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The Electricity Supply Bill.

THE Electricity Supply Bill, the text of which has now been published, contains no surprises. The framers of the Bill have kept two eminently desirable objects in view, namely, the utilisation to the best advantage of the heat generated by the combustion of coal and the cheapening of the supply of electrical energy in Great Britain for lighting and power to the consumer. The project if carried out will increase the value of coal and will prevent its waste. A cheap supply of electrical power ought to enable many of our export industries to compete successfully in the world's markets. The project, therefore, is of national importance and ought to be discussed from a national point of view. In all problems of this nature, however, the 'human factor' has to be considered.

In the Bill, provision is made for the establishment of a Central Electricity Board which will consist of a chairman and seven other members. The main duty of this Board will be to supply electricity to authorised undertakers, but it will only generate electricity in exceptional cases. One of the first duties of this Board will be to submit to the Electricity Commissioners a scheme which will state what generating stations, existing or to be built, will be 'selected stations' for supplying electricity for the purposes of the Board. The Board is to provide for interconnexion of selected stations and authorised undertakings by means of main transmission lines which it will purchase or construct. It will also take means to standardise the frequency of the alternating current supply.

When the scheme is completed it will be published, and all persons interested in it can then be heard. The owners of supply stations affected have the right of appeal to the Electricity Commissioners, who have won golden opinions from every one in the past by the fairness and judicial calmness they have displayed when adjudicating on contentious matters. In the event of the owners and the Board failing to agree, the Board will have the right to acquire the undertaking. If no suitable authority be found willing to operate it, then the Board itself can make arrangements for carrying on the work.

The owners of selected stations are to operate as the Board may direct and are to sell to the Board on specified terms. The Board has to construct and lay down the mains and transmission lines which are requisite for purposes of interconnexion. It has also to supply the authorised undertakings at a price fixed so that the receipts may cover the expenditure when taken over a number of years. The tariff will be a 'John Hopkinson' tariff, consisting of two parts, a fixed charge and a charge depending on the load. If

any authorised undertaking refuses to accept the Board's terms, then the Board has power to compel the undertaking to supply the consumer at the same rate as if it purchased its supply from the Board.

Roughly speaking, the Government has in view the selection of several highly efficient large power stations which will supply over transmission lines, belonging to the Electricity Board, to industrial centres. The small generating stations in these centres which now convert the heat obtained from the combustion of coal into electricity with a low efficiency will cease to be generating stations and will become merely distributing centres.

In order that the distribution may be done economically, it is certain that very high voltage must be used. The fixing of this voltage will be one of the first duties of the Board. Probably 110,000 volts will be chosen for the pressure of transmission, and the system adopted will almost certainly be the three-phase system. Except in the proximity of towns, the three large copper or aluminium conductors will be suspended from lattice steel towers at a considerable height from the ground. These steel towers, with wires suspended between them, are not beautiful, but they will not spoil the landscape so much as railway lines do. They will take many months to complete, and so perhaps it is necessary to state that the public should not expect any immediate reduction in the price of electricity.

The success of the scheme depends largely on the constitution of the first Board. We hope that some of the members will be young electrical engineers who have had experience of high-tension work in other countries. One also should be an expert in underground cable work, with first-hand knowledge of the maximum electric pressures that can be used in underground work. The questions of the maximum economy of transmission which are essential to the success of the scheme can only be solved by advanced mathematics and engineering intuition. The latter is necessary, as unfortunately we cannot foretell what will be the best distributing points ten years hence. In engineering it is sometimes necessary to make rapid decisions on insufficient data and to move forward warily, always being ready to amend the scheme when unforeseen developments arise.

Luckily, most of our leading engineers are almost wholly engrossed by their work. They take pride not only in its excellence but also in the amount of work they can do. In this respect they are unlike their humbler brethren, who are sometimes dominated by their fellow-workmen so that they are afraid to do their best or work their hardest.

Difficulties common to every great scheme for improving industry will doubtless arise. Certain engineers will have their stations 'selected,' others equally capable will be left in the humbler ranks of the distributors. There are many capable electrical engineers who have been working for the last ten or twenty years converting unprofitable supply undertakings into profitable ones. They have laboured well and hard and have exercised thrift in every possible direction. Plant laid down twenty years ago is still in excellent working order, although naturally it is not nearly so efficient as large modern plant. Other stations are burdens either on the shareholders or the ratepayers. Engineers have scrapped plant from which they were unable to get the maximum output or make work economically. New plant has been purchased, the thermal efficiency of which may meet the approval of the Board. Our sympathies are, however, with the hardworking and thrifty engineer, who, although he has made a commercial success of his undertaking, will doubtless in the future be merely a 'distributor.' It is sometimes truer economy to buy a set of cheap engines to help carry the 'peak' load than to buy a large turbine, with all its auxiliary plant, before it is really needed.

The new era, however, will give rise to new problems. Although we sympathise with those capable engineers, the importance of whose positions will be injuriously affected by the Bill, yet this is the way of progress. The Ministry of Transport has a heavy responsibility in appointing the new Board. Engineers who are familiar with the much less important problems arising in town distribution may not be the right men to handle the much graver problems which this scheme proposes. It is certain that, whatever system is adopted, it will in time become antiquated. It is necessary, therefore, to keep an open mind and to modify the system whenever by any means, present or future, economies can be effected by so doing.

Climate and Man in the United States.

The Climates of the United States. By Prof. Robert DeCourcy Ward. Pp. xvi + 518. (Boston, New York and London: Ginn and Co., 1925.) 4 dollars.

IN this work, Prof. Ward, the well-known climatologist of Harvard, gives us not merely a compilation of statistics relating to the distribution of the meteorological elements over his country, but to a very considerable extent, also, he exercises the true function of the climatologist in presenting vivid descriptions of climate, and its effects upon economic status and national life. The twenty-three chapters of the book, abundantly illustrated with charts and curves, including a handsome map of mean annual rainfall, discuss historical matter, the geographical controls of climate,

the different types of climate met with in the United States, the regional and seasonal distribution of all the chief elements, namely, pressure, wind, temperature, humidity, sunshine, rain, and snowfall, etc., together with the relation of climate to crops and of climate to health. Thunderstorms and tornadoes, hot and cold waves, which are all in their great intensity characteristic American weather phenomena, come in for special discussion, as also 'blizzards,' Chinook winds (the föhn of the Rockies), and that peculiar phase of autumnal weather known as the 'Indian summer'—the great beauty of which in the eastern States is expatiated upon.

The use of the plural form in the title will be observed in regard to an area which includes a 'Mediterranean' type of climate on the Pacific coast, an almost tropical type on the shores of the Gulf of Mexico, an arid type in the Great Basin, semi-arid in the Plains, an extreme continental type with intensely cold winters, somewhat modified near the Great Lakes, along the Canadian border, and an Atlantic coast type which so far resembles the Atlantic coast of Europe as to have variable weather and a well-distributed, abundant rainfall. It must not be imagined, indeed, that we in England have any monopoly of changeable weather, for in New England the vicissitudes, just as frequent, are far more severe, and the New Yorker in winter time must be prepared for a change, within forty-eight hours, of, say, from +65° F. to −10° F., the like of which the Londoner has never dreamed. It is a little inconsistent, perhaps, to find the outlying Arctic territory of Alaska accorded the entire concluding chapter, while Cuba and the Sandwich Islands, also politically American, receive no mention—even though the Philippines, which physically belong to Asia, might well be excluded by reason of distance. The intense 'cold waves' of the north-east States are stated to occur between December and March, and the insufferable 'hot waves' between June and September; but we think that November and May, respectively, ought to be included within these periods. Certainly in Europe the frosts of November and the heat-spells of May are already very emphatic.

We have only one serious charge to launch against this excellent book, and that is a certain backwardness of outlook, noticeable especially in the entire omission of any reference to the modern theory of the polar front. In the constant emphasis laid upon the violent changes of temperature which mark the passage of the great winter cyclones across the northern tier of States, as the wind shifts from a warm to a cold quarter, every meteorologist, certainly in England, will recognise that the United States is the very country where 'discontinuities' between 'equatorial' and 'polar air' attain their sharpest development, associated with intense cyclonic activity in winter, along the Great Lakes, in New England and Nova Scotia, as currents of warm, damp air from the Gulf of Mexico and the Gulf Stream interact with supplies of intensely cold, dry air from the interior of Canada, along the so-called polar front. It is not that the theory of the polar front is by any means the last word in the dynamics of cyclones; what makes the omission serious is that the theory furnishes a common-sense, geographic background of reference in studying the interchange of air between the equator and the poles that has made more powerful appeal to the imagination than any idea in meteorology for a long time. We hope, therefore, that in a second edition the facts of climate which illustrate this theory so forcibly in America will be translated into a terminology which has by now passed into common use by British and Continental meteorologists, and is certainly familiar in the United States itself.

We could wish in this, as in many other works, for a rather more instructive systematisation and categorisation of the geographical factors which control the distribution of climate. The geographical distribution of climate is determined by (*a*) latitude; (*b*) altitude; (*c*) a highly complex, interdependent set of factors connected with the distribution and character of land, water, snow, and ice comprised under the designation 'continentality and oceanity'; (*d*) mountainous configuration (as distinct from mere altitude) affecting rainfall and exposure to wind, sun, and frost. Now it is quite impossible to class prevailing winds which transfer continental conditions seawards (as in the eastern United States) and oceanic conditions landwards (as in the British Isles) other than as a sub-factor of (*c*). This emerged with unmistakable clearness at a fairly recent discussion of Spitaler's Continentality maps. (See *Geographical Journal*, July 1924.) Imagine a *uniform* globe, divested, that is to say, of all differential effects of land and sea, and of polar ice: it is clear that over such a surface the undisturbed planetary winds could produce no local climatic differentiation, that air currents changing latitude would, on the average, quickly readjust their temperatures, and that if any cyclonic eddies developed along a poorly marked polar front, they must be very different in character from those with which we are actually so familiar. In fact, on a uniform earth, factors (*c*) and (*d*) above, being obliterated, and (*b*) only existing with regard to the free atmosphere (since *ex hypothesi* there are no vertical inequalities), climate would be a function of (*a*) alone, as regards, at least, its geographical distribution.

In the United States, the planetary westerly winds normal to the latitude are powerfully affected by the monsoonal influences of the North American continent,

being twisted over the eastern States into prevailing south or south-west winds in July, and north-west winds in January.

There is no better chapter in the book than that dealing with climate and health, together with the summer and winter health resorts of the United States; and we do not think that any member of the medical faculty could find fault with the philosophy displayed. It is clearly recognised that climate to a considerable extent acts indirectly on the human organism, and that the same phases of weather and climate may produce effects variously, for good or evil, according as hygienic, economic, and social factors are sound or faulty, and according to the level of health of the individual. In England, for example, we know that a spell of frost and snow sends up the crude death-rate, but we also know that the same weather is a fine tonic to those who can react to it and love the open air.

L. C. W. BONACINA.

The Psychology of Selecting Men.

The Psychology of Selecting Men. By Prof. Donald A. Laird. Pp. xii+274. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 15*s.* net.

ENGINEERS and chemists have long been an essential part of the staff of every large factory. No new machine is bought before it has been carefully examined and good proof evinced of its worth. Samples of raw materials are analysed by the chemists to observe their purity or strength. It is but recently, however, that the importance has been realised, in full, of the scientific selection of staff. The success of many a factory depends as much, or more, on the skill of the men who use the machines as on the machines themselves. It is no uncommon thing to find two operatives with equal experience, working side by side on similar machines, one of whom will produce half again as great an output as his companion.

