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The Treatment of Tuberculosis by Public Authorities.

THE Tuberculosis Bill introduced by the Ministry of Health having passed through the House of Commons without material amendment, it may be assumed that it will become law. It is an important enactment in its actual provisions, and interesting because it constitutes an attempt to retrace the erroneous steps taken when the National Insurance Bill became law in the year 1911.

Under the National Insurance Act the sanatorium benefit was perhaps the most popular provision, with the possible exception of the maternity benefit. The sanatorium benefit was boomed in the discussions on the Bill until the idea became fixed in the minds of the general population that a first-class hotel in favoured rural surroundings was to be available for every insured consumptive with a reasonable prospect of the cure of his disease. The limitations and the extent of utility of sanatoria in the treatment of tuberculosis were even then well recognised by physicians; but the ideas of Insurance Committees were of a different order, and the pressure brought to bear on these committees by insured persons was so great that many thousands of patients, suitable only for attention in hospitals, were treated in sanatoria, while accommodation for earlier curable cases was deficient in amount. The sanatorium benefit provided also dispensary and domiciliary treatment for insured persons, and in the latter respect encroached on the treatment given by the panel doctors. There was the further difficulty that in counties and county boroughs, the public health committees of which had made provision for the institutional treatment of the entire population, insured persons were in a position but little better than that of the non-insured, except in respect of treatment at home.

The fundamental mistakes in the making of these provisions were such as were almost inevitable when amateur medical and lay opinion took the place of skilled advisers having administrative experience in the treatment and prevention of tuberculosis and in general public health work, of which the prevention of tuberculosis forms an essential part. The best that can be said for the actual provisions of the Insurance Act is that it hurried on the general provision of anti-tuberculosis measures, and that especially the associated large grant for the erection of tuberculosis institutions helped to this end. It is necessary to add that had enactments similar to those now embodied in the Tuberculosis Bill been substituted for the extravagant and inefficiently redundant services provided under the Insurance Act, the efforts of public health authorities would have been much more efficient, the friction of duplicated work would have been avoided, and the present position in regard to the treatment and prevention of tuberculosis would be much more satisfactory than it is.

It must not be assumed that the present measure represents all that is necessary for a rapidly successful, because complete, crusade against tuberculosis. It removes from the Insurance Committees responsibilities which they should never have possessed; it agrees to regard as "adequate" those arrangements by the councils of counties and county boroughs for the treatment of tuberculosis which have already received Governmental approval (many of these arrangements are imperfect and incomplete); it makes it obligatory on the councils of counties and county boroughs which have not already made "adequate" arrangements to do so at once, on pain of action at their expense by the Ministry of Health if they default; and it gives power for the provision of after-care and for setting up joint committees when necessary.

All familiar with the actual state of tuberculosis administration in this country know how partially and imperfectly our present knowledge for the treatment of this disease is being utilised.

The war is doubtless responsible for this in part; the divided responsibility of poor law, public health, and insurance authorities has seriously contributed to the same result; and until poor-law hospitals become available generally for non-pauper advanced and acute consumptives there will still persist on a large scale failure to utilise to the utmost already existing arrangements for the hospitalisation of those consumptives whose continued residence in small dwellings, where good nursing and good hygiene alike are impracticable, is a chief reason why our national death-rate from tuberculosis is not declining so rapidly as it can be made to do.

It is unfortunate that in the campaign for the better housing which is so badly required no importance has been attached—apparently from lack of penetration or knowledge—to the fact that, so far as the problem of tuberculosis is concerned, a great, and the most urgent, contribution to the housing problem consists in securing attractive hospital beds for those advanced and acute cases of tuberculosis which are now treated at home under unsatisfactory conditions.

Health and Work.

The Health of the Industrial Worker. By Prof. E. L. Collis and Dr. Major Greenwood. Containing a chapter on Reclamation of the Disabled, by Dr. A. J. Collis. With an Introduction by Sir George Newman. Pp. xix+450. (London: J. and A. Churchill, 1921.) 30*s.* net.

MANY books have been written on the diseases of occupations, but this is the first adequate modern treatise upon the hygiene of industry in general. A more ideal combination of authors for the purpose it would be difficult to find. Prof. Collis, professor of preventive medicine in the Welsh National School of Medicine, was formerly one of H.M. Inspectors of Factories; during the war he served as Director of Welfare and Health in the Ministry of Munitions and was an active member of the Health of Munition Workers Committee. Dr. Greenwood, who is reader in medical statistics in the University of London, was in charge of the Medical Research Branch of the Ministry of Munitions during the war. By his refinements and judicious application of statistical methods he has done more than anyone else in this country to discourage the issue of statistically worthless medical and physiological data. Both authors are members of the Industrial Fatigue Research Board, and they have made full use in their book of the valuable reports published by the Board.

As they point out, the keynote of the nineteenth century was the discovery of the industrial value of the inanimate machine; while the keynote of the twentieth century will prove to be the discovery of the industrial value of the living, intelligent worker. They indicate the relation of the early epidemics of plague and typhus to want and overcrowding, and the effects of the now restricted employment of children in improving physique and reducing birth-rate. They describe the medieval measures in this country to prevent the worker from changing his trade and from leaving his district; they show the far greater protection now afforded by the law to women than to men workers; and they point out the opposition which each legislative advance has had to meet before it was finally countenanced.

The very thoughtful chapter on the utilisation of statistical methods in industrial preventive medicine deals with the fallacies of comparing average ages at death, the methods of standardisation, and proportionate mortality in vital statistics. A well-founded plea is advanced for the instruction of medical students in the elements of statistics.

Chap. vi. contains a fascinating epidemiological inquiry into phthisis, especially valuable for its keenly critical and temperate character. The greater decline of phthisis among women than among men in the past fifty years is attributed to the more potent influence of factory conditions on the latter, so that they react more readily than the women to the home influences of overcrowding and of poor (? vitamin-poor) diet. Stress is laid on the importance of viewing industrial phthisis from the industrial aspect, sanatorium treatment being useless unless combined with suitable and remunerative occupation for the skilled convalescent craftsman and with organised methods to nurse the patient back to his proper industrial sphere.

The next chapter discusses the increasing death-rate from cancer. The authors regard the remarkable increase between 1900 and 1913 as being too great to be attributable to improved methods of diagnosis. Evidence is adduced that the prevalence of cancer is connected with industrial conditions, and that, *ceteris paribus*, its frequency is greater in cities and among males.

The striking statistical regularity of accidents is demonstrated in chap. viii., comparable to that of the frequency curves of disease. The maximal reduction in accident-rate, obtainable by the better safeguarding of machinery, is estimated

at only 10 per cent. The workers' conservatism in wearing loose clothes, in displaying loose hair, and in objecting to the use of goggles, and their diverse mental constitution which renders certain of them especially liable to accidents, afford illustrations of the importance of a psychological study of accident determination. "The psychical factor," we are rightly told, "is one of the most important in accident causation."

Chap. ix. deals with the industrial employment of women. From it we learn how man invaded woman's primitive concern in industry when hunting and fighting began to wane. No evidence is forthcoming that woman's present work in factories is more arduous than it was in times preceding the Industrial Revolution.

In the course of the remaining eight chapters useful illustrations are given of canteen menus, washing and drinking appliances, seats, and overalls; and a final chapter on reclaiming the disabled, by the Medical Superintendent of the Ministry of Pensions Hospital at Leicester, brings this original and invaluable work to its conclusion.

Invaluable it cannot fail to prove to him who desires a lucid, critical, and temperate summary of our knowledge in any one of the many fields above referred to, or who seeks a list of references to guide his further reading. Only one defect may perhaps be suspected, namely, that the authors have not kept fully abreast of recent advances in the physiology of the neuro-muscular system and in our psychological outlook on the worker. Thus, in discussing the physiology of muscular contraction, they ignore the recent work of Lucas, Adrian, and others, as a result of which physiologists are now chary of supposing that the strength of an impulse along a given nerve-fibre is variable, or that the staircase (*treppe*) phenomenon is due to practice. The authors' invariable use of the term "end-organ" when they mean "end-plate" may also indicate some lack of freshness in dealing with the same problem. Their informing chapter on alcohol reveals an inability to distinguish between the physiological and the psychological, or else a desire to ignore the latter. "First," they say, "we have to notice some simple physiological or rather psycho-physiological results." But when we come to these results we discover them to be neither simple nor physiological, but to be the outcome of a study of the effects of alcohol on the psychological processes (the physiological bases of which are quite unknown to us) of learning Latin hexameters, and of using the typewriter and the adding machine. The authors, apparently for similar reasons, give us no account of the perhaps more valuable and more purely psychological investigations on the subject by Prof. McDougall and Miss May Smith, published last year by the Medical Research Council. They even apologise for discussing the psycho-neuroses, whereas apology is due for their brief treatment of so important an industrial subject. They refer only to the work of Breuer (misspelt Bruer) and Freud (published in 1895!), and they are concerned merely with such hysterical manifestations as disturbances of locomotion and speech, neglecting the far commoner and more important anxieties, fears, and mild obsessions which so strikingly affect industrial efficiency.

The truth must be faced that no one writer and no one "certifying surgeon" can combine in himself a knowledge of canteen management, dentistry, eye and limb injuries, pulmonary and other diseases, vital statistics, and industrial psychology. Hitherto the recognition and the prevention of mental disturbance have been ignored as completely in industry as they have been in crime. The prevalence of the psycho-neuroses among workers has not been evident because it has never been looked for, and because until recently no adequate treatment was available for it.

In other respects this book reaches an exceptionally high standard. The defects to which we have directed attention are only slight blemishes, if the wide scope of the work be taken into consideration. They should be easily remediable in the subsequent editions which its assured popularity is certain to evoke. CHARLES S. MYERS.

British Stratigraphy.

Handbuch der Regionalen Geologie. Herausgegeben von Prof. G. Steinmann und Prof. O. Wilckens. 20 Heft, iii. Band, 1 Abteilung. *The British Isles: The Channel Islands.* By thirteen contributors. Local editor, Dr. J. W. Evans. Pp. 354. (Heidelberg: Carl Winters Universitätsbuchhandlung, 1917.) 15*s*.

THIS book is remarkable both in contents and in origin. An excellent survey of the whole range of British stratigraphy by a group of highly qualified British authorities, it was published in Germany by German publishers in the very thick of the war (1917). It is part of an ambitious scheme, planned in Germany before the war, to embrace the geology of the whole earth in a series of separate "handbooks" by specialists writing in one of the three languages, German, French, or English. The separate parts were to be combined into volumes, of which the prospective size may be gauged when we take note that the substantial volume before us is part i. of vol. iii.; with France, Spain (already

published), and Portugal as the other parts. Of the fifty-eight parts projected, twenty-one were shown as published when the present volume appeared; but these treat mostly of the smaller European countries and of regions beyond Europe, while the parts to be devoted to Germany, Austria, Hungary, etc., not to speak of those relating to France, Italy, Belgium, Switzerland, etc., were still lacking. This suggests that the German plans, in this as in other matters, have been found easier than the German performance.

For what we have received, however, let us be thankful. In the present part we have a most useful and authoritative summary of our geological knowledge of the homelands. The local editor, Dr. J. W. Evans, has skilfully selected his team, who have dealt individually with the formations on which they have specialised, and possess the fullest and latest information. There is, of course, some unevenness of treatment, but the general scheme is coherent throughout. The classification, subdivision, and local variation of each system in turn are broadly described without much local detail, and illustrated by sketch-maps and sections (mostly reproduced from previous publications, but here conveniently assembled) and by full correlation-tables. The names of the authors of the chapters are sufficient guarantee for the quality of the work. Prof. W. W. Watts deals with the pre-Cambrian, Cambrian, and Ordovician rocks of England; Prof. J. W. Gregory with the pre-Cambrian of Scotland, as well as with the morphology; Dr. A. Harker with the igneous rocks, in a series of short articles under the formational headings; Dr. A. Morley Davies with the morphology of England and Wales, and with the Jurassic and Cretaceous rocks of Britain, except portions of the Scottish Jurassics which are described by Prof. P. G. H. Boswell along with the Scottish Trias; Prof. O. T. Jones with the Silurian; Dr. J. W. Evans with the Devonian; Prof. P. F. Kendall with the Carboniferous, Permian, and Quaternary deposits; Mr. L. Richardson with the Trias and Rhætic; Mr. H. J. Osborne White with the Upper Cretaceous and Tertiary; Prof. G. A. J. Cole with the whole of the Irish formations and with Irish morphology; and Mr. J. Parkinson with the Channel Islands. Room is also found for a short chapter on British earthquakes by Dr. C. Davison.

It is inevitable that there will be many individual points in an embracing work of this kind on which one reader or another will feel inclined to challenge the authority; one might take exception, for example, to the inclusion of the Albian in the Lower Cretaceous, after the unfamiliar German practice, and to the unwarranted implication here and there that German usage is equivalent to "Continental usage." But we have no space for criticism of detail, which would, indeed, in most cases resolve itself merely into the statement of difference of opinion upon minor points. We commend the book to the attention of every advanced student of British geology.

G. W. L.

Chemical Research in the Elementary Laboratory.

The Experimental Basis of Chemistry: Suggestions for a Series of Experiments Illustrative of the Fundamental Principles of Chemistry. By Ida Freund. Edited by A. Hutchinson and M. Beatrice Thomas. Pp. xvi+408. (Cambridge: At the University Press, 1920.) 30s. net.

MISS FREUND'S "Study of Chemical Composition" has established for itself a position in chemical literature which has many of the elements of permanence, mainly because of the abiding charm and freshness of the contact which it gives with the great pioneers of chemical discovery. To repeat this successful adventure in a laboratory manual of practical chemistry would appear to be a much more formidable task; but the ten chapters on "The Experimental Basis of Chemistry" which have been prepared for the Press by Mr. Hutchinson and Miss Thomas demonstrate the value, even in an elementary laboratory, of an intimate knowledge of and love for chemical literature.

The earlier portions of the book are of a missionary character. The gospel preached is that knowledge comes only by labour, and that the hasty and inexact work of a beginner is too insecure a foundation on which to base the laws of chemistry. The latter must be derived from the painstaking and exact work of the great masters of the science. In particular a protest is made against those aspects of the "heuristic" method of teaching in which the student is expected to discover in class laws and facts which would demand months and years of work if the discovery were only genuine. Even to prove the correctness of these laws and facts is usually beyond the ability of the worker, and all that is really possible is to work out (in the words of the sub-title) "a series of experiments illustrative of the fundamental principles of chemistry."

The experiments selected for this purpose include a considerable number which are new in form or method; but a more important feature of the book is the discussion of the limits of error as revealed by a comparison of the results of indi-

vidual workers with one another and with the results attained in the most exact researches. This leads up to a consideration of the conclusions that can be drawn from the work, or of the additional experiments that must be made before any conclusions can be drawn.

It is to be feared that those teachers who most need the stimulus and the criticisms of this book will be the last to read it; but many younger teachers, who have already tasted of the tree of knowledge, will find in the book fresh inspiration for the study of chemical discovery, and guidance as to its application in the daily routine of the school. T. M. L.

Cocoa and Chocolate.

Cocoa and Chocolate: Their History from Plantation to Consumer, by Arthur W. Knapp. Pp. xii+210. (London: Chapman and Hall, Ltd., 1920.) 12*s*. 6*d*. net.

MR. A. B. WALKLEY has recently explained in his inimitable fashion how the whole future of the drama and dramatic art in England depends on the withdrawal of the rule that chocolates must not be sold in theatres after 8 p.m. A commodity which has such a profound, if indirect, influence on an important phase of English culture merits serious treatment, and it was clearly time that the history of cocoa and chocolate should be written, and written in a popular fashion.

When, about 1735, Linnæus coined for the cacao tree the picturesque name of *Theobroma cacao*, the English chocolate-making industry had been in existence about seven years. It made slow progress in its early days, and 100 years after its inception the imports of cacao beans amounted to only 450 tons per annum. Since then, and especially in the last ten years, the rise has been remarkable, the imports of the raw material for home consumption in 1919 being over 64,000 tons. In addition, there are considerable imports of foreign-made cocoa and chocolate. The chocolate-maker has, therefore, no reason to complain of the descent of chocolate from its lofty estate as a food of the "gods" to the more humble condition of the flapper's confection.

Mr. Knapp is connected with an enterprise which not only makes everything that can be made from cacao beans, but also owns plantations of cacao trees. He has had, therefore, unique opportunities of making himself acquainted with every branch of the industry, and he has clearly not only utilised these opportunities to the full, but also has thought to some purpose about the numerous unsolved problems connected with cacao-planting and the preparation of the beans for the market. There must be few planters whose ideas on the shading of cacao trees, the fermentation of the beans and the characteristics of a good cacao will not be clarified by a perusal of Mr. Knapp's pages.

Though chocolate is regarded by the ordinary person as a luxury, it has always had a band of devotees, who regard it as an important foodstuff. Mr. Knapp is one of these enthusiasts, and he provides the inevitable table, comparing the "fuel value" of chocolate with those of some ordinary foods. He omits, however, all reference to price per calorie, which would bring out the interesting fact that even plain chocolate is an expensive food, and that when consumed in the form of those super-confections which, if one may judge from the contents of chocolate-shop windows, constitute the bulk of the chocolate consumed to-day, it is a very expensive food—in fact, as the plain man believes, a luxury. The author of so interesting a book as this may, however, be forgiven a trifling obsession of this kind. It is a book which should be in the hands of all officials of tropical agricultural departments (for whose experimental work Mr. Knapp expresses much admiration) and of all cacao planters, and it is so simply and clearly written that it might even be read by the chocolate consumer if there were in this country any adequate machinery for making the existence of interesting technical literature known to the general public. The illustrations are numerous, good and well selected. T. A. H.

Our Bookshelf.

An Introduction to Combinatory Analysis. By Major P. A. MacMahon. Pp. viii+71. (Cambridge: At the University Press, 1920.) 7*s*. 6*d*. net.

IN this little book Major P. A. MacMahon has given a short introduction to his two volumes on combinatory analysis which were published in 1915–16. The theories of combination, permutation, arrangement, order, and distribution which are dealt with in those volumes present technical difficulties; it is, therefore, a great advantage that such an introduction should exist, for the gradual development of the subject by easy stages will prove interesting to the reader and whet his appetite for the larger tomes which await him.

In the first chapter the elementary theory of symmetric functions is introduced, and on it the theory of distributions is afterwards based. The author treats in turn the simplest problems of the distribution of objects into boxes, one object

only being placed in each box, then the various complicated problems which result when the restrictions are removed, and finally the general problem of distributing s different sets of similar objects of which there exist p_1 of one kind, p_2 of a second kind . . . and p_s of another kind, into boxes of which there are m_1 of one kind, m_2 of a second kind . . . and m_t of another kind, the whole number of the boxes being any number not greater than the whole number of the objects.

It is a great achievement to expound a difficult subject in a simple manner, and for that reason alone Major MacMahon is to be congratulated. For some reason which is not at present clear, the theory of the combination of different sets of similar possibilities (which can conveniently be represented as the distributions of balls in boxes) is of the utmost importance in many different branches of science. For example, it is clear that this theory must enter into such a question as the formation of a muddy liquid from molecules which occur in groups of one, two . . . n. The theory will also be relevant in a serious consideration of error in relation to causal laws. The subject is, therefore, of great importance in applied as well as in pure mathematics, and might very well prove another example of the extraordinary way in which abstract mathematics leads the way in applied science.

DOROTHY WRINCH.

Il Regime delle Acque nel Diritto Pubblico e Privato Italiano. By Avv. Antonino Vitale. Pp. x+480. (Milano: Ulrico Hoepli, 1921.) 25 lire.

