M.
October 16 . . .	7.37 P.M.	8.22 P.M.

Three of these phenomena will be easily observable if the condition of the atmosphere is suitable. But that in June will require a good telescope, as it occurs in the strong sunshine of the early afternoon.

Occurrences of this kind are of great interest to the amateur astronomer. When an occultation of Aldebaran occurs at night the star may be watched with the unaided eye until the moon approaches very close to it. In fact, the disappearance of the star might be observed without instrumental aid by persons who possess acute vision, but only on occasions when the moon happens to be in a crescent form. When either gibbous or full, the light from the moon is so strong as to overpower that of the star, and a field-glass or small telescope is necessary to enable the occurrence to be witnessed.

MERCURY.—The most favourable appearance of Mercury during the year will occur in April within the fortnight April 7-21. The planet sets more than two hours after the sun during the greater part of this period and may be viewed after sunset over the W.N.W. horizon.

It is often stated that Mercury can be observed only with great difficulty, but this is scarcely true, for when an observer can command a good open view of the horizon and the weather is suitable, the planet may be recognised with comparative ease. Its brightness is quite equal to, and sometimes exceeds, that of a first magnitude star, so it is not too faint to be seen; in fact, a person with inferior sight may distinguish the planet if he knows exactly where to look and surveys the sky at a time when the air is suitable for his purpose. That Mercury is not often seen in England is attributable to the circumstance that clouds are very prevalent in this country and particularly so near the horizon. Should any difficulty be experienced in finding the planet, it will be desirable to search along the horizon with an opera or field glass of low power. The object will probably soon be detected in this way, and may afterwards be glimpsed with the unaided eye and followed until it sets if the air is fairly free from the mist or fog which often floats about at low altitudes.

Research Items.

CLAY FIGURES OF PALÆOLITHIC AGE.—In *La Nature* for March 8, M. P. Barrau de Lorde records the discovery by M. Norbert Casteret of some remarkable examples of palæolithic art from the neighbourhood of Saint-Martory (Haute Garonne). In the hitherto unexplored parts of a cavern through which a subterranean stream runs for a distance of 1200 metres, M. Casteret found in a side gallery, not only rock carvings of bison, deer, horses, and a human head, but also clay models in the round and in bas-relief. A number were nearly destroyed by the action of the water, but some fine figures of horses were fairly well preserved. A natural head had evidently been employed to complete the figure of a crouching bear, as the skull lay between its fore-paws. Three lions, or tigers, which were attached to the wall, measured 1·70 metres in height and 1 metre in length. The bear and the tigers were covered with holes representing javelin thrusts. Geological evidence indicates that these figures and carvings date from a cold and very dry period, when the subterranean stream was dry or very low, and permitted ingress to the parts of the cave now inaccessible except by diving. The find is notable in that the only previous discovery of clay figures of palæolithic age is that made by M. le Comte Bégouen at the Tuc d'Audoubert in 1912.

CEREMONIAL OBJECTS IN STONE AND ALGONKIN SYMBOLISM.—Mr. H. Newell Wardle has published in the Proceedings of the Academy of Natural Sciences of Philadelphia, vol. lxxv., an attempted correlation of the obscure "ceremonial stones" of North America with the mythology and pictographic symbols of the Algonkin stock. Broadly speaking, the distribution of these ceremonial stones coincides with that of this stock. The cone, it is suggested, represents the domed back of the turtle, which in the creation legends of the Delaware appears as the earth and in the pictographs supports the hero-god or the people. The so-called boat-stones represent the "stone canoe" of the culture hero Michabo, the visible sign of his power. Birds were peculiarly sacred to Michabo among the Algonkin, and names of birds were favourites as personal designations, hence the ceremonial use of bird forms in stone. The "banner-stones," the most discussed of all the forms, it is suggested were ceremonial objects primarily intended to be mounted on a staff and representing in their forms not the thunder bird alone, but also other superhuman powers. For the stone tablets with one or two holes, various symbolic meanings are suggested, such as the tortoise, the world—a four-lobed form—the heart as the source or centre of life and the emotions, the beaver, the wolf's foot, the turkey, and, again, the thunder bird.

ZOOLOGICAL NOMENCLATURE.—The following Opinions (78-81) have been rendered by the International Commission on Zoological Nomenclature. Opinion 78: On the basis of the premises presented, *Dermacentor venustus* dates from Marx in Neumann, 1897, type specimen Collection Marx No. 122 (U.S. National Museum), from *Ovis aries*, Texas, and that *Dermacentor andersoni* dates from Stiles, 1908, holotype U.S. P. H. & M. H. S. 9467, from Woodman, Montana. Opinion 79: "Rigidly construed," Lamarck's (1801a) Système des Animaux sans Vertèbres is not to be accepted as designation of type species. Opinion 80: The Echinoderm genus Holothuria Linn., 1767, restr. Bruguière, 1791, type *H. termula* 1767 = *H. tubulosa* 1790, and the Siphonophoræ genus Physalia Lamarck, 1801, type *P. pelagica* 1801 = *Holothuria physalis* 1758, are hereby placed in the Official List of Generic Names. Opinion 81: On the basis of the premises before the Commission, the common bedbug of Europe, *Cimex lectularius*, is the genotype for Cimex 1758, Acanthia 1775, Clinocoris 1829, and Klinophilos 1899 (Cliniophilus 1903), and its proper technical designation under the Rules is *Cimex lectularius*. Cimex Linn., 1758, type *C. lectularius* is hereby placed in the Official List of Generic Names.

MALAYAN BLATTIDÆ.—Dr. R. Hanitsch, who has been carrying on his work on the Malayan Blattidæ in the Hope Department of the Oxford Museum, has lately published a second part of his treatise, thus completing his monograph of the group. The value of a work of this kind depends on the care with which the literature of the subject is searched, and the accuracy with which the descriptions of new species are drawn up and the synonomy of known forms is determined. These requirements are well met in the present treatise, which will accordingly not only be indispensable to those interested in the systematic study of the group, but will supply good material for the use of workers in questions of general biology. Problems of especial importance are those arising from the facts of geographical distribution, and on these studies such faunistic data as are supplied by Dr. Hanitsch's treatise are of undoubted value. It is interesting, for example, to gather from the distributional tables on pages 462 to 468, that while 44 species of Blattidæ are recorded from Java and not from Borneo, and 82 from Borneo and not from Java, only 27 appear to be found in both islands. A conspicuous example of sexual dimorphism occurs in *Cabara rugosicollis*, where the male is slender, delicate, and long-winged, while the female is short, stout, and entirely apterous, with a dense brush on the anterior tibiæ. This structure may be of use, as has been suggested by Mr. Hamm, to the female for cleaning itself, the insect being of a burrowing habit, and the work of burrowing being probably undertaken by the female alone. The monograph is well illustrated by the author's text-figures and two coloured plates by Mr. Valentine Knight.

PLANKTON OF THE SARGASSO AND MEDITERRANEAN.—No. 7 of the Reports of the Danish Oceanographical Expeditions of 1908–10 in the Mediterranean and adjacent seas (Copenhagen, 1923) contains several papers on the biological results and some miscellaneous papers of particular interest. The limits of the Sargasso Sea have been determined for the first time by observations of the density of the floating weed, and there are also good descriptions of the systematic forms of Sargassum. A number of collections of the macroplankton of this region were also made by using surface nets in a standardised way and counts of the organisms so obtained were made. The result is to confirm the estimates made by Victor Hensen: the Sargasso Sea and its margins are characterised by a relative paucity of macroplanktonic life when compared with the North Atlantic south from Greenland, round Iceland, north and west from Great Britain, the North Sea and the Bay of Biscay. The Mediterranean also shows this paucity of planktonic life. It is pointed out that the same general results were also obtained by Lohmann in a study of the microplanktonic life. The report in question contains an account of drift bottle experiments made in the Sargasso Sea and a further account of the elvers of North and South Europe.

COTTON DUSTING FROM AEROPLANES.—Bulletin 1204 of the U.S. Dept. of Agriculture (published January 1924) is of exceptional interest. It is

written by Mr. B. R. Coad, entomologist, Mr. E. Johnson, agricultural engineer, and by Lieut. C. L. McNeil of the U.S. Air Service, who have worked in collaboration on cotton dusting from aeroplanes. The possibility of applying insecticides by means of aeroplanes was first brought to public notice in August 1921 by the State Experiment Station of Ohio, in co-operation with the U.S. Air Service. In this test lead arsenate was distributed from an aeroplane over a grove of catalpa trees attacked by larvæ of the catalpa sphinx (*Ceratomia catalpæ*). The experiment proved successful, and suggested the need for further tests of a similar nature. The possibility of using the aeroplane to combat the cotton-boll weevil immediately suggested itself. An opportunity, however, was afforded to test this method of insecticide distribution in combating an outbreak of the cotton leafworm (*Alabama argillacea*). Arrangements were accordingly made with the Air Service of the U.S. army for detailing aeroplanes for the purpose. The result of the experiment, using calcium arsenate, was quite satisfactory, and, as nearly as could be determined, about 2 lb. of this compound per acre delivered from an aeroplane proved as effective as 5 lb. per acre delivered from a ground machine. Somewhere about 400-500 acres can be dusted per hour, but only a smaller portion of this time is devoted to the actual process: much time, on the other hand, is occupied in going backwards and forwards for fresh supplies of arsenate, as the containers were only adapted to hold about 125 lb. of the poison. The same terrain was infested with the boll weevil, but the extent to which this pest was controlled as the result of the operation was uncertain, and only casual observations were made. The practicability of effective dusting from an aeroplane seems well established, but whether it will prove equally successful against insects other then openly-feeding lepidopterous larvæ further trials can alone decide.