How can selection be successfully made among applicants for a position? What method can be used to gain a true indication of their innate capacity for the work? Dr. Laird in the work before us has answered this question with as much detail as is at present available. His book is admirably planned. He starts by outlining the need for employment psychology, and then proceeds to show how its basis rests on the degree and extent of individual differences, and how it is generally safe to postulate that in an unselected group of individuals, these differences approximate to normal distribution.

The validity of the older methods of selection—the letter of application, the interview, the so-called "scientific character reader"—is discussed, and Dr. Laird gives definite proof that their selective value in many cases, especially with young workers, is little better than that obtained by chance. The unwary reader is himself trapped into making judgments from handwriting and photographs and thus shown his limitations. Many factors are concerned in the inadequacy of these methods. Often they measure irrelevant factors—you can tell but little of a prospective engineer's ability from his conversation, or of a carpenter from the letter he writes. But even in cases where the methods themselves have potential prognostic capacity, this is often lost through slipshod application, and lack of a standard by which to judge the results.

All this, however, is by way of introduction; though useful as a warning, it is merely negative criticism. The second half of the book is more constructive. There Dr. Laird is concerned with the use and evaluation of psychological tests of selection. Almost any sort of task can be used as a test if only it will give an accurate indication of the applicant's ability, or predict with great success his future performance. There is, as Dr. Laird says, no mystery about mental tests. "They are simply an application of the scientific method." The tasks, whether they are actual samples of the work, or simple trials of the fundamental capacities underlying ability at the work, must prove their worth before they are used. "They must show their consistency from day to day, their consistency from user to user, and their internal consistency of measuring what they aim to measure."

It must be remembered, however, that "tests are part of employment psychology, but by no means are they the sole contribution of psychology to employment." The interview and letter of application can be improved by making them more objective and supplying standards. It is especially important to analyse the personal data of successful and unsuccessful workers by group comparisons or other methods, to discover if there are any distinct differences in such matters between the two groups.

Dr. Laird's book is, as he says in his preface, "a product of necessity." The demand among employers for scientific assistance in the selection of their workers is becoming pronounced, perhaps even more in Great Britain than in America. The subject is still in its infancy and an enormous amount of research is necessary, but already psychological tests have proved themselves more than idle theory, and are in use in many offices, shops, and factories. They have been approved of alike by the employers who have benefited by the increased output, and by the employees who appreciate the justice of this method of selection. With such economic and social value their future is assured.

W. SPIELMAN.

Astronomical Physics.

Astronomical Physics. By F. J. M. Stratton. Pp. xi+213+32 plates. (London: Methuen and Co., Ltd., 1925.) 12*s.* 6*d.* net.

WITH the whole universe for its field of inquiry, astronomical physics is necessarily a very large subject, and an attempt to present its methods and results in a single volume of modest size can scarcely be expected to satisfy the requirements of all classes of readers. In some respects, however, the author of the book before us has achieved his task with distinct success. In the space of two hundred pages he has covered the whole range of astronomical physics from its beginnings to the most recent speculations in cosmogony, and we have failed to notice any subject of importance which has not received some mention.

The author's aim has been "to provide a useful book on the subject for the student, and one which every astrophysicist and not a few spectroscopists would want constantly within reach," and he has endeavoured to compensate for brevity of treatment by giving an abundance of references. As a guide to original sources of information the book will certainly be of great value to actual workers in astronomical physics, and to all serious students of the subject who have access to a suitable library. Physicists desiring to become more closely acquainted with the inter-relationships of physics and astronomy, which are becoming more and more numerous, will also find the book of great service, and to them it may possibly not appear to suffer from undue compression. It seems unlikely, however, that the book will appeal to the general reader, for whom it is to be feared that much of the text may be too sketchy for intelligibility. One wonders, for example, how such a reader would fare in trying to interpret the photographs showing Zeeman effects in sunspots (Plate 17) from the few lines of description which accompany them.

Historical references, instruments, and laboratory investigations form the subjects of the earlier chapters, and these are followed by others on the sun, the solar system, stellar radiation, motion in the line of sight, stellar classification, giant and dwarf stars, nebulæ, novæ, variable stars, stars with peculiar spectra, and, finally, by a chapter on speculations in cosmogony. Among the subjects most fully dealt with are the criteria for the various groups of the Harvard classification of stellar spectra, and the determination of the orbit of a spectroscopic binary. Misprints are very few, but attention may be directed to the unfinished deduction of the formula for the Doppler displacement on p. 83 and the necessity for substitution of u for u/c in the last equation.

The thirty-two plates which illustrate the volume have been well chosen and are satisfactorily reproduced. Diagrams are only four in number, and additional ones might have been introduced with advantage, as, for example, light-curves of typical variable stars. A number of useful tables, including standard wave-lengths, are given as appendices. It is difficult, however, to see the application to the subjects dealt with of the table for correcting wave-lengths to vacuum; a list of bright stars with particulars of their spectra and other characteristics would have been of greater interest.

As a summary of the main facts of astrophysics, and as a reminder on problems awaiting solution, the book is a welcome addition to the few works on the subject at present available.

Conduction in Nerves.

The Theory of Decrementless Conduction in Narcotised Region of Nerve. By Prof. Genichi Kato. New edition. Pp. v+166+6 plates. (Tokyo: Nankōdō, Hongo, 1924.) 3 dollars.

UNTIL Prof. Kato had contributed this most important monograph to the study of the nervous system, it had been held generally that a nerve impulse passing through a length of nerve which had been rendered un-normal in some way, as by the action of narcotic drugs, underwent a gradual diminution in its course ('decrement'), leading, if the narcotised region were sufficiently long, to its complete extinction. If the impulse did regain normal nerve without suffering extinction, it regained its normal magnitude to the full.

The author contends that this view is erroneous. He and his colleagues in Keio University have used in their experiments a sciatic-nerve-gastrocnemius-muscle preparation which is 10 centimetres long, obtained from the Japanese toad *Bufo vulgaris Japonicus*. Such a preparation may be put in a narcotising chamber without fear of diffusion from the outside—and consequent dilution of the narcotic—upsetting the narcosis of the region observed. By varying the length of the chambers and the narcotising solutions or vapours therein contained, or by observing the electrical responses from narcotised nerve, evidence is produced against there being a gradual diminution. The impulse is subnormal but it does not suffer 'decrement.' On reaching again un-narcotised nerve, the impulse becomes normal. When the degree of narcosis is pressed, excitability and conductivity disappear simultaneously.

The unusual length of nerve in the Japanese toad gives also latitude for observations on the spread of

current along the nerve, which may be for a distance so great as 2 cm. This is claimed as another source of error which workers with nerve-muscle preparations of only European magnitude cannot avoid. In the array of careful experiments described in detail with their protocols are some in which the conditions simulated those of earlier workers, who of necessity have used smaller animals than the Japanese toad. Then the results agree, until, altering conditions and avoiding the error of diffusion in narcotisation and of escape of current, as is possible with the great length of nerve, it is shown that no interpretation involving decrement of the impulse can be permitted. On other aspects of the passage of the impulse in nerve there is no wide disagreement with previous observers.

There are many small printing errors. On p. 79, "entangled" for "disentangled" or "untangled" is probably the worst. The book deserves an index.

These small failings will not detract from the far-reaching possibilities of Genichi Kato's work and inspiration.

Our Bookshelf.

The Fight for Everest: 1924. By Lieut. Col. E. F. Norton and other Members of the Expedition. Pp. xi+372+32 plates+2 maps. (London: Edward Arnold and Co., 1925.) 25*s.* net.

IT would indeed be a strange personality which would not be stirred by this thrilling account, ending, alas, in tragedy, of the third expedition towards the summit of Mount Everest. The first in 1921 was in fact no more than a reconnaissance, the second in 1922 is described as "The assault," while we may well hope that the 1924 volume now published under the title of the "Fight for Everest" will be itself succeeded by the final volume, the "Attainment."

The introduction by Sir Francis Younghusband should persuade even the most cold-blooded reader of the value of such an effort. Most of the members of the expedition contribute a chapter or more: commencing with "The Start" by General Bruce, soon to be invalided back to the base and to be succeeded in command by Colonel Norton, there follow in succession (an enumeration of the chapter sub-titles tells the story), the march across Tibet, the Rongbuk Glacier, the North Col, Norton and Somervell's attempt, Mallory and Irvine's attempt, the return to Base Camp.

Mallory's letters, too, are fascinating reading, giving a glimpse of that enthusiasm which carried him and Irvine to their last final climb. The actual cause of their deaths will always remain a mystery. Did they reach the summit and fail to find their camp again or did they meet with an accident? We sympathise with the relatives and friends of those who died, a sympathy mingled with pride that Britain can still produce these men.

Second only to the last climb are those of Norton and Somervell and of Odell; a height of 28,000 feet seems well within the reach of such men, while it seems only a few years ago that a climb to 24,000 feet was considered an impossibility.

Part III. deals with the scientific results, the physiological effects, and the use of oxygen, as well as the natural history, geology and glaciology and photography, each of which are well treated.

Although newspaper articles and the well-known cinema, the "Epic of Everest," have familiarised us with most of the details of the expedition, this volume forms a valuable permanent record, well illustrated as it is with an exceptionally artistic map.

Landmarks in the Struggle between Science and Religion. By Prof. James Y. Simpson. Pp. xiv + 288. (London: Hodder and Stoughton, Ltd., 1925.) 7*s.* 6*d.* net.

ONE may surmise that in writing this book Prof. Simpson had in mind the religious layman rather than the scientific man, who will, we fear, find the discussions of early theology, especially in the first half of the book, somewhat wearisome. Prof. Simpson covers a very wide field, in theology, pre-history, science and philosophy. His book is erudite and well documented, and indicates a remarkably wide acquaintance with many extremely diverse branches of knowledge. There is, however, a certain disjointedness in the treatment of his almost superabundant historical material, which does not make for easy reading, nor is his central theme of the struggle between science and religion developed in any sustained and systematic way.

This said by way of criticism, we must remark on the competence and open-mindedness of the author's handling of a difficult and controversial subject. His attitude is that of a deeply religious man who is not afraid to accept all the well-substantiated results of science, and is able to harmonise them with his own beliefs. His position is that "Science describes, the philosophy of science explains, and religion interprets; and description, explanation, and interpretation are alike elements in the process of man's mental and spiritual adjustment or adaptation to the Universe. Each is necessary, the one to the other, and must enter into any intelligent understanding of the world as a whole. Science leaves us with descriptions which philosophy explains in terms of a phenomenal dynamic Universe; religion interprets the whole most satisfactorily, after an examination of all other interpretations, as the self-expression or unfolding of the activity of a creative God" (pp. 270-71).

We take it that science has no real quarrel with religion, as a certain attitude to the universe, but only with the accretions of dogmatic theology. That science had a hard fight to free itself from the trammels of theological and other dogmatic thought is made abundantly clear in Prof. Simpson's book, and vigilance is still necessary to preserve this hard-won freedom. But it is well to remember that the scientific man must beware of dogmatism also in his own sphere; he must continually test and criticise accepted theories lest they become dead and traditional; and he must guard against the danger of erecting a convenient method of science into a philosophy of life. E. S. R.

L'Adaptation. Par Prof. L. Cuénot. (Encyclopédie scientifique: Bibliothèque de biologie générale.) Pp. 420. (Paris: Gaston Doin, 1925.) 20 francs.

PROF. CUÉNOT has done biologists a service in writing this book. It contains treasures of knowledge, which have been treated with great skill and acumen.

Especially valuable, perhaps, are the sections distinguishing the different types of adaptation (necessary and sufficient adaptation, statistical adaptation, etc.); those dealing with the important but limited rôle of what is usually called pre-adaptation; the assemblage of interesting facts on co-adaptation; the section on adaptations which are analysable into individual modifications and germinally-determined characters both acting in the same sense; and that on the reason for the rarity or absence of primitive and intermediate types.