THE rapidly increasing development of the water-power resources of Italy since the commencement of the war, and the probability of still further extensions in its use in the future, have led many writers in Italy to attempt a clear exposition of the legal aspect of the question, which is an extremely wide one, covering, as it does, the interests of the State, communities, and individuals. The author of the present work, Advocate Vitale, who is attached to the Ministry of Public Works, brings to his study a special competence. After a reasoned consideration of the question whether there exist private waters in contradistinction to public waters, or whether there is a private title to certain waterfalls as compared with the public title, he deals at length with the legal aspects of private title. The question of administrative control is treated in three large sections, the first of these bearing on the harnessing of water-power and the protective measures involved; the second on the actual utilisation and control of falls, rivers, and streams; and the last on contentious points of law and administration. In this survey all possible applications of water-power, including hydro-electric stations, irrigation plants, river diversions for water supply, transport, etc., have received consideration. The volume contains copious references to existing legislation on the subject and to the works of other authors. The main interest of the book is naturally to Italians, although, of course, existing and subsequent enactments would affect corporations and syndicates anywhere which might anticipate obtaining concessions for the development of water-power in Italy.

E. S. H.

A Text-book of Physics. By Dr. W. Watson. Seventh edition. Revised by Herbert Moss. Pp. xxvi+976. (London: Longmans, Green, and Co., 1920.) 21*s.* net.

THE new edition of this well-known text-book is substantially a reprint of that of 1919. The additions made include the spherometer, Young's extensometer, the McLeod gauge for measuring low pressures, and the travelling microscope. The discussion of Young's modulus, Poisson's ratio, and rigidity has also been considerably amplified, while descriptions of the pyrheliometer, the Callendar continuous-flow method of mixtures, and the Beckman and clinical thermometers now find a place. Further additions include a proof of Gauss's theorem with illustrations, likewise illustrations of the applications of Kirchhoff's laws, and in electron theory a concise account of "canal" or positive rays. The explanation of diffraction through a slit has been extended, and "resolving power" is also treated.

The values of physical constants have been revised, and under "Terrestrial Magnetism" the majority of the maps and diagrams replaced by recent plottings. It is interesting to note therefrom that the east line of zero declination, or agonic line (1917), now consists of a nodal curve with intersecting branches, in place of the former simple curve and Siberian oval, as in 1907.

In its present form Watson's "Physics" is the most comprehensive single-volume text-book of physics in the English language. It contains little that may now be adversely criticised, and the compilers have improved the index by increasing it to nearly twelve pages.

A. W. BAIN.

La Colloidothérapie: Résultats Cliniques. By Dr. J. Laumonier. (Collection Médicale.) Pp. ii+283. (Paris: Félix Alcan, 1920.) 5.50 francs.

THIS book, as its title suggests, has been written by one who has no doubts as to the answer to a question which gives pause to many—namely, whether any special therapeutic value can be assigned to preparations of metal and other substances in the colloidal state which can be attributed to their state.

The theoretical section is commendably brief, the main body of the work being devoted to a systematic account of the method of preparation, uses, and physiological action of colloidal solutions of silver, gold, platinum, arsenic, etc.

The author's reading is limited, and his references are confined practically solely to the work of his compatriots; but the work of the French school affords ample material for the object in view—namely, the production of a book of reference for the practitioner.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Magnetic Storm of May 13–17.

A TIME of unusually severe and protracted magnetic disturbance began on May 13, at about 13h. 10m. G.M.T., with an S.C. ("sudden commencement"). This was clearly oscillatory in D (declination), movements to west, east, and again west following in rapid succession, their extreme range being about 15′. Within about a minute of the S.C., H (horizontal force) was enhanced about 120γ. The appearance of the trace suggests a very rapid preliminary fall, but this is not clear. Immediately after the large rise a fall began in H, but the element remained above its normal value for about five hours. The disturbance following the S.C. was only moderate until nearly 20h. on May 13, when considerably larger movements appeared in H. Disturbance continued throughout May 14, but there was a comparative lull between 8h. and 16h. Subsequent, however, to 16h. disturbance became very active, and the night of May 14-15 was much more disturbed than the previous night.

The most disturbed period, on the whole, was from 0h. to 8h. on May 15. During this time the D trace was off the sheet three times, but only for a few minutes at a time, in the easterly direction, and twice on the margin or off the sheet in the westerly direction. The range actually shown was 2° 12′. In the course of an hour—4h. 25m. to 5h. 25m. on May 15—movements occurred of at least 108′ E., 107′ W., 94′ E., and 92′ W. Few, if any, of the larger D movements were absolutely unidirectional. The variations in the light intensity along the curve showed that superposed on the larger movements were incessant short-period oscillations. The H trace was similarly oscillatory, but it was beyond the limits of registration in the direction of H, diminishing from about 3h. to 7½h. on May 15; so the range shown, 650γ, was doubtless much exceeded.

In vertical force the disturbance was considerable on the night of May 13 between 21h. 45m. and midnight, but on the night of May 14–15 it was enormously greater. Assuming the scale-value to be unchanged since its last determination, the range reached 1500γ. Between 3h. 53m. and 4h. 10m. on May 15 there was a rise of 1400γ. A little later, in the course of twelve minutes, there were a fall and a rise each exceeding 950γ. These and other large movements had shorter period oscillations superposed on them. The abnormally disturbed state of vertical force lasted from 22h. on May 14 to 8h. on May 15. During most of this time the value was much depressed.

Disturbance continued over the whole of May 15 and 16 and until the early hours of May 17. There was a very highly disturbed time on May 16 between 2h. and 10h. The H trace was off the sheet for fully 1½ hours between 8h. and 10h. C. CHREE.

Kew Observatory, Richmond, Surrey,
May 17.

The Reparation Act and the Cost of German Publications.

MAY I direct attention, through the columns of NATURE, to the serious position of scientific institutions in this country in respect to the operation of the German Reparation (Recovery) Act, 1921? Under this Act, of the cost of goods imported from Germany, half is taken by the Government towards the German reparation indemnity. Of course, most objects of commerce imported from Germany can be made in this country, and perhaps the Act is partly designed to assist home industries. There are, however, certain chemicals which are not at present made with sufficient purity, but this can be corrected.

The serious point is that there are German publications which in no circumstances can be conceived as likely to be published in this country. The advance of science necessitates the study of these publications as soon as possible after issue. Booksellers and publishers in Germany with whom I have communicated have informed me that they cannot afford to sell them at less than the published price. To pay the published price I have to send my cheque for actually twice the published price, viz. to pay 100 per cent. extra.

I am now informed by the Board of Trade that a committee "have given consideration to the question of the exemption of German books and periodicals, but they have not felt themselves able to make any special recommendation regarding German publications." The matter seems to me to be serious, and one which might be profitably considered by the scientific world and the societies representing it in this country.

J. STANLEY GARDINER.

Zoological Department, Cambridge,
May 12.

Auroral Display.

A DISPLAY of the aurora borealis was observed from Pontypridd Common between 9.40 and 9.55 G.M.T. on Friday evening, May 13, the sky being quite clear of clouds.

The chief appearance was a single band of light, varying from 5° to 15° in breadth, and reaching from a little below Regulus, which appeared almost central in it, near the zenith, and thence to the horizon about east by north, where the view was limited by a hill-top with an altitude of about 15°. The band varied both in width and in intensity, the middle third of its length fading away and the ends alone remaining; then the middle grew bright again, the ends disappearing; then the full length reappeared and the whole faded away evenly. The band showed no colour and no flicker, only fairly rapid changes of intensity; its edges were undefined and its axis the most brilliant part. It was many times more brilliant than the Milky Way, and might be compared with the region of the sky round the moon as seen when the latter is hidden by holding up the hand. At the beginning there was a parallel band of similar appearance a few degrees to the south of the eastern third of the main band, and at one time when the ends were disconnected they no longer appeared to be in the same straight line. A. E. L. HUDSON.

The Colours of Primroses.

MAJOR LATHAM'S letter (NATURE, May 5, p. 301) on the coloration of primroses has attracted me, for I have been studying the genus for several years. For

use in my work I have accumulated a considerable collection of wild varieties of *Primula acaulis*, some of which have been kept merely for observation, whilst others have been used for experimental work in genetics, in the course of which facts having some bearing on the colour problem have emerged.

As was inevitable, I obtained the red-flowered form of the primrose very early, and soon noted its occurrence in restricted areas. In Northumberland and Durham I know it from only two wild stations, one on the coal measures of North Durham, and the other in a ravine on the slopes of Kilhope Law, at the head of West Allendale, in Northumberland. The latter is far above the levels of gardens, and nearly 800 ft. above the range of the cowslip, so that the possibility of hybridity is excluded. Nevertheless, all the plants bear red flowers.

With the view of testing how the red colour was inherited, several plants were transferred in spring, 1915, from an elevation of above 1500 ft. to our garden only 30 ft. above sea-level. Although these plants produced red flowers in their first season, just as their relatives did in their mountain home, I made no crosses that year, intending to let the plants establish themselves. To my amazement, however, in 1916, when they flowered, their colour was exactly that of the normal primrose, and as long as I kept the plants —until 1918—only normally coloured flowers appeared. On the other hand, plants brought from Kilhope Law to the Vicarage garden at Ninebanks (elevation just above 1000 ft.) showed no change whatever in flower colour.

From the above it is clear that the altitudes at which the plants grow have something to do with the problem, and that the actual agency may be the average temperature is indicated by the failure of some rose-coloured varieties of *Primula sinensis* to develop their proper colour unless a certain temperature is attained.

Further evidence, indicating that the same influence is at work, appears in the form of two other primroses in my possession brought from a height of 1200 ft. in Upper Teesdale. These bear yellow flowers much deeper in hue than usual, and, in addition, clothed with a dense vestiture of white hairs. As the cowslip ascends in Teesdale to the limestone of Harwood Dale (at 1600 ft.) hybridity is not excluded here, but against this is the fact that although I have examined hundreds of primrose-cowslip hybrids I have never encountered a plant in the least like these.

The insect to which Major Latham refers as the "primrose sprite" is no doubt *Bombylius major*, a fly often to be seen poised, with proboscis extended, over primroses in April. Aiding it in the work of pollination, but carrying on their operations in a more or less illicit fashion, are the thrips, *Taeniothrips primulae*, and larvæ of the Geometrid moth, *Larentia didymata*. J. W. HESLOP HARRISON.

Armstrong College,
Newcastle-upon-Tyne, May 7.

Earthworms Drowned in Puddles.

THE explanation suggested by Sir E. Ray Lankester (NATURE, May 12, p. 329) of the occurrence of dead earthworms in surface "puddles" described by Mr. Friend had occurred to me, viz. that they were drowned. As to the survival of such worms in cool, clear, running water for some time, it is well known to most "bottom" fishermen that worms will survive for a considerable time *on a hook* in such water, and it is conceivable that their ultimate death is due to a too free exchange between the body-fluid and the surrounding water at the wounds made by the hook rather than to inability to breathe.

I walk warily in dealing with zoological matters, but I may suggest that with the breathing apparatus described the "moist surface" must, when underground, frequently or usually be in contact with other moist surfaces, so that the worm is, in effect, partly immersed in water. The great advantage of breathing through the agency of a moist *film*, as the worm does when above ground and as mammals do, is that the exchanges between air and blood can take place very rapidly owing to the steep gradient of oxygen tension in the film. An animal normally living in water has to expend a great deal of energy in pumping water through its respiratory system in order to get enough oxygen to support life. Fish when in water very far from saturated with oxygen or saturated at a relatively high temperature are unable to get the water through their gills at a sufficient speed; in the latter case the temperature coefficient of vital activity is against them, as they live faster at higher temperatures.

The oxygen dissolved in water is very small in amount. At 15° C. it is about 7 c.c. per litre, or one part by weight in 100,000. The oxidisable matter in moderately contaminated water will consume about 0·2 to 0·4 part of oxygen in five days at 18° F. (Adeney's test). The consumption of oxygen would naturally be relatively rapid in the early stages. Rain-water is approximately saturated with oxygen, but the considerable mass of oxidisable matters in dead and rotting leaves might easily take up the dissolved oxygen much more rapidly than re-absorption could take place in a stagnant pool of appreciable depth. If so, the worms which might manage to keep going for a time in well-aerated water, although with difficulty, would die in water which did not continually provide a surface layer fully saturated with oxygen in contact with their skin.

I hope to be able to make some quantitative investigation of the matter. J. H. COSTE.

Teddington, May 13.

The Physical Continuity of "Space."

IN the "space-æther" discussion clarity is lost by a failure to distinguish between "container" and "content." The relativist does not assert that there is no content. He is concerned with the geometry of the container; if this geometry assists the metaphysician or philosopher to a better understanding of the content, he is satisfied. If the container is called the world-frame (a term free from the ambiguity of æther), the relativist maintains that its geometry is four-dimensional and hyperbolic (semi-Euclidean) in character so long as the content is free from the influence of energy. This may be a condition of absolute rest or it may not. When the content is disturbed and energy manifested, the world-frame geometry is altered, and the world-frame may then be better described as the world-fabric.

Einstein relates the intensity of disturbance to the change in the geometry of the fabric with respect to that of the frame. He does not concern himself with the content of the frame, but only with that content of the fabric which manifests itself as free or bound energy. He leaves it to the metaphysician to deduce

that the content of the frame is the content of the fabric in absolute rest, or to make any other deduction he logically can. He does not pretend to explain what energy is or what it may become if reduced to absolute rest. He does not assert that there is no absolute rest, but that it escapes his and all experience.

JOHN G. MCHARDY,
Commdr. R.N. (Retired).

16 Ebury Street, S.W.1, May 6.

The Production of Metallic Zinc.

IN the issue of NATURE for April 28 I observe under "Notes" (p. 279) a reference to the small volume on zinc recently issued by the Imperial Mineral Resources Bureau. In this reference it is pointed out that the figures relative to the production of metallic zinc in the United Kingdom for 1913 do not harmonise with the figures of production and imports of zinc-ore. Naturally so, for there are other factors involved in the production of metallic zinc in any given year. The output of metallic zinc is not necessarily derived entirely from the ores produced at home or imported in that particular year; the part played by "secondary" production—that is, metal obtained from hard zinc—is of importance in this connection.

As regards the use of the expression "long ton," to which the writer of the note objects, preferring the words "statute ton," it has been made abundantly clear in the prefaces to the Bureau's publications that "the weights are expressed in long tons—that is to say, the British statute ton of 2240 lb." The ton of 2240 lb., though the "statute" ton in the United Kingdom, is not necessarily the "statute" ton in other countries. The expression "long ton" has not only the advantage of conciseness, but it is also well understood throughout the mining and metallurgical world.

R. A. S. REDMAYNE,
Chairman of the Imperial Mineral Resources Bureau.

2 Queen Anne's Gate Buildings,
Westminster, London, S.W.1.
May 4.

SIR RICHARD REDMAYNE puts forward two explanations to account for the discrepancy in the statistics published by the Imperial Mineral Resources Bureau. The first of these, namely, that stocks of ore may be carried over from year to year, is, in view of the relatively small differences from year to year, inadequate to account for the great discrepancy noted. The second is, in fact, the true explanation. Secondary zinc accounts for about one-half of the so-called zinc output of the country, and thus seriously affects the statistics.

THE WRITER OF THE NOTE.

The Theory of Vision.

PROF. JOLY'S papers on vision are very interesting. He adopts the visual purple as the visual substance, but there is no evidence that the rods are percipient elements. The view that they are percipient elements is based on errors, as, for instance, that certain animals—the tortoise is the most quoted—possess only cones; that the periphery of the retina is colour-blind; and that the Purkinje phenomenon is not found with the fovea. The tortoise has the rods and cones as definitely marked and distinct from each other as in man. Has any reader seen a retina in which there are only rods or only cones in any animal? The periphery of the retina is not colour-blind. Red of sufficient luminosity can be seen to the extreme periphery. The Purkinje phenomenon is found with the fovea, and is a photochemical phenomenon. It is very improbable that the rods are percipient elements. An elaborate nervous mechanism is required to regulate the sensitiveness of the photochemical film, and this appears to be the function of the rods.

The stimulus in vision is undoubtedly liquid, as shown by the movement of positive after-images.

The decomposition of the visual purple stimulates the ends of the cones. The ends of the cones consist of a series of discs varying in diameter.

F. W. EDRIDGE-GREEN.

May 7.

A New British Land Planarian.

MR. MORISON'S discovery of the interesting planarian worm (*Rhynchodemus Scharffi*) in a garden at Chiswick, as described in Prof. Dendy's letter in NATURE of May 5 (p. 298), shows that this species has a wider range than was at first anticipated. As Prof. Dendy states, it was first discovered in a Dublin garden in 1894, but since that date it has turned up in the Royal Botanic Gardens at Glasnevin, Dublin. I thought it had probably been introduced into both localities, but that nevertheless it was indigenous to Ireland.

It seemed to me most likely to have been brought from the country with a load of turf. This view was confirmed when, in April, 1901, I found several specimens of this planarian worm in the open country under a fallen tree-trunk near Ballymote, Co. Sligo (see *Irish Naturalist*, vol. x., 1901, p. 133).

R. F. SCHARFF.

National Museum, Dublin, May 12.

Cutting Sections of Cotton Hairs.

IN our laboratory we have now, for some months, utilised Mr. H. J. Denham's plan for celloidin-paraffin embedding of the cotton hairs, on the lines of Kultschitzky's and other processes (Worden: "The Nitro-cellulose Industry," p. 805), described in NATURE of May 5, p. 299, which Mr. Denham kindly communicated to us when he first suggested it, and we have found it most satisfactory. We immerse the hairs in dilute celloidin, which is then boiled down to a syrup (Gilson's process); the hairs are next transferred to paraffin-chloroform, and thence to 60° C. paraffin (Ide's process); this makes a very rapid technique, cut sections being available within two hours. We have also tried the method of Willows and Alexander, but find it cytologically inferior to this celloidin-paraffin technique, which gives us excellent sections at 2·5μ setting on a Leitz sliding microtome, with accidental sections even thinner.

W. LAWRENCE BALLS.
H. A. HANCOCK.

Experimental Department,
The Fine Cotton Spinners' and Doublers' Association, Ltd.,
Manchester, May 13.

British Scientific Instruments.

IN the review of the "Dictionary of British Scientific Instruments" published in NATURE of May 12, p. 324, it is stated that the British Optical Instrument Manu-

facturers' Association, which has issued the dictionary, "is one of the industrial associations working in connection with the Department of Scientific and Industrial Research." Will you permit me to correct a slight misunderstanding here? The British Optical Instrument Manufacturers' Association is a trade association, and is independent of the Department of Scientific and Industrial Research. The industrial research association formed under the scheme of the Privy Council for the promotion of scientific and industrial research is the British Scientific Instrument Research Association. Most of the leading British manufacturers of scientific instruments are members of both associations, but the credit of publishing the dictionary referred to is due wholly to the British Optical Instrument Manufacturers' Association.

J. W. WILLIAMSON,
Secretary, British Scientific Instrument Research Association.

26 Russell Square, W.C.1, May 13.

Picture-hanging Wire.

I SHOULD be glad to know the best kind of wire and the best form in which to use it for hanging pictures, etc., on walls.

Some ten years or so ago I was advised to use twisted brass wire of five strands, which was then immensely strong with a breaking strain of probably more than 100 lb., but it has become so rotten as to break under a weight of a pound or two. This wire has been in use in a very dry room with electric light only. My own experience has proved that plain copper wire in one strand has lasted three times as long as the twisted brass wire, though bearing far heavier weights. Before the war a "wire" consisting of a steel core with some other wire braided over it was recommended, but it is soon affected by rust, and appears to be much stronger than it really is.

R. B. MARSTON.

Surrey Lodge, 160 Denmark Hill, S.E.5.
May 12.

The Occurrence of Bombus in the Indian Plains.