THE "ROSS DEEP" OF THE SOUTHERN OCEAN.—A single sounding of "4000 fathoms, no bottom," which Sir J. C. Ross took in 1843 in lat. 68° 34′ S., long 12° 49′ W., led to a belief in a great area of very deep water in that part of the Southern Ocean, and the probable high southern latitude of the coast-line of Antarctica. In 1904 the *Scotia*, under W. S. Bruce, re-sounded within a mile of Ross's position and found 2660 fathoms. The explanation of Ross's mistake is that his hempen sounding rope was carried northwards by a strong undercurrent which certainly exists in that area. Lt.-Com. R. T. Gould has found in the Hydrographic Department a report by Ross on this sounding, which is published in the *Geographical Journal* for March. It is of considerable interest, since the time taken for each successive 100 fathoms to pass out of the boat are recorded. These data show a steady retardation in the speed of the line until 2200 fm. had been run out. Then occurred a sudden and well-marked retardation which remained constant for a long time. Lt.-Com. Gould rightly suggests that this change at 2200 fathoms was due to the sinking striking the bottom: beyond that the line was lying on the floor of the ocean. A depth of 2200 fathoms within a mile or so of the *Scotia's* 2660 fathoms is not improbable.

POLYGONAL SURFACE MARKINGS.—The polygonal surface markings of Spitsbergen and some other parts of Arctic regions are well known and have been studied by Wulff, Högbom, Nansen and others, but are not yet fully explained. In the *Geographical Journal* for March, Messrs. J. S. Huxley and N. E. Odell record their observations on these markings in Spitsbergen and throw some new light on their formation. Of the two kinds, the fissure polygons, which are separated from one another by cracks and show no differential distribution of fine and coarse material, arise in damp fine-ground soil, in the first instance, either by drying or by contraction at thawing. Repeated frost action helps to reinforce this process. The stone polygon, with a characteristic border of large stones and a centre of sticky mud, is much more difficult to explain. Högbom explains their origin by repeated acts of freezing causing differential movement in mixed soil of various sizes. This leads to the materials being sorted according to size. Nansen believes, on the other hand, that this kind of polygon originates round the edge of snow patches when the splitting action of the frost is operative throughout the summer owing to the supply of moisture from the snow. Thus differential weathering occurs. The authors think that the true explanation is to be found in a combination or extension of the two theories, and they discuss the evidence in considerable detail. The paper is an important contribution to the study of polygonal markings even if it does not solve all the puzzling aspects of the subject.

PLANORBIDÆ IN THE INDIAN MUSEUM, CALCUTTA.—In 1921 the first part was issued of a "Catalogue of the Planorbidæ in the Indian Museum (Natural History), Calcutta," by Dr. Louis Germain (Rec. Ind. Mus., xxi.). The final, fourth, part has now come to hand containing the plates and index. The whole will be a valuable reference work, though not a trustworthy guide, for students of this group. Dr. Germain has adopted Dall's classification as originally published in 1905 (Harriman Alaska Exped., xiii.), errors and all, but has apparently overlooked that writer's important modifications which appeared in 1908 (Proc. Malac. Soc. Lond., viii.). Where Dr. Germain has added to Dall it has not always been successfully done. Thus in the synonymy of the genus he includes Cornu of Schumacher, which, as a matter of fact, does not contain any form approaching Planorbis. The plates are mostly phototype and good of their kind, while there are excellent text illustrations.

CLOUD-HEIGHTS AT MELBOURNE OBSERVATORY.—The report of the Australasian Association for the Advancement of Science, vol. 16, 1923, contains a discussion on the above by Capt. E. Kidson. Observations were made by means of photographs for the absolute determination of the height and velocity of clouds at the Melbourne Observatory under the direction of Mr. P. Baracchi, the Government Astronomer, during the years 1897–1901. The observations were part of a scheme agreed upon in 1894 at the Upsala meeting of the International Meteorological Committee. In all 430 pairs of photographs were taken and measured, but the final reductions were not made. The author became attached to the Central Weather Bureau at Melbourne in 1921, and shortly afterwards undertook the discussion of the observations. In the scheme for obtaining the observations, two cameras, as nearly as possible identical, were mounted with their axes vertical at two stations 6820 feet apart. Precise details are given of taking and dealing with the observations, which may be helpful to others carrying out similar work. The individual observations of the several clouds and the general meteorological conditions are given in tabular form. A summary of the results shows that *true cirrus* ranged in height from 20,000 ft. to 42,000 ft., most frequently at 36,000 ft. to 38,000 ft., and 32,000 ft. to 34,000 ft. *Cirro-stratus* ranged from 20,000 ft. to 39,000 ft., the great bulk being between 26,000 ft. and 36,000 ft., with a pronounced maximum

at 29,000 ft. *Cirro-cumulus* ranged from 18,000 ft. to 34,000 ft., the maximum frequency being between 24,000 ft. and 26,000 ft. *Cumulus*, greatest height recorded, 14,000 ft. *Strato-cumulus* was recorded up to 12,000 feet. Cirrus is the most rapidly moving cloud, averaging more than 70 miles per hour. In the great majority of cases the centres of depressions pass to the south of Melbourne.

POWDERED COAL IN FURNACES.—The use of powdered coal in furnaces has raised the question of the rate of fall of the powder through the furnace gases and its bearing on the problem of the speed of combustion. A discussion of the laws of fall of such a particle by means of the theory of dimensions was undertaken by Mr. J. Blizard of the United States Bureau of Mines, and his paper is contained in the issue of the Journal of the Franklin Institute for February. He shows that the measurements of the terminal velocities of dust particles of various densities falling in different gases made recently by M. E. Audibert (*Annales des Mines*, vol. 1, p. 153) can all be expressed by the equation $3{\cdot}4v = (\rho/\rho_0)^{0{\cdot}44} r^{0{\cdot}9} (1/\nu)^{0{\cdot}27}$, where v is the terminal velocity, r the radius, and ρ the density of the particle, ρ_0 the density and ν the kinematical viscosity of the gas. For practical furnace calculations the gas may be taken as air.

PHOTO-ELECTRIC ACTION IN COLOURED ROCK SALT CRYSTALS.—Herr J. Bingel has recently employed W. C. Röntgen's method for measuring the "photo-electrical current in naturally and artificially coloured rock salt," *Zeitschrift für Physik*, Feb. 16, 1924. The same conditions were made use of which were employed by Gudden and Pohl with the photo-electrically conducting crystals having a refractive index greater than two, which show the simple phenomena of the photo-electric current. With the rock salt crystals it was found that the measurements are reproducible even after some weeks; there is a linear connexion between current and voltage, and no sign of saturation even at 50,000 volts/cm. The current is proportional to the amount of luminous energy employed; with partial illuminations the additive law holds. The observations made leave it undetermined whether there is real photo-electric conduction or polarisation of the dielectric. A comparison of the "output" of current with the quantum equivalent law rather suggests that there is true conduction; in any case, it appears that the phenomena cannot be due to movements of electrical charges merely through molecular distances. Quantitative determinations were made of the diminution of the photo-electric "currents" with time observed by Röntgen.

α-PARTICLES FROM POLONIUM.—In the *Zeitschrift für Physik*, February 25, 1924, Herr W. Kutzner describes an elaborate series of measurements on α-radiation from polonium, using Geiger's method of counting the α-particles, which depends on the excitation of a point discharge. A platinum point, enclosed in a small metal chamber to which the α-rays were admitted, was connected to the grid of a triode valve; the anode and cathode were connected through a battery to the primary of a transformer, the secondary being connected to a string galvanometer with photographic registration. Time divisions on the records, in which the number of particles counted lie near the mean value, occur more frequently than is to be expected according to the law of probability, and those in which this number is above and below the mean less frequently. In other words, the "cocked-hat" curve is distorted. This is the more marked the greater the activity of the preparation per square millimetre. It is suggested that there must be some mutual action between the single polonium atoms, or between single α-particles and the atoms, to account for this. An α-particle, colliding with an atom which has approached the condition in which disintegration takes place, may break it up, just as in Rutherford's experiments the atoms of some of the lighter elements are disintegrated by α-ray bombardment.