Prof. Cuénot is perhaps less good on the bearing of mutations on the problem. It is difficult to see why he regards natural selection as only weeding out mutations which depart from the type: Why should not the neo-Darwinian scheme work with mutations as its raw material? Also, in his discussion of orthogenesis and co-adaptations, he often forgets, or seems to forget, the important fact that an organism's environment is largely composed of other organisms, and that therefore we should expect to find an improvement in one organism bringing out improvements in another, as improvements in naval guns brought out improvements in armour plate and vice versa. This principle will at least help to account for many (though probably not all) of the simultaneous, slow, 'orthogenetic' lines seen in palæontology. He could have accounted for some other orthogenetic phenomena by reference to the mechanisms of heterogonic growth (as summarised by Champy in his "Sexualité et Hormones").

Prof. Cuénot is sceptical as to the value of any of the existing explanations of adaptation, whether by Lamarckian means, by slow selection, by large mutation, or by predetermined orthogenesis. However, whether we share his scepticism or not, he has here provided considerable food for thought on one of the central problems of biology.

Penrose's Annual: the Process Year Book and Review of the Graphic Arts. Edited by William Gamble. Vol. 28, 1926. Pp. xvi + 146 + 70 + 57 plates. (London: Percy Lund, Humphries and Co., Ltd., 1926.) 8*s.* net.

THE editor, in his usual review of process work, says that he regretfully confesses that the year 1925, the end of a quarter century, shows "no new process, nor change of method, which is of outstanding importance; nothing, in fact, that could be regarded as a milestone of progress passed in the onward march of our art and craft." Much is being done, but it is in continuance of work started in previous years, especially since the War, and it may be expected to bear fruit in the immediate years to come. The editor then describes the remarkable progress that has been made during the quarter of a century just completed, which includes the introduction of the offset method and rotary photogravure. Colour gravure, based on three-colour principles, is making great headway, and an example is given of a flower study reproduced by this process, and also by a letterpress method from four blocks, so that the two results can be compared. Collotype is still printed on slow-running flat-bed machines which are turning out excellent work, and "it hardly seems likely that this practice will ever be altered." The progress of the various methods of replacing the ordinary type setting of text by photographic methods are passed in review, but it seems that none have yet convinced the printing trade of the advantages of these inventions over existing methods.

The text consists of 34 articles by experts, who give experiences or data of value. The curious chemical equation at page 129 shows that practical men should be content to leave theory to those that understand it. The fifth of the series of "The Work of the Private Presses" is by Mr. Chas. T. Jacobi on the Eragny Press, 1894–1914, and is illustrated with specimens. The numerous plates may be considered as showing the best that can be done to-day by perhaps every process that is in use.

A System of Physical Chemistry. By Prof. William C. McC. Lewis. (Text-Books of Physical Chemistry.) In 3 vols. Vol. 2: Thermodynamics. Fourth edition. Pp. viii + 489. (London: Longmans, Green and Co., 1925.) 15*s.* net.

THE third edition of Vol. 2 of Lewis's "Physical Chemistry" appeared in 1920, and included 445 pages of text. The fourth edition has been increased to 481 pages, mainly by the inclusion of half a chapter on "The Activity Theory of Evolutions" and half a chapter on "The Milner-Debye Theory of Strong Electrolytes." In accordance with the author's policy of quoting extensively from original sources, the latter section is taken from a paper by A. A. Noyes which appeared in the *Journal of the American Chemical Society* in 1924.

British Birds. Written and Illustrated by Archibald Thorburn. New edition. In 4 vols. Vol. 2. Pp. ix + 130 + 48 plates. (London: Longmans, Green and Co., 1925.) 16*s.* net.

THE first volume of the new edition of Mr. Thorburn's "British Birds" has already been noticed in these columns (September 12, p. 390); the second of the four has now appeared. The coloured plates are again very beautiful, but the amount of space given to rarities, in text and picture, continues to keep the treatment of more important birds within rather narrow limits. One is glad to note, however, the figuring of so many as three plumage-phases of the great spotted woodpecker, and that the immature plumage of the gannet is also shown.

Laboratory Manual of Elementary Colloid Chemistry. By Emil Hatschek. Second edition. Pp. 153. (London: J. and A. Churchill, 1925.) 7*s.* 6d. net.

THE second edition of Hatschek's "Laboratory Manual of Elementary Colloid Chemistry" contains new chapters on "Oxide and Hydroxide Sols" and on "Non-aqueous Emulsoid Sols and Gels." Methods for determining the coagulation velocity and for demonstrating the variation of viscosity with rate of shear have also been included.

Letters to the Editor.

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

Light Quanta and Photo-electric Emission.

I VENTURE to think that no theory has suffered so much from the application of an arbitrary selection principle to the consideration of experimental results as the quantum theory. The treatment of the whole subject, at least so far as it is concerned with X-ray phenomena—and in no branch of study is the acquaintance with the quantum rules and with their limitation so intimate—is based upon a very inadequate knowledge of facts. It could scarcely be otherwise when experimental acquaintance with the subject is so meagre. For the present I should like to mention only one point.

The 'light-quantum' theory receives its strongest support in the phenomenon of electron emission when radiation is absorbed. It is thought by some—apparently by many—that the "light-quantum" retains its individuality between the process of emission and that of absorption. May I then record an experimental fact bearing upon the subject?

The ionisation produced by a heterogeneous beam of X-rays in a gas or the electronic emission from a metal plate (measured by ionisation outside the plate) may be abruptly and enormously increased either by (*a*) superposing on that beam a very feeble radiation of slightly shorter wave-lengths, or (*b*) by taking away from the complex radiation a very small amount of the radiation of longer wave-lengths as by filtering; that is, either by adding higher frequency radiations to, or eliminating lower frequency radiations from the beam, the same effect is produced, namely, a sudden large increase in the ionisation. The magnitude of a sudden increase may be from 100 to 150 per cent. of the original magnitude. This is the *J* ionisation produced by the *J* photo-electric emission accompanying the *J* absorption. Where then are the discrete and independent quanta?

These experimental results again show quite definitely that this *J* electron emission is an effect of the radiation as a whole. The quality of the full stream of radiation decides whether or not this shall take place. It appears (though this is much less certain) that the absorption is an absorption of all the constituents.

Such results were obtained by Miss White and myself six or seven years ago, but were withheld from publication until they could be confirmed by many experiments such as we have recently recorded (and others at present being obtained by Miss Mair), showing that these form part of a consistent whole. If then a small-angled prism of aluminium—a wedge—is placed in the path of a heterogeneous beam of X-rays, there is transmitted a spectrum of radiations varying in *average* wave-length, capable of showing both *J* absorption lines and *J* absorption edges by the ionisation method, as do homogeneous radiations. The phenomenon is now being studied photographically.

C. G. BARKLA.

University of Edinburgh,
March 6.

Eka-cæsium and a Suggestion about Radiation and the Elements.[1]

IN endeavouring to confirm the identity of the X-ray line 1·032 on Film No. 3 (see NATURE, January 30, 1926, p. 153), which would seem to correspond with the La_1 line of eka-cæsium (87) of calculated wave-length 1·0276, I have had this film intensified and then remeasured by Messrs. Adam Hilger, Ltd. (see *Chemical News*, February 12, 1926, p. 101).

The result is that the lines which according to the original measurement were 1·434, 1·232, and 1·032 now measure 1·434, 1·234, and 1·029, thus confirming the first values obtained, as it must be remembered we are not able to determine the lines very accurately, there being a possible error of 0·005, as previously stated.

The strong line of mercury, $L\beta_1$ of wave-length 1·0458, seems, however, to be ruled out, unless something has happened to the film originally. I understand that films on development tend to shrink rather than to stretch. This would not satisfy the suspicion that the line attributed to element 87 is the mercury one in question. There seems to be no other alternative than that the line is 87 La_1. More work in this field is obviously necessary.

Unfortunately, the first experiment cannot be repeated with the present apparatus, as there is now very little of the original material prepared by Dr. J. G. F. Druce.

Glass photographic plates are now being used in order to ensure greater accuracy, especially in measurement.

The question whether such elements as 85 and 87 can exist without being appreciably radioactive has been considered. There are several well-known instances of comparatively stable and even non-radioactive elements having the same atomic number as those which are very unstable; and uranium, the last-known member of the general series, is far more stable than most of those elements of somewhat lower atomic number. Therefore there is no absolute criterion as a guide in this respect.

Potassium and rubidium are feebly radioactive, but, curiously enough, no products from their radio-change seem to accumulate—at least, not so far as I know. If these common elements are contaminated with those of atomic numbers 85 and 87, and if these are radioactive, then the problem would only be partly solved. There is, however, no evidence of this kind. Both elements are mentioned on account of some statements to follow here.

Those elements of high atomic number are unstable and they emit corpuscular radiation and electromagnetic radiation; that is, α-, β-, and γ-rays, with variations according to the radio-element considered.

Conversely, one might think of the elements at the other end of the general series as having absorbed such 'radiation' at one time in their history, and thereby growing into larger and larger atoms, as are now known. Blackett's well-known experiments on the disruption of the nitrogen atom by high-speed alpha particles, as previously accomplished by Rutherford, further reveal photographically, by using the C. T. R. Wilson ionisation cloud method, that when an H-particle (proton) is ejected from the nitrogen nucleus, the bombarding alpha particle, which caused the ejection, becomes absorbed in the nitrogen nucleus. Henderson's experiments indicate that capture and loss of electrons by alpha particles is also a process which comes under the general head of *mass absorption and mass radiation*.

[1] The word radiation in this title is here used more particularly in the sense of *corpuscular* or *mass* radiation.

There is a further consideration: one might ask whether there could be a half-way state in which some elements spontaneously carry out both processes; that is to say, they absorb "radiation" and then emit it in the radioactive manner, as distinguished from the photoelectric effect proper. Some further statement seems necessary here, since at best the idea may only be a half-truth.

However that may be, this idea is suggested by the fact that potassium and rubidium spontaneously emit electrons (β-rays). Have we here the intermediate type of activity hinted at above? If these elements could absorb and then re-emit electrons, the process repeating, their radioactivity would be accounted for without the accumulation of disintegration products. Furthermore, this dual process may reside in an impurity (elements) present in potassium and rubidium.

Considering again the experimental side, I have succeeded in exposing normal manganese phosphate (Kahlbaum's) for 10 hours without getting anything on the photographic film other than the copper lines (including a faint satellite in connexion therewith) and two almost invisible lines of wave-lengths 1·433 and 1·233. It would appear that these were the La_1 and $L\beta_1$ lines of element 75 of calculated wave-lengths 1·4298 and 1·2358. Berg and Tacke (*Naturwissenschaften*, 1925, 26, p. 571) calculate the values respectively as 1·4306 and 1·2355. The range of exposure was from the silver absorption edge to the copper Ka_1 and Ka_2 lines, which were, by the way, resolved. There was a good deal of phosphate on the anticathode. I believe this experiment shows good technique. Whether the above pair of exceedingly faint lines were those of $ZnKa_1$ and Ka_2 combined, and $HgLa_1$, is partly immaterial to the present argument, for it suggests that it would be worth while examining potassium and rubidium in this way in order to detect if possible traces of, say, 87 in one of them.

This work is now in hand and the technique is steadily being improved. In these experiments the cathode should be in good condition; that is, not bored out by the anode rays.

The wave-lengths given above are in Angström units as before. F. H. LORING.

The Magnetic Moment of the Orbit of the Valency Electron of the Solid Alkali Metals.