As it is generally agreed among naturalists that the genus Bombus—the "bumble-bees" of Europe—is in India entirely confined to the hills, and never descends below 3000 ft., I write to record its occurrence in the plains.

Nearly three years ago, when my entomological knowledge was yet in a rudimentary state, I remember occasionally seeing a bee, which I considered a species of Bombus, at Sukna, situated at the base of the hills of the eastern Himalayas. The few friends to whom I mentioned the incident generally politely turned the conversation aside, but the actual capture a few days ago in Calcutta of two specimens of *Bombus tunicatus* seems to indicate that my first observation was probably correct, and that "bumble-bees" do (very rarely, of course) occur in the Indian plains in the cold season. CEDRIC DOVER.

Indian Museum, Calcutta, December 28.

Symbols in Vector Analysis.

IN books on mathematics and physics where vector analysis is used it is customary to use clarendon or thick-letter type to distinguish vector from scalar quantities. This practice has, among others, the disadvantages that it reduces the number of symbols available for other purposes, and is impossible to reproduce in manuscript.

It is justified only by the fact that it prevents confusion between the two types of quantities and the consequent application of algebraic operations to vector quantities and *vice versa*.

Another means of reaching the same results without the above disadvantages would be to replace the symbols +, −, and = by new symbols in vector analysis. This would be of itself sufficient to differentiate vector from algebraic symbols, and would be more logical, as the symbols stand for quite different ideas in the two systems of analysis.

R. H. NISBET.

Kut, March 26.

Young's Interference Experiment.

I HAVE read with considerable interest Dr. Houstoun's letter on Young's experiment in NATURE of April 28, p. 268, and I beg to state that we have been using the spectrometer for some time in the University College of Science, Calcutta. For making the double slit, a rectangular slit, about 2 cm. × 2 mm., is cut in a piece of cardboard. Two Gillette razor-blades are placed on two sides of this slit by small pieces of wax. At the centre a fine cocoon fibre, or preferably a spider thread, forms a double slit. By mounting the cardboard on the prism-table the fringes are easily seen, and as the rotation of the table alters the width of the slit the change in the nature of the fringes can be easily examined. P. N. GHOSH.

97 Finborough Road, S.W.10,
May 9.

The Origin of "Churning at 62°" on Dairy Thermometers.

MR. HEDGER WALLACE'S question (NATURE, April 28, p. 268), "Why do makers of dairy thermometers mark their thermometers 62° F. as churning temperature?" interests us as thermometer-makers who are frequently asked to supply floating dairy thermometers to a particular pattern. In many cases the customer decides the pattern, and we are prepared to satisfy our customers' requirements. We make and sell a large number of dairy thermometers not marked at any particular temperature for churning, and we advise this pattern, as we are told by dairy experts that any temperature between 45° and 62° F. may be required, according to conditions. It appears that no definite temperature can be fixed; therefore, to mark 56° F. as a fixed point for churning would be equally in error. A. C. COSSOR AND SON.

Accoson Works, Vale Road, London, N.4,
May 9.

Organism in Flint.

IN reference to Prof. Cole's suggestion (NATURE, May 12, p. 333), the possibility of the organism being a radiolarian was considered long ago and rejected. The consensus of opinion is now in favour of its being a beetle. Under higher powers the clavate and merismatic antennæ are very conspicuous. There is no micro-slide of the fossil; the photographs are taken direct from the flint-surface. Special photographs of the organism's separate parts are now being prepared under more favourable conditions, and will be available shortly. C. CARUS-WILSON.

May 13.

Direction-finding Wireless and Marine Navigation.

By J. J. BENNETT.

THE use of wireless telegraphy for direction-finding purposes, which came into vogue in the Navy during the war, seems likely to remain as a permanent auxiliary to sea navigation. France, the United States, and Canada have each adopted the system, and it is understood that Germany is maintaining some of the stations which she erected for war purposes, although definite information on the subject is lacking. So far as Great Britain is concerned, the Admiralty has established direction-finding wireless stations at the Lizard and at Carnsore Point; and it is also continuing for the present the stations at Berwick and Flamborough. Although a nominal fee of only five shillings is charged for giving a vessel a bearing by wireless, our merchant service does not appear so ready to take advantage of this assistance as it was anticipated it would be. This attitude of indifference is probably due to the value of the system not being understood sufficiently. Nevertheless, direction-finding wireless has proved of great help to the seaman on many occasions, and, beyond all doubt, will grow in favour as the mercantile marine becomes more familiar with its working.

The principal use of the system is to enable the bearing of a vessel in open waters, or when approaching pilotage waters, to be determined from one or more fixed points by intersection. All bearings thus obtained are the Great Circle bearings at the place of observation, which may be on shore or aboard ship, according to the method employed. If proper care be exercised, the average of error will be very small—less than one degree. Experience has shown that day readings over water are always trustworthy, and, unless high land is close to the vessel, day readings over land are approximately accurate. Night readings over water are approximately correct at short ranges of about one hundred miles; but night readings over land and over long distances are liable to error. Sunrise and sunset times should both be avoided, as bearings then obtained by wireless cannot be relied upon for accuracy.

There are at least three methods of using directional wireless to give ships their bearings and position. One requires no special apparatus in the ship, the others do. In the case of the first-mentioned, any vessel fitted with wireless telegraphy can call up a shore station and ask for a bearing. The station signals back that it is ready to give the bearing; then the vessel makes her call sign continuously for a short period, during which time the shore station ascertains the bearing by means of its direction-finder, or radiogoniometer, and then transmits to the vessel her true bearing with the time at which it was observed. Responsibility for accuracy rests, in this instance, upon the station. If the vessel requires simultaneous bearings from two stations in order to obtain her position, she calls up the controlling station of the shore group and states her need. Both stations then determine simultaneously by their direction-finders the respective bearings of the vessel; the controlling station collects both bearings, and either transmits them to the vessel, with the time at which they were determined, or, if equipped with the necessary instruments for the purpose, the station fixes the position of the vessel as obtained from the bearings and sends the information to the vessel. The main disadvantage of this method is that only one ship at a time is able to call up a station. If more than one tried to do so, "jamming" might result. Further, the distance over which bearings can be obtained is limited to one well within the maximum range of the ship's installation. If the bearing only is transmitted,

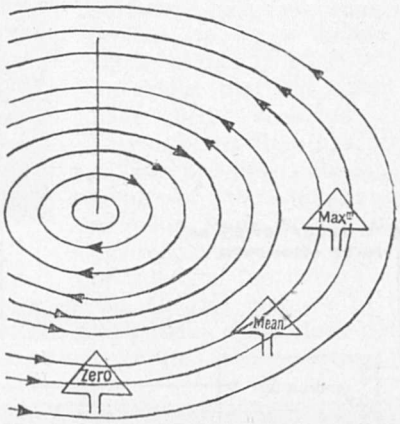


FIG. 1.—Field of magnetic lines of force through a loop aerial. This aerial may be regarded as inductive to the field of magnetic force of the advancing waves in certain positions, but as non-inductive in certain other positions. In the figure, for the sake of simplicity in drawing, it is assumed that the loop is being moved round the transmitting station so that its plane is pointing at the station at the right hand or maximum current position, and is facing the transmitter at the lower or zero current position.

the ship must be furnished with special charts or special tables of correction, as the bearings obtained are the Great Circle bearings at the shore station.

As to the station itself, it must have a direction-finding plant, as well as an ordinary wireless transmitting installation. The plant consists of wireless direction-finder set, tuning apparatus, receiving and amplifying set with accumulator batteries, dry batteries, etc., and a small power plant for charging purposes. Where two or more stations are grouped together for co-ordinate direction-finding work, the controlling one may be equipped with wireless transmitting apparatus, the others with direction-finding apparatus only, and be connected with the master station by telegraph or land telephone. Any ordinary shore transmitting station is suitable for undertaking communication with ships requiring bearings, so

that, as an alternative, two or more direction-finding stations of a group covering a certain area may be equipped with receiving gear only, and an ordinary separate transmitting and receiving station may undertake the controlling duty. A station may be self-contained. In such case the aerials for the direction-finding receiver and for the transmitter must be spaced a short distance apart, whilst the receiving and the transmitting apparatus must be housed in separate buildings, the whole of the receiving being done on the direction-finding receiving apparatus, and the transmitting apparatus being operated electrically from the direction-finding room.

A ship equipped with directional wireless apparatus can obtain bearings from any known ordinary wireless telegraphy shore station; but it is preferable that certain of these stations should be detailed to transmit, simultaneously or successively, signals on given wave-lengths at definite times during each hour. This is known as the Beacon Station method. Only vessels fitted with direction-finding apparatus are able to use it. The apparatus comprises a twin direction-finding aerial system consisting of either suspended fixed wires or large rigid frames, together with wireless direction-finder, tuning apparatus, and receiving and amplifying gear, with batteries and charging plant. A cabinet for the apparatus and operator, and telephone or buzzer communication with the ship's steering position, are also necessary. Such an installation costs about 300*l*., apart from the expense of fitting it. Any number of ships can obtain bearings, or fix their position, at the same time from the same station by this method, and are able to do that over much longer ranges than is the case with the method first described. As, however, ships using their own direction-finding sets are responsible for the accuracy of the bearings obtained by them, their staffs require some technical skill in the work, and it is necessary that the instruments should be calibrated and checked occasionally.

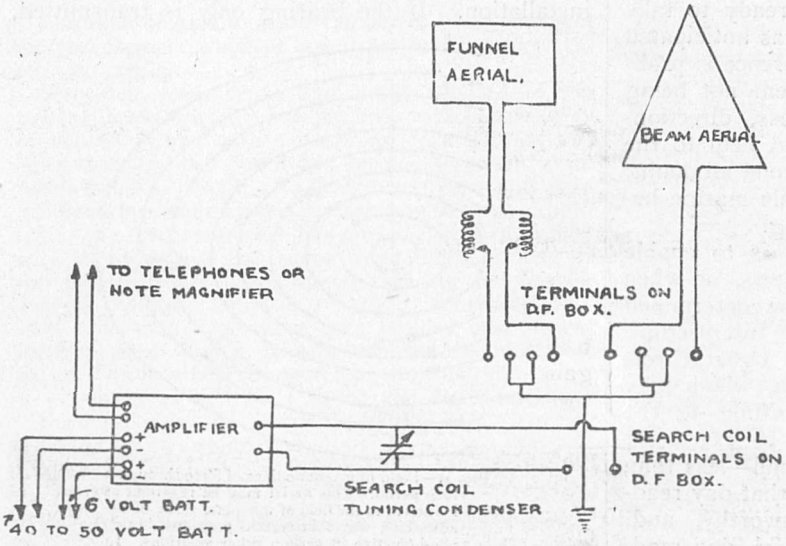


FIG. 2.—Simple circuit for aperiodic aerial and spark reception aboard ship. The beam aerial is rigged in the thwartship line so that it receives no induced signals from the ship. The funnel, or fore-and-aft, aerial receives signals direct *plus* induced signals from the ship. If the two aerials are adjusted to an equal sensitivity, they will always produce a resultant field in the direction-finding transformer in the same line as the incoming wireless wave, and the bearings obtained will be correct.

In the third method a rotating directional wireless beam having a fixed angular velocity is transmitted by a specially fitted fixed transmitting station. The rotating beam has a sharply defined zero direction which passes through North and South at given times. Knowing the angular velocity of the beam, and by observing the time interval between the given times at which the zero passes through North and South and the time at which the zero signals are received in the ship, the bearing of the station can be determined.

In order to ensure that the watches in the transmitting station and the receiving ship are synchronised, the station transmits a timing signal before commencing the rotating beam. To use this method, a ship must carry on her bridge a special watch, the face of which is marked in degrees, the scale corresponding to the angular velocity of the rotating beam. If this watch is started at the moment indicated by the timing signal, the bearing in degrees of the ship from the station can be noted from the watch at the moment when zero signals are received, and this bearing can be checked with subsequent zeros. During the war Germany had three stations working by this method, but Great Britain has none.

Aboard ship the simplest form of direction-finding apparatus is a single-loop aerial rotated round its vertical axis through a horizontal scale. To increase the current through the loop, it is usual to tune the loop with a condenser to the wave-lengths required to be received, and instead of a single loop a frame fitted with a multi-turn loop may be used. In the Bellini-Tosi system, in place of a rotating loop aerial two fixed loop aerials are employed, these being connected to an instrument known as the radiogoniometer, or direction-finder transformer. Inside the latter is a small revolving coil attached to a pointer moving over a scale by which the direction of the signals can be determined. Since, however, the receptive powers of a comparatively small loop aerial, such as can be employed in direction-finding aboard ship, are very much inferior to those of the ordinary type of ship or shore station earthed aerial, a signal-amplifying apparatus employing several vacuum valves is an essential feature of the direction-finding receiver.

Cloud Forms.[1]

By CAPT. C. J. P. CAVE.

MOST writers on clouds put forward their own system of classification, much to the confusion of the subject; Mr. G. A. Clarke is therefore to be congratulated on adhering to the international classification in his recently published book. He says that even to divide the recognised types into sub-types makes the classification unwieldy, and is open to the objection that, "particularly in the case of the cirrus . . . one sub-type may be transformed into another and then perhaps return to its original form all within the space of a few minutes." He even suggests that any change should rather be in the direction of further simplification. In chap. ii. the international classification is given in full, so that for English readers Mr. Clarke's book may well supersede the Cloud Atlas, for the former contains all the essentials to be found in the text of the latter, and the illustrations cannot for a moment be compared. Where the atlas gives a few illustrations, some very indifferent, of each type, Mr. Clarke gives numerous examples that for variety, wealth of detail, and excellence of production easily surpass previous pictures.

FIG. 1.—Lenticular cirro-cumulus at sunset. From "Clouds."

There are many plates of cirrus and cirro-cumulus, some giving details of structure, and some whole skyscapes of these the most beautiful of all the forms of clouds. Very noticeable is the plate of cirro-stratus, "a thin whitish sheet of clouds," and therefore very difficult to depict satisfactorily. Mr. Clarke has carefully studied lenticular clouds and gives many examples, while in the text will be found a discussion of these extremely interesting and hitherto rather neglected forms of cloud; an example, perhaps the most striking photograph in the book, shows such a cloud with its front edge lit up by the setting sun, while part of its under surface, also in sunshine, is broken up by a double set of ripple marks (Fig. 1). There is no doubt that the cloud sheets have been rendered by Mr. Clarke better than has been done in any previous publication; but some of the photographs of cumulus leave something to be desired, chiefly owing to the use of a lens of too narrow an angle for the size of the clouds; pictures of cumulus gain in effect if the main cloud does not fill up the whole of the picture. The most remarkable plate in the whole book from a photographer's point of view is that which shows a rainbow on the shower from the base of a cumulo-nimbus cloud (Fig. 2); to show a rainbow, three super-

FIG. 2.—Rainbow on screen of rain falling in middle distance. From "Clouds."

[1] "Clouds." By G. A. Clarke. Pp. xvi+136+40 plates. (London: Constable and Co., Ltd., 1920.) 21s. net.

numerary bows, a secondary bow, and the lighter space inside the primary bow requires a photographic technique of a high order. It is with regret that we miss a chapter on cloud photography from the hand of such a master. Everyone has a slightly different technique, but Mr. Clarke unfortunately gives no hint of his own methods. The series of plates ends with some fine photographs taken by Capt. C. K. M. Douglas from an aeroplane.

There are also several coloured plates and drawings; the frontispiece is a delightful coloured sketch of a beam of a searchlight revealing two layers of fine condensation before striking the main cloud sheet; it vividly recalls a phenomenon which must have been noticed by many meteorologists during the war. Another very beautiful plate shows a halo, sun pillar, mock sun ring, and two arcs of contact. The four sketches showing stages in the history of a line squall cloud are interesting as diagrams, but as pictures they make the clouds look too solid.

If more notice has been taken of the plates than of the text, it is because they form the most striking part of the book; but the text contains much interesting matter. Cloud forms are described, and use is made of recent researches into upper-air temperatures in explaining cloud phenomena. There are chapters on cloud distribution, and the association of cloud forms with weather types. Mr. Clarke has produced a standard book on cloud forms, not only for the meteorologist, but also for the general reader, who will surely find it an incentive to a further study of the weather. Author and publishers are to be congratulated on the excellence of the work.

Unveiling the Senussi Shrines.

By ARTHUR SILVA WHITE.

THE story of Mrs. Rosita Forbes's journey to the oasis of Kufra, situated in the heart of the Libyan Desert, constitutes the "something new out of Africa" of which few vestiges remain to be revealed. The three instalments recently published by the *Times*, under the title of "Secrets of the Sahara," contained the latest, and in some respects the only, information from a locality in the Libyan Desert unexplored since the visit of Gerhard Rohlfs in 1879.

Rohlfs made two attempts to reach Kufra. On the first he was turned back (although travelling under the protection of a *firman ali* of the Sultan of Turkey) from Aujila and Jalo because the Mojabra (slave traders) refused to give him a guide without Senussi's consent; and on the second attempt, when he succeeded in reaching Kufra, he was made captive and barely escaped with his life. Where Gerhard Rohlfs failed, and found no European successor for forty years, Mrs. Forbes has succeeded; but, it is to be noted, the reason for this remarkable achievement is to some extent explained by the total change of circumstances. In the interval between the two adventures, the Great War has resulted in the military conquests of France and Britain in that region of Africa and in the overthrow of the Senussi domination. Moreover, Mrs. Forbes had the supreme advantage of entering Libya at the psychological moment of complete accord (the ratification of a treaty) between Italy and the Grand Master of the Senussi Confraternity, whose personal support she obtained, and of travelling, not as a European, but as a Moslem in the interests of Islam—that is to say, practically as a Moslem convert or Senussi propagandist, since the Senussi commonly employ women in that capacity. That Mrs. Forbes could have kept up this disguise through all the vicissitudes of travel and the dangers encountered is in itself one of the stories out of Africa which deserve to be remembered.

Mrs. Forbes, accompanied by Ahmed Bey Hassanein, an Egyptian (son of Sheikh Mahamed Hassanein el Bulaki, a professor at El Azhar University), started from Benghazi, the maritime terminus of the ancient trans-Saharan caravan route, and rode eighty miles south to Jedabia, where the desert journey began. Here she was hospitably received by Sidi Rida (brother of Sidi Idriss, the Sheikh es-Senussi or Grand Master), who made himself responsible for her caravan. But the usual delays, leading to divided counsels among the Senussi brethren (Khuan), necessitated a midnight flight in Bedwin disguise without a guide. After wandering round Jedabia for three hours, the fugitives found themselves only one mile away in the open desert when day dawned. Riding south for two days, accompanied by two trusted Senussi, they were joined by two black soldiers unprovided with rations. The party, numbering six, were saved from starvation by meeting with a Mojabra caravan, and together they travelled by short stages to the oasis of Aujila. Here they were caught up by the caravan prepared by Sidi Rida, who sent also a letter of introduction to the Kaimakam at Jalo, near by, the gate of the Libyan Desert.

The caravan, now fully organised, comprised eighteen camels, nine black servants, two slave-girls, a guide (Abdulla el Zawia), three Bedwin, Ahmed Bey Hassanein, and Sitt Khadija—"a Moslem of half English, half Egyptian blood"—otherwise Mrs. Rosita Forbes. For so large a party eighteen camels were far from adequate, especially as these were in bad condition, for a

journey in the Libyan Desert. Consequently, from the very outset privations overtook the party.

The first stretch across the desert, from Bir Battifal to the oasis of Taiserbo (which was passed unheeded), with no wells on the route, was accomplished with ever-increasing difficulties, owing apparently to the failure of the guide to pick up his landmarks and the consequent delays. It took nine days to reach El Harrash, where water was found, and two days more to reach Buzeima. Here, after the fatigues and sufferings of the march, a halt of three nights was called to rest the caravan. Four days onwards, passing through a region of sand-dunes, they came to Hawari, on the outskirts of Kufra oasis. Taj, the objective of their pilgrimage, lay more than twelve miles further south.