THE HIGHER ORDER SPECTRA OF ARGON, KRYPTON, AND XENON.—Messrs. L. and E. Bloch have studied the spectrum of mercury vapour in a tube without electrodes, using an oscillating discharge, and have found that there are three different orders of spectrum, E_1, E_2, and E_3, which probably belong to the ions Hg^+, Hg^{++}, and Hg^{+++}; in collaboration with M. G. Déjardin, they have employed the same method with argon, krypton, and xenon, and describe the results in *Comptes rendus* of the Paris Academy of Sciences of Feb. 25. With the first two gases, when the potential is gradually raised the reddish ring characteristic of the arc spectrum is first observed, then a blue ring showing the spark spectrum of the first order, and finally a white ring which accompanies the formation of the spectra of higher order. With xenon it is difficult to distinguish the first phases, and a very bright white ring is very quickly produced. In the spectroscope the arc lines appear first as long lines, and then the first order spark lines begin to appear as short lines at the edges; they have already developed into long lines when the higher order lines begin to show as short lines. In most cases it is possible in this way to classify the lines with certainty. There are certain recognisable analogies between the corresponding spectra of the three gases. The spectrum E_1 is the most intense one and has most lines; it reaches from the extreme red to the extreme ultra-violet; E_2 has fewer lines, and starts suddenly at the end of the violet or the commencement of the ultra-violet, with no lines in the visible part of the spectrum; E_3 has lines distributed fairly regularly throughout the spectrum, but they are more numerous in the ultra-violet.

FOUR-WHEEL BRAKES FOR MOTOR CARS.—The question of fitting brakes to all the wheels of a motor car has attracted considerable attention recently, and an interesting discussion is given in a paper read before the Institution of Automobile Engineers by Mr. F. A. Stepney Acres. There are various arrangements possible, namely: (*a*) the front and rear wheel brakes independently operated, (*b*) semi-independent, (*c*) coupled, and in each of these there are combinations of hand-operated and foot-operated brakes. A case is made out for the independent type with hand-operated front brakes and foot-operated rear brakes on the grounds of efficiency, trustworthiness, simplicity, weight and cost. The author cannot say a good word for the coupled system, under present conditions at any rate; it is heavy, complicated, and costly as compared with independent brakes, and cannot possibly give the best holding power under all conditions, good and bad. The difficulties of fitting brakes to the front wheels are purely mechanical, and hinge chiefly on the lack of rigidity between the brake shoes and the frame, more particularly in the axle itself. The risk of fitting front brakes to a chassis not originally designed for them is also pointed out. A table giving the results of stopping tests with four-wheel brakes is given in the paper, from which it appears that the coefficient of friction between the tyres and the road may reach, or exceed, unity. One example taken from the table is that of a vehicle travelling at 30 miles per hour and pulled up in a distance of 28·4 feet; this gives a value for μ of 1·06.

Some Scientific Aspects of Scottish Fisheries.[1]

At ever-recurring periods, for at least eight hundred or nine hundred years, appeals have been made to the Legislature concerning the decadence of the fishing industry; yet the harvest of the sea continues century after century, notwithstanding the fears of the fishermen and the distrust or indifference of the public. Without alluding to the earlier Commissions or Committees, the Commission of 1863, including Prof. Huxley, Lord Eversley, and Sir James Caird, first resolutely set itself against the prevailing view of the impoverishment of the sea—solely from the evidence brought before it. Frank Buckland's inquiry, somewhat later, adopted the same view. In 1883 Lord Dalhousie's Commission made a new departure and appointed a scientific zoologist to make investigations on sea and in laboratory. Amongst the results were the institution of statistics and the closure of certain bays for experiments, the results of which after ten years' work have been duly dealt with elsewhere. Now comes the Departmental Committee, which, without much allusion to previous investigations, has carefully and conscientiously treated the subject from evidence *de novo*.

Scientifically, the ocean and its finny inhabitants are either capable of holding their own against man and other predatory forms, or they are not. The Departmental Committee seems to have been impressed with a fear that the latter condition prevails and that intensive fishing and the destruction of the young is slowly but surely leading to disaster. But the same fear has been present from time immemorial, and rests on no solid scientific foundation. We know that from early times vast myriads of the eggs of the food-fishes (as "roe") have been placed on the slabs for sale, their numbers far exceeding any destruction of adult or young caused by man or by other enemies. If the annual drain of such prodigious numbers fails to affect the plenitude of the food-fishes, it is unlikely that any method of fishing devised by man can.

Further, the destruction of ova by the fishes themselves is an important factor. Thus the stomachs of no less than eighty boxes of large haddocks have been found filled with the ova of the herring, whilst the cod is no less greedy. Yet in neither case are the hordes of the herring affected. Indeed, large bays are sometimes carpeted with newly hatched herrings like chopped threads. Again, the young of the sole, a species so often despaired of, has been almost daily destroyed by the shrimpers at the mouth of the Thames, and yet for eight hundred years this has gone on without affecting the safety of the adults. The plaice, now so prominently brought forward for protective legislation, is known to be distributed in its adult state over the whole of the northern North Sea (in reference to Scotland), so that the haven of rest supposed by the Departmental Committee to be in the Moray Firth is of slender consequence for the supply of ova, which are supposed by the Scottish Fishery Board and the Committee to be carried by currents from the Moray Firth southward along the Scottish shores. Unfortunately, these currents lately were found moving in the reverse direction.

The Committee, again, appears to think that the Moray Firth is the locality most frequented by spawning plaice and cod, and the chief source of the supply for the northern North Sea. There are many other spawning areas of both species off the Scottish shores. The statement the Committee gives of the life-history of the haddock is too brief, for whilst both haddock and cod spawn in deep water, the subsequent ways of the fishes are wholly divergent, for the young cod seeks the inshore water when about an inch long, whereas the young haddock keeps to deep water until it ranges from three to five inches in length.

The fertilisation of the eggs of the plaice in the upper layers of the water also needs explanation, and the body of the post-larval plaice is deeper than that of a round fish. The plaice and the haddock (shoals of large examples of which frequent the Moray Firth) are thought by the Committee to be at present in danger, but so long as the multitudes of the tiny young of the plaice appear at the margin of the tide in sandy bays the species is safe. In the same way, so long as the larval and post-larval haddock keeps to deep water, the safety of the species is secured—notwithstanding the regrettable destruction of forms five to seven inches in length by both liners and trawlers. Further, so long as swarms of gadoids (haddocks included) occur north of the North Sea—more than sufficient to supply the whole area of that sea—so long will the haddock be secure. Persistent trawling or seining in a limited area doubtless will diminish the larger forms, but the multitudes of young by-and-by fill the gap. The waste of young fish-life in most methods of fishing is to be deplored, and, if possible, prevented, but it has not hitherto been disastrous.

The Committee makes a strong point of the accumulation of large plaice in the North Sea after the War, but it does not mention that such may have been due to the eager rush of all kinds of vessels to the pursuit, and that opinions were divided on this subject. Further, the notion that, as time passes, trawlers go farther and farther to sea because the home grounds are exhausted, needs modification, since long before trawling was introduced, for example in Australia, it was noticed that the liners followed exactly the same course as years advanced.

The Committee in its anxiety as to the safety of the fisheries states, amongst the adverse circumstances which may affect them, that the eggs of the fishes may not be fertilised, but no unfertilised egg has been met with by the writer in the tow-net; nor do currents and hydrographical changes disturb the ways of Nature, other than at a meeting of surging waters the eggs are sometimes carried to the surface, and thus the ducks are enabled to feed on them. There is no lack of nourishment, for the food of the larvæ and young fishes abounds in the sea at all times. Lastly, the decimation by enemies may be noteworthy, but is found to be negligible. It is concluded that biological data must be attended to before making detailed regulations, an advice given by Lord Dalhousie's Commission in 1885.

Whilst the foregoing criticisms are deemed necessary, it is evident that the Committee has spared no labour in its office, and, though it did not search the sea itself in the *Norna*, its finding is the result of cautious and independent judgment. Nevertheless, the fisheries of our own and other maritime countries—buttressed by all the complex resources of Nature—have stood the test of so many centuries that there are grounds for confidence rather than distrust.

W. C. M'Intosh.

[1] Report of the Scottish Departmental Committee on Trawling and Policing of Scottish Sea Fisheries. (H.M. Stationery Office, 1924.) 5s. 6d.

Models of Sailing Ships in the Science Museum.[1]

ONE of the rarest sights at sea to-day is a ship under full sail. According to Lloyd's Register there are at present only 125 iron and steel sailing vessels owned in Europe which are occupied on long voyages, and only five of these fly the Red Ensign. A hundred years ago steam tonnage was insignificant; fifty years ago it nearly equalled our sailing tonnage, but to-day steam and oil have practically driven the sailing ship from the ocean. Moreover, sails disappeared from fighting ships some thirty years ago, and not a single able seaman now in the Navy was trained in the fine old school of masts and yards.