THE normal state of the atoms of the vapours of the alkali metals is an 's' state, the atoms consisting of a rare gas core round which revolves the valency electron in a n_1 orbit (4_1 for potassium, 5_1 for rubidium, 6_1 for cæsium). One would then expect that the vapours of these elements would be paramagnetic and that, when the diamagnetic properties of the rare gas cores were allowed for, a magneton number would be found corresponding to 1 Bohr magneton or 8·6 Weiss units. Data as to the magnetic properties of these vapours are apparently wanting, but the spectroscopic evidence leaves no doubt as to what is to be expected.

It is of some interest to see how far these predictions can be extended to the case of the solid state and what information the magnetic measurements can provide as to the nature of the atoms in the solid. If the lattice of the latter were built up of atoms in the same state as those of the vapour, one would expect that the metals would be paramagnetic, would follow the law $\chi(T+\Delta)=C$, and that, supposing Δ to have a value of the order usually found, the atomic susceptibilities of all the alkali metals would lie round about $+1300\times10^{-6}$.

If, on the other hand, there is a non-polar linking between the atoms of the solids, the valency electrons being shared by neighbouring atoms, one would expect that the total magnetic moment of the orbits of the valency electrons would be zero or nearly so on account of the complete or approximate compensation of the actual moments of the pair of shared orbits. The valency electrons would then contribute at most a small positive amount to the total moment of the atom and the substances would be diamagnetic. Probably, too, these shared orbits would not take a definite part in the thermal agitation of the atoms, and their positive contribution to the susceptibility would be independent of the temperature.

Further, it would be expected that the closest distance of approach between atoms of the solid alkali metals would then be smaller than the largest dimension of the n_1 orbit and larger than the radius of the rare gas core.

The experimental data for the susceptibilities of the solid alkali metals have until recently been somewhat chaotic. Recent measurements by Miss Crow (*Proc. Roy. Soc. Canada*, 19, 63, 1925) seem to be more satisfactory. The susceptibilities of solid potassium, rubidium, and cæsium, together with the contributions to the susceptibilities due to the rubidium and cæsium ions were measured with the following results: atomic susceptibilities $K-1\cdot9\times10^{-6}$, $Rb-7\times10^{-6}$, $Cs-8\times10^{-6}$, $Rb^+-29\cdot8\times10^{-6}$,[1] $Cs^+-37\cdot4\times10^{-6}$. We may add the value $-16\cdot4\times10^{-6}$ for K^+, being the mean of the figures given by Pascal (*C.R.* 158, 37, 1914) and Joos (*Zeits. f. Phys.*, 32, 835, 1925).

We thus see that the contributions to the susceptibility of the valency electrons are as follows: $K+14\cdot5\times10^{-6}$, $Rb+22\cdot8\times10^{-6}$, $Cs+29\cdot4\times10^{-6}$. A small correction for the diamagnetic properties of the actual orbit of the valency electron has still to be applied, but the values will remain of the same order of magnitude. It will be seen that these values are very much smaller than what would be expected for a normal n_1 orbit, but are of the order one would expect for the residual moment of nearly completely compensated shared orbits.

The contributions of the valency electrons to the atomic susceptibilities are approximately in the ratio $4^2:5^2:6^2$ for K, Rb, Cs.

The susceptibilities of the solid alkali metals are also apparently independent of the temperature, and the closest distance of approach of the atoms in the lattice falls in between the values for the major axis of the n_1 orbit and the radius of the rare gas core, being 2·25 Å.U., 3·2 Å.U., and 1·55 Å.U. respectively for potassium.

Measurements of the magnetic properties of the alkali metals would thus indicate that the orbits of the valency electrons for the solid state are not the independent n_1 orbits shown by the spectroscopic data, but are shared by the neighbouring atoms to form a non-polar binding. L. C. JACKSON.

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[1] There appears to be an arithmetical error in the paper referred to, the mean for A/B being 449 and not 451, so that the susceptibility of Rb^+ is $-29\cdot8\times10^{-6}$ in place of $-29\cdot9\times10^{-6}$ as actually given.

Chemical Effects produced by Resonance Radiation.

WE have read with interest the communication of Prof. H. S. Taylor and his collaborators on the subject of chemical effects produced by resonance radiation, in which some exception is taken both to our experiments and to the conclusions given in our letter of December 19, p. 899. It may be as well

to indicate briefly the points on which we are in agreement and those on which a divergence of opinion apparently exists.

It is generally agreed that the reactions under consideration involve the photosensitisation of mercury atoms, which on impact with hydrogen molecules render these in some way active for combination with gases. In our view, these reactions involve the simple addition of active hydrogen molecules to molecules of the reactants such as O_2, N_2, C_2H_4, CO. In a recent communication to the Cambridge Philosophical Society, this view was supported by the isolation of H_2O_2, the first step in the formation of water, and of N_2H_4, the second step in the formation of ammonia. The presence of hydrogen peroxide we note has now been observed by Prof. Taylor. On the other hand, from the Princeton communications we gather that they incline to the view that the processes involve a series of chain reactions in which atoms and unstable groups such as H, C_2H_5, OH play a part, the chains being started by one excited mercury atom.

The second point on which some slight difference of opinion exists lies in the relation of a liquid mercury surface to the progress of these reactions. We agree that the mercury atoms forming part of the liquid are not active in photosensitisation: in fact, the selective action of the light $\lambda 2537$ indicates that the absorbing atoms must be free from all constraints. The divergence in view is therefore concerned rather with the distribution of active mercury vapour in the illuminated system, when reaction is proceeding, than with the fundamental mechanism of the process. In the flow method large rates of reaction are obtainable with a continuous supply of fresh mercury vapour, but in a static system the mercury atoms in the gas phase apparently only preserve their photo-sensitising power for a very short time. Prof. Taylor apparently believes that the liquid mercury serves no other purpose than to supply by evaporation the wastage of mercury atoms in the homogeneous gas phase caused by chemical combination, *e.g.* mercuric oxide. We can confirm this removal in the case of the hydrogen-oxygen combination. Since similar results are obtained for hydrogen and ethylene, chemical removal may not be the only method by which mercury atoms lose their photo-sensitising powers.

This removal or loss of potential activity must proceed so rapidly that after but a short period of illumination the gas phase is almost devoid of active mercury atoms, and practically all the chemical action is confined, at high gas pressures at any rate, to a thin layer in close proximity to the liquid mercury.

Finally, one small point remains. From the Princeton letter it would appear that these various reactions were discovered there and that, after publication of their results, work was commenced at Cambridge on the same lines. Without the least intention of detracting from the interest and value of the communications from Prof. Taylor, to whom we are indebted for the suggestion of employing a water-cooled arc, we must affirm that neither of these conclusions can be considered as quite correct. Franck and his co-workers may well be claimed as the discoverers of these reactions. Whilst it is true that our first note on our experimental work was contained in the letter referred to above, the apparatus had been constructed for us by the Thermal Syndicate in 1924 for the purpose of investigating these very reactions. Our early experiments were extremely unsatisfactory owing to the weakness of the resonance line obtained with air-cooled mercury arcs, and it is to Prof. Taylor that we are indebted for the suggestion of water-cooling. We may add for the information of the many other workers in this interesting field that the employment of an electromagnet in addition to water-cooling, as suggested by Prof. R. W. Wood, leads to a very considerable augmentation in intensity of the resonance light.

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HERBERT S. HIRST.
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Cambridge.

The Subjective Analysis of Musical Tone.

EVERY one who has attempted to analyse a musical sound by the unaided ear and has acquired some experience at such work will recognise the peculiar nature of the difficulties met with. The first stage is, of course, to learn to concentrate attention on the particular partial sound sought to be recognised, and this is greatly assisted by previously sounding a note of the same pitch and firmly fixing it in the memory, as recommended by Helmholtz in his "Sensations of Tone." But even after one has acquired this habit of attention and has had years of practice and experience in acoustical work, the difficulty is only diminished and is not removed, as is shown by the fact that one may fail in some cases to distinguish a partial even if it be present, and that the use of a resonator is always a great advantage.

Helmholtz, in a chapter on the subject in his "Sensations of Tone," has discussed the difficulties experienced in the subjective analysis of sound at great length, and considers them to be the result of a natural tendency to fix attention on the synthetic rather than on the analytic characters of a compound sensation. This explanation is psychological rather than physical. That it does not go to the root of the matter is shown by a fact which Helmholtz himself mentions, namely, that it is easier to hear the unevenly numbered partials than the evenly numbered ones; this suggests that we should seek for a physical and mechanical explanation rather than a psychological one. Further, it is possible to work under conditions which eliminate any explanation of the difficulty of subjective analysis as due to lack of attention. When the observer has carefully prepared himself, as indicated above, *immediately* before an observation is made and his faculty of attention is at its highest level, he succeeds in observing the partial only in certain cases and not in others. From this, one may reasonably infer that the power of discrimination is limited chiefly by circumstances depending on the physical character of the sound and of the auditory mechanism of the ear, rather than by factors dependent on nervous perception.

Some observations recently made by me indicate that the difficulty felt in the subjective analysis of musical tone arises mainly, if not entirely, from the phenomenon of the masking of pure tones of higher pitch by those of lower pitch discovered by A. M. Mayer (*Phil. Mag.*, **2**, 500, 1876), whose results have more recently been confirmed and extended by R. L. Wegel and C. E. Lane (*Physical Review*, **23**, 266, 1924). Mayer discovered that sounds which are of considerable intensity when heard by themselves are liable to be weakened and even completely obliterated by graver sounds of sufficient force. The surprising character of this phenomenon must be experienced to be fully appreciated. That the auditory masking of pure tones of high pitch by those of lower pitch is the explanation of the difficulty felt in the subjective analysis of musical tone may be shown by simple experiments with a monochord. The observer selects a particular partial, say the 5th, for examination. By gently touching a node of this partial with one finger, and plucking the string repeatedly with

another finger, the attention of the ear is fixed on the pitch of this partial. The damping finger is then removed, and the string is plucked sharply at a point not far from the end to elicit the full series of partials. The observer listens carefully for the 5th partial for a second or so, and then touches the string exactly at its node so as to damp out all the partials lower than the 5th. The 5th partial then sings out, and though theoretically its intensity should have been the same, actually a large *apparent* increase of intensity is usually perceived. The sound of the 5th partial, previously masked by the sound of the graver partials, asserts itself with vehemence when they are removed.

A further confirmation of these ideas is furnished by studies of the manner in which the audibility of the upper partials alters when the absolute intensity of the sound or its quality is varied. These details are reserved for consideration in a forthcoming paper.

C. V. RAMAN.

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Calcutta, India,
January 27.

Intensification of the Metallic Image in Gerlach and Stern's Magnetic Experiments.

IN the course of some attempts to measure the magnetic moment of the cadmium atom by a slight modification of Gerlach and Stern's original arrangement, a new method of intensifying the effect of a deposit of a very small number of metallic atoms on glass has been used, which although perhaps rather obvious has not, so far as I can ascertain, been employed for this purpose before. In Gerlach and Stern's first experiments on the silver atom a chemical method of rendering the deposit of atoms on the glass plate visible was used. In their later experiments on other metals it was found that in certain cases the deposit was visible without intensification, but in others it had to be developed by the same means. It is, however, plain that the use of comparatively huge quantities of liquid when dealing with a metallic deposit which may be at the most on the average only one molecule thick is dangerous, as solution of the deposit might easily occur. The method now to be described avoids this difficulty and is also probably easier to work. It depends on the fact that, while cadmium vapour at low pressures will not condense on a clean glass surface at ordinary temperatures, it does so readily at liquid air temperature. If, however, the smallest deposit of cadmium is already present on the glass, the vapour will condense on it at ordinary air temperature, quickly forming a visible deposit.