Intrigues and plots had to be faced and overcome before the guests of the Sheikh es-Senussi were allowed to continue their journey; and no wonder! Indeed, there must be a sharper cleavage than ever before between the more rigid Senussi of the banished Grand Master, Sayed Ahmed, who was answerable for the war against Egypt and the Nosrani (Christians), and the post-war adherents of the ruling Sheikh, Idriss, who, according to the doctrine of their Order, must be regarded as a renegade Senussi. In the precincts of the sacred city, Taj, our suspect travellers were on dangerous ground.

The Kaimakam of Taj, Sidi Saleh el Baskeri, after due inspection of their credentials, received the travellers well, and lodged Mrs. Forbes in the house of Sidi Idriss. In the home of the Sheikh es-Senussi this courageous young Englishwoman "lived the life," as she says, "of a veiled Arab woman of Taj for nine days, and visited the holy *Kubba* of Sidi el Mahdi," the son and successor of the founder of the confraternity. Of course, she was under suspicion, and fifteen tribal Sheikhs offered objection to her wandering abroad, since such a privilege is unknown to Arab women and the women of Taj. Nevertheless, a flying visit under the official auspices of the Kaimakam (presumably the Turkish Resident) was made to the west, a ride of seventeen hours, providing some interesting sight-seeing of which we may hope to hear later.

When the time came for her departure from Taj, Mrs. Forbes decided "to attempt to open up a new route to the north, hoping to facilitate future trade with Egypt." The route she selected and afterwards followed appears, however, to have been one of the direct routes (Kufra to Jarabub, Kufra to Siwa, and Kufra to Khargeh) reported to have been opened up by the Senussi, after their settlement at Jalo and Jof. These routes, as also that from Siwa to Farafra oasis, were at one time kept open for the use of all followers of the Prophet, so that even single travellers might use them and find refuge at the end of each day's march—at least, that was the boast of the Senussi, who undoubtedly did make settlements for so-called slaves, and built cisterns along some new routes in the Sahara. Apparently, then, the direct route between Kufra and Jarabub, selected by Mrs. Forbes, fell into disuse (if used only by the Senussi family) in consequence of the absence of Sheikh el Senussi at the seat of war. That is my conjecture.

The homeward journey, starting from Hawari, was begun on January 25, 1921. Previously, Mrs. Forbes had sent back the soldier slaves and others to Jalo and Jedabia, and her new caravan for this hazardous journey to Jarabub comprised only nine camels. Besides herself and Ahmed Bey Hassanein, the party consisted of Yusuf, a Zawia student named Amar, and the guide Suleiman, an oldish man with defective eyesight. Zakar, a well that had not been used for four years, and, therefore, had to be cleared, was reached in four days; and from that spot onwards no well or cistern was available during the twelve days' march through the arid desert to the outlying parts of Jarabub. They carried twelve skins of water, dates for the camels, fuel, but no tents. Marching for thirteen hours daily, averaging thirty miles a day—presumably at night, to make such good progress—they endured great hardship on a simple and scanty diet. Sand-dunes both at the beginning and at the end of their journey were encountered. On the eleventh day from Zakar they entered broken country beyond the dunes, and stumbled upon Bir Salama (?Tarfaja), on the Jalo-Jarabub caravan route. Thence to Jarabub was but a day's march.

At Jarabub—the Mecca of the Senussi—which never before had been entered by a European, Mrs. Forbes was lodged inside the Zawia in a house belonging to the Khuan (brethren), and she was even permitted to kiss the tomb of the sainted founder and to visit the University quarter.

On February 13 the journey was resumed, and, with four camels and a guide, Mrs. Forbes came joyfully to Siwa under the escort of a Camel Corps patrol sent out to meet her. Thence, after a cordial reception from the officers at Siwa, she motored (new style) across the desert for 430 miles to Alexandria.

This bare recital of Mrs. Forbes's remarkable journey raises in the mind of one who knows something of the country and of the Senussi confraternity profound admiration for the woman who accomplished it; and further details of her experiences will be eagerly awaited. The information she brings from Kufra and Jarabub, in particular, will appeal to geographers, who will not be too critical as to her revision of the map unless other instruments than a magnetic compass were used by her. In addition, any information about the Senussi sect will prove of the highest interest, in view of the fundamental changes in their doctrine and policy superinduced by their defeat in the field under Turko-German leadership.

Obituary.

PROF. H. W. G. VON WALDEYER.

THE years of the war were disastrous to German anatomy, the deaths of men like Gaupp and Brodmann, Bütschli and Edinger, to mention only four, leaving gaps which have not been filled. But on January 23 of this year the Nestor of German anatomy, Geheimrath Heinrich Wilhelm Gottfried von Waldeyer-Hartz, died in the eighty-fifth year of his age, a month after Austria had lost one of her leading anatomists, Prof. Holl, of Gratz. Waldeyer was a man of genial and commanding personality, who, from the time he became professor of anatomy in Berlin in 1883, had been the recognised leader of German anatomists and biologists, and their spokesman at home and abroad. Even in his old age he was tireless in his attendance at congresses and scientific meetings, and undertook long journeys to all parts of Europe and poured forth fluent orations in sonorous and easy periods. But, apart from his gifts as an orator and congressman, Waldeyer had an exceptionally wide knowledge of anatomy, histology, embryology, pathological anatomy, and anthropology, in each of which he was regarded as an expert who could speak from a personal acquaintance with the facts.

Born on October 1, 1836, Waldeyer did not proceed to his doctorate until 1861, when he submitted to the Faculty in Berlin a dissertation "De claviculæ articulis et functione"; for when he entered the University of Göttingen he devoted himself to pure science, and then, from 1856 to 1858, to physiology and pathological anatomy. But during those years he came under the influence of the great Göttingen anatomist Henle, who was responsible for giving Waldeyer an aim in life and the inspiration to follow it. The next three years he spent as assistant to the anatomist Budge; then as an assistant for two years in the physiological institute at Königsberg, and for another year in a similar position under R. Heidenhain at Breslau, where in 1865 he was made extraordinary professor of pathological anatomy, and two years later an ordinary professor of the same subject. He held this position until 1872, and so great was the reputation he established as a pathologist that fifteen years after he had given up pathological for normal anatomy he was called to the bedside of the Emperor Frederick at San Remo as an impartial witness to settle the dispute which had arisen between the surgeons, British and German, as to the nature of the laryngeal growth from which the penultimate Kaiser was suffering. During the long tenure of his chair of pathology Waldeyer did not neglect his chief interest, normal anatomy and embryology; for during this period he wrote his famous work "Ueber Eierstock und Ei," illustrations from which have ever since been in every textbook of anatomy, histology, and embryology.

In 1872 Waldeyer for the first time was given charge of a department of anatomy: it was a position of quite exceptional difficulty and delicacy in the new school which the Prussians built up in Strassburg after wresting it from the French. Here Waldeyer displayed his remarkable abilities as a tactful administrator and peace-maker. So successful was he in this formidable task that in 1883, when the Prussian Government had another difficult problem to solve, to find a successor to the senile Reichert in Berlin, Waldeyer was appointed, although Koelliker, Gegenbaur, and His were senior to him and had a greater prestige as anatomists. Waldeyer had a very difficult task to reduce to order the chaos bequeathed to him by Reichert; but he set to work to build up a great institute, not merely of gross anatomy, but also of histology and embryology. Five years later he was able to secure the establishment of a second professorship of anatomy, to which O. Hertwig was appointed, to relieve Waldeyer of part of the work in histology and the whole of embryology. Waldeyer relinquished his position only about three years ago. In Berlin he came to be regarded as the father of German anthropology after the death of Virchow. He succeeded Max Schultze as editor of the *Archiv für mikroscopische Anatomie;* after His's death he became editor of the anatomical part of the *Archiv für Anatomie und Physiologie,* and after Virchow's death editor of the *Jahresbericht für die gesamte Medizin.* He also succeeded Du Bois-Reymond as the secretary of the Berlin Academy of Sciences, and was made a member of the Prussian Herrenhaus.

In spite of this overwhelming programme of disturbing engagements, and his ubiquitous presence and active participation in congresses at home and abroad, Waldeyer continued his work of original investigation, and published an unbroken stream of memoirs ranging over the whole of anatomy, histology, embryology, and anthropology. Almost every domain of anatomy that he invaded, whether it was the structure of fibrous tissue or bone, the development of teeth, the morphology of the reproductive organs, the comparative anatomy of hair, or the interpretation of the central nervous system, he reduced to order, and left some clarifying conception, and as a rule some new term, to clear away difficulties of interpretation. His work is so voluminous and many-sided that it is impossible to review it concisely. But his well-known efforts to clear up confusion on the subject of karyokinesis, and his attempt in 1891 to dissipate the chaos of interpretation of nervous structure by inventing the term *neurone* (Greek νεῦρον—German Neurōn—*anglice* neurone), are typical of Waldeyer's *métier.* If he was not a brilliant genius, he was a man of calm judgment and exceptionally clear insight. It was these qualities that made him so great a power in the modern

history of anatomy and the author of so many clarifying expressions of what other people were trying in vain to set forth.

As a lucid exponent and as a teacher he was pre-eminent. Many young anatomists have had occasion to appreciate his fairness and his weighty help in defending themselves from attacks even from his own countrymen. With his death there passes away perhaps the most influential anatomist of modern times. G. ELLIOT SMITH.

Notes.

THE large group of sun-spots which became visible a few days ago has been accompanied by disturbances of the magnetic and electrical conditions of the earth, manifested by magnetic storms, interruptions of the telephone and telegraph services over the greater part of the world, and brilliant auroral displays. Large sun-spots often appear without producing any such terrestrial effects, and magnetic storms sometimes occur in the absence of sun-spots, so that the relationship between the two phenomena is obviously exceptionable. There is evidence that solar prominences are more closely related to the production of magnetic disturbances on the earth than are sun-spots, which are only visible effects of solar disturbances the exact nature of which remains to be discovered.

THAT wireless telephony is fast emerging from the experimental stage into that of practical utility is evidenced by the interesting demonstrations, in which the *Times* participated last week, between stations equipped by the Marconi Co. at Southwold, in Suffolk, and Zaandvoort, in Holland. There is no technical reason why these stations should not be linked up with the ordinary telephone systems of Great Britain and Holland, so that it would be possible to communicate freely between any point in either country to any point in the other. It is interesting to note that the stations work on the short wave-length of 100 metres, which makes them free from interference from the 600-metre wave commonly used for marine communication and from the higher wave-lengths of the long-distance stations, as well as less likely to be influenced by stray disturbances than if a longer wave-length were employed. Other methods of protection against interference are being experimented with, and also of securing a greater degree of directive effect instead of broadcast emission, which, when such stations multiply, should contribute very materially to freedom from mutual interference. It is not generally known that wireless telephony is already employed by the Stock Exchange in Amsterdam for communicating prices to points all over Holland, and that these messages can be picked up in this country without difficulty. Dr. J. A. Fleming, the pioneer in the applications of the thermionic tube, upon which so much of the advance in wireless telephony is due, points out, in an interview in the *Times*, the great possibilities as well as the great achievements of wireless telephony, and emphasises its advantages over line-working in that no distortion of the wave is produced; as, in the case of wireless, all the harmonics are attenuated in the same proportion as the fundamental, because they are all propagated at the same rate.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 4. The observatory will be open at 3.30 for inspection by invited guests.

PROF. JOHN MERLE COULTER, of Chicago, Dr. Samuel Garman, Prof. Giovanni Battista Grassi, of Rome, Prof. Louis Alexandre Mangin, of Paris, and Prof. Jean Massart, of Brussels, have been elected foreign members of the Linnean Society of London.

AT the anniversary dinner of the Royal Geographical Society, to be held at the Connaught Rooms at 7.30 p.m. on Tuesday, May 31, the guests will include the French Ambassador, General Bourgeois, Earl Beatty, Earl Buxton, Viscount Chelmsford, the High Commissioner for Canada, and Bishop Gore.

IN connection with the Royal Microscopical Society a Paper Industries Section is in course of formation. It will deal with researches relating to timber, wood-pulp, paper, etc. All interested in the subject and willing to assist are invited to communicate with Mr. J. Strachan, 74 Blenheim Place, Queen's Cross, Aberdeen.

THE CROWN PRINCE OF JAPAN, accompanied by Prince Kan-in and a large party, which included Admiral Ogouri and seven senior naval officers, visited Greenwich Observatory on Monday, May 16. The party was received by the Astronomer Royal, Sir Frank Dyson, and the two chief assistants, Mr. H. Spencer Jones and Mr. J. Jackson, and examined with interest the chief instruments in the observatory.

AT the meeting of the Franklin Institute, Pennsylvania, held on May 18, the Franklin medal and certificate of honorary membership were presented to M. Jusserand, French Ambassador to the United States, for Prof. Charles Fabry, of the University of Paris, for his studies in the field of light radiation. The Franklin medal and certificate of honorary membership were also presented to Mr. Frank J. Sprague, New York City.

THE Wild Birds Advisory Committees appointed for England and Scotland by the Home Secretary and the Secretary for Scotland to advise regarding the protection of wild birds held their first meetings on May 12, and a joint meeting on May 13, when general questions of wild bird protection in Britain were discussed. The chairmen of the committees are Viscount Grey of Fallodon, K.G., and Mr. H. S. Gladstone, and the secretary of the Scottish committee is Dr. James Ritchie, Keeper of the Natural History Department, Royal Scottish Museum, Edinburgh.

THE prolonged pause in the seismic activity of the well-known Comrie centre seems to be coming to an end. Towards the close of a similar, but briefer, pause from 1801 to 1839 slight shocks gradually became more frequent, until they culminated in the strong earthquake of October 23, 1839. There was no pronounced movement between the summer of 1898 and that of last year. On July 21, 1920, a shock of intensity 3 (Rossi-Forel scale) occurred, followed by one of intensity 4 on September 14. On April 30 last a still stronger earthquake, the most distinct known to the present inhabitants, was felt at 10.35 a.m. (Greenwich mean time). The shock was strong enough to throw down crockery from shelves, and was accompanied by the usual sound, like the firing of guns.

MR. G. SHEPPARD, of Edmonton, Alberta, informs us that in view of the coming importance of the MacKenzie River Basin of the North-West Territory of Canada by reason of the oil strike made there in 1919, the Imperial Oil, Ltd., has purchased two monoplanes, which are to be used for general reconnaissance and topographical work in these unknown regions. An aerodrome has been established at Peace River Crossing, about 300 miles north of Edmonton, and from this base the planes will operate as far as Fort Norman and the Great Slave Lake areas. The journey takes, normally, three to four weeks under favourable conditions, but it can be made easily in three days by air. The aeroplanes are to be equipped with suitable cameras, by which it will be possible to photograph all water-courses and similar features of the landscape. These photographs will be of value to surveyors and others for checking up the country without using ordinary topographical methods.

AT the annual general meeting of the Institution of Civil Engineers held on April 26, the result of the ballot for the election of officers for the year 1921–22 was declared as follows:—*President:* Mr. W. B. Worthington. *Vice-Presidents:* Dr. W. H. Maw, Mr. C. L. Morgan, Mr. B. Mott, and Sir William H. Ellis. *Other Members of Council:* Dr. C. C. Carpenter, Mr. G. M. Clark, Dr. P. C. Cowan, Col. R. E. B. Crompton, Mr. M. Deacon, Sir Archibald Denny, Bart., Mr. W. W. Grierson, Sir Robert A. Hadfield, Bart., Mr. K. P. Hawksley, Sir Brodie H. Henderson, Mr. E. P. Hill, Mr. G. W. Humphreys, Mr. S. Hunter, Mr. H. G. Kelley, Mr. C. R. S. Kirkpatrick, Mr. F. W. MacLean, Mr. H. H. G. Mitchell, Sir Henry J. Oram, Mr. F. Palmer, Mr. G. Richards, Capt. H. Riall Sankey, Sir John F. C. Snell, Mr. W. A. P. Tait, Mr. E. F. C. Trench, Prof. W. H. Warren, and Sir Alfred F. Yarrow, Bart.

THE members of the Gilbert White Fellowship have resolved to commemorate the bicentenary of the birth of the renowned naturalist whose name their organisation bears by erecting a permanent memorial at Selborne, and by undertaking a regional survey of the parish rendered famous by his great work, "The Natural History of Selborne." The memorial is to take the form of an outdoor bench or seat in stone and timber. The results of the regional survey it is hoped to publish as the work proceeds, so as to make them immediately available to all interested. Many admirers of Gilbert White outside the circle of the fellowship are likely to be glad of the opportunity of taking part in this tribute to his memory. Such contributions as those interested may feel disposed to make should be sent to Messrs. Grindlay and Co., bankers, 54 Parliament Street, London, S.W.1, to be credited to the account of the Gilbert White Memorial Fund, or to the honorary secretary, Winifred M. Dunton, 18 Crockerton Road, Wandsworth Common, London, S.W.17.

AN important step has been taken in America for the presentation of science and scientific facts to the lay public by the formation of a Science Service (*Science*, April 8). The charter is a wide one, authorising the organisation to publish books and magazines, to conduct conferences and lectures, and to produce kinematograph films; the function will be that of liaison officer between scientific circles and the general public. The governing board will consist of ten men of science and five journalists, and any profits which may accrue will be devoted to the development of new methods of popular education in science. The present board of trustees consists of three representatives from the National Academy of Science, three from the American Association for the Advancement of Science, three from the National Research Council, three from the Scripps Estate, which is financing the undertaking, and three professional journalists, under the presidency of Dr. W. E. Ritter, director of the Scripps Institution for Biological Research of the University of California. Dr. Edwin E. Slosson, who for some twelve years was professor of chemistry in the University of Wyoming, and for the past seventeen years has been literary editor of the *Independent* of New York, has been chosen as editor. At present the Science Service will not publish any periodical of its own; it is considered that better results will be obtained by directing attention to the various journals of popular science already in existence, and by supplying newsagencies with authentic, popular articles. The headquarters of the institution have been established provisionally in the building of the National Research Council, 1701, Massachusetts Avenue, Washington, D.C.

DR. T. W. FULTON, scientific superintendent of the Fishery Board for Scotland, has just retired after a service of thirty-four years. The Scottish Scientific Department owed its institution to the recommendation of the Dalhousie Trawling Commission, and in 1888, when Dr. Fulton was appointed, had been in existence for only a few years. In England the scientific study of the sea in connection with fisheries was taken up by the Plymouth Laboratory, and later by certain of the Sea Fisheries Committees, two of which, those of Lancashire and Northumberland, have much good work to their credit. The fisheries are a very intricate, many-sided subject, and Dr. Fulton has laboured to solve many problems which have cropped up in the Scottish administration. The attempt has been made to render the statistics as

accurate and informative as possible in an industry which does not lend itself readily to minutely made records. In order to locate the regions in which the fishes were captured by means of the trawl, Dr. Fulton devised the scheme subdividing the North Sea into equally sized divisions numbered consecutively. This arrangement was adopted and found to be of great service. Dr. Fulton has served during the past twenty years as one of the experts on the International Committee for the Exploration of the North Sea, a body which has published many important reports dealing with fisheries biology. In 1911 a Departmental Committee of which he was a member inquired into the Scottish fishing industry; the wide extent and thoroughness of its labours are indicated by the large report which it issued. Dr. Fulton's publications deal with the development, distribution, and migrations of fishes; they are numerous and of great interest and value.