These considerations lend peculiar interest to the beautiful models of notable sailing vessels preserved at the Science Museum at South Kensington, and to the new Catalogue of them, recently issued by the Board of Education. In the Museum the collection illustrating water transport is divided into ten sections: (i.) Sailing ships; (ii.) mechanically propelled vessels; (iii.) smaller vessels; (iv.) ship design and construction; (v.) marine engines; (vi.) marine boilers; (vii.) propellers; (viii.) marine auxiliary machinery; (ix.) harbours and docks; (x.) rivers and canals. It is, however, apparently not intended to issue catalogues for each of these sections, for though that under notice is confined to sailing ships, the next catalogue will deal with steam ships of war, and will no doubt treat of both ships and machinery.

Beginning with primitive craft and early ships, the Catalogue then refers to fifteenth- and sixteenth-century ships, seventeenth- and eighteenth-century ships of war, nineteenth-century sailing ships of war, and finally merchant sailing ships. Altogether some 232 exhibits are described, and twenty-three are illustrated, the photographs fortunately being placed among the text and not grouped at the end as in some of the museum catalogues. One illustration of surpassing interest is that of the fine rigged model of the *Santa Maria* (Fig. 1), the flagship of Columbus on his epoch-making voyage of 1492, the model being a present from the Spanish Government. Other illustrations include H.M.S. *Prince*, built by Phineas Pett at Chatham in 1670, H.M.S. *Vanguard*, a famous *Symondite* ship of 1835, the clipper *Stonehouse* of 1863, and the four-masted barque-rigged ship *California*, the last and the largest of the sailing vessels of the White Star Line. Of 3099 tons gross register and 329 feet long, she was surpassed in size

FIG. 1.—S. *Santa Maria* (1492). From "Catalogue of the Collections in the Science Museum, South Kensington. Water Transport: 1. Sailing Ships." By permission of the Controller of H.M. Stationery Office.

[1] Board of Education. Catalogue of the Collections in the Science Museum, South Kensington, with Descriptive and Historical Notes and Illustrations. Water Transport. 1. Sailing Ships. Compiled by G. L. Overton. Pp. 71+12 plates. (London: H.M. Stationery Office, and the Science Museum, 1923.) 1s. net.

by a few other vessels, and Mr. Keble Chatterton in his fascinating book on "The Sailing Ship" says the largest of all such ships is the German five-master, the *Preussen*, 407·8 feet long, 53·6 feet broad, and 27·1 feet deep.

Besides the descriptions and illustrations, the Catalogue contains short articles on the progress of ship construction, and here we meet with such names as Peter and Phineas Pett, Anthony Deane, Bouguer, to whom we owe the discovery of the metacentre, Sir Robert Seppings, and Admiral Sir William Symonds, the last Surveyor of the Navy to design and build a purely sailing ship. These notes will be of considerable assistance to the student, and should be read in conjunction with the opening chapter of the late Engineer-Commander F. L. Robertson's "The Evolution of Naval Armament."

While the Museum contains models of many notable ships, it is still without one of Nelson's *Victory*. There is an engraving of the ship dated 1781, but now that through the untiring efforts of Admiral Sir Doveton Sturdee the famous flagship is in a fair way to be preserved to the nation, it is to be hoped this blank will be filled. In future editions of the Catalogue we should like to see a spirited sketch of the *Victory* on the cover. This we feel would prove far more attractive to the youthful visitors to the Museum than the "blue book" style of binding nearly always adopted for Government publications. Eng.-Capt. E. C. Smith, who has just been appointed guide lecturer to the Science Museum, will have few more interesting subjects to talk upon than that dealt with in this Catalogue.

Forests and Rainfall.

THE question of the influence of woodland upon rainfall is a very old one, yet it cannot be said even now to be fully answered. While there is indisputable evidence from all parts of the globe that the reckless destruction of forest-growth has brought progressive desiccation in its train, it has only comparatively recently come to be realised that the problem is essentially hydrological rather than meteorological. When, indeed, one reflects that a forest is itself primarily an adaptation to rainfall and other climatic conditions, it is somewhat surprising that the earlier investigators should have expected to find anything more than a secondary reaction of the forest upon rainfall. No doubt the characteristic type of forest prevailing in moist regions like Europe helps by maintaining the humidity of the atmosphere to equalise, if not slightly to increase, the rainfall over the year as compared with denuded tracts; but, on the other hand, recent research by Quayle in Australia (Proc. Roy. Soc. Victoria, vols. 33 and 34, 1921 and 1922) has shown that where forest and scrub are composed of drought-resisting species, reducing transpiration to a minimum, a distinct increase of rainfall has followed deforestation in the interests of settlement and the replacement of xerophilous vegetation by grass and crops.

It is, however, as a hydrological agent that forest plays an immensely important part in conserving moisture in the soil, regulating its discharge into rivers, and in general modifying the natural drainage of a country—though the precise effect must vary with the nature of the country and the climate. It is satisfactory to find that this deeper understanding of what is in reality a very complex problem in physical geography is leading to investigations abroad, as in Italy, where, according to Prof. Filippo Eredia, the various hydrological services are studying the relation between rainfall and woodlands in all its aspects ("Boschi e precipitazioni acquee," *La Meteorologia pratica*, N. 1, 1922).

One very important fact bearing upon this subject remains to be pointed out. It was shown by that eminent climatologist, Julius von Hann, that there is a way in which forests *do* very decidedly increase "rainfall" in the broader sense of the term, namely, by collecting the moisture of fog. This is especially true of hill-fog and mountain-mist. Upland fog is, by its different mode of origin, normally wetter than lowland fog, and on drifting across wooded mountain slopes deposits large quantities of moisture. Even in the drier lowland fogs produced by radiation on cold nights, it is a familiar fact of observation that there is a constant dripping of water beneath trees, which, when the temperature is below freezing-point, become heavily decked with rime, often collecting on the ground like a light snowfall.

In this connexion, the experiments of Dr. Marloth on Table Mountain in the opening years of this century, and published in the *South African Journal of Science* and elsewhere, deserve to be more widely known. He showed that the vegetation of the mountain, as well as rain-gauges fitted with wire-netting, collected large quantities of water from the hill-mists produced in the moisture-laden S.E. Trade. L. C. W. B.

University and Educational Intelligence.

CAMBRIDGE.—F. P. Ramsey, scholar of Trinity College, has been elected to the Allen scholarship.

LONDON.—Prof. A. E. Jolliffe has been appointed as from August 1 to the University chair of mathematics tenable at King's College. As a scholar of Balliol College, Oxford, he won the Junior and Senior University Scholarships in Mathematics, and in 1892 he was elected to a fellowship at Corpus. Since 1920 Prof. Jolliffe has been University professor of mathematics at Royal Holloway College, and he has published papers in various learned journals. Mr. J. Dover Wilson has been appointed as from August 1 to the University chair of education tenable at King's College. From 1906 to 1909 Mr. Wilson was Lector in English language and literature at the University of Helsingfors, and since 1912 he has been special inspector in English, history, and economics under the Board of Education.

Having learned that the Board of Education proposes to revive this year the scheme for the award of State scholarships to assist scholars from grant-aided Secondary Schools in England and Wales to attend university institutions, the Senate has resolved to inform the president of the Board of Education that it welcomes the revival of the scheme and will make the necessary arrangements for the nomination of candidates. The Senate has appointed a committee to advise the Board of Education as to the amount of grant which shall be awarded in aid of fees and students' maintenance.

Grants have been made from the Publication Fund as follows:—Mr. H. Frankfort: 40*l.* in aid of the publication by the Royal Anthropological Society of his M.A. thesis entitled "Studies in Early Pottery of the Near East." Mr. R. H. Tawney and Miss E. E. Power: 100*l.* in aid of the publication of their book on "Documents illustrating Tudor Economic and Social History." Prof. R. C. Priebsch: 45*l.* in aid of the publication of his work on "The Heliand Manuscript." Prof. H. H. Dixon: 30*l.* in aid of the publication by the University of London Press of his advanced lectures on "The Transpiration Stream."

The degree of D.Sc. (*Economics*) has been conferred

on Miss G. M. Broughton, of the London School of Economics, for a thesis entitled "Labour in Indian Industries."

THE Council of the University of Paris has decided to confer honorary doctorates on the following men of science: in the faculty of science, Prof. H. A. Lorentz (Leyden) and Dr. C. D. Walcott (Washington); in the faculty of medicine, Prof. W. Wright (London) and Prof. Ramón y Cajal (Madrid).