This phenomenon was originally discovered by Langmuir. He showed that by its use it was possible to obtain a visible deposit if only one cadmium atom per 3000 surface molecules of the glass was present. It is accordingly eminently suitable for our purpose. During the course of an experiment, the bottom of the glass flask on which the cadmium atoms impinge after passing through the magnetic field is immersed in liquid air. At the end of the experiment, to intensify the cadmium image, it is only necessary to remove the liquid air, allow the glass vessel to attain air temperature, and then evaporate a small quantity of cadmium inside the vessel by suitable means. The cadmium vapour will now only condense on the glass surface which has already a small trace of cadmium on it, and it has been found that a visible deposit quickly forms if any such trace is present. Blank experiments have also shown that if there is no cadmium originally present on the glass, no deposit will form. The pressure of the developing cadmium vapour must not be raised too high, as if this is done it may in certain circumstances condense on clean glass. In practice, however, it fortunately does not seem very easy to attain this state, especially if any metal objects are present in the vacuum, as the cadmium will readily condense on them, thus quickly lowering the pressure.

This method of intensifying small metallic deposits on glass can also be used in the cases of the other more volatile metals such as zinc and magnesium. It is also perhaps indirectly applicable to metals such as copper, which condense on glass at air temperature, as my experiments seem to show that cadmium vapour will condense on most metals at air temperature. Whether, however, a very few atoms of another metal will cause the cadmium vapour to condense I have not yet succeeded in proving, but on the whole the outlook seems hopeful. It is also possible that the presence of an electric charge on the surface of a quartz plate might cause condensation, but again this point has not been tried. However, without entering on these possible applications, it is evident that this method may be of great use in any experiments in which we have to deal with streams of either atoms or molecules the velocity of which is too low to affect a photographic plate, and the presence of which it is accordingly very hard to detect.

J. H. J. POOLE.

Physical Laboratory,
Trinity College, Dublin,
February 20.

Greenland or Polar Front?

No meteorologist could be less disposed than myself to underrate the importance of Greenland as a *factor* in determining the characteristic circulation over the North Atlantic Ocean, but I challenge the extravagant contention that cyclonic circulation, which is an integral part of the general circulation, depends *entirely* upon the "katabatic" operations of a relatively small and accidental feature in the configuration of the northern hemisphere like Greenland. To contend that the analogous Pacific centre of cyclonic activity, scarcely less intense than the Atlantic, is nourished by the same katabatic action of Greenland's ice-dome is surely out of the question.

Owing to pressure on space I cannot deal in any detail with the points raised in Prof. Hobb's letter to NATURE of February 13, but will briefly indicate the general line of reply. First of all, the discrepancy between the fact of relatively high pressure over the North Pole and the fact that the *Fram*, in the course of her drift in 1895 along the 85th parallel in the European sector of the Arctic, experienced a slight, 10 per cent, excess of southerly over northerly winds, can be reconciled by a closer study of Mohn's isobaric charts, which show a shallow elongation of the Icelandic pressure minimum north-eastwards towards Spitsbergen. With the trend of the isobars in this particular sector the slight excess of southerly winds recognised by Mohn himself is quite consistent. But the major fact of the existence at all seasons of an "Arctic Wind Divide," shown by Mohn to lie across the polar basin between the Atlantic and Pacific minima, means that in the day-to-day changes there must be many occasions when air drains southwards over Europe whether reinforced from Greenland or not; and I am sure that any British weather forecaster will bear me out that there *are* many such occasions.

Secondly, the monthly distribution of the fog-frequency shows that only June, July, August, and September during the voyage of the *Fram* could in

any sense be called foggy, the other eight months being, either absolutely or nearly, fogless ("Scientific Results of *Fram* Expedition," 1893–96, vol. 6, p. 572). But these fog statistics which Prof. Hobbs tries to turn in his favour have really little bearing on the argument at all, inasmuch as fog can exist at temperatures far below freezing; and, in any case, if fog-laden air moved outwards from the polar basin into warmer latitudes the moisture would soon be dissipated and the air become in perfect condition to form discontinuities with warm humid equatorial air along the polar front.

Thirdly, Prof. Hobbs is incorrect in underestimating the cold of the North Pole in winter, as Mohn's isothermal charts should convince him. The Arctic Ocean in its outer portions is milder than the inner polar basin, and the fact referred to by Prof. Hobbs, that along the Arctic shores of Siberia and Canada southerly winds in winter are colder than northerly, is in accordance with the principle lately formulated by Dr. C. H. Pollog of Munich, that where there is a sudden transition from land-ice to sea-ice, the air over the latter is warmer because heat is conducted upwards through the ice from the unfrozen water beneath (*Mitt. Geog. Gesell. München*, vol. 27, No. 2, 1924).

L. C. W. BONACINA.

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February 19.

Parasitism of the Dodder.

THE paragraph on Dr. Thomson's interesting work (1925) in NATURE of February 6, p. 210, contains a reference to the results of "earlier observers" which I cannot pass without comment.

Thomson found no phloem in the haustorium of Cuscuta, either in the shaft or in the brush of hyphæ; and no special connexion to the phloem of the host, corresponding with the xylem connexions. But Peirce (1893) described and figured both xylem and phloem in the shaft of the haustorium. This phloem I also found (1911), and Zender, who is not here, as the writer of the note states, in complete agreement with Thomson, also refers to phloem that is "only found in the primary portion" of the sucker (*Inst. de Bot. Genève*, 1924, p. 9). This phloem is small in amount; the sieve tubes are rather short, but quite typical and like those in the main stem of Cuscuta. Peirce and I cannot have differed in our descriptions of the position of the phloem in the shaft, as I did not attempt to describe the anatomical distribution of the tissues either of the main stem or of the shaft of the haustorium.

My work concerned mainly not the above typical phloem in the shaft but the strings of short sieve tubes in the distal part of the haustorium of Cuscuta. Here there are no elongated sieve tubes with well-bored-out sieve plates. This part of the haustorium is formed from the brush of hairs or 'hyphæ' which originate from the tip and sometimes from the sides of the haustorium proper. Thomson and others before him have described the formation of strings of short xylem elements from some of these invading hyphæ. I find similar strings of short phloem elements (perhaps better called sieve elements than sieve tubes) developed from other of the invading hyphæ, nearer the periphery of the brush. There is no possibility of regarding these elements as other than phloem, as there are well-defined sieve areas in their walls; one cannot mistake a typical sieve area properly stained by the safranin and London blue method, each deep red string surrounded by its blue callus rod. The method cannot be used with material which has been in alcohol, and histological work of this kind requires, of course, very high magnifications and critical illumination.

Just as, where a 'hypha' becomes attached to a xylem element of the host, the cell walls of the hypha become lignified, so in a hypha which is attached to a host sieve tube the division walls of the hypha develop sieve areas. These attachments do not appear to be so numerous as those in the xylem, but I found them quite as definite in the species I studied as did Zender. The wall of the hyphal tip disappears and the naked protoplasm is applied to the host sieve plate. The further very elaborate behaviour of the protoplasm inside the cavity of the host sieve tube, which is described by Zender, has not been seen by me.

I have explained that the statement that Peirce and I are "not in agreement as to the position of the phloem" is based on a misapprehension. I hope I have made it clear that the evidence of independent observers renders the assertion that "the earlier observers . . . were in error in reporting its presence" somewhat hasty, especially as it is not possible to judge of Dr. Thomson's methods.

M. G. THODAY(SYKES).

University College, Bangor,
February 20.

Ozone and the Upper Atmosphere.

A BENIGHTED chemist, I listened with awe and interest to the discussion by the physicists on the electrical state of the upper atmosphere, on March 4, at the Royal Society. Apparently they were not quite at home above cloudland. The blessed word "ionisation" played a great part but did not seem to mean more than "conducting." Ozone was referred to with respect. Perhaps a chemist may be allowed to suggest a way in which it might serve as an "accumulator."

Those who attended the late Sir James Dewar's wonderful demonstrations at the Royal Institution may have witnessed the production of ozone, at the surface of liquid and even of solid oxygen, under the influence of ultra-violet radiation and will often have seen the glow of its decadence (to oxygen). Presumably, ozone is not the direct or immediate product of the action of such radiation upon mere oxygen but is formed *reversibly, in a complex electrolytic system*, in which oxygen is associated not only with a determinant ($\epsilon\delta$) but also with a catalyst (κ)—as the outcome of a series of interactions. I may refer to my article on "Catalysis and Oxidation," in NATURE of August 22, 1925, p. 294, where I have discussed the process.

The necessary conditions may well prevail in the upper atmosphere—they must, in fact, if it be formed at all. Let it be assumed then, that the condition be such, that the change of oxygen into ozone is not greatly encouraged—that it is difficult, on the whole, a large quantity being produced, during daylight, only because of the intensity of the solar effect. Then it equally follows, that the reverse action will take place only slowly and the accumulated energy be let down (electrically) only slowly, so covering the period of darkness, perhaps.

It may be dangerous for the mere chemist to put foot down where the angels tread but lightly: still, these are matters to which we have paid some attention and our intervention may not be altogether foolish—the more if it lead some day to better appreciation of the philosophy of dirt, at present unnoticed by the physicist.

HENRY E. ARMSTRONG.

Weather Prediction from Observation of Cloudlets.

I WAS greatly interested in Mr. C. D. Stewart's letter (NATURE, February 20, p. 270) which expresses my meaning exactly. But I do not know why he should think I regard "as a general method of prediction one which is applicable only in particular conditions, namely, those of showery uncertain weather, and, it may be, in particular localities; and also, to some extent, to the lack of precise definition of the type of cloud to be observed"—*i.e.* "the smallest and thinnest fragment of cloud that can be clearly isolated." Captain Cave mentioned some exceptions, and I others. Before the rains in India, I have often seen big clouds form and then dissolve without dropping moisture. I wrote "only for the man who, perhaps knowing nothing about scientific meteorology, desires to ascertain for himself the kind of weather he is likely to experience during the next few hours." Such a one is not likely to examine the sky when it has settled to be wet or fair. Nevertheless, even during a downpour, if he is able to isolate a little dark cloudlet under the grey pall and see it dissolve, he may, even then, predict the early probability of finer weather with fair safety. Not long ago I arranged a game of golf under such conditions. I also wrote, "The nearer the cloudlet (the lower it is) the more closely do the conditions in which it floats approximate to those on the ground, and the more easily may it be observed; and, therefore, the more confident may be the prediction." Of course, therefore, I referred to 'doubtful conditions' and to the 'scud' which then occurs. My eyes, at any rate, cannot make sure of cloudlets very high in the sky, for, because of the distance, what seem to be cloudlets may be considerable clouds. Moreover, these high clouds are so remote, and the conditions in which they float so unlike those in which I stand, that observation of them can be of little utility for weather prediction. On the other hand, observation of the fact that the sky is clear for all the distance up to them gives me an indication of the continuance of fine weather. G. ARCHDALL REID.

March 9.

Ancient Coins from Pondoland.

IN Prof. Raymond Dart's article in NATURE, March 21, 1925, p. 425, reference is made to a find of ancient coins which Prof. Dart states was made in Pondoland by Mr. Cook about fifty years ago (p. 427).

At considerable trouble I have traced these coins, and find that there are several very peculiar circumstances regarding them, which I consider throw a completely new light on the whole question.

The coins fall into three distinct groups:

(1) Ptolemaic.
(2) Late Roman.
(3) Byzantine.