IN an account of the leeches of the Chilka Lake (in the province of Bihar and Orissa) Mr. W. A. Harding records (Memoirs Indian Museum, vol. v., 1920) the occurrence of a colour variety of *Glossosiphonia heteroclita*, a species well known to occur in fresh-water in North America and throughout the greater part of Europe, but now recorded from India for the first time. Mr. Harding has received examples collected in many other parts of India, and the species is evidently widely distributed there. A new species of Piscicola, from fish, and one of Placobdella, from mud-turtles of the genus Emyda, are also described.

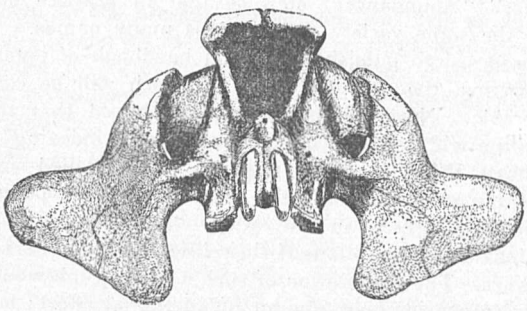
As a result of the late war and the consequent dearth of foodstuffs in certain parts of Central Europe, increased interest is being aroused in the wider utilisation of wild plants—more especially fungi—as food for human consumption. An association has been formed in recent years, having its headquarters in Heilbronn a. N., styled the "Pilz- und Kräuterzentrale," amongst the main objects of which are the fostering of the study of fungi and the dissemination of information, particularly as regards the nutritious qualities of the various edible kinds and the properties of those that are noxious or specifically poisonous, amongst the lay public. In furtherance of its aims a congress of mycologists is being arranged under the auspices of the association to be held in Nürnberg during the coming autumn. The association issues a monthly periodical, *Der Pilz- und Kräuterfreunde*, now in its fourth year of publication. The articles in this periodical are naturally more or less of a popular nature, but descriptions of new fungi are also included. One of the recent issues contains a description, with a coloured plate, of a new poisonous species of agaric, *Inocybe lateraria*. In the list of supporters of the association are to be found such well-known names as Günther-Beck v. Managetta, Bresadola, Falck, and Lindau.

THE National Institute of Agricultural Botany has recently published the report of its Potato Synonym Committee for the year 1920. The necessity for reducing to order the chaos existing in the nomenclature of potato varieties has become more urgent than ever in recent years, owing to the fact that some varieties are immune to the dreaded wart disease, while others are susceptible. Two hundred and forty-two varieties are dealt with in the report, and they are classified in forty-two groups. Immunity or susceptibility to wart disease is generally indicated. In a large number of cases the varieties, although possessing different names, were found to be indistinguishable in morphological and certain physiological characters (such as time of maturity, immunity or otherwise to wart disease) from well-known types such as "Up-to-Date," "Abundance," etc., so that in practice one and the same variety may possess many names. It is proposed to publish an annual handbook of potato synonyms, the practical value of which will be considerable. Nevertheless, it is to be hoped that the institute will not rest content with a mere indexing of names. What is really required is a detailed and scientific monograph of the leading types of potato varieties at present in cultivation, with adequate illustrations and descriptions of their differentiating characteristics. The preparation of such a monograph would entail a considerable amount of additional effort; but a better opportunity for embarking on such a project is scarcely likely to occur than that now presented by the work of the National Institute at its Ormskirk Trial Grounds, while it would be difficult to find men more thoroughly equipped for the enterprise than those who form the Synonym Committee.

THE annual report of the Marlborough College Natural History Society for the year ending Christmas, 1920, has just been received. It forms an interesting record of the work carried out by this active and vigorous association. No fewer than fourteen papers were read to the astronomical section dealing with such diverse subjects as the moon, stellar photometry, tides, and relativity. The botanical, ornithological, and entomological sections also receive notice in the report. Their activities were confined mostly to recording the appearance of plants, birds, and insects in the neighbourhood, and the results provide useful contributions to the knowledge of the local natural history. The report concludes with a summary of the meteorological observations made at the college during the year; maximum, mean, and minimum barometric and thermometric readings for the several months are given, together with remarks on observations of wind, rainfall, and sunshine for similar periods. We are glad to see that this useful society is, according to the annual balance-sheet, in a sound position and proposes to carry on and, if possible, extend its labours to other branches of natural history.

THE Queensland Museum recently obtained from post-Tertiary sand on the Darling Downs a marsupial cranium apparently of the species *Nototherium dunense*, founded by De Vis in 1887 on some mandibles and cranial fragments. The new skull is described and figured in the Memoirs of the museum (vol. vii., part 2) by the director, Mr. H. A. Longman, who feels impelled to establish for the species a new genus, Euryzygoma. The character that suggests the name is the enormous relative width given to the skull by

the extension, from the lower outer angle of each cheek-bone or zygomatic arch, of a large side-process buttressed by a horizontal platform beneath the orbit. Mr. Longman considers that these processes were for the support of large cheek-pouches, as in the pocket gophers of North America. However that may be, such extensions are characteristic of the Nototheres, and an exaggeration of the character, with the correlated modifications, would scarcely warrant the generic separation of this species from *Nototherium*



Front view of the cranium of Euryzygoma, slightly restored. Actual width 680 mm.

Mitchelli and *N. tasmanicum*. Mr. Longman, however, states that the upper premolar tooth, on which some stress has been laid by classifiers of marsupials, is oval in the normal Nototherium, but subtriangular in Euryzygoma. From the half-tone reproduction of a greatly reduced photograph it is impossible to check the alleged differences. In all other technical respects Mr. Longman's presentation of his results calls for praise. He is also to be congratulated on an interesting discussion of the most remarkable Diprotodont yet discovered.

ALASKA magnetic tables and magnetic charts for 1920 have been published by the U.S. Coast and Geodetic Survey as Special Publication No. 63, prepared by Daniel L. Hazard, Assistant-Chief, Division of Terrestrial Magnetism. Charts are given for the several magnetic elements, declination, inclination or dip, and horizontal force or intensity. The area covered by the discussion includes not only Alaska, but also its boundary waters, parts of the North Pacific, the Bering Sea, and the Arctic. Declination and dip are given on the charts to each 1° and the horizontal force for intervals of 0·01 C.G.S. unit. Results are for observations since 1870, and the data now published are said to be sufficiently numerous to show areas of local disturbance, some of which are remarkable. Lines of equal annual change of declination are shown on the isogonic chart, but they are stated to be only rough approximations to the truth. East declination is decreasing in Alaska except in the south-eastern portion, where the change is negligible. It is not considered advisable at present to attempt to draw lines of equal annual change of dip or of horizontal force. The tabular matter shows that the dip appears to be decreasing in the greater part of Alaska at the rate of 1′ or 2′ a year, and that the annual change of horizontal intensity is decreasing in the southern part of the territory and increasing in the northern, but the rate of change is small.

WE have received from Dr. J. Newton Friend a copy of his paper entitled "Iron in Antiquity," reprinted from the Transactions of the Worcestershire Naturalists' Club. Dr. Friend recalls the statement of Cæsar that the Britons were accustomed to use bars of iron in place of coins as currency. Several hundreds of these, which have escaped, more or less, the ravages of time, have been found and placed in different museums, notably the British Museum and the local museum at Worcester. They resemble swords and consist of a flat and slightly tapering blade with blunt vertical edges. Owing to corrosion all the bars have suffered some loss in weight, but many of them have been only slightly oxidised, and a rough estimate of their original weight can be made. The weights are found to approximate 309 grams, or some multiple or sub-multiple of this amount. In all, six different denominations have been found. In spite of their resemblance to swords, Dr. Friend advances good reasons for considering that these are the currency bars referred to by Cæsar, the use of which, indeed, dates back to the early Greeks, and survives to-day in some parts of Africa. His paper also deals at some length in an interesting way with early British water-clocks.

THE Dewey decimal system of classifying books in a reference library is being adopted in America, and modifications of it are widely used. The radio laboratory of the Bureau of Standards has extended this method and applied it to the classification of books and pamphlets in its library. In the Dewey classification "radio" would be represented by 621·384. The number 600 denotes the class (useful arts), the number 20 denotes the division (engineering), and the number 1 denotes the section (mechanical). Similarly, 0·300 stands for "electrical," 0·080 for "communication," and 0·004 for "radio." As the library is a collection of matter dealing with radio, the number 621·384 is denoted by R, and a further number of three figures is added. For instance, R211 stands for "resonance methods of measuring wavelengths." R200 contains information on "radio measurements and standardisation," R10 denotes "theory," and R1 "statistics." An essential part of the method is the alphabetical index. We look up, for instance, "resonance methods" and find R211. This gives us the number of the shelf in the library on which the required books or pamphlets will be found, the shelves all being classified in numerical order. The books on the adjacent shelves also treating of cognate subjects can sometimes be usefully consulted at the same time. The classification is good and the alphabetical index very complete. We missed, however, the word "thermionic."

MESSRS. C. BAKER, of 24 High Holborn, W.C.1, have issued a new edition (No. 72) of their catalogue of second-hand scientific instruments. As is customary in these lists, the items are grouped in sections according to the subjects with which they are related. Twelve such sections appear in the list before us, five of which deal with apparatus which may be classed as physical. Section I., dealing with microscopes and their accessories, includes particulars of

a number of microscopes both large and small, and a long list of object-glasses, eye-pieces, condensers, etc. The astronomical section (No. III.) describes numerous telescopes of different types and a very varied collection of eye-pieces. Section VII. is devoted to what may be termed academic physical apparatus, and Section X. to photographic apparatus. The book list (Section XI.) includes a number of books and journals, among which we notice vols. xxviii.–civ. of NATURE.

MESSRS. G. BELL AND SONS will publish next month "Motya: A Phœnician Colony in Sicily," by Joseph I. S. Whitaker (of Malfitano, Palermo). Motya was one of the latest sites occupied by the Phœnician colonisers of Sicily. Though its exact position was long a matter of doubt, it is now identified by archæologists with the small island of San Pantaleo at the north-west extremity of Sicily. Recent excavation undertaken by its owner, Mr. Whitaker, has confirmed this conclusion, and the forthcoming volume contains a detailed account of his discoveries.

IN a paper entitled "Studies on Phototropism in Solution," part i. (Journ. Amer. Chem. Soc., vol. xliii., 1921), Prof. B. K. Singh indicates some interesting cases of phototropism in solution which he is investigating, and points out that his preliminary results do not fall into line with Senier and Shepheard's explanation that phototropic transformations are due to extramolecular rearrangements.

UNDER the title *Dactylography* a bimonthly magazine is to appear on July 1. It will deal chiefly with the evidence for criminal and other identifications by means of finger-prints; but attention will also be given to a study of the detective aspects of footprints, tattoo marks, deformities, and related matters. The magazine will be conducted by Mr. Henry Faulds, Regent House, Hanley, Stoke-on-Trent.

MR. F. EDWARDS, 83 High Street, Marylebone, W.1, has issued at an opportune moment an interesting catalogue (No. 413) of nearly four hundred entries of books, manuscripts, letters, documents, and engravings relating to Napoleon and his times. Many choice works are offered for sale. The list can be obtained free of charge.

MR. P. BRUCE WHITE directs attention to a misinterpretation indicated by a sentence in the article on researches on bee disease in the issue of NATURE for April 28, p. 284. Instead of "The tracheæ become darkened and ultimately black by the increasing deposition of chitin," it should read: ". . . by the increasing amount of fæcal matter deposited by the mites."

Our Astronomical Column.

COMETS.—A new comet 1921*c* was discovered by M. Dubiago, Petersburg, on April 29. The following orbit has been received by telegram:—

$T = 1921$ May 7·611 G.M.T.
$\omega = 104° 45'$
$\Omega = 66° 4'$
$i = 21° 42'$
$\log q = 0·02731$

Ephemeris for Greenwich Midnight.

		R.A. h. m. s.	N. Decl. ° ′	Log r	Log Δ
May	20	8 56 45	39 46	—	—
	24	9·21 6	37 33	0·0419	9·9661
	28	9 44 44	34 58	0·0492	9·9620

Herr Reinmuth, of Königstuhl, obtained a twelve-minute exposure plate of Reid's comet on April 30. It shows a faint tail 40′ long in P.A. 266°, slightly curved at its extremity towards smaller P.A. There is also a group of short streamers with centre in P.A. 225°.

Corrections to the ephemeris of Pons-Winnecke:—May 22, −31½m., −1° 0′; May 26, −45m., −5′; May 30, −59m., +1° 43′. It is a curious coincidence that the three comets now visible are all circumpolar, and their perihelion distances are nearly equal, all being slightly in excess of unity.

Mr. Denning writes that on April 10 Winnecke's comet was an easy object in a 6½-in. refractor, power about 20. The comet was estimated to be about 9th magnitude, and some 5 or 6 minutes of arc in diameter, though it was difficult to define exactly the outer faint limits of the nebulosity. As the comet is brightening, it should become rather conspicuous even in small telescopes after the present moon has left the evening sky, on about May 25. On that date the comet will be 17 millions of miles from the earth, and its position in the heavens will be two degrees south of δ Cygni. It is travelling rather swiftly to the south-east, and on May 30 will be eight degrees south-south-east of α Cygni. It will then probably be about 7th magnitude, but many comets vary in their light in an inexplicable manner.

THE ECLIPSING VARIABLE U CEPHEI.—The study of eclipsing variables, from which a large amount of information on the sizes, densities, and brightness of the components may be gained, played a large part in the development of the theory of giant and dwarf stars. It is therefore not surprising that Mr. R. S. Dugan, one of the assistants of Prof. H. N. Russell at Princeton, has produced a monograph on U Cephei. The eclipse of the primary star (which is of type A_0) is total, so that we get the spectrum of the secondary isolated. Miss Cannon has recently determined its type as K_0. Since this is the larger star, but the less luminous, both would appear to be in the giant stage.

The light-comparisons were made visually, and in the course of them reason was found to suspect the variability of B.D. 81·27° and 81·30°. The secondary minimum, being an annular eclipse, gives information as to the degree of darkening at the limb. In the final elements the limb-light is taken as one-third of that at the centre. The orbit is sensibly circular; taking its radius as unity, the radii of the stars are 0·20 and 0·32, and the inclination of orbit plane 86·4°. The densities are (somewhat conjecturally) given as 0·214 and 0·022 of that of the sun. From asymmetry in the light-curve it is concluded that the bright star rotates more rapidly than the period of revolution, producing a tidal lag of 24°. A further result of tidal friction is traced in the lengthening of the period of variation by 9 seconds in 60 years; this is indicated with considerable probability by some early observations of magnitude by Schwerd and Carrington. The system thus furnishes an interesting illustration of tidal evolution.

Æther Waves and Electrons.[1]

By SIR WILLIAM BRAGG, K.B.E., F.R.S.

NEWTON put forward a corpuscular theory of light, and Huyghens believed that it was essentially a wave motion. Each gave wrong reasons for his belief. Newton argued that it ought to be possible to see round a corner, since the passage of waves round a corner was a common effect. Huyghens declined the corpuscular theory on the grounds that corpuscles could not go fast enough, and that if two people looked into each other's eyes the corpuscles must hit each other and prevent mutual vision. But the wave theory carried all before it, and, developed by Young, Fresnel, and other workers, proved to be capable of explaining optical phenomena in perfect fashion.

With the advent of X-rays and radio-activity the process of radiation as a whole is seen to depend in part on the movement of electrons. In the X-ray bulb, to take an example, a stream of electrons, which is truly a corpuscular radiation, strikes a block of metal in the centre of the tube. Energy of radiation is carried outwards through the walls of the tube in the form of X-rays; that is to say, of wave motions in the æther. When they strike matter, such as the film of a photographic plate, the wave radiation disappears and is replaced by moving electrons which produce all the well-known effects ascribed to X-rays. It is probable that this mutual plane of waves and electrons is carried throughout the whole realm of radiation, and the ultimate explanation of all optical problems must involve the recognition of corpuscular radiations, at times replacing and being replaced by the waves. Thus once more the corpuscular theory appears again as a working hypothesis.

But in its relation to the wave theory there is one extraordinary and, at present, insoluble problem. It is not known how the energy of the electron in the X-ray bulb is transferred by a wave motion to an electron in the photographic plate or in any other substance on which the X-rays fall. It is as if one dropped a plank into the sea from a height of 100 ft. and found that the spreading ripple was able, after travelling 1000 miles and becoming infinitesimal in comparison with its original amount, to act upon a wooden ship in such a way that a plank of that ship flew out of its place to a height of 100 ft. How does the energy get from one place to the other?

Very lately considerable new information has come to hand regarding the way in which atoms play a part in this extraordinary transference of energy. In many ways the transference of energy suggests the return to Newton's corpuscular theory. But the wave theory is too firmly established to be displaced from the ground that it occupies. We are obliged to use each theory as occasion demands and to wait for further knowledge as to how it may be possible that both should be true at the same time. Toleration of opinions is a recognised virtue. The curiosity of the present situation is that opposite opinions have to be held and used by the same individual in the faith that some day their combined truth may be made plain.

[1] Summary of the Robert Boyle lecture delivered at Oxford on May 12.

The Natives of the Gilbert Islands.

AT a meeting of the Royal Anthropological Institute on April 21, Dr. W. H. R. Rivers, president, in the chair, Mr. Arthur Grimble read a paper entitled "From Birth to Death in the Gilbert Islands." The paper, which was of considerable importance, as it dealt with a people about which we possess little information, described in detail the ceremonies used at marriage, birth, and death by the Gilbertese-speaking communities.

The rules relating to consanguinity among the Gilbertese are genealogical in character, and evidently allied to the Polynesian systems as typified by the Samoan; but the concubitant relations which exist between a man and his wife's sisters are of a type generally found in Melanesian communities. An extremely interesting relationship is that of *Tinaba*, under which a woman owes both filial and sexual duties to the brothers of her husband's father and a man to his wife's mother's sister. Incest is regarded with horror, and the hatred of the sun for incestuous couples is much stressed in native myth.

There were several forms of marriage ceremony in vogue. On certain islands marriage by capture was practised. Rather more common was the fishing fiction, in which the suitors seated in a loft let down lines into the room underneath, where the girl made a pretence of being caught by one of them. This act was succeeded by the anointing of the couple with coco-nut oil, and the union was complete. The most usual form of ceremony, however, was that known as *te iein*, of which the essential motive was to test the virginity of the bride. After birth mother and child remained for three days in the place of confinement, while the infant's soul was encouraged into its body by merrymaking, in which fire played an important part.

A boy's training was conducted with the view of excluding all sexual interests. The cutting of his hair from time to time was performed with rigid ceremonial, until the climax was reached in the initiation ceremonies (which were chiefly trials by fire) undergone when his pectoral and axillary hair was well in evidence. After submitting to these ordeals he was isolated until he passed certain tests of strength and endurance. He would then be allowed to marry.

A girl on reaching the age of puberty was isolated in a darkened room for the purpose of bleaching her skin and thus rendering her like the fair-skinned ancestral gods of the race. On release from the bleaching-house she was ready for marriage.

Great precautions were taken at death to drive away the soul. The body was usually buried on the fourth day, sometimes on the tenth; occasionally it was sun-dried and kept for a number of years. The skull was often kept. In the lagoon islands the body lay on its back, fully extended, with toes pointing up; on Banaba the knees were flexed outwards in a frog-like position.

The paper closed with a summary of the beliefs concerning the destination of the departed spirit and of the possible inferences which may be drawn therefrom. The names of the various bournes of the dead have an extraordinary resemblance to certain place-names in Indonesia.

Parliamentary Visit to the Rothamsted Experimental Station.

ON May 13 the Minister of Agriculture (Sir Arthur Griffith-Boscawen) and the Agricultural Committee of the House of Commons, together with members of the House of Lords interested in agriculture, visited the Rothamsted Experimental Station at the invitation of the chairman, the Right Hon. Lord Bledisloe, and the director, Dr. E. J. Russell.