DR. J. KENNER, senior lecturer in chemistry at the University of Sheffield, has been appointed professor of organic chemistry at the University of Sydney. During the War, Dr. Kenner was in charge of the big gas station at Calais. During the fourteen years he has been at the University of Sheffield, he has carried out numerous researches in organic chemistry.

THE Baghdad correspondent of the *Times* records that on March 15, the anniversary of the declaration of Arab independence in the Hejaz, King Feisal opened the first block of the new Baghdad University of Al al Bait, and laid the foundation stone for the central administrative building.

THE results of a noteworthy experiment in the technical training of apprentices in France are recorded in the November issue of the Bulletin of the Société d'Encouragement pour l'Industrie Nationale. Three years ago the founders, Bonvillain and Ronceray, with the support of the Union of Moulders, instituted a course for the technical training of their first-year apprentices which proved so successful that courses for the second- and third-year men were added. Last year a competition was held in which each apprentice was required to produce a casting and to answer verbal questions addressed to him by judges appointed by the Union of Moulders. The results of the competition are given in the Bulletin along with photographs of the prize-winners and their castings. Some of these are remarkable as showing what a boy of fifteen properly trained for a year or eighteen months can do. The Union of Moulders has also started Sunday morning courses for foremen, and an evening technical school for more advanced work opened on January 7 at a fee of 500 francs per session.

THE International Federation of University Women has published in its "Occasional Paper No. 3, March 1924" a preliminary programme of its third conference, to be held at Christiania on July 28 and four following days. Among the subjects proposed for discussion is the training and experience needed for work in politics, industry, commerce, international finance, the handling of raw materials, etc. On this subject Prof. Caroline Spurgeon, of Bedford College, president of the Federation, has given a lead in an interesting article published in the same paper. She points out that whereas women are every day coming more and more into positions of responsibility and power, their education and experience are not progressing at the same rate. Some of the best-trained and best-equipped women ought, she thinks, to turn their attention to commerce and finance; for the forces dominating and moulding the world are the national struggles for control of markets and raw materials; and until a proportion of the best-educated women turn their attention to these matters, women cannot expect to have any real weight in the councils of the world. The American Association of University women is, it appears, undertaking an investigation of what women are already doing in these fields of work, and Prof. Spurgeon looks to the Christiania conference to prepare the way for "a campaign to open up to women throughout the world careers in commerce, industry, and finance."

Early Science at the Royal Society.

April 6, 1664. Dr. Charleton remarked, that there were some knowing persons, who would maintain, that images are erected in the retina; and that, notwithstanding the diversity of mediums in the eye, there was made but one single refraction. It being urged by him, that those persons offered to prove their assertions by experiments, he undertook to engage them to do so.—A letter of Col. Long to Sir Robert Moray was read, acknowledging his philosophical debts to the society, and giving account of elms becoming great trees from chips having some bark upon them; as also from boughs chopt on each side, and put into a nursery of good ground, laying them along in trenches. This was ordered to be communicated to Mr. Evelyn.

1671. Mr. Henshaw read part of his translation of Signor Montanari's paper concerning the glass drops: and as this discourse was long and deserved consideration, fifty copies of it were ordered to be printed, that it might be the more conveniently distributed amongst the members for perusal. [Early instance of advance proofs.]

April 7, 1686. A note of Dr. Papin concerning the firing of gun-powder *in vacuo* was read.

1687. A letter of Mr. Leewenhoeck, dated at Delft, concerning the structure of the teeth, was produced and ordered to be translated.

April 8, 1663. Mr. Boyle brought in a written account of potatoes from his gardiner, and is as follows: I have, according to your desire, sent a box of potatoes. My care hath been to make choice of such, that are fit to be set without cutting; for many, that have not small ones enough, are constrained to cut the great ones: but I do not approve of that husbandry, neither do I make use of it, because when they are cut, the worms do feed on them; and so devouring the substance, the branch groweth the weaker, and the root small. I could speak in praise of the root, what a good and profitable thing it is, and might be to a commonwealth. . . .

1669. That Dr. Merret be conferred with against the next meeting concerning Thomas Willisel, the botanic traveller, to testify what he knows of his abilities in collecting plants and other natural curiosities; and that Willisel be summoned to attend to receive resolutions and orders.

1685. A paper was communicated from the Philosophical Society at Oxford, occasioned by a discourse there, concerning the advantage, which those men, who want sight, may have as to memory.

April 11, 1666. Sir Robert Moray presented the society with the stones taken out of the Lord Belcarre's heart, in a silver box, together with a written account of the dissection of his body, attested by a physician and chirurgeon in Scotland, with this condition only, that in case the lady Belcarres, the deceased lord's mother should send for it, it might not be denied her.

1667. Dr. Wilkins renewed his motion that the physicians of the Society would employ their interest with those of their profession, who had staid in London, to obtain from them, their observations of the late plague in 1665.

April 12, 1665. The operator was appointed to try again the feeding of spiders upon one another, by shutting two or more of them up in a close glass. As also to put a house-spider among a good number of ants, and to see, whether it would be torn and eaten by them; Dr. Wilkins having related, that such a house-spider being put with a multitude of ants upon a barrel-head, the ants first ran away from the spider, but then returned, and tore it in pieces.

Societies and Academies.

LONDON.

Royal Society, March 27.—W. A. **Bone**, A. R. **Pearson**, and R. **Quarendon**: Researches on the chemistry of coal. Part III.—The extraction of coals by benzene under pressure: A new form of apparatus is described for the extraction of coals by means of benzene under pressure up to 700 lb. per square inch under "Soxhlet" conditions. A large proportion of the benzene extracts from bituminous and sub-bituminous coals (except the Morwell brown coal from Victoria, Australia) always comprises an important group of nitrogenous "humic" bodies, mainly responsible for the coking propensities of bituminous caking coals, of which they constitute 4·5 to 7·0 per cent. The amount of "resins" ordinarily contained in bituminous coals does not exceed 1 per cent. of the whole coal substance, and they contribute in minor degree only to the coking propensities. The benzene extracts of all the bituminous and sub-bituminous coals examined contain important amounts of neutral wax-like non-nitrogenous bodies, of very low oxygen content, which do not, however, contribute at all to their coking propensities. The residues left after extraction of bituminous coking coals are *per se* all practically devoid of coking propensities. The extract from the Morwell brown coal consists chiefly of non-nitrogenous unsaponifiable resenes, resene-esters, and aliphatic or alicyclic acids (and esters), of which the last two are highly oxygenated substances.—R. V. **Southwell** and Sylvia W. **Skan**: On the stability under shearing forces of a flat elastic strip: The investigation relates to a flat elastic strip, of uniform breadth, thickness, and material, upon which a uniform shear is imposed by tangential tractions applied at its edges and in its plane. These tractions affect both the modes and the frequencies of the free transverse vibrations. If sufficiently intense, they will bring about a condition of limiting elastic stability, since they will neutralise in certain types of distortion the restoring effects of the flexural stresses. Rotatory inertia is neglected. For purposes of comparison, approximate results are obtained by Lord Rayleigh's method, in which the frequency is calculated from the energy equation for a displacement of an assumed type. The correspondence is close, and supplies further confirmation of this method.—J. E. P. **Wagstaff**: Experiments on the duration of impacts, mainly of bars with rounded ends, in elucidation of the elastic theory: A method depending on duration of discharge of a condenser through a circuit of known resistance and self-inductance has been developed for the accurate determination of duration of collision of steel bars. Variation of time of impact t with initial relative velocity of approach v has thus been studied for a large variety of bars, and a relation of form $t = Av^{\gamma}$ represents the results: γ varies with the length l and radius r of the bar according to an equation $-1/\gamma = A'' + kl/r$ where A″ and K are constants. The time of impact is not strictly a linear function of length, for short bars, and shows considerable variation with diameter. From results obtained with steel bars, the time of impact for very long bars is extrapolated and compared with the Saint-Venant wave-formula. The result apparently emerges that the pulse, intense and probably largely adiabatic, travels along the bars, about 50 per cent. faster than an isothermal wave. Bars of brass and aluminium are also tested. An extended series of experiments was undertaken with bars of the same cross-section, of unequal lengths, and of masses equalised by loading. Relationships of the form $t = Av^{\gamma}$ were found as before, but they break down for large initial velocities.—E. V. **Evans** and H. **Stanier**: Sulphur studies in coal gas. I.—The removal of carbon bisulphide by a nickel catalyst. In removing the sulphur present as carbon bisulphide, the gas is passed over heated nickel. The products are mainly carbon and hydrogen sulphide. In most cases in which nickel is used as a catalyst in promoting combination with hydrogen, sulphur acts as a poison. The apparently anomalous behaviour of carbon bisulphide is probably due to the fact that the actual catalyst is nickel subsulphide, Ni_3S_2.—N. **Ahmad**: Absorption of hard γ-rays by elements. By means of a balance method the absorption in a large number of substances of γ-rays from radium B + C, filtered through 1 cm. of lead, has been measured. The results indicate that the laws of absorption of these penetrating radiations are of the same type as for X-rays. The apparent atomic absorption (μ_A) can be represented by $\mu_A = 1{\cdot}68 \times 10^{-25} z + 1{\cdot}60 \times 10^{-31} z^4$, where z is the atomic number of the absorber. The first term represents the part of absorption due to scattering, the second term that due to "true" absorption. For elements of low atomic weight, the apparent absorption is almost entirely due to scattering, and for those of high atomic weight at least one-half. Estimates of wave-length, based on the two terms in the above formula, lead to values 0·015 and 0·019 Å.U. for the *mean effective wave-length* of the radiation employed.