Groups (1) and (2) have been accurately described by Prof. Dart. Group (3) consists of two much-defaced coins—a small copper of Constantine II. and a large copper of John I. Now, since this last is the latest coin in the find, and it cannot be given an earlier date than A.D. 969, and since it is so worn that the obverse is completely obliterated, I suggest that the earliest possible date for the burial of the horde would be about a century later, say A.D. 1070, by which date the Arabs were established at Sofala and were probably trading as far south as Inhambane.

Roman coins still, I believe, pass in the Peninsula, and it is quite possible that all the pieces in the find were imported by Arabs.

One most striking feature about the whole thing is the amount of wear shown by the different groups. The Ptolemaic coins are in fair condition, many of the late Roman group are almost in mint state, though others are more or less worn. The Byzantine coins, on the other hand, are so worn that I had considerable difficulty in identifying them. But when it is born in mind that the horde covers from first to last a period of more than twelve and a half centuries, one ceases to be surprised at anything.

J. F. SCHOFIELD.

P.O., Durban, February 16.

Uncertainty.

MY exuberant friend Prof. Armstrong (NATURE, Feb. 6, p. 195) seems uncertain about many things for which there is good evidence, and to glory in his uncertainty; but there is no merit in uncertainty in itself: it is just as much a sign of crankiness to reject good evidence as it is to accept bad. His attitude prevents his own enjoyment of the great discoveries of the present generation, because they do not dance to the *drone* of his water bagpipe—a serviceable instrument but in danger of becoming a fetish. I can only suppose that in his educational policy he has so long refrained from dogmatic instruction, and so persistently advocated other methods as more truly educative, that now he can scarcely recognise a true doctrine when he encounters it.

Yet the object of science is truth, not hesitating ignorance; and though caution is admirable it may degenerate into obscurantism. Prof. Armstrong would probably have been on the side of the orthodox in the days of Galileo, and might now justify himself by relativity; but progress and truth were on the side of Galileo nevertheless, however crude his formula. A pioneer is usually ahead of orthodoxy.

In his letter, Prof. Armstrong virtually asks me to withdraw from the Royal Society because I have gradually reached complete conviction on a subject of age-long debate and uncertainty, and have said so: while as yet the majority of Fellows still doubt. I can promise that when such a request is made officially I will resign promptly without giving trouble; but I will not refrain from stating what I firmly conceive to be the truth, as demonstrated by clear and repeated evidence, whenever such statement seems called for. If I had any uncertainty about it I would say so, but it is madness to be false to truth—no matter what the penalty may be. OLIVER LODGE.

Italy, February 10.

The Constitution of Glauconite.

IN a recent paper (*Rec. Geol. Surv. India*, 1925, vol. 58, pp. 330-337) Dr. L. L. Fermor proposes for glauconite a formula analogous with that already given by Clarke, which I had regarded as inadmissible (*Min. Mag.* 1922, vol. 19, pp. 330-333). Dr. Fermor's conclusion is based on the fact that the mean of the glauconite analyses agrees with this formula. But, as he himself shows, the composition varies widely. Indeed, it would be equally logical to derive a rational formula from the mean of the published analyses of plagioclase. Dr. Fermor concludes: "It must be pointed out that . . . the formulæ given are based on averages, and that many of the individual analyses depart considerably from these formulæ." It was exactly for this reason that I felt compelled to reject the formulæ in question in favour of one which agrees almost perfectly with nine out of the twelve analyses available for this rather obscure mineral. A. F. HALLIMOND.

49 Cromwell Avenue, N.6, March 1.

The Electrical State of the Upper Atmosphere.[1]

By Prof. S. CHAPMAN, F.R.S.

DIRECT simultaneous measures of temperature and pressure up to 25 kilometres, by sounding balloons, give complete information as to the variation of pressure, density, and temperature over this range. The temperature falls in the first 10 kilometres from 285° absolute to 220°, and then remains constant up to 25 or 30 kilometres. The temperature above this height was a subject merely for speculation until Lindemann and Dobson published their theory and discussion of meteors. They concluded that the temperature remains at 220° up to 50 or 60 kilometres, after which it rises (perhaps rather rapidly) to about 300°, which is its value up to about 140 kilometres; thus at this height the air is warmer than near the ground. This rise of temperature is inferred from the estimated densities of the air between 60 and 150 kilometres, the density at 100 km. being more than ten times as great as it would be if the temperature had remained at 220°. Higher up the difference between the estimated density and that calculated on the latter assumption is still greater. The mean free molecular path, calculated on the assumption that the air is mainly nitrogen over this range, increases from about 1 cm. at 90 km. to about 10 cm. at 130 km.

Above this level, even if the temperature were fully known, the pressure and density could not be inferred without a knowledge of the composition, as to which, at present, there is much uncertainty. In the lowest 10 km. the air is thoroughly mixed by winds, but at some height H in the stratosphere diffusive separation may begin, the heavier constituents settling out so that the proportion of the lighter constituents steadily increases upwards. Up to about 100 km. the pressure and density do not depend much on H, but the composition is largely affected by it: $H=20$ km. and $H=50$ km. would give very different results. If we take $H=20$ km. as a likely value, nitrogen is still the main constituent at 100 km., its molecules being about fifty times as numerous as those of oxygen and helium. Above 150 km. there will be very little oxygen, and such lighter gases as are present (possibly helium and hydrogen) should be the main constituents.

The question of the composition at 90 km. or 100 km. is of interest in connexion with the auroral spectrum. The conditions there, in any case, are by no means those of a large excess of helium, as supposed by McLennan and Shrum in their discussion of the auroral spectrum. The auroral spectrum shows that nitrogen and oxygen (accepting McLennan and Shrum's identification of the green auroral line) are present at auroral heights. At the lower auroral levels this is quite in accordance with expectation, but auroræ are also said to appear at heights of 500 km. The evidence for this, given by Störmer and Vegard, seems quite satisfactory. The presence of nitrogen and oxygen at such levels seems explicable only on the assumption that the atmosphere is partly supported at great heights by electrical forces, such as were discussed by Atkinson in his criticism of Vegard's theory of the aurora. If such electrical forces operate, either permanently or merely temporarily when auroræ occur, they may have the effect of allowing the lighter gases, hydrogen and helium, to escape altogether: a suggestion which would, if substantiated, explain the rather remarkable absence of hydrogen and helium lines from the auroral spectrum.

Another matter of interest concerning the upper atmosphere is the highly conducting layer, the existence of which is indicated by the diurnal magnetic variation, according to the theory of Balfour Stewart and Schuster. The conductivity of the layer must be of the order 3×10^{-6}, which is so great as to be difficult to explain. But recently Appleton and Barnett have assigned 10^5 as a lower limit to the number of electrons per c.c. at the level, about 80 km. high, at which wireless waves are reflected at night. From this it appears that the specific conductivity must be 10^{-14} c.g.s. units at this height; a layer having this specific conductivity would require to be 3000 km. thick to account for the total conductivity 3×10^{-6}. This excessive thickness can be reduced to a more reasonable figure, however, if the ionisation by day is several times as great as by night (as the diurnal magnetic variations themselves indicate), and if allowance is made for the increase in the mean free path above 100 km. The downward extension of the conducting layer, by day, into regions where the mean free path is less than at 100 km., may not add very much to the total conductivity. There seems no longer, however, any insuperable difficulty in supposing the thickness of the conducting layer to be of the order of 200 or 300 km., without assuming an excessive specific conductivity.

By Sir HENRY JACKSON, G.C.B., F.R.S.

Radio communications have never been noted for their consistency. At first this was attributed to atmospheric disturbances and to the low energy emitted, with reception by unreliable apparatus, but when the power radiated was greatly increased and modern appliances of great sensitivity and constancy were brought into daily use, it was still found that the intensity of the received signals from any station at long distances was variable at times, though it was seldom if ever that signals were entirely lost at the stations designed to receive them. When directional wireless was brought into use, it was found that, in addition to variable strength of signals, great variations were experienced at night in the bearings of the observed stations.

The cause of these variations in intensity and direction have been very systematically investigated during the last five years by the International Union of Scientific Radiotelegraphy and others, and in Great Britain especially by the Radio Research Board; many hundreds of thousands of observations have been made by skilled observers with suitable and reliable apparatus, and the results have been carefully analysed to try to find a law which could explain the reason of the variations.

The analysis showed plainly that both types of variations were subject to seasonal, diurnal, and 'untraced' effects, and that the altitude of the sun had evidently a great effect on them, but nothing more

[1] Contributions to a discussion at the Royal Society on March 4.

definite than this was obtained. However, in considering the effects of electromagnetic waves of radio frequency on a wireless receiver, it was deduced that the causes of variation in signal strength and direction could all be accounted for if two or more waves from the same source and of the same frequency reached the receiver simultaneously but at different phases of their oscillations, and for some directional variations, if one of them was polarised in a different plane from the others.

When shorter waves than those employed (until about four years ago) came into general use for broadcasting and also for communications, another variation came prominently to notice; namely, the rapid variations in signal strength called 'fading,' though probably this is only an exaggeration of the first-mentioned effect; and also the fact that although signals may be received at short and also at long distances, there are intermediate zones in which no signals on the wave-length in use can be received at all, or only very occasionally. The Kennelly-Heaviside layer theory had not been lost sight of in the investigations already referred to, and the most recent theories on this were studied and experiments carried out to try if deflexions and conduction by some such agency as this layer could be measured. This has been successfully accomplished by several observers using different methods, and the collective results they have obtained, and independently published, I think, go far towards establishing the validity of the idea. Before a decision can be given, however, it is necessary to know what this deflecting layer must be able to do to meet the calls that are now being made upon it to account for all the varying results that are now observed in radio communications which cannot be attributed to locality, to the apparatus in use, or to the personnel operating it. I will briefly give some typical examples of these, with short waves; those with long waves and directional apparatus have been well known for a long time.

The quantitative effect of the earth's attenuation of moderate and long wave-lengths passing over its surface is not accurately known, but it varies as some power of their length. For high power and long wave stations, such as Rugby, Nauen, and others of this type, it seems possible that this effect is small, and the wave may cover the whole of the earth's surface, and to a lesser extent with shorter waves with less radiated energy; the layer in this case would act principally as a deflector of the waves downwards. But in the case of the very short waves, say less than 50 metres in length, experiments show they are rapidly attenuated by the earth, and not received directly at any great distance from the transmitter.

With Admiralty permission, I will quote a very recent example showing this, namely, with a wave of 12 metres in trials now being carried out under carefully organised conditions and supervision. A ship starting on a long voyage transmitted this wave according to programme every 4 hours for 12 minutes. The signals were regularly received with diminishing clarity up to 100 miles of one of the shore stations, then lost until the ship was 1100 miles off, when they were again received for some days intermittently, and again at about 3500 to 4000 miles, lost again, and then received again with perfect clarity at 6000 miles.

Now this is a case in which the phase difference I previously mentioned cannot well have been the cause, for the ship on its passage either directly or obliquely away from the receiving station, would pass through a wave-length and any of its various phases in about 2 seconds, and in the 12-minute period of transmission would have every chance of changing any phase difference between two waves arriving at different angles.

The small loss (if any) of signal strength at 6000 miles is very noticeable, and from personal observations on four other wave-lengths from this ship, emitted every 4 hours according to programme, I have been able to compare their strength and behaviour with others of the same wave-length emitted by two other Admiralty shore stations similarly equipped, at distances of 90 and 1100 miles respectively. The three stations send consecutively, the ship coming in between the other two, the shore stations. The signals from the nearest station are, on the average, decidedly weaker than those from that at 1100 miles. Those from the ship vary, sometimes being very weak, at other times very strong, but at the extreme distance reached, 6500 miles, they were noticeably weaker than when under 5000 miles, at which distance I have received them without Æ or E. Fading of these signals is also noticed, during both day and night, from all three stations, but is more irregular and frequent from the ship at great distances than from the other two (30 per cent. from ship, 22 per cent. from shore stations: 300 observations); but generally, when one of the stations fades, the others do as well. Reception seems better from all three stations when they are transmitting in darkness than in daylight, especially the one at 90 miles on the longest of the wave-lengths. Occasionally double fading is noticeable, that is, a short period of small amplitude, superposed on one of considerable period with large amplitude, *e.g.* 10 seconds and 2 minutes, with amplitudes of 2 to 4, and 0 to 6 in the usual scale of telephone intensities.