Fortunately the weather was fine, and the plots were inspected under favourable conditions. The fields visited included those in which the classical experiments on the growth of wheat, barley, and meadow-grass are conducted, and the salient features were demonstrated by members of the staff. Other experiments were shown to ascertain the comparative fertiliser effects of ammonium chloride and ammonium sulphate on cereals and potatoes, the effects of potassium and magnesium salts on potatoes, the most suitable time of application of nitrogenous fertilisers to cereals, and the relationship between the quantity of fertiliser used and the crop obtained, the last being particularly interesting inasmuch as the effectiveness of small and moderate dressings increases more rapidly than the dressing, while with larger quantities the effectiveness falls off. The experiments on electro-culture were demonstrated, as also was the recent work on the production of farmyard manure without the intervention of animals.

The whole of the laboratory work was seen, ranging over the chemical, physical, statistical, and biological sciences, the last including bacteriology, botany, entomology, mycology, and protozoology. Many interesting specimens were shown, and there were other exhibits to illustrate the work going on in the study of the soil, the growing plant, and plant diseases.

In his speech after lunch Lord Bledisloe welcomed the guests and expressed the hope that this first visit would be followed by many others of those members of both Houses of Parliament interested in agriculture. He directed attention to the report shortly to be issued, in which the work is discussed in full detail and its bearing on agricultural practice indicated. Dr. Russell outlined the more important investigations now proceeding, and emphasised the necessity for the development of a sound agricultural science which could be of use to the teacher, the expert adviser, and the progressive farmer.

The Minister of Agriculture expressed his recognition of the great importance of the work being done at Rothamsted and other research institutions, and emphasised the fact that in such work lies one of the best hopes for agriculture. Legislative enactments are of course essential, but they cannot provide the material for progress and development that is furnished by sound scientific investigation. Although the necessity for economy in every branch of public activity was insistent, he would, so far as it lay in his power, see to it that agricultural research should not be called upon to suffer in the name of a false economy.

Habits of the Hedgehog.

THE Memoirs and Proceedings of the Manchester Literary and Philosophical Society for 1918–19 contain a paper by Mr. Miller Christy on "The Ancient Legend as to the Hedgehog Carrying Fruits upon its Spines." In the introduction to his paper Mr. Christy pointed out that the legend is very old, and that it is important to remember that since the hedgehog is almost wholly a nocturnal animal it is difficult to verify statements regarding its habits by actual observation. The earliest recorded statement that hedgehogs carry fruit on their spines was made by Pliny the Elder; Claudius Ælianus, who wrote about A.D. 250, relates a similar tale. No further evidence is recorded until the twelfth century, while during the Middle Ages a number of writers and poets of many countries related stories of hedgehogs carrying various fruits in this way. Mr. Christy takes the view that most of these people copied blindly the statements of their predecessors. Of the more modern naturalists Buffon discredited the legend, though other naturalists of his time stated definitely that they had witnessed the transportation of fruit by these means. Among present-day writers on natural history little credence is given to the tale, though two cases are reported in which the evidence in support is regarded as trustworthy. We reprint below the substance of the summary of the evidence and the conclusions based thereon with which Mr. Christy concluded his paper.

The hedgehog-and-apples legend is at least two thousand years old—more if it originated with Aristotle, as has been stated; also it is prevalent throughout practically the whole of Europe. There must have been (one would think) some substratum of actual observed fact, renewed from time to time, to keep any legend of the kind alive so long and to cause it to become so widespread. Nevertheless, it cannot be denied that most modern writers on mammals, if they refer at all to the old legend, either dismiss it as too absurd to be worth a moment's consideration or at least show themselves decidedly sceptical.

But is the story really so incredible, after all? Are we not apt, in these highly scientific days, to become too contemptuously sceptical in regard to all ancient legends of the kind, and to forget that, however absurdly improbable they may appear at first sight, not a few of them have been shown to have some genuine basis in fact—often slight, but sufficient to substantiate and justify them? In all such cases a cautious scepticism should be, of course, maintained up to a certain point; but it is well to remember a dictum to which the late Prof. Huxley gave utterance many years ago: "I have always felt a horror of limiting the possibilities of things."

But before accepting the old legend unreservedly, there is one point which requires first to be considered: Does the hedgehog ever eat fruit? As to this crucial question many contradictory opinions have been expressed. The truth seems to be that the creature undoubtedly affects, in the main, an animal diet, consisting chiefly of small reptiles, worms, snails, slugs, insects, beetles, birds' eggs, and the like. In confinement it will readily eat meat, either cooked or uncooked, bread and milk, and many such substances as are usually given to cats and dogs. Its partiality for eggs has gained for it a very bad name among gamekeepers, poultry-keepers, and such people. In all probability, however, the robberies of eggs from the nests of game-birds and poultry which are usually ascribed to the hedgehog are really the work of some other animal.

On the other hand, there is equally little doubt that on occasion the hedgehog will readily subsist on a vegetable diet. Knapp says ("Journal of a Naturalist," third edition, 1830, p. 130): "In the autumn crabs, haws, and the common fruits of the hedge constitute its diet." Macgillivray asserts ("British Quadrupeds," 1838, p. 119) that it "eats fruits, especially apples that have fallen from the trees."

Yet another cognate point which has to be considered is: Does the hedgehog lay up a store of food for the winter? Obviously, of animal food *he could not*. Of vegetable food, however, *he might*, and some writers have stated explicitly that he does. Yet others of at least equal authority have stated that he does not; and the author agrees with them. He has seen many nests of hedgehogs dug out of rabbit-holes when ferreting in winter, but none has ever been accompanied by a store of winter food. It is on this account, no doubt, that the animal's hibernation is by no means complete, and that he sometimes leaves his winter nest and comes abroad even on cold days. Probably the fruit of various kinds which hedgehogs have been seen carrying on their spines has been intended by them rather for immediate consumption than as winter sustenance.

Several friends and correspondents of the author—some excellent naturalists among them—have advanced the argument that, as they have kept many tame hedgehogs and have never observed them even attempting to transport fruit on their spines, the habit cannot be one they practise in a state of nature. This argument seems to be entirely unsound. The habits of animals in nature and in confinement are often different; and in this particular case it may be urged that a hedgehog in confinement, being (in a way) at home, would scarcely be likely to feel a need to carry food home.

From the foregoing it becomes clear that there are, beyond doubt, not a few cases, both ancient and modern, in which a hedgehog has been *actually seen* carrying objects impaled upon the spines upon its back—in most cases various kinds of fruit; in one case eggs of the pheasant. Unfortunately, none of these observations (though made by persons whose *bona fides* is in little doubt) can be regarded as wholly conclusive, all being to some extent second-hand or made by persons of little education. Nevertheless, taking them in the mass and viewing them in conjunction with the very ancient and extremely persistent legend relating to the matter, it seems impossible longer to doubt that, *at times at any rate*, the animal really does transport fruit in the way asserted.

There is yet another legend pertaining to the hedgehog (and almost as ancient and widespread as the fruit-carrying legend), namely, that it sucks the milk of cows grazing in the fields. This statement, in the crude form in which it is usually made and understood, is a manifest impossibility. In the first place, no hedgehog by stretching up would be able to reach the teats of any cow of ordinary stature; and, even if it could do so, the fact remains that the hedgehog's mouth is far too small to allow it to suck milk effectively from the teats of any such cow.

Nevertheless, the legend in question is probably true in a way, and a perfectly natural explanation as to its origin can be given. We know well, from the evidence of hedgehogs kept in confinement, that the animal is exceedingly fond of milk; and there can be no possible doubt that, in a state of nature, it would take every opportunity to secure milk. Obviously, it could do this only when a cow was lying down. In such a case, as is well known, milk often runs from the teats of a milch cow; and there can be little or no doubt that the milk-sucking legend has originated in the fact of a hedgehog having been seen sucking drops of milk from the teats of a recumbent cow or from the ground immediately after she has risen.

The "Flight" of Flying-fish.

APROPOS of the recent correspondence concerning the "flight" of flying-fish, Prof. W. Galloway has sent us a copy of a paper ("The Flying-fish," Trans. Cardiff Nat. Soc., vol. xxiii., 1891) in which he discussed the whole subject thirty years ago. His own observations, made from the bows of a ship, are in agreement with those of Prof. Wood-Jones and of Mr. J. S. Huxley: the impetus is given by the tail, the pectoral fins are used as planes, and new impetus can be gained by immersing and vibrating the lower lobe of the tail. Prof. Galloway adds further interesting particulars. Changes of direction made in air are usually slight, the fish describing arcs of very large radius; if a sudden change is required, the fish drop into the water, to emerge almost instantly headed in the new direction. The ordinary velocity of flight is from 25 to 35 miles per hour. When the wind is very strong (25 to 30 miles per hour) the fish are unable to rise with it, falling back into the water almost immediately. When, therefore, they are startled by a ship travelling with a strong wind, they rise *against* the wind, and then, having gained sufficient velocity, tilt right or left to describe a semicircle with radius of 40 or 50 ft. and sail down-wind for very long distances (200–300 ft. or more); if desirous of flying again they do not attempt to drop their tail into the water, but submerge totally, leap out once more against the wind, and once more turn. Prof. Galloway also summarises the previous literature. One point deserves mention. Möbius (*Zeit. wiss. Zool.*, vol. xxx., 1878, Suppl., p. 343) agrees with various observers that marked vibration of the pectoral fins may and does occur (Prof. Galloway states that it usually does so immediately on emergence). This, Möbius states, is solely passive, due to the air resistance when the "wings" happen to be held parallel to the plane of flight; similar effects can be produced artificially on a bird's wing or a piece of stiff paper. We are thus, it seems, warranted in regarding the following points as proven:—

(1) The pectoral fins of the true flying-fish act as lifting and, to some extent, as turning planes in air. (2) Rapid turns are made under water. (3) The impetus to flight is not given by the pectoral fins, nor is it the result of a single leap into the air after the fashion of a salmon. A rush is made which takes the fish clear of the water, but at a very small angle with the surface, and by means of motion of the elongated lower lobe of the tail additional motive power is provided during the traverse of several yards. (4) When velocity slackens it can be re-acquired repeatedly by immersing and vibrating the lower lobe of the tail. (5) Vibration of the pectoral fins does occur, but is probably a passive effect. (6) In a strong wind flying-fish can rise only against the wind.

The Royal Society Conversazione.

THE first conversazione this year of the Royal Society was held at Burlington House on May 11, and was attended by a large number of fellows and guests, who were received by the president, Prof. C. Sherrington, and the officers of the society. Many exhibits of objects and apparatus of scientific interest were shown, and we have grouped together those on related subjects in the subjoined summaries of some of them from the descriptive catalogue.

Prof. K. Onnes, Sir R. A. Hadfield, and Dr. H. R. Woltjer: Apparatus and specimens used in research on the influence of low temperatures on the magnetic properties of alloys of iron with nickel and manganese. A series of iron–manganese and iron–nickel alloys was exposed to the temperatures of liquid air, liquid hydrogen, and liquid helium respectively and the specific magnetism tested after return to atmospheric temperatures. Tests were also made during immersion in liquid hydrogen (−253° C.). The alloys with the higher percentages of manganese cannot be made magnetic even by immersion in liquid helium (−269° C.). The existence of one magnetic and one non-magnetic manganese-iron compound is shown to be probable.

Messrs. Evershed and Vignoles, Ltd.: Needham's pulsator system of speed measurement and control. This system provides a sensitive electrical means of measuring speed, and may be employed as a speed telegraph of a novel and extremely trustworthy character. In addition to signalling from one or a number of control positions, measurements may be effected simultaneously and independently at a number of positions, so that the system is one of great flexibility. It also indicates the direction of rotation. The system is extremely suitable for use on ships, in power stations, and in other places where the measurement or indication of speed is desired at a distance from the moving machinery.

The Hon. Sir Charles Parsons and Mr. Stanley S. Cook: An attempt to reach high instantaneous pressure by the collapse of a hollow sphere of lead under external pressure suddenly applied by an explosive. The sphere is made up of two hemispheres placed together with tissue-paper between and soldered around the periphery of the joint. In the cavity is placed the substance to be compressed. If its final diameter in nuclear form is 1/200th that of the initial hollow, and the pressure of the explosive 20 tons per square inch, the nuclear pressure produced is 1,000,000 tons. The explosive is fired in six places simultaneously.

Cambridge and Paul Instrument Co., Ltd.: Apparatus similar to Mr. C. T. R. Wilson's original cloud expansion apparatus, but improved by Mr. T. Shimizu so that α-, β-, and X-rays may be continually demonstrated.

Mr. E. A. Griffiths: Liquid oxygen vaporiser. The liquid oxygen is contained in a metal vacuum vessel. The emission of gas is governed by bringing a flexible portion of the outer wall into contact with the inner, the degree of contact determining the rate of transmission of heat across. The bottom of the outer vessel is a corrugated plate of silver to the centre of which is soldered a copper block shaped to fit the contour of the inner vessel. The displacement of the diaphragm is controlled by a screw. Any desired rate of gas evolution can be obtained up to 10 litres per minute, and the delivery remains constant with any particular setting for several hours.

Mr. J. St. Vincent Pletts: The Davis-Pletts slide rule. In this slide rule the log-log scale and its reciprocal scale are related to the log scale in such a way that the numbers on the latter are the common logarithms of the numbers opposite them on the former. This enables full advantage to be taken of the properties of characteristics and mantissas for the purpose of indefinitely extending the non-recurring log-log scales. Further, scales for all the ordinary exponential, circular, and hyperbolic functions are arranged to read on the same log scale, so that any product or ratio of such functions can be obtained. Thus all such compound functions as $e^x \sin a$ and $\log a \cosh x$ can be obtained with a single setting of the slide and cursor, while every combination of the various functions is obtainable with two or more settings.

The National Physical Laboratory: (1) Radiotelegraphic direction-finding apparatus (Mr. R. L. Smith-Rose). This apparatus is of the type developed by Capt. Robinson, of the Royal Air Force. Instead of finding two positions of a receiving coil for which the signals have equal intensity, two coils at right angles are connected in series and rotated together until the signal strength is unaltered by reversing the connections of one of them. This gives the direction from which the signal is coming, and, therefore, the apparent bearing of the transmitting station. Differences between the apparent and the true bearing are found to occur, especially at night; these differences raise many interesting questions in connection with the transmission of electro-magnetic waves in radiotelegraphy. (2) Resistance alloy "omal" for electrical standards (Dr. W. Rosenhain, Mr. S. W. Melsom, and Mr. S. L. Archbutt). The material is of the type usually known as "manganin," and is an alloy of copper, manganese, and nickel. Prior to the war the product was supplied almost exclusively by Germany, and great difficulty was experienced by makers of scientific and ordinary measuring instruments in obtaining material suitable for their purpose from any other sources. The question was investigated at the laboratory, and as a result alloys were made and watched through the various processes that meet the requirements as regards temperature coefficient, constancy, resistivity, and secular change. The material is made in two types, one having a resistivity of 45 michrom-cm. and the other of 25 michrom-cm. Samples of the product are shown in various stages of manufacture in the form of cast ingots, rod, strip, and wire, together with micrographs and curves of temperature coefficient. (3) Relay for breaking moderately large electric currents (Dr. Guy Barr). The difficulties due to sparking at the contact of ordinary relays are avoided by causing the make-and-break to occur between mercury electrodes in an atmosphere of hydrogen. An iron core floating in mercury carries at its upper end a silica cup, also full of mercury. Connections are made to the mercury outside and inside the cup. A solenoid pulls the core and cup down and thus makes the contact; the current is broken by the core floating up so that the surface of the mercury is cut by the silica. The spark is sufficiently quenched to allow currents up to 20 amperes at 100 volts to be broken easily. The mercury remains clean. (4) Standard optical pyrometer (Dr. Kaye and Dr. Griffiths). This instrument has been designed with the view of facilitating the accurate measurement of high temperatures by the "disappearing filament" method. An image of the hot object is superimposed on the filament of the pyrometer lamp and the brightness matched by varying the current through the lamp. Monochromatic

red light is obtained by means of a filter-glass in the eyepiece. To enable the observer to check the permanency of the calibration of the pyrometer, two lamps are fitted which can be interchanged exactly in the field by a simple transverse motion. Each lamp is provided with fine adjustment in three mutually perpendicular planes. The use of the pyrometer for measuring the "black body" temperature of lamp filaments was demonstrated.

Dr. E. E. Fournier d'Albe: Latest form of the optophone. The optophone is an instrument which enables totally blind people to read ordinary printed books and newspapers. It is based upon the reflection of beams of rapidly intermittent light from the type on to a selenium preparation, which produces sounds in a telephone varying according to the shapes of the letters. The instrument shown was kindly lent by the National Institute for the Blind, London, where it is in daily use.

Dr. Leonard Hill: Recording kata-thermometer. This instrument gives a continuous record of the cooling power of the environment exerted on the surface of the bulb of the kata-thermometer, which is automatically kept at skin-temperature. Introduced into the bulb of the "kata," which is filled with alcohol, is a coil of wire with a large temperature coefficient of resistance. This coil forms one arm of a Wheatstone bridge, which is balanced when the coil is at a temperature of 36·5° C. An automatic device is used by which the current sent through the coil varies according to atmospheric conditions, so that the coil is kept at 36·5° C. The ammeter placed in series with the coil indicates the variations of current, and so the cooling power.

Sir J. J. Dobbie and Dr. J. J. Fox: Photographs of absorption spectra of alkaloids. The absorption spectra of the alkaloids are characteristic of the substance, and within certain limits may be used to distinguish the class of alkaloid. The bands obtained are the bands due to the unreduced part of the molecule of the alkaloid. Thus the bands of quinine, cocaine, and morphine are practically identical in position with those of 6-methoxyquinoline, benzoic acid, and catechol respectively. Emetine, cephæline, corydaline, laudanosine, and certain other alkaloids all give absorption spectra showing that they contain the unreduced catechol grouping. The photographs exhibited show that minute quantities of the alkaloid are sufficient to obtain the characteristic spectrum. Thus 0·3 milligram of strychnine suffices to detect and characterise this substance.

Mr. J. E. Barnard: The microscopic appearance of animal tissues in ultra-violet light. Certain animal tissues show marked differentiation of structure when illuminated by means of ultra-violet light. The image obtained is a fluorescent one, and the resulting colours or tints depend on differences of chemical constitution. Such images are often dissimilar from those resulting from staining reactions. The light-filter used is glass transparent to ultra-violet radiations, approximately 300–400 $\mu\mu$ wave-length, made by Messrs. Chance Brothers. This is combined with a quartz cell filled with a 20 per cent. solution of copper sulphate. The optical illuminating system is of quartz and the sub-stage quartz condenser of the "dark-ground" type. Apart from the biological interest of the method, the image so formed is of considerable value for testing the optical qualities of microscopic objectives, as the object so illuminated is a perfectly self-luminous one.

The Protozoological Laboratory, Rothamsted Experimental Station, Harpenden: The protozoan fauna of the soil. The Rothamsted experiments have demonstrated the presence in soil of an active protozoan fauna, and investigations are now in hand to ascertain the mode of life of the organisms and their effect on other soil inhabitants, especially bacteria. For this purpose daily counts are made of bacteria and of protozoa in a natural field soil, discriminating between active and encysted protozoa and between various kinds of amœbæ and of flagellates. Typical forms were shown, including an interesting binucleate amœba. The daily counts were set out on curves which show a remarkable periodicity in the case of the flagellate *Oicomonas termo,* Martin, and an inverse relationship between the numbers of active amœbæ and of bacteria.