Geological Society, March 12.—Prof. W. W. Watts, vice-president, in the chair.—Jane **Longstaff** (*née* Donald): Descriptions of Gasteropoda, chiefly in the late Mrs. Robert Gray's Collection, from the Ordovician and Lower Silurian of Girvan. By far the greater number, namely, twenty-five species and one variety, belong to the Pleurotomariidæ; of these twenty-one are new to science. Three species previously placed in the genus Raphistoma Hall are transferred to Liospira Ulrich, as the possession of a sinual band distinguishes them from members of the former. Among other new species described are two of Clisospira, which are not only new to science, but the genus itself does not appear to have been recorded before from the British Isles.—A. **Heard** and R. **Davies**: The Old Red Sandstone of the Cardiff district. A new fish-band was discovered in the Red Marl Group. This Coed-y-Coedcæ Fish-Bed contains innumerable fragments of Cephalaspis and Pteraspis, together with Pachytheca and obscure plant-remains. The petrological investigation revealed a rich assemblage of pebbles and minerals. Three definite mineralogical zones are established, corresponding roughly with the stratigraphical groups. The Old Red Sandstone represents estuarine and deltaic deposits derived mainly from a pre-Cambrian massif on the north-west. The Silurian rocks of the Cardiff district are entirely different and distinct from the Old Red Sandstone. No pebbles from the Silurian have been observed in the lowest Old Red Sandstone beds. The definite petrological break represents a non-sequence; the hypothesis of the "Welsh Lake" is untenable. A probable connexion with the Devonian of North Devon is suggested.

EDINBURGH.

Royal Society, March 17.—Prof. F. O. Bower, president, in the chair.—R. **Kidston** and W. H. **Lang**: (1) Notes on fossil plants from the Old Red Sandstone of Scotland. No. 2, *Nematophyton Forfarense*, Kidston, sp. The specimen from Reswallie, in Forfarshire, previously described under the name *Cryptoxylon Forfarense*, Kidst. sp., on re-examination proves to be a species of Nematophyton, and the name

is altered to *N. Forfarense*, Kidst. sp. The tissue, though almost entirely altered and pseudo-cellular, is found in places to retain clear traces of the characteristic tubular structure. It is a form of Nematophyton with "medullary spots." No. 3. On two species of Pachytheca, based on the characters of the Algal filaments. Two new species of Pachytheca with well-preserved structure are described. Both have the algal filaments which inhabited the spherical fossil preserved; specific distinctions can only be satisfactorily based on such specimens. The description of *P. sphærica*, Hk., and *P.* (*Æthetotesta*) *devonica*, Dawson, do not afford such diagnostic characters. Preservation of the algal filaments has previously been known only for specimens of Wenlock age which are here named *P. Hookeri*. This, like the two new species described, shows a distinction of medulla, cortex composed of radial tubes and an outermost clear layer that was presumably mucilaginous. In *P. media* from Balruddery the algal filaments are more slender than those of *P. Hookeri*, but are of the same type, and only one is contained in each cortical tube. In *P. fasiculata* from beds of black shale at Stob Dearg, Glencoe, the algal filaments are much more slender, and a number of them are contained in each cortical tube. The filaments emerge from the ends of the tubes in a bundle, and can be traced across the clear mucilaginous zone. This is a very distinct type of construction in the genus. (2) On the presence of tetrads of resistant spores in the tissue of *Sporocarpon furcatum*, Dawson, from the Upper Devonian of America. Specimens of dark, thalloid, bilobed structures, obviously incomplete at the lower undivided end, occur in large numbers in the black shale of Upper Devonian age at Columbus, Ohio. They were described and figured by Dawson under the name *Sporocarpon furcatum*, but no spores were found in them. A re-investigation has shown that there are tetrads of spores in some of the specimens, within the parenchymatous cellular tissue. They are usually placed parallel to the concavity between the two lobes. The spores resist the action of ammonia, following treatment with Schultze's macerating fluid, and thus agree in their behaviour with cuticularised walls. The same holds for a cuticle that is sometimes preserved on the outside of the thalloid tips. The spores have a tri-radiate marking separating the three planes of contact with the other spores of the tetrad. The plant is of great morphological interest even though only its forked tips are known. It is most probably a thalloid alga, but the resistant cuticle and spores are features not known in any other plants of this group. On the less likely view that it was a thalloid Pteridophyte the occurrence of the spores as isolated tetrads in the tissue would be a unique feature. Plants showing such a combination of characters make it difficult to draw a sharp line between algæ and Pteridophyta. —C. W. **Wardlaw**: Size in relation to internal morphology. I. The vascular system of Psilotum, Tmesipteris, and Lycopodium. The detailed examination of the stelar structure in the Psilotales and Lycopodiaceæ reveals a general similarity of behaviour on increase of size. The changes in form of the xylem are comparable in one respect. In neither is the larger stele merely the magnified image of the smaller, but in both the xylem becomes increasingly disintegrated on passing from smaller to larger size. The surface of the xylem in contact with the thin-walled living tissue may be regarded as a surface of interchange. In the sporeling the proportion of surface to bulk of the xylem is high, and by the principle of similar structures, if the form be unchanged this proportion will decrease as size increases. In both Psilotum and Lycopodium it has been shown by actual measurements that the changes which accompany increase in size of the xylem are such as to maintain a relatively high proportion of surface to bulk. This is much higher than it would have been supposing the simple structure in the sporeling had been retained throughout. It has been achieved in both classes of plants by progressive decentralisation and disintegration of the xylem. Structural evidence of this nature indicates that size is a factor in determining the internal morphology of the stele in these plants.

PARIS.

Academy of Sciences, March 3.—M. Guillaume Bigourdan in the chair.—F. E. **Fournier**: The cause and the origin of cyclones and typhoons. It is suggested that these have their cause and origin in a cyclonic vortex of cirrus clouds.—Charles **Moureu** and Charles **Dufraisse**: Autoxidation and anti-oxidising action. The catalytic properties of iodine and its compounds: the generalisation of the phenomenon. In a previous communication the authors have given a general theory of the catalysis of autoxidation. The present note has for its object the establishment of the generality of the phenomenon in the case of iodine and its compounds. The general behaviour of iodine is in agreement with the results predicted.—G. **Tzitzéica**: The affine geodesic representation of surfaces.—Bertrand **Gambier**: The polygons of Poncelet.—J. **Haag**: A problem of probabilities.—E. **Jouguet**: The internal potential of elastic bodies.—Mlle. Suzanne **Veil**: The evolution of the molecule of nickel hydroxide in the presence of water. Measurements of the magnetisation coefficients of nickel hydroxides and of the oxides of nickel obtained by their ignition. The magnetisation co-efficient of the nickel oxide depends on its methods of preparation.—Victor **Henri**: The absorption of ultra-violet light by acrolein. The ultra-violet absorption bands produced by acrolein have been compared with those given by propaldehyde, trimethylethylene, and acrylic acid. A series of narrow bands given by the liquid are resolved, in the vapour, into a number of fine bands and lines. This indicates that the molecule of acrolein possesses an electrical polarity, the CO group and the ethylene group presenting opposite electrical charges.—Arnold **Lassieur**: The rapid electro-analytical separation, by graded potentials, of silver, copper, and bismuth.—A. **Damiens**: A new re-agent for carbon monoxide. The re-agent proposed is a suspension of finely divided cuprous oxide in strong sulphuric acid: the compound formed by absorption of carbon monoxide is $Cu_2SO_4 . 2CO$.—G. **Chesneau**: Chemical study of the stained glass from the Church of Saint-Remi at Rheims.—B. **Bogitch**: The removal of sulphur from metals in the solid state. Details of the proportions of sulphur removed from nickel and cobalt after prolonged heating with carbon to 1100° C.—P. **Gaubert**: The orientation of crystals of ammonium iodide by the cleavage plates of mica. The researches of Frankenheim, Wolleront, and Mügge on the relations between the crystallisation of potassium iodide on micas have been extended. Ammonium iodide was found to be more suitable than potassium iodide: the orientation of the crystals readily distinguishes not only the micas between themselves, but their decomposition products.—J. **Thoulet**: The density of sea-water: its rôle in the study of oceanic circulation and marine fishing.—René **Souèges**: The embryogeny of Graminaceæ. Development of the embryo in *Poa annua*.—A. **Maige**: Variations of the limit of amylogenic condensation of the plastids in the hypocotyl