At other times, from the ship at long distances, the dots if made fast disappear or are very faint, as if it took an appreciable time to build up sufficient intensity to start the signal on its way. Occasionally long dashes from the ship at long distances are distorted into an audible wave of varying pitch and intensity. Communication on two of these short waves seems to be reliable during some part of the day to the extreme distance the ship reached.

With a longer wave (nearing 100 metres), signals were maintained at night up to 1000 miles, then lost and only received twice in the remainder of the voyage though transmitted 6 times daily.

These results indicate that the layer must exercise but little attenuation on short waves, which show little loss of energy in their passage along it, but that it appears to deflect down some wave-lengths at various places, and others possibly at all points over the earth, and that two or more waves must sometimes reach the receiver in varying phases to account for the extraordinary fading effects that are so often noticed with them.

Is a layer that will fulfil all these functions a physical possibility, is the question which requires an answer; *if not*, what is the cause of these variations?

By Dr. W. H. ECCLES, F.R.S.

Preceding speakers having marshalled the available evidence for the Heaviside layer, it may be most useful for me, while agreeing broadly with the conclusions drawn from that evidence, to refer to some other points of view and other agencies. For example, in connexion with wireless phenomena at short distances from the transmitting station, the diminution of the density of the air with increase of height, which causes the lower atmosphere to act as a prism with its base on the ground, taken together with diffraction, must be remembered. Consider a source from which electric waves of length 20 metres, 600 metres, and 20,000 metres are being simultaneously emitted, and consider especially the rays emitted horizontally. Up to distances of 100 kilometres, all these waves can be detected by an ordinary aerial—beyond that distance the 20-metre waves vanish but the others remain perceptible. This, I suggest, indicates diffraction of the longer waves, as is supported by the fact that an aerial on a high mast or hill can detect short waves passing overhead like the beam of a searchlight. I want to suggest also that variations of signal strength at these short distances may be due to variations in or movements of the lower atmosphere. (The well-known vertical oscillations of pilot balloons at a height of 10 kilometres suggest movements of the air.)

Beyond 100 kilometres, in daylight, the 20-metre signals are completely lost, the others are continuously perceptible. It has been found (*e.g.* by Hollingworth) that after falling off with distance, the long wave signals increase up to a distance of 400 kilometres. Here it seems that the ionised atmosphere is aiding diffraction and the prismatic action. At 700 kilometres the lost 20-metre signals reappear, though the tangent plane through the source passes 100 kilometres above. This suggests that the horizontal rays from the source have followed a trajectory perhaps only 30 kilometres in height at its apex and now graze the ground again. Rays starting with an upward angle from the source would, on this view, descend to earth at greater distances and perhaps at grazing incidence. These possibilities have caused me to remain unconvinced by Prof. Appleton's use of the 'skip' of short waves to deduce the maximum electron density at a sharply defined Heaviside surface nearly 100 kilometres high. This possible explanation by the aid of non-intersecting and gradually bending trajectories of varying height demands considerable thickness in the Heaviside layer. It is perhaps in disaccord with Sir Joseph Larmor's recent review of an old theory; for he appears to deny the possibility of bending in the lower atmosphere and also supports the 'whispering gallery' view, which assumes the formation of a thin caustic layer of radiation in the sky.

The preceding remarks refer to daytime propagation. At night the 20-metre waves make a larger skip, say 4000 miles, and are picked up at all distances beyond; the 600-metre waves are picked up at all distances to 5000 miles, and the 20,000-metre waves go everywhere. Measurements are available on the medium wavelengths and show that in the great fluctuations of strength beyond 2000 miles, the maximum may exceed the strength calculated for a perfectly conducting flat earth with a non-absorbing atmosphere. This seems one of the best proofs of the existence of the Heaviside layer, for otherwise we must believe that the earth is flat.

The Glaciers of Savoy.

AN important and unusually interesting report, of more than two hundred pages, on the glaciers of Savoy, especially those of the Mont Blanc "massif," the Tarantaise Alps, and those of Haut Maurienne, has been recently issued by the Ministère de l'Agriculture, Département (Direction Générale) des Eaux et Forêts. It is entitled "Études glaciologiques," and represents most valuable results, from the beginning of the century down to the year 1920, obtained by a special "Commission glaciaire de Savoie," composed of high officers of the Département des Eaux et Forêts, aided by specially appointed geologists, geodesy experts, M. Tairraz, the well-known Alpine photographer of Chamonix, and the late M. Joseph Vallot of the Mont Blanc observatory. In spite of the unavoidable reduction of the staff during the War, several members indeed being among the fatal casualties, the work was continued throughout the terrible four years 1914–1918.

The results achieved consist in annual, and in some important cases monthly, measurements of the lengths of the glaciers, determinations of their relative movements at the sides, snouts, upper surfaces, beds, and various parts of their width, estimations of their depths, total volumes, amounts of water they discharge at their lower ends, their gain by snowfalls, and their loss by solar fusion. In addition, a careful record has been compiled of all catastrophic occurrences, such as exceptional avalanches, bursts of lakes and water pockets, earth-quakes and -tremors which have resulted in avalanches or alterations of beds and configurations; and to render this portion of the report still more interesting, historical data have been added concerning all known happenings of this character since the year 1800.

During the last ten years (1910–1920) of the period dealt with, the glaciers on the Savoy side of the chain of Mont Blanc have in general been advancing. For example, the Glacier du Tour reached its minimum length and showed a tendency to grow in 1909, and although there was a slight set-back in 1910 due to special solar activity, in 1911 a distinct move forwards was made, and has continued without interruption up to the end of the report period, 1920. The progressive movement was only communicated to the Argentière glacier four years later, in 1913, as regards maximum length, but even from 1911 there was a growth of several metres a year on the right flank of the snout, until the total length became at last affected in 1913, and the elongation became more and more marked until in 1920 the glacier end moved forwards 40 metres.

The Mer de Glace was difficult to investigate, as its end had been hidden, by its retrogression, in an inaccessible ravine. But from such observations as could be got of the snout, and especially from those on the glacier proper above the Montanvert, it is clear

that there has been a forward movement occurring, ever since 1916 with certainty, and probably from 1914. From further observations of the higher portions known as the Glacier du Géant, and of its tributaries, the Glaciers de Leschaux and Talèfre, it is shown that there has been a very considerable increase in the bulk of the glacier, an augmentation of thickness having been observed ever since 1913.

The Glacier des Bossons, the central glacier of Mont Blanc itself, offers the most interesting results, for owing to the snout being so readily accessible by the exceptional advance of the glacier on to the very meadows of the valley of Chamonix, it has been found possible since March 1917 to obtain monthly records of progress. They show that the glacier does not advance *en bloc*, but with a waddling motion, sometimes one side, sometimes the other, and sometimes the middle of the front, moving most during the month, like a heavy man walking in such a manner as to advance each shoulder alternately. Moreover, in summer the left of the front moved, on the whole, the more rapidly, and in spring and winter the right; the former is due to greater melting of the ice on the side showing least motion, and the latter to the form of the glacier bed, the line of maximum movement of a sinuous glacier being, as is well known, on the convex side of the central line of the glacier, that is, nearer to the concave border. Since the year 1910 the annual march of this glacier has varied from 33 metres during the first year (July 1910–July 1911) to 51 metres in 1917, from which it slowed down to 23 metres in 1920. The advance was greatest in spring, then next in summer, then in winter, and slowest in autumn. The mean values for the four years 1917–1920 were 11 metres in spring, 5·2 metres in summer, 5·1 metres in winter, and 1·7 metres in autumn. In spring there is extra pressure from above, owing to accretions from the névé of the higher snowfields, undiminished by melting, as the spring sun has first to melt the fresh winter snow. But in summer the movement is diminished by real fusion and thereby loss of solid ice, combined with reduced pressure from above, the weight of the winter snow having been removed by melting.

The Glacier de Bionnassay has been advancing since the year 1916 with certainty, and probably since 1914. The last measurements had been in 1913, and between then and 1916 the front of the glacier had advanced 30 metres. It continued at this rate more or less steadily down to the report period 1920.

Thus it is clear that the glaciers of the French Savoy side of the chain of Mont Blanc have all advanced, the amount being accentuated in the cases of the steeper glaciers, Le Tour, Argentière, and Les Bossons. In the more slowly moving cases, the Mer de Glace and the Trélatête glacier, the increase has been chiefly one of bulk and of thickness.

The glaciers of the Tarantaise, and other Savoy Alps, which are much influenced by the Lombardian winds of the valley of the Po, have either advanced to a less amount than those of Mont Blanc, or have retrogressed. The latter, for example, has been the case with the Glacier de la Vache (Source de l'Isère).

Special reference should be made to the particularly interesting determinations of the thickness of certain glaciers. The late M. Joseph Vallot obtained results on the Mer de Glace, at widely different positions in its course, which varied from one hundred to two hundred metres of solid ice; and he came to the conclusion that the latter figure represents the maximum depth. This estimate is almost exactly confirmed by these later measurements and estimations by the Department des Eaux et Forêts, the opinion being that, if not quite accurate, it errs on the low side.

The observations conclude with some remarkable estimates of the volume of additional ice represented by the advance of these glaciers. The Glacier du Tour has increased per annum between 1911 and 1920 by the amount of eight and a half million cubic metres. The glacier of Argentière has increased in volume by one to three million cubic metres per annum of solid ice; and the Mer de Glace has shown a similar amount of swelling, until in 1920 the exceptional heat caused a slight net loss. The Bossons glacier has enlarged by amounts varying from one-sixth to one-half million cubic metres a year. The glaciers of Bionnassay and Trélatête have gained in volume of solid ice between 1912 and 1920 more than five million and seventeen million cubic metres, corresponding to an increase of thickness of the glaciers of seventeen and six metres respectively.

The French Department des Eaux et Forêts is to be most sincerely congratulated on this magnificent piece of accurate work. It is to be hoped that the observations have been carried on beyond the year 1920 in an equally satisfactory manner, and that they will be continued. It would appear that this is being done, for the writer has several times come on the officers of the department at work during his recent summer visits to the Savoy mountains, both Mont Blanc and the Tarantaise Alps, including one paid this last summer, and has had personal experience of the admirable way in which the measurements are being carried out.

A. E. H. TUTTON.

Obituary.

SIR PHILIP WATTS, K.C.B., F.R.S.

SIR PHILIP WATTS, who died on March 15, was born in May 1846, being thus nearly eighty years of age when he died. He was educated at the Dockyard School at Portsmouth and the Royal School of Naval Architecture, South Kensington, completing his education in 1870. Until 1885 he spent most of his time at the Admiralty on the Naval Constructor's staff, which afterwards became the Royal Corps of Naval Constructors.

During this time Sir Philip was engaged in the design work of the office which then produced such original designs as the *Inflexible* with 24 in. of armour and four 16-in. 80-ton guns; the *Iris and Mercury*, the first all-steel ship and the fastest then produced; the *Polyphemus*, an armoured ram which was almost submerged; and many other original designs. He assisted Mr. Wm. Froude in the classic observations on the behaviour of the battleship *Devastation*, one of the first of the mastless turret ships in H.M. Navy. He took a leading part in the investigations of the *Inflexible* Committee, which was created as the result of doubts expressed as

to the fighting and seaworthy qualities of that ship. He designed the rolling chambers of the *Inflexible*, and went to sea in her to observe the effects of the chambers on rolling.