Prof. Walter Garstang: Some remarkable Gastropod larvæ (Echinospira). *Echinospira diaphana* was discovered at Messina and described in 1853 by Krohn, who showed it to be the pelagic larva of Lamellaria. It has two shells, one inside the other. The outer is cast aside at metamorphosis. A complete series of a related species from Plymouth was exhibited, where the metamorphosis for the first time has been observed. Diagrams of related species illustrated the larval evolution of the group and its remarkable parallelism to the development and evolution of Ammonites.

The Hon. H. Onslow: Abraxas grossulariata (the magpie or currant moth) and its varieties, showing mode of inheritance. There are many varieties of the magpie moth, which are inherited according to the well-known laws first formulated by Mendel. The black pattern of the type-form usually shows dominance over the other varieties. The patterns of the pale variety, *lacticolor,* and of the melanic variety, *varleyata,* are combined to produce a new form, *exquisita.* As is well known, the *lacticolor* pattern is linked to the female sex, and in the same way the radiated variety, *actinota,* is linked to the male sex.

Dr. John Rennie: Preparations showing various aspects of acarine disease in hive-bees. The specimens exhibited were (1) the mite, *Tarsonemus Woodi,* Rennie, which is the causal organism in acarine disease in the honey-bee; (2) infested tracheæ of bees, showing *T. Woodi* in all stages of development; and (3) tracheæ showing pathological development of chitin in the areas of infestation. (4) Other mites found in association with hive-bees, including one other species of Tarsonemus. The disease, apparently restricted to the British Isles, first appeared in 1902. Affected bees usually lose their power of flight.

The Zoological Department, King's College (University of London): Reconstruction models and drawings made by Dr. F. J. Wyeth, illustrating the development of the auditory apparatus and adjacent structures in the New Zealand Tuatara (Sphenodon). The models were made of wax plates 1 mm. in thickness, each plate representing an enlarged microscopic section, the different systems of organs being distinctively coloured. The drawings were for the most part made from the models to illustrate Dr. Wyeth's memoir on the development of the auditory apparatus, etc., in Sphenodon, communicated to the Royal Society by Prof. A. Dendy.

Department of Zoology, British Museum (Natural History): Life-history of the common eel (Mr. C. Tate Regan). The researches of Dr. J. Schmidt have shown that the common eel or fresh-water eel (*Anguilla vulgaris*) of Europe breeds in the Atlantic south-east of Bermuda. A series of larvæ, 9–60 mm. long, from the middle and western North Atlantic was exhibited; these growing larvæ have long and slender pointed teeth. The metamorphosis into the elver, or young eel, was shown by a photograph. Models illustrated the changes in the adult eel when it migrates to the ocean and becomes mature.

Zoological Laboratory, Imperial College of Science, South Kensington, S.W.: (1) Embryonic calcareous structures of the lantern of the sea-urchin, *Echinus miliaris* (Mr. Devanesen). The calcareous parts of the lantern, with the exception of the teeth, arise as tri-radiate spicules. While the jaws, the epiphyses, and the compasses each make their first appearance as a pair of spicules, the rotulæ alone arise from single spicules. Each tooth is made up of two adjacent vertical rows of rectangular lamellæ which afterwards fuse together. (2) The spermatogenesis of the louse, *Pediculus corporis* (Mr. H. G. Cannon). The somatic chromosome number in both sexes is twelve, but spermatogonial mitotic figures show only six, and there is evidence that these are double. There is only one spermatocyte division, which is extremely unequal, leading to the separation of a minute polar-body-like cell which degenerates. It is this division which was exhibited.

Royal Botanic Gardens, Kew: Abnormal development of lime-tree branches due to the presence of mistletoe (*Viscum album*, Linn.). Large and small swellings often occur on the branches of lime-trees infested with mistletoe, and there can be little doubt that they are due to the presence of the parasite, although on the larger swellings mistletoe is weak and sometimes difficult to find, while on small swellings, or where very little abnormal increase in girth is noticeable, mistletoe may be very vigorous. From the presence and character of the dead haustoria in the older parts of the large swellings it is apparent that healthy mistletoe was present at an earlier date. Canker, however, occurred, whereby the mistletoe became insecure and was eventually torn away by the wind. Vigorous new aerial branches did not appear, but buds and haustoria in the bark continued to grow, and the affected part of the lime branch developed at an abnormal rate, the consequent thickening of the bark probably inhibiting any strong aerial growth of the parasite.

Dr. W. Bateson: Variegated prothallia of a fern. The variegated fern, *Adiantum cuneatum* var. *variegata*, produces prothallia of which many are green and some variegated. From these arise ferns which may be green, variegated, or white. Apparently segregation here occurs in haploid tissue.

Mr. Franklin Kidd: Application of cold-storage and gas-storage to English apples. The Food Investigation Board has been investigating the possibilities of the cold-storage method and of a new method known as "gas-storage" in application to the English apple crop. Improved methods of apple storage are required in order to bring the home-grown apple into successful competition with imported apples throughout the winter season. In cold-storage the apples are kept just above freezing point. The method is costly. In "gas-storage" the apples are held in a gas mixture created and maintained by their own respiratory activity, no machinery being required. This method is cheaper.

Dr. W. Lawrence Balls: Portable cotton-sorting mechanism. The "sorter" mechanism is designed to analyse a collection of such fibres as cotton-hairs by distributing them on a collecting surface in the order of their individual lengths, thus enabling the frequency distribution of length to be plotted. The instrument shown was re-designed from the original automatic form in order to provide a portable pattern convenient for the use of cotton-growers and agricultural experiment stations abroad.

Dr. A. Smith Woodward: Fossil fishes from the Old Red Sandstone of Shetland. This is part of a collection lately made by Mr. T. M. Finlay, of the University of Edinburgh, and is important as including well-preserved specimens of a Palæoniscid fish related to the Carboniferous Rhadinichthys. Scales of a similar Palæoniscid are already known from Upper Devonian formations in North America and Antarctica.

Dr. F. A. Bather: Some questionable fossils. (1) Tubular quartzite of Cambrian age from Sweden and of Lower Devonian age from the Eifel. Are the structures produced by worms or by ascending air-bubbles? (2) Echinoderm remains of Permian age from Timor. Are they spines of sea-urchins or bases of crinoids? (3) Horned Trilobites of Middle Devonian age from the Eifel. What, if any, was the use of the horns?

Mr. J. Reid Moir: A series of ochreous flint implements, cores, and flakes of Early Chellean (Palæolithic age) from the base of the Cromer Forest Bed deposits. The specimens exhibited were collected from a limited area of foreshore exposed at low water at Cromer, Norfolk. The series included implements of Early Chellean forms, such as have been found hitherto in river-terrace gravels, together with rostro-carinates, choppers, scrapers, points, cores, and a large number of flakes. If the specimens are assigned correctly to the base of the Cromer Forest Bed, then the earliest Palæolithic cultures are referable in East Anglia to the Upper Pliocene deposits.

Mr. George H. Gabb: The original portrait of Galileo by D. Tintoretto, in oil, painted about 1605–7, when Galileo was from forty-one to forty-three years of age. This portrait is of great historic interest as probably the earliest original existing portrait of Galileo, a somewhat earlier one by Santè di Tito having been lost. At the time D. Tintoretto painted the portrait Galileo was master of mathematics at Padua, which is indicated by the inscription on it, "Gallileus Gallileus Mathus." This was some years before he began the great astronomical discoveries by means of the telescope which consolidated the theory of the Copernican system and immortalised his name. A small engraving by Schiavoni was made of this portrait about 1812.

University and Educational Intelligence.

CAMBRIDGE.—The Adams prize has been awarded to Dr. W. M. Hicks, St. John's College.

It is proposed to form an advisory committee on geodesy and geodynamics to make provision for study and research in geodesy, including arc measurements, primary triangulation, precise levelling, and gravity determinations; also for geodynamics and tidal phenomena. It is hoped to take the first active step towards the foundation of a school of geodesy and geodynamics which would eventually meet the practical needs of the surveys of the Empire. The advisory committee would be largely nominated by outside bodies, and both the Hydrographer of the Navy and the Director-General of the Ordnance Survey would be represented on it. Further steps in organisation await the appointment of a prælector in geodesy by Trinity College.

LONDON.—The following new appointments have been made at University College:—Mr. T. A. Brown, senior lecturer in pure mathematics for the session 1921–22, and Dr. Percy Stocks, medical officer in connection with the department of applied statistics and eugenics (this appointment has been instituted by means of a grant made by the London County Council).

Sir William Tilden will deliver three public lectures at University College on "The History of Chemistry in the Nineteenth Century" on Fridays, May 27 and

June 3 and 10, at 5 p.m. The chair at the first lecture will be taken by Prof. J. Norman Collie.

MANCHESTER.—The council has instituted a new chair in the Faculty of Commerce, and appointed Mr. G. W. Daniels as professor of commerce and administration as from September 29 next. Dr. Albert Ramsbottom has been appointed professor of clinical medicine. The following appointments have also been made by the council:—Senior lecturer in economics, Mr. T. S. Ashton; lecturer in histology, Miss Ruth Fairbairn; assistant lecturers in physics, Dr. J. C. M. Brentano and Mr. H. Lowery; and assistant lecturer in metallurgy, Mr. Hugh O'Neill.

PROF. EINSTEIN will deliver this year's Adamson lecture of the University of Manchester on some day during the first week in June. He will afterwards visit King's College, London, and other institutions which approached him after he had arranged to go to Manchester.

THE open competitive examination for assistant examiners in the Patent Office will begin on Tuesday, July 26, instead of on July 12 (as stated in the printed regulations), and will last until Saturday, July 30. Any candidate who has attained the age of twenty on July 26, and has not attained the age of twenty-five on July 12, will be regarded as eligible in respect of age to compete on this occasion.

WE learn from *Science* that at a recent meeting of some of Sir William Osler's students an Osler Memorial Association was formed for the purpose of founding an Osler memorial lectureship in the University of California, which will provide for an annual lecture on a scientific subject. The expense will be met by a yearly assessment of the members of the association. Dr. John M. T. Finney, Baltimore, has accepted an invitation to deliver the first lecture.

THE Salters' Institute of Industrial Chemistry (Salters' Hall, St. Swithin's Lane, E.C.4) invites applications for a limited number of fellowships, value 250*l*. per annum, from those who by October next will have completed three years' training in chemistry and seek an industrial career. Full particulars of training and war service (if any) of candidates should reach the director of the institute before June 18.

THE council of the British Medical Association is prepared to receive applications for an Ernest Hart memorial scholarship, of the value of 200*l*. per annum, for the study of some subject in the department of State medicine, and for three research scholarships, each of the value of 150*l*. per annum, for research relating to the causation, prevention, or treatment of disease. Each scholarship is tenable for one year, commencing on October 1, but a scholar may be re-elected for a period not exceeding two additional terms. A number of grants for assisting research will also be awarded, preference being given to members of the medical profession and to applicants who propose to investigate problems directly related to practical medicine. Applications for scholarships and grants, which must be made not later than June 25, should be accompanied by testimonials, including a recommendation containing a statement as to the probable value of the work to be undertaken, from the head of the laboratory, if any, in which the applicant proposes to work. Forms and further particulars can be obtained from the Medical Secretary of the British Medical Association, 429 Strand, W.C.2.

THE eighth annual report on the industrial fellowships of the Mellon Institute in the University of Pittsburgh directs attention once again to the scheme for promoting industrial scientific research which was initiated by the late Prof. Robert Kennedy Duncan in the University of Kansas in 1907 and in the University of Pittsburgh in 1911. The principles upon which the scheme is based, which were described in a report by Mr. T. Ll. Humberstone published some years ago by the Board of Education, should by this time be well known in this country. Although not "commercial" in spirit, the Mellon Institute has been able to render a great national service by demonstrating to American manufacturers that industrial research is a paying proposition. The number of industrial fellowships in operation in the institute is now forty-eight, and the money contributed by industrial firms in the last ten years amounts to 1,534,273 dollars. A considerable number of fellowships have been established by groups of firms, and the report points out that some of the larger multiple fellowships are now so well established and so distinctive in their fields of inquiry that they are not uncommonly regarded as independent organisations. This development will, no doubt, require watching in future. Several experimental plants have been set up in connection with the institute. Recent subjects for investigation include magnesia products, fruit beverages, asbestos, and refractories. The Kennedy Duncan system of industrial fellowships has now been thoroughly tested and its fundamental principles remain unshaken; and it may well be asked why, with so much public money freely spent in this country on applied scientific research, this admirable method of establishing a link between the universities and industry has not been given a trial.

THE list of the summer courses in England and Wales prepared by the Special Inquiries Office of the Board of Education for the use of education authorities and teachers has just been issued. The information provided is in tabular form under the following headings:—Authority responsible for course; place; date; fee; subjects of instruction; address for further particulars; and remarks. In the eastern counties of England there will be a course on the origin and development of the physical geography of Europe, map construction, anthropogeography, historical, political, and economic geography at Cambridge, and another on the principles and practice of horticulture at Chelmsford. At the South-Eastern Agricultural College, Wye, lectures and demonstrations will be given illustrating the teaching of chemistry, botany, mycology, and entomology applied to everyday life. In the Midland Counties courses on teaching method as applied to geography will be given at Nottingham; and there will be lectures and conferences on the teaching of numerous subjects, including geography and science, at Oxford. In the south-western area courses in geography, chemistry, mathematics, physics, and psychology will be held at Exeter; while at Weston-super-Mare the subjects include experimental science, botany, rural science, and hygiene. At both places the courses will be designed to fit teachers for continuation-school work. In the northern counties lectures on oceanography and fisheries will be given at Barrow-in-Furness. At four places in Wales there will be courses in science subjects. At Amman Valley County Intermediate School there will be a course on mine surveying, and at Madryn Castle Farm School one on school gardening and rural science. At Cardiff courses will be given in pure and applied science, particularly in various branches of engineering, and at Bangor on the teaching of geography and regional survey work. The table of courses can be obtained from H.M. Stationery Office or from E. Ponsonby, Ltd., 116 Grafton Street, Dublin (4*d*. net).

Calendar of Scientific Pioneers.

May 19, 1786. Carl Wilhelm Scheele died.—Pre-eminent as an experimental investigator and chemical discoverer, Scheele worked as an apothecary in various towns in Sweden, devoting his leisure to chemistry. Included among the many substances he discovered are chlorine, ammonia, oxygen, and several acids.

May 20, 1793. Charles Bonnet died.—A well-known naturalist of Geneva, Bonnet made researches on parthenogenesis, the respiration of insects, and the use of leaves. He also published works on psychology.

May 20, 1880. William Hallowes Miller died.—A fellow of St. John's College, Miller from 1832 to 1870 was professor of mineralogy at the University of Cambridge. He developed a system of crystallography adapted to mathematical calculation.

May 21, 1894. August Adolf Eduard Eberhard Kundt died.—A student under Magnus, Kundt in 1888 succeeded Helmholtz as professor of experimental physics and director of the Berlin Physical Institute. His most successful work related to sound, light, and magneto-optics.

May 22, 1666. Gaspar Schott died.—To Schott, Guericke, and Johann Sturm belongs the credit of reviving the study of the physical sciences in Germany after the Thirty Years' War. Schott was educated in Italy as a Jesuit, but afterwards taught at Wurzburg. His "Mechanica—hydraulica—pneumatica" (1657) contains the first description of the air pump.

May 22, 1868. Julius Plücker died.—A mathematician and physicist of Bonn, Plücker extended analytical geometry, and was known for his discovery of magneto-crystallic action, and for his researches on spectroscopy and the electric discharge in rarefied gases.

May 23, 1857. Auguste Louis Cauchy died.—Covering the whole field of mathematics and mathematical physics, the work of Cauchy is noteworthy for the rigorous methods he introduced. He was a professor at the Ecole Polytechnique.

May 23, 1894. George John Romanes died.—After early work on the nervous and motor systems of the Echinodermata Romanes turned his attention to such questions as mental evolution in animals. He was an intimate friend of Darwin, and did much to popularise his views.

May 23, 1895. Franz Ernst Neumann died.—Neumann was born in 1798, and from 1829 to 1876 was professor of mineralogy and physics in the University of Königsberg. He did important work on the dynamical theory of light and on the mathematical theory of electrodynamics.

May 24, 1543. Nicolas Copernicus died.—Born at Thorn in 1473, Copernicus, or Koppernigk, was the fourth child of a merchant. After studying at Cracow, Bologna, Padua, and Ferrara, Nicolas, through his uncle the Bishop of Ermland, became a canon of Frauenburg Cathedral. Later on he was administrator of the diocese. Among his great contemporaries, Luther, Erasmus, Leonardo da Vinci, and Paracelsus, Copernicus is the representative of the reformers of astronomy. All his leisure was given to observation; his "De Revolutionibus" is the result. The first printed copy of this work was placed in the hands of Copernicus when he was dying. Dedicated to Pope Paul III., many years afterwards it was placed upon the Index.

May 24, 1837. Karl Ernst Adolf von Hoff died.—The friend of Werner and Goethe, Hoff is known to geologists for his "History of the Changes on the Surface of the Earth" (1822–41). E. C. S.

Societies and Academies.

LONDON.

Linnean Society, April 21.—Dr. A. Smith Woodward, president, in the chair.—Prof. R. **Newstead**: Some observations on the natural history of the Upper Shiri River, Nyasaland. The common types of the flora and fauna were discussed. The flora was dealt with under three sections:—(1) The river and its banks, (2) the open "dambo" or savannah, and (3) the forest. Dealing with the insects, special reference was made to a highly protective species of Mantis (*Taracodes perloides*) and the common tsetse-fly of the country (*Glossina morsitans*), the latter being the chief factor in the dissemination of sleeping sickness in man. Seventy-eight species of birds were collected; among these a new species of flycatcher (*Erithrocerus nyasae*); and large flocks of the rare lorikeet (*Agapornis lillianae*) were observed.

Faraday Society, May 9.—Prof. A. W. Porter, president, in the chair.—E. K. **Rideal** and U. R. **Evans**: The problem of the fuel-cell. Fuel-cells may be classified as:—(1) Direct fuel-cells burning solid fuel. These suffer from current polarisation due to the low velocity with which carbon enters into electrodic reactions. (2) Semi-direct fuel-cells burning gaseous fuel. These suffer usually from current polarisation due to the difficulty of keeping the electrode material saturated with gas. Mond and Langer overcame this, but in doing so used so much platinum that their cell became far too expensive for practical use. An attempt to use nickel instead of platinum as the substratum of a gas-electrode was unsuccessful. (3) Indirect cells of (*a*) oxidation-reduction type. These suffer from not only (i) *current* polarisation, dependent on the electrode area, but also (ii) *time* polarisation, dependent on the cell *volume*. This second kind of polarisation is economically most important, but has been overlooked by some workers. Some fresh cells of this type were tested, but proved unsuitable. (*b*) Metal anode type. Zinc appears unsuited, but preliminary experiment with different cells (both hot and cold) in which tin was the active element gave results which seemed promising.—L. F. **Knapp**: The solubility of small particles and the stability of colloids. A theoretical paper in which Ostwald's relation between the solubility and size of particles is modified for the case where the particles are electrically charged. An attempt is made to explain the connection between the stability of colloids and the charge carried by their particles.

EDINBURGH.