of the bean.—Edmond **Gain**: Anomalies in Helianthus obtained from seeds previously heated to temperature between 120° C. and 150° C.—R. **Anthony** and (Mlle.) F. **Coupin**: The brain of the bear at birth. The small weight and slight differentiation of the brain of the newly-born bear are in proportion to its reduced stage of growth.—E. F. **Terroine**, R. **Bonnet**, R. **Jacquot**, and G. **Vincent**: Comparative energy yields in the development of moulds at the expense of carbohydrates or of proteids and specific dynamical action. The experiments described lead to the conclusion that in any living being the formation of a carbohydrate results in a very small energy loss if it is made at the expense of another carbohydrate, more if it arises at the expense of fat, and considerable loss if derived from proteids.—Henry **Cardot** and Henri **Langier**: Diffusion and generalisation of stimulation in the centres during prolonged effort.—J. **Athanasiu** and A. **Pézard**: The influence of castration on motor nerve energy.—Anna **Drzewina** and Georges **Bohn**: The expulsion of the green algæ symbiotic in *Convoluta roscoffensis*, under the influence of carbonic acid.—M. de **Luna**: Remarks on the note on the participation of a peroxydase in the appearance of the pigment in *Drosophila melanogaster*.—Jacques **Benoit**: The endocrinal activity of the testicle before puberty in the Gallinaceæ.—H. **Hérissey** and R. **Sibassié**: Biochemical researches on the nature and quantity of the principles hydrolysable by invertin and by emulsion, contained in some leguminous seeds.—Henri **Labbé** and B. **Theorodesco**: The action of insulin on hyperglyæmia due to caffeine.—A. **Maubert**, L. **Jaloustre**, P. **Lemay**, and C. **Guilbert**: The influence of X-rays on the catalase of the liver. X-rays exert a progressive paralysing action on catalase of the liver, which increases with the time and intensity of the irradiation.—A. **Boquet** and L. **Nègre**: The action of the various constituents of the Koch bacillus on the evolution of experimental tuberculosis in the rabbit and the guinea-pig. The fatty material and the lipoids of the Koch bacillus exert opposed effects in experimental tuberculosis. The fats accelerate the extension and generalisation of the lesions, whilst the lipoids, insoluble in acetone and soluble in methyl alcohol, slow down the course of infection, retard the invasion of the lungs, and in certain cases favour the appearance of a cicatrical process of sclerosis.—M. **Mazé**: The manufacture of Port-du-Salut cheese, and of Dutch cheeses (Edam and Gouda).—G. **Guittonneau**: The Microsiphoneæ of the soil.—A. C. **Guillaume**: The functions of the blood capillaries.—Auguste **Lumière** and Henri **Couturier**: Anaphylactic sensibilisation through the eye.

March 10.—M. Guillaume Bigourdan in the chair.—F. E. **Fournier**: The variations of the fall of the barometer and rotating winds in cycles and typhoons.—M. **de Broglie**: The change of wavelength by diffusion in the case of the K lines of tungsten. The lines arising from diffusion were registered simultaneously on the same plate with fluorescence lines. The observed deviations were of the order of magnitude predicted by the theory of Compton and Debye.—Alexandre Degrez was elected a free Academician in the place of the late M. A. de Gramont.—R. **Gosse**: The equations $s+f(x, y, z, p, q, r)=0$ which are of the first class.—Th. **Varopoulos**: Functions having a finite number of branches.—F. H. **van den Dungen**: The *a priori* determination of the vibrations of the blades of turbines.—M. **Galerkin**: Thin elastic plates, limited by two arcs of concentric circles and two radii under the action of concentrated forces.—Louis **Kahn**: The apparent diminution of the resistance of a wing agitated in a current of air, and its application to the theory of the flight of birds.—Louis **Breguet**: The conditions to be fulfilled by a glider for best utilising the fluctuations of the wind favourable to hovering flight.—Ernest **Esclangon**: Observations of the eclipse of the moon of February 20, 1924, made at the Observatory of Strasbourg. Observations were made under very favourable atmospheric conditions. Details of the photometric results will be published in a later communication.—Pierre **Auger**: The β secondary rays produced in a gas by the X-rays. The trajectories of the electrons forming the secondary rays were simultaneously photographed in a Wilson apparatus in two directions at right angles to each other.—Adolphe **Lepape**: The search for thorium emanation (thoron) in thermal springs by the method of induced activity. Out of 200 springs in Colorado, Lester found only one containing thoron. This might be due to the rarity of thoron or to the difficulty of detecting its presence owing to its short life. The author describes a sensitive method of detection based on the study of the deposit of induced activity. Five springs in the Pyrenees gave negative results for thoron: three springs in the Central Plateau showed traces only.—André **Charriou**: The electrolytic purification of precipitates. Chromic acid carried down by alumina is completely removed by prolonged electrolysis from the precipitate suspended in water. Adsorbed sulphuric acid and permanganic acid are also removed under this treatment.—Mlle. Paule **Collet**: The paramagnetism of iron in potassium ferrocyanide.—A. **Boutaric** and M. **Vuillaume**: The influence on the properties of sols of arsenic sulphide of some physical factors intervening during their preparation. The factors studied were concentration of the solution of arsenious anhydride, temperature, velocity of the current of sulphuretted hydrogen, and excess of the latter.—André **Kœhler**: A new method of examination for detecting adulteration in cocoa fat.—E. **Pitois**: The differentiation of steels by the examination of the sparks produced by friction in air and in oxygen.—L. J. **Simon** and M. **Frèrejacque**: The methylation of tertiary amines and of alkaloids by means of sulphomethyl esters derived from phenols. The sulphonic ester used in this reaction may be $(1:4)C_6H_4(OCH_3)(SO_3CH_3)$, or the corresponding cresol derivatives. These react with bases such as urotropine, pyridine, and other tertiary bases giving compounds insoluble in chloroform or benzene. Precipitates are also given by alkaloids.—Charles **Dufraisse** and Alfred **Gillet**: Stereochemical researches in the benzalacetophenone series. Some derivatives of dibenzoylmethane and of benzolacetophenone.—Louis **Longchambon**: The rotatory dispersion of tartaric acid.—Jacques **Bourcart**: Recent movements in western Albania.—Gabriel **Guilbert**: The abnormal trajectories of cyclonic centres.—A. **de Puymaly**: The vacuome of the green Algæ adapted to life in air.—A. **Lebediantzeff**: The modifications undergone by arable soil after drying in air.—Mme. L. **Randoin** and H. **Simonnet**: The food problem regarded from the point of view of the ratios existing between the fundamental elementary substances (vitamins) and the energy-producing substances.—Henri **Piéron**: The question of the energy minimum in the luminous stimulation of the retina by short light exposures.—Jousset **de Bellesme**: The conditions of aerial locomotion in insects.—Jacques **Pellegrin**: The Salmonideæ of Morocco.—Maurice **Manquat**: The oxidising power of the nuclei of the epithelium of the renal caniculi of *Perca fluviatilis*.—A. **Vandel**: The determinism of the development of the oostegites of isopods and the temporary secondary sexual characters of the Crustacea.

Official Publications Received.

Proceedings of the Lake Superior Mining Institute. Twenty-third Annual Meeting (Minnesota Ranges) held at Duluth, and Hibbing, Minnesota, August 28, 29, 30, 1923. Vol. 23. Pp. xxx+211. (Ishpeming, Mich.)

Carnegie Institution of Washington. Year Book No. 22, November 1, 1922, to October 31, 1923. Pp. xix+381. (Washington.)

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Redaktor (Rédigées par) Bohuslav Hostinsky. Rok 1923, Čís 33: Sur l'influence de la pression sur la réfraction d'hydrogène. Par François Schacherl. Pp. 28. Čís 34: Úvahy o theorii kvadratických zbytků pro kmenné moduly s novými vztahy k theorii kvadratických forem s kmennými zápornými determinanty (Études sur la théorie des résidus quadratiques suivant un module premier. Relations nouvelles avec la théorie des formes quadratiques ayant un déterminant négatif et premier). Napsal M. Lerch. Pp. 44. Čís 35: Iter Turcico-Persicum. Pars 1: Plantarum collectarum enumeratio (Ranunculaceae–dipsacaceae). Scripsit Fr. Nábělek. Pp. 144+16 Tab. Rok 1924, Čís 36: Étude analytique de l'élément linéaire projectif d'une surface. Par Édouard Čech. Pp. 24. (Brno: Přírodovědecká Fakulta.)

Journal of the Department of Agriculture. Vol. 8, No. 2, February: Farming in South Africa. Pp. x+97-260. (Pretoria: Government Printing and Stationery Office.) 6*d*.