Royal Society, May 2.—Prof. F. O. Bower, president, in the chair.—Dr. Dawson **Turner** and Mr. D. M. R. **Crombie**: Behaviour of an electrified pith ball in an ionised atmosphere. This communication concerns a delicate method of demonstrating the ionised atmosphere surrounding flames and hot bodies by means of a pith ball suspended from the knob of a charged Leyden jar. The effectiveness of various sources of ionisation was demonstrated, and the directive influence of the charged Leyden jar shown. The conclusions arrived at were:—(1) A charged pith ball can serve as a very delicate indication of the electrical condition of its surroundings. (2) The ions are concentrated along the straight line joining the centre rod of the charged jar and the source of ionisation. (3) The ions tend to be carried upwards by convection currents. (4) The ionisation of the atmosphere does not depend upon the luminous or actinic intensity of the flame, but is associated with a radiation of longer wave-length. (5) The effect

upon the electrified pith ball appears to be independent of the nature of its charge.—Dr. R. **Kidston** and Prof. W. H. **Lang**: Old Red Sandstone plants, showing structures from the Rhynie Chert Bed, Aberdeenshire. Part iv.: Restorations of the vascular cryptogams, and discussion of their bearing on the general morphology of the Pteridophyta, and the origin of the organisation of land plants. Restorations of the four plants, *Rhynia Gwynne-Vaughani, R. major, Hornea Lignieri,,* and *Asteroxylon Mackiei,* are given. A few additional features, supplementary to the descriptions in preceding papers of the series, are described. The hemispherical projections of *Rhynia Gwynne-Vaughani* are shown to have originated underneath stomata. A comparison is made between them and certain intamescences in existing plants. Areas of necrosis and marked wound-reactions of the tissues around them are described for both species of Rhynia. The apex of a stem of *R. major* is figured. The discussion summarises the authors' views on the bearings of the facts described in the Parts i.–iv. on problems in plant-morphology. Part v.: The Thallophyta occurring in the peat-bed; the succession of the plants throughout a vertical section of the bed, and the conditions of accumulation and preservation of the deposit. The Thallophyta found in the silicified peat are described. The most abundant are fungi represented by hyphæ of the mycelium, and vesicles or resting-spores borne on this. With the exception of one specimen, the hyphæ were non-septate, and the fungi are regarded as belonging to the Phycomycetes. A number of form-types are described; the species distinguished are *Palaeomyces Gordoni, P. Gordoni* var. *major, P. asteroxyli, P. Horneae, P. vestita, P. Simpsoni,* and *P. agglomerata.* The possibility of there being a symbiotic (mycorrhizal) relation between certain fungi and the vascular cryptogams is discussed; there is no conclusive evidence in favour of this. The majority of the fungi in the Rhynie peat were certainly living as saprophytes. Bacteria were doubtless present in abundance, but are difficult to distinguish in the granular matrix. A representative of the Schizophyta, a filamentous organism with the small protoplasts preserved, is named *Archaeothrix oscillatoriformis,* and compared with Beggiatoa and Oscillatoria among existing plants. Scattered remains of an alga, the vegetative structure of which presents a number of resemblances to existing Characeæ, are described under the name *Algites (Palaeonitella) cranii.* Two fragments belonging to an organism with the characteristic structure of Nematophyton are described as *N. Taiti.* The specimens show the structure of the peripheral region, which in specimens previously described has not been preserved. The succession of the plants throughout a section of the Chert Bed as exposed *in situ* is followed, and the conditions of formation of the Rhynie deposit are discussed. On grounds mainly of resemblances presented by Asteroxylon to *Tharsophyton (Lycopodites) Milleri,* the Rhynie Chert Bed is allocated to the Middle Old Red Sandstone age.

PARIS.

Academy of Sciences, April 25.—M. Georges Lemoine in the chair.—C. **Guichard**: Triply indeterminate systems of right lines and their conjugates with respect to a linear complex.—L. **Cuénot**: The different modes of regeneration of the antennæ in *Carausius morosus.*—C. **Nicolle** and A. **Cuénod**: New acquisitions in the experimental study of trachoma. An account of results obtained in experiments on apes and rabbits.—I. **Tarazona**: Observation of the annular eclipse of the sun on April 7, 1921, at the astronomical observatory of the University of Valencia (Spain). Comparison of the observed and calculated times of contact.—P. **Fox**: Measurements of stellar parallax at the Dearborn Observatory. The table giving the parallax of twenty-four stars is based on photographic observations with the 48-cm. equatorial.—A. **Leduc**: The principle of equivalence and reversibility.—H. **Buisson** and C. **Fabry**: The displacement of the solar lines under the action of the gravitational field. The differences observed between the lines of the solar spectrum and those of the arc in vacuum can be perfectly interpreted by the following hypotheses: the pressure in the reversing layer is small, and consequently the effect of the pressure can be neglected, and the Einstein effect is the only cause of the displacement of the lines of the solar spectrum.—Mme. P. **Curie**: The γ radiation and the evolution of heat from radium and mesothorium. The heat evolved is measured by an ice calorimeter with a capillary tube, one division of which corresponds to about 0·03 calorie. A method for the determination of the relative quantities of radium and mesothorium in a sealed tube can be based on the calorimetric measurements, and it may also be possible to determine the age of the specimen by observations with time-intervals of several months.—Mlle. Irène **Curie**: The atomic weight of chlorine in some minerals. Three minerals were examined, a Canadian sodalite, a Norwegian apatite containing chlorine, and a salt from Central Africa. The hydrochloric acid prepared from these minerals was converted into barium chloride, and comparative experiments were made on the silver chloride obtained from these and from ordinary pure barium chloride. With the sodalite and the apatite the differences observed were of the same order as the experimental error; in the case of the salt the atomic weight found was 35·60. This difference was proved not to be due to the presence of bromine or iodine, and further experiments with this material will be carried out.—M. **Laporte**: The measurement of the mobility of gaseous ions by the toothed-wheel method. The mobility of gaseous ions has been measured by a method based on that used by Fizeau for the determination of the velocity of light. Some preliminary results are given.—G. **Contremoulins**: The protection against X-rays of persons other than the operator and patient. The effects of modern X-ray tubes can be felt outside the operating-room, and in thickly populated districts may be a source of danger. Experiments are described bearing on the precautions required to prevent the rays penetrating beyond the operating-room.—A. **Dauvillier**: The working of the Lilienfeld tube.—C. **Matignon**: The principles of some new methods applicable to the determination of molecular weights. The utilisation of chemical equilibria for the measurement of molecular weights.—L. **Guillet**: The tempering of brasses containing tin.—M. **Pierrat**: The solubility of various potassium salts in mixtures of water and alcohol. Alcoholic solutions of varying strength in alcohol of the salts examined (potassium bitartrate, perchlorate, chloroplatinate, fluosilicate, and cobaltinitrite) were prepared by prolonged shaking of the salt with the mixture, the alcohol removed by evaporation in a current of dry air, the liquid made up to its original volume with water, and the concentration of the salt determined by the electrolytic conductivity method. Solubilities for each of the above salts are given for six different concentrations of alcohol.—P. **Dumesnil**: The acid ethyl diethylmalonate.—M. **Randoin**: Contribution to the study of the globular silica representing the flint clay to the south of the Paris basin.—M. **Delépine**: The active racemic com-

pounds. The author regards a crystalline structure as racemic if it is composed of equal numbers of dextrorotatory and lævorotatory molecules. The optical activity is only an accessory phenomenon depending on the nature of the molecules of each configuration, and is zero in the particular case of simple enantiomorphs.—J. **de Lapparent**: The episodic character of the layers of carboniferous limestone in the Boulonnais and the dolomitisation of certain of them.—S. **Stefanescu**: Some morphological characters of the crown of the molars of mastodons and elephants.—R. **Souèges**: The embryogeny of the labiates. The development of the embryo in *Mentha viridis*.—A. **Goris** and C. **Vischniac**: The alkaloids of valerian. The authors' results confirm those of Waliszewski and Chevalier. Valerian root contains two alkaloids, chatinine (soluble in ether) and valerine (insoluble in ether, but soluble in chloroform). The proportions found in the root are very small, and, as their physiological action is slight, these substances probably have no bearing on the therapeutic action of the valerian.—J. **Politis**: The mitochondrial origin of the anthocyanic pigments in fruits.—E. **Licent**: The structure and evolution of the nucleus in the meristem cells of some Euphorbiaceæ.—R. **de Litardière**: Remarks on the chromosomic processes in the diploidic nuclei of *Podophyllum peltatum*. The author's observations on the evolution of the somatic chromosomes of *P. peltatum*, given in detail, are not in accord with those of Overton.—A. **Desgrez** and H. **Bierry**: Food rations and vitamins.—A. **Lumière**: Surface tension and the anaphylactic shock. Reply to the criticisms of W. Kopaczewski.—A. **Vandel**: The regeneration of the genital glands in Planaria.—A. **Labbé**: The adaptive modifications of *Dunaliella salina*.—A. **Magnan**: The variation in weight of the lowering and lifting muscles according to the extent of the wing-surface in birds.—S. and A. **Mayer**: The fundamental organic substance of amylopectin. The amylopectin was separated by electrodialysis from a starch solution. Its chemical and physical properties are compared with those of the amylose solution obtained in the process of preparation.—E. **Roux**: Some remarks on the action of light and heat radiations in heliotherapy.

Books Received.

Coke-Oven and By-Product Works Chemistry. By Thos. B. Smith. Pp. x+180+7 plates. (London: C. Griffin and Co., Ltd.) 21*s*.

The Clayworker's Hand-book. By Alfred B. Searle. Third edition, revised. Pp. viii+381. (London: C. Griffin and Co., Ltd.) 21*s*.

The Way of a Trout with a Fly, and Some Further Studies in Minor Tactics. By G. E. M. Skues. Pp. xvi+259. (London: A. and C. Black, Ltd.) 18*s*. net.

Tables of Refractive Indices. By R. Kanthack. Vol. ii.: Oils, Fats, and Waxes. Pp. 295. (London: Adam Hilger, Ltd.) 25*s*. net.

Atlas Météorologique de Paris. By Joseph Lévine. Pp. vi+83+ix plates. (Paris: Gauthier-Villars et Cie.) 20 francs.

Principles and Methods of Physical Anthropology. By Rai Bahadur S. C. Roy. (Patna University Readership Lectures, 1920.) Pp. xiii+181. (Patna: Government Printing Office.) 5 rupees.

The Psychology of Everyday Life. By Dr. James Drever. Pp. ix+164. (London: Methuen and Co., Ltd.) 6*s*. net.

Handbook of Instructions for Collectors. Fourth edition. Pp. 222. (London: British Museum (Natural History).) 5*s*.

A Handbook of the British Lichens. By Annie L. Smith. Pp. vii+158. (London: British Museum (Natural History).) 6*s*. 6*d*.

Calculus for Beginners: A Text Book for Schools and Evening Classes. By H. Sydney Jones. Pp. ix+300. (London: Macmillan and Co., Ltd.) 6*s*.

Cotton Spinning. By W. S. Taggart. Vol. ii. Sixth edition, with Appendix. Pp. xv+291. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Eminent Chemists of our Time. By Dr. Benjamin Harrow. Pp. xvi+248. (London: T. Fisher Unwin, Ltd.) 9*s*. net.

Some Birds of the Countryside: The Art of Nature. By H. J. Massingham. Pp. 208. (London: T. Fisher Unwin, Ltd.) 12*s*. 6*d*. net.

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ending June 30, 1920. Pp. 210+3 plates. (Washington: Government Printing Office.)

Annual Report of the Director, United States Coast and Geodetic Survey, to the Secretary of Commerce for the Fiscal Year ended June 30, 1920. Pp. 173. (Washington: Government Printing Office.)

Fermat's Last Theorem: Proofs by Elementary Algebra. By M. Cashmore. Third edition. Pp. 67. (London: G. Bell and Sons, Ltd.) 2*s*. 6*d*. net.

Fisheries: England and Wales. Ministry of Agriculture and Fisheries: Fishery Investigations. Series iii., Hydrography. Vol. i., The English Channel. Part vi., Across the Mouth of the Channel. Pp. iii+32. (London: H.M. Stationery Office.) 5*s*. net.

Official Statistics: What they Contain and How to Use Them. By Prof. A. L. Bowley. (The World of To-Day.) Pp. 63. (London: Oxford University Press.) 2*s*. 6*d*.

The Moral and Social Significance of the Conception of Personality. By the late Arthur G. Heath. Pp. viii+159. (Oxford: Clarendon Press.) 7*s*. 6*d*. net.

Catalogue of the Fossil Bryozoa (Polyzoa) in the Department of Geology, British Museum (Natural History). The Cretaceous Bryozoa (Polyzoa). Vol. iii.: The Cribrimorphs. Part i. By Dr. W. D. Lang. Pp. 12+cx+269+viii plates. (London: British Museum (Natural History).) 30*s*.

A Book about the Bee. By Herbert Mace. Pp. x+138. (London: Hutchinson and Co.) 4*s*. net.

A Monograph of the Pheasants. (In four volumes.) By William Beebe. Vol. ii. Pp. xv+269+plates. (London: H. F. and G. Witherby.) 12*l*. 10*s*. net.

Activism. By Henry L. Eno. Pp. viii+208. (Princeton: University Press; London: Oxford University Press.) 6*s*. 6*d*. net.

Introduction to General Chemistry: An Exposition of the Principles of Modern Chemistry. By Prof. H. Copaux. Translated by Dr. Henry Leffmann. Pp. x+195. (Philadelphia: P. Blakiston's Son and Co.) 2.00 dollars net.

Diary of Societies.

THURSDAY, MAY 19.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—E. Law: The Architecture and Art of Hampton Court Palace: I. In Tudor Times.

INSTITUTE OF PATHOLOGY AND RESEARCH (at St. Mary's Hospital, Paddington), at 4.30.—Dr. H. H. Dale: Anaphylaxis and Immunity.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 5.—R. E. Fry: Architectural Heresies of a Painter.

ROYAL SOCIETY OF MEDICINE (Dermatology Section) (Annual General Meeting), at 5.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—E. H. Clifford: Scheme for Working the City Deep Mine at a Depth of 7000 ft.—The following Papers will be submitted for Discussion:—F. P. Caddy: Stope Measuring at the Passagem Mine of the Gold Mines of Ouro Preto, Ltd.—J. A. P. Gibb: Notes on Some Useful Alignment Charts.

CHEMICAL SOCIETY (Informal Meeting), at 8.

RÖNTGEN SOCIETY (in Physics Lecture Theatre, University College), at 8.15.—Prof. A. V. Hill: Electrical Instruments and Phenomena in Physiology (Fourth Silvanus Thompson Memorial Lecture).

FRIDAY, MAY 20.

ROYAL SOCIETY OF MEDICINE (Otology Section) (Annual General Meeting), at 5.—F. J. Cleminson: Sinusitis in Children.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—A. Arnold: Liquid Fuels.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.1), at 8.15.—Lt.-Col. H. Kirkpatrick: Trachoma.—C. H. Marshall: New Method of Treatment of Human Trypanosomiasis.—C. França: An Early Portuguese Contribution to Tropical Medicine.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section) (Annual General Meeting), at 8.30.—Discussion: The Stomach.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. E. H. Starling: The Law of the Heart.

SATURDAY, MAY 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. Legge: Gnosticism and the Science of Religions. I.

MONDAY, MAY 23.

VICTORIA INSTITUTE (at the Central Hall, Westminster), at 4.30.—Rev. Dr. W. St. Clair Tisdall: The Date of Daniel.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents), at 7.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Very Rev. Dean Rashdall and Others: Discussion on Dr. Inge's "The Idea of Progress."

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8.—General Meeting.

ROYAL SOCIETY OF MEDICINE (Odontology Section) (Annual Meeting), at 8.—J. H. Mummery and G. J. Harborow: A Composite Odontome.—A. T. Pitts: The Prophylactic Extraction of the Third Molars.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Mrs. Rosita Forbes: Across the Libyan Desert to Kufara.

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 9.—Lord Dawson of Penn: The Colon and Colitis (Annual Oration).

TUESDAY, MAY 24.

INSTITUTION OF GAS ENGINEERS (at Institution of Civil Engineers), at 10 a.m.

ROYAL HORTICULTURAL SOCIETY (at Chelsea), at 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—E. Clodd: Occultism: Its Origin and Development.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

ROYAL STATISTICAL SOCIETY (at Surveyors' Institution), at 5.15.—G. Udny Yule: The Time-correlation Problem, with Especial Reference to the Variate-difference Method.

ROYAL SOCIETY OF MEDICINE (Medicine Section) (Annual General Meeting), at 5.30.—Dr. C. Riviere and Others: Discussion on Artificial Pneumothorax.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie during the month of April, 1921.—Dr. C. F. Sonntag: The Comparative Anatomy of the Tongues of the Mammalia. IV. Families 3 and 4. Cebidæ and Hapalidæ.—R. Broom: Some New Genera and Species of Anomodont Reptiles from the Karroo Beds of South Africa.—R. I. Pocock: The External Characters of some Species of Lutrinæ (Otters).—Dr. C. W. Andrews: Note on the Skull of *Dinotherium giganteum* in the British Museum.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—(Technical Meeting.) Scientific Aspects of Studio Lighting.—L. Gaster: The Selection and Use of Illuminants for the Studio.—J. C. Elvy: Illumination Problems in Kinematography.—J. W. P. Walsh and H. Buckley: Methods of Light Distribution.—I. G. Priest: A Possible Standard of White Light.

WEDNESDAY, MAY 25.

INSTITUTION OF GAS ENGINEERS (at Institution of Civil Engineers), at 10 a.m.

ROYAL HORTICULTURAL SOCIETY (at Chelsea), at 3.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—G. W. Lamplugh: The Junction of Gault and Lower Greensand near Leighton Buzzard (Bedfordshire).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) (at Institution of Mechanical Engineers), at 6.—C. F. Elwell and Others: Discussion on Long-Distance Wireless Transmission.

ROYAL MICROSCOPICAL SOCIETY (Leather Industries Section), at 7.30.—P. Hampshire: "Run" Pelts in Sweating Process of Dewoolling.

ROYAL SOCIETY OF ARTS, at 8.—Dr. C. M. Wilson: The War and Industrial Peace: An Analysis of Industrial Unrest.

THURSDAY, MAY 26.

INSTITUTION OF GAS ENGINEERS (at Institution of Civil Engineers), at 10 a.m.

ROYAL HORTICULTURAL SOCIETY (at Chelsea), at 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—E. Law: The Architecture and Art of Hampton Court Palace. II. In Stuart and Later Times.

ROYAL SOCIETY, at 4.30.—*Probable Papers.*—Sir Alfred Ewing: The Atomic Process in Ferro-magnetic Induction.—C. D. Ellis: The Magnetic Spectrum of the β-rays excited by the γ-rays.—S. Datta: The Spectra of the Alkaline Earth Fluorides and their Relation to Each Other.—Dr. W. L. Balls: A Simple Apparatus for Approximate Harmonic Analysis and for Periodicity Measurements.—Dr. G. R. Goldsbrough: The Influence of Satellites upon the Form of Saturn's Ring.—Dr. H. Jeffreys: Certain Geological Effects of the Cooling of the Earth.—T. Kikuchi: The Moving Striations in a Neon Tube (title only).

INSTITUTE OF PATHOLOGY AND RESEARCH (at St. Mary's Hospital, Paddington), at 4.30.—Dr. J. A. Murray: Aims and Progress of the Experimental Study of Cancer.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.

CONCRETE INSTITUTE (Annual General Meeting), at 7.30.

FRIDAY, MAY 27.

ROYAL SOCIETY OF ARTS (Indian and Colonial Sections), at 4.30.—Sir Charles H. Bedford: Industrial (including Power) Alcohol.

PHYSICAL SOCIETY OF LONDON (at University College), at 5.—The General Electric Co. (communicated by C. C. Paterson): A Method for the Micro-analysis of Gases by the Use of the Pirani Pressure Gauge.—H. Pealing: The Reflection of the K-ray Spectrum of Palladium from Fluorspar.—Sir W. H. Bragg: The Intensity of X-rays reflected by the Diamond.—Exhibits of Crystal Models, and of Photographs by the Duc de Broglie of Cathode Ray Spectra attendant on the production of X-rays.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—J. G. Graves: The World's Money System.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—A. Mallock: Elasticity.

SATURDAY, MAY 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. Legge: Gnosticism and the Science of Religions. II.

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