Dominion of Canada: the Honorary Advisory Council for Scientific and Industrial Research. Report No. 14: On the Utilization of the Low Grade Iron Ores of Canada, submitted by the Sub-Committee on Iron Ores of the Research Council. Pp. 55. (Ottawa: F. A. Acland.)

Report of the Administrative Chairman of the Honorary Advisory Council for Scientific and Industrial Research, for the Year ending March 31, 1923. Pp. 55. (Ottawa: F. A. Acland.)

New South Wales. Department of Mines: Geological Survey. Bulletin No. 4: Iron. By L. F. Harper. Pp. 23+6 plates. 1*s*. Bulletin No. 5: Antimony, Arsenic, Bismuth, Molybdenum, Tungsten. By E. J. Kenny. Pp. 47+6 plates. 3*s*. 6*d*. (Sydney: Alfred J. Kent.)

South Australia. Annual Report of the Director of Mines and Government Geologist for 1922. Pp. 14. (Adelaide: R. E. E. Rogers.)

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Boletim Meteorologico, Anno de 1920. Pp. 152. (Rio de Janeiro.)

Meddelelser fra Kommissionen for Havundersøgelser. Serie Hydrografi. Bind 2, Nr. 8: Current Measurements from Danish Lightships. Pp. 78. Serie Fiskeri. Bind 7, Nr. 2: Investigations of Plaice from the Western Baltic, June 1921-August 1922. By Kirstine Smith. Pp. 48. Bind 7, Nr. 3: On the Age and Growth of the Cod (*Gadus callarius* L.) in Icelandic Waters. By Bjarni Sæmundsson. Pp. 35. Bind 7, Nr. 4: On the Plaice Population of the Horns Reef Area in the Autumn of 1922. By Kirstine Smith. Pp. 78. (København: C. A. Reitzel.)

Report of the Rugby School Natural History Society for the Year 1923. Fifty-seventh Issue.) Pp. 47. (Rugby.)

Diary of Societies.

MONDAY, APRIL 7.

VICTORIA INSTITUTE (at Central Buildings, S.W.1), at 4.30.—Prof. F. F. Roget: The Influence of Calvin down the Centuries on the Religious and Political Development of the Protestant Nations.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Osteomyelitis (Demonstration).

THE SOCIETY OF ENGINEERS, INC. (at Geological Society), at 5.30.—A. C. Ionides: Gas-Firing (Flame Control).

ROYAL SOCIETY OF ARTS, at 8.—Dr. T. Slater Price: Certain Fundamental Problems in Photography (Cobb Lectures) (3).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Royal Institution), at 8.—Prof. H. E. Armstrong: Sir James Dewar as an Experimental Inquirer.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Capt. P. K. Boulnois: On the Western Frontier of the Sudan.

TUESDAY, APRIL 8.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 4.30.—Annual General Meeting.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. T. McCrae: The Clinical Features of Foreign Bodies in the Bronchi (Lumleian Lectures) (2).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—W. J. Wilson: The Crude Oils of Burmah and Assam.

INSTITUTION OF CIVIL ENGINEERS (Joint Meeting with Institution of Mechanical Engineers, Institution of Electrical Engineers, Institution of Naval Architects, Institute of Marine Engineers, North-East Coast Institution of Engineers and Shipbuilders, Institution of Engineers and Shipbuilders in Scotland, Institute of Chemistry of Great Britain and Ireland, British Electrical and Allied Manufacturers' Association, and British Engineers' Association, co-operating in the work of the Special Committee on Tabulating the Results of Heat-Engine and Boiler Trials), at 6.—G. J. Wells: Standards of Comparison in connexion with the Thermal Efficiency of Internal-Combustion Engines.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—P. J. Higgs: Observation Notes on a 20,000-ton Ship with Oil Engines and Electric Propulsion.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group) (Annual General Meeting), at 7.—At 7.30.—K. C. D. Hickman: The Washing of Photographic Products. Parts III. and IV.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—Prof. W. T. Gordon: Henry Witham and the Genus Pitys.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Dr. J. H. Hutton: The Use of Stone in the Naga Hills.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Annual General Meeting.

WEDNESDAY, APRIL 9.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—Duke of Northumberland: Presidential Address.—Sir Doveton Sturdee, Bart.: Strategical and Tactical Considerations governing Warship Design.

ROYAL METEOROLOGICAL SOCIETY, at 5.—I. D. Margary: Glaisher Stand *versus* Stevenson Screen. A comparison of 40 years' observations of maximum and minimum temperature as recorded in both screens at Camden Square, London.—R. Hill: A Lens for Whole Sky Photographs.—F. J. W. Whipple: The Significance of Regression Equations in the Analysis of Upper Air Observations.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. H. H. Thomas and Prof. A. H. Cox: The Roch, Trefgarn, and Sealyham Volcanic Series, Pembrokeshire.—L. Hawkes: An Olivine-Rhyolite from Eastern Iceland.

THE NEWCOMEN SOCIETY for the Study of the History of Engineering and Technology (at 17 Fleet Street), at 5.30.—W. A. Young: Ambrose and John Crowley—Citizens and Ironmongers of London, 1682–1728.

RADIO SOCIETY OF GREAT BRITAIN (Informal Meeting) (at Institution of Electrical Engineers), at 6.—L. F. Fogarty and others: Discussion on The Use of Rectified Alternating Current as a Substitute for Accumulators and Dry Batteries in Receiving Circuits.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Civil Engineers), at 6.30.—L. A. Legros: Traction across Rough and Roadless Country (Lecture).

ROYAL SOCIETY OF ARTS, at 8.—F. Hope-Jones: The Free Pendulum.

THURSDAY, APRIL 10.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—A. Hurd: The Future of Sea Transport.—Comdr. C. D. Burney: Development of the Airship, with Special Reference to Transport.—Sir Alfred Read: Sea-borne Coastal Trade.—At 3.—M. P. Payne: Results of some Rolling Experiments on Ship Models.—Prof. K. Suyehiro: The Drift of Ships caused by rolling among Waves.—At 8.—R. W. Allen: Application of Steam Turbines to Auxiliary Machinery.—F. G. Martin and A. T. Wall: High Elastic Limit Mild Steel and its General Applications.

ROYAL SOCIETY, at 4.30.—Prof. T. H. Havelock: Optical Dispersion and Selective Reflection, with application to Infra-red Natural Frequencies.—J. H. Jones: The Quantum Theory and the Dielectric Constant.—A. M. Mosharrafa: Half-Integral Quantum Numbers in the Theory of the Stark Effect and a General Hypothesis of Fractional Quantum Numbers.—E. A. Fisher: The Discontinuity of the Drying Process.—S. F. Grace: A Spherical Source in a Rotating Liquid.

ROYAL SOCIETY OF MEDICINE, at 5.—Dr. Rajchman: The Health Organisation of the League of Nations.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. T. McCrae: The Clinical Features of Foreign Bodies in the Bronchi (Lumleian Lectures) (3).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. J. Allen: Scientific Research on Sea Fisheries (2).

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—Annual General Meeting.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Prof. T. P. Nunn: The Philosophy of Gentile.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—S. C. Bartholomew: Power Circuit Interference with Telegraphs and Telephones.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—H. Dennis Taylor: The Feasibility of Cinema Projection from a Continuously Moving Film.—E. W. Taylor: A New Perfectly Anallatic Internal Focussing Telescope.

INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers, Inc.), at 8.—Dr. G. H. Gulliver: Failures in Metals and Alloys.

FRIDAY, APRIL 11.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—Eng.-Comdr. R. Beeman: Further Experimental Work on Diesel Engines.—H. W. Nicholls: Vibration of Ships.—G. Vedeler: The Torsion of Ships.—At 3.—J. L. Kent: The Effect of Wind and Waves on the Propulsion of Ships.—Dr. T. E. Stanton and Miss D. Marshall: The Effect of Length on the Skin Friction of Flat Surfaces.—A. Shigemitsu: Skin Friction Resistance and the Law of Comparison.—J. Tutin: The Analysis of Ship Resistance.

ROYAL ASTRONOMICAL SOCIETY, at 5.—E. Nevill: The Critical Ancient Eclipses of the Sun.—Dr. W. J. S. Lockyer: Recent Observations of some Bright-Hydrogen-Line Stars.—S. D. Tscherny: Determination of the Relative Parallax of α Ursæ Minoris.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Irregularities in the Growth of the Palate and of Eruption of the Teeth (Demonstration).

MALACOLOGICAL SOCIETY (at Linnean Society), at 6.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—Annual General Meeting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. H. Vickers: The Photography of Wild Birds and Animals.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Discussion on Paper by L. M. Jockel on Water-tube Boilers.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. Jocelyn Thorpe: Colours, Stains, and Dyes.

SATURDAY, APRIL 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. Singer: Leonardo da Vinci as a Man of Science.