Sir Philip was thus associated with most of the scientific development of naval architecture at the Admiralty between 1870 and 1885, at which date he began his independent career in charge of the design and construction of warships at Armstrong's works on the Tyne, in which position he remained until 1902, when he accepted the position of Director of Naval Construction at the Admiralty. His active career as warship designer extended for well over half a century, and during this time he was associated with a continuous increase in efficiency and battle power of the many ships for the design of which he was the responsible creator. His reputation stands unrivalled for the quantity and quality of his work. Of the warships which he designed and built when at Armstrongs, the cruisers were the fastest and best armed of their day, and the battleships were the most powerful. Nearly all the warship fighting done by the Japanese victorious fleet in 1894 and 1905 was done in Watts's ships.

When Sir Philip went to the Admiralty, two of the King Edward class of eight battleships had been commenced. He produced designs having much greater gun power, and not inferior in other respects, with the view of building a squadron of eight ships much more powerful than the King Edwards, but My Lords decided to complete the inferior ships. This was discouraging to the man who wanted to give our ships as much gun power as possible. On the appointment of Admiral Fisher as First Sea Lord, however, Sir Philip's chance came, and he had hard work to give Fisher all the guns he wanted. The all-big-gun ship was wanted. Its adoption was approved by the Committee on Warship Design appointed to consider the question, and the Director of Naval Construction produced the complete designs for the Dreadnought type approved by that Committee. Thus, by the energy of Fisher and the skill of Watts, was begun the series of Dreadnoughts and super-Dreadnoughts of which the Grand Fleet was largely composed—which, to adapt the phrase of Mahan, stood between the Germans and the conquest of the world. Watts could not have attained and maintained such a position without a very full knowledge of all that pertains to warships, not only the structure of the ship but also the principles underlying armour, gun and machinery production, and a full appreciation of the strategy and tactics of sea warfare and of the life and ambitions of the great sailors of his time.

Watts was one of the earliest graduates of that school of naval architecture which began in the 'sixties, developed in the 'seventies into the Royal Naval College at Greenwich, and has continued ever since to turn out men of high attainments to fill not only that able Corps of Naval Constructors (over which Sir Philip presided) but also the Royal Naval Engineers, who have so ably assisted in the enormous developments of marine engines which have taken place since the school was founded. Sir Philip, like his predecessors and successors, saw to it that this source of supply of naval constructors and engineers was fully maintained. He assisted in the creation of the professional chairs and the schools of naval architecture in Glasgow, Durham, and Liverpool, from which so many naval architects and marine engineers have graduated and have found scope for their abilities in the ship and engine works of Great Britain.

Sir Philip's great scientific attainments and his practical skill in applying his knowledge were recognised by the Royal Society, of which he was a fellow and vice-president, and by the universities which conferred on him LL.D. and D.Sc. degrees. It was, however, in the Institution of Naval Architects that his work was best known. He contributed many papers of high value and always took an active part on the Council of the Institution. He frequently presided at the council and general meetings, being for many years the senior vice-president. When at Armstrong's he was an enthusiastic territorial gunner and had the rank of Colonel. He was not a great talker in public or private, but all who had the privilege of his friendship will remember him as a generous and genial man with sound common-sense and wide scientific interests, which, combined with a gifted imagination and great courage, enabled him to carry through his important work successfully.

PROF. ERNST EHLERS.

PROF. ERNST EHLERS was born on November 11, 1835, in Lüneburg in the kingdom of Hanover, where his early education, carefully supervised by his father, who was a merchant, was received, and where the ancient buildings and historical surroundings doubtless had an influence on his sensitive mind. His training consisted of a good knowledge of classics, of history, mathematics, French, and chemistry, whilst his natural bent found a congenial field in faunistic works. He then (1857) proceeded southward to the University of Göttingen, where he energetically studied medicine and natural science, two subjects so intimately related, as all history shows, that the efforts of the late Scottish Universities Commission to separate them are vain. Amongst the professors there, none interested him more than W. Keferstein, R. Wagner, and Bödeker. There were comparatively few zoologists of the period who, like Ehlers, entered on their later studies with broad views and a thorough acquaintance with both vertebrate and invertebrate anatomy. It is true in his early days he had not the advantage of a life on the sea-coast and of familiarising himself with marine life from Protozoa to mammals, but he balanced this by his able researches on structure and by his skilful pencil, so that amongst the distinguished zoologists of the period he stands prominently forward.

Ehlers' abilities and natural bent were soon observed by Keferstein, who took the young naturalist with him to Naples and Messina, introducing him to the rich marine fauna there, the joint authors producing a memoir on the Siphonophores. In 1861 he received the degree of M.D. at Göttingen, his thesis being the "Anatomy of *Priapulus caudatus*," the material for which he had obtained from the well-known Japetus Steenstrup of Copenhagen. The same year he was appointed prosector to the Anatomical Institute of Göttingen, and two years later a private tutor in zoology and comparative anatomy.

His association with the leading zoologists of Germany and Austria led Ehlers to select the fine field for

work in the group of the polychæts, so that in an expedition (May–August) to Fiume in the Adriatic, he worked his nets and searched the beach specially for those forms, to the study of which he applied modern methods. A better seaman than his distinguished countryman, Albert Kölliker (who was helpless in the surging English Channel), he was enabled to make full use of his opportunities in these waters. Ehlers began systematic work in the polychæts at a time when—by the labours of Grube, De Quatrefages, Johnston, W. Baird, Agassiz, and others, they were attracting attention everywhere—no less from their beautiful coloration than from their wonderful structure and life-histories; and he resolutely, from first to last, adhered to their elucidation both as regards European and more distant seas.

Ehlers' two early volumes "Die Borstenwürmer," each with about a dozen quarto plates, were by their careful systematic treatment sufficient to lay the foundation of a solid reputation, and they attracted much attention in Great Britain, so that when the results of the *Lightning* and *Porcupine* Expeditions were dealt with, Ehlers was assigned the polychæts dredged below 500 fathoms, and they formed a valuable contribution in the *Zeit. f. w. Zool.* for 1871. It would not be possible to deal minutely with his great labours —even in the polychæts—which added many new genera and species to the group, and brought to light new features in their structure and life-history; for his observations ranged from the fossil forms in the Solenhofen slate to the most recent deep-sea expeditions of his own country and of the Americans, and extended from the Atlantic to the shores of New Zealand, as well as ranging from pole to pole. Some of his memoirs formed quarto volumes of considerable size, and most were finely illustrated, sometimes in colour, by his skilled artist, O. Peters. He was *facile princeps* in the Department in his day, yet he bore himself with perfect modesty and was ever ready to help others. Nor were his labours confined to the polychæts. The gephyreans, tunicates, and Bryozoa on one hand, *Lepidosiren*, the Porbeagle shark, the *chorda dorsalis*, and the anatomy of Manis on the other hand, each became the subject of one or more memoirs—thus demonstrating the versatility of his vigorous mind and his indomitable powers of work.

Ehlers' connexion with the *Zeitschrift für wissenschaftliche Zoologie*, the leading journal of zoology in his country, dates from 1875, when the veterans Von Siebold and Kölliker added him to the staff, and as the seniors passed away he became sole editor —until lately. His entrance into this work was signalised by an increase in the size of the journal, and indeed it occasionally doubled its bulk both as regards memoirs and plates. Yet he did not desert the Göttingen publications, in which many of his contributions appeared afterwards. The name of Ehlers is honoured wherever the science of zoology is known, and he truly wore the sword out instead of letting it rust out, for he held office until he had almost reached his ninety-first year, when release from his labours reached him. His unselfish devotion to zoology moved his friends, at home and abroad, in 1905 to prepare a *Festschrift* in his honour, and the memoirs were published in the *Zeitschrift f. w. Zool.*, and are a sufficient testimony to his fame. Moreover, a second *Festschrift* was in process of arrangement in 1914, but the outbreak of the War put an end to the project. Ehlers thus forms a conspicuous example to all the younger zoologists for his unswerving devotion to his early subjects, his wide and accurate knowledge, his skill with his pencil, and for his arduous and unceasing academic labours. Of him Göttingen may well be proud. W. C. M'INTOSH.

DR. C. V. PIPER.

BY the death, on February 11, of Dr. Charles Vancouver Piper, the United States Department of Agriculture loses a worker of wide reputation and long service. At the time of his death he was in charge of the Office of Forage Crop Investigations, and through his efforts many plants and grasses of much value to American agriculture have been introduced and established in the United States. He was best known to the general public through his work in developing the creeping bent grass for use on golf greens. In 1919 he discovered a particularly useful variety, propagated it by vegetative means, and distributed it throughout the northern section of the United States, where it is now found growing on thousands of golf greens. Dr. Piper was keenly interested in the game, and utilised his knowledge to the full to improve conditions for players everywhere.

Dr. Piper's contributions to the forage and grass industry of practical agriculture were numerous, perhaps the best known being the introduction and establishment of the Sudan grass (from Africa), which is now a very valuable hay and pasture grass in the States. More than one hundred books and papers on agriculture and allied subjects stand to his credit, and he was consulting agricultural editor for the McGraw-Hill Book Company. In his search for new forage plants he travelled widely, spending much time in Japan, China, India, Java, Egypt, the Philippines and Alaska.

Dr. Piper was born at Victoria, B.C., in 1867, took his M.S. degree at Washington in 1892, and remained there as professor of botany until 1903, when he received his appointment to the Agricultural Department at Washington, D.C. He was associated with many societies, serving in 1908-9 as president of the Botanical Society of Washington, and in 1913-14 of the American Society of Agronomy.

WE regret to announce the following deaths:

Dr. William Tufts Brigham, director-emeritus of the Bernice Pauahi Bishop Museum, Honolulu, known for his work on Hawaiian customs, on January 29, aged eighty-four years.

Sir Bradford Leslie, known for his work on bridge design and construction, who studied his profession under Brunel, on March 21, aged ninety-four years.

Dr. William E. Safford, economic botanist for the United States Department of Agriculture, who devoted himself to the study of the plants and plant products of the American aborigines and of the early history of cultivated plants generally, on January 10, aged sixty-six years.

Prof. Sutherland Simpson, since 1908 professor of physiology in Cornell University, Ithaca, and formerly lecturer in experimental physiology in the University of Edinburgh, the author of numerous papers on the nervous system, body temperature, and secretory glands, aged sixty-three years.

News and Views.

THE controversy which has arisen through the Admiralty Order of November 1925, which adversely affected the status of engineer officers in the Royal Navy, has been carried a step further by the publication of the Memorandum drawn up by the Joint Committee of the Engineering Institutions. We referred to the deputation which waited upon the First Lord, the Right Hon. W. C. Bridgeman, M.P., in our article "The Status of the Naval Engineer" in our issue of February 6, p. 185. Mr. Bridgeman's written reply is evidence of the conservatism which seems to pervade the Admiralty, and the reply of the Committee states that "they view his statements with grave concern as a symptom of the attitude of mind prevailing at the Admiralty." The Committee adds that it is proposed to take steps both in the Press and in Parliament to make its views known to the public. It certainly seems an anachronism to-day, when the engineering branch is of such vital importance, that the Engineer-in-Chief has not a seat on the Board, even when matters affecting his department are discussed.

THERE is an aspect of the question of the status of the engineering personnel of the Royal Navy to which attention should be directed. The Admiralty has published particulars regarding the forthcoming examination for special entry cadets, eight of whom will be required for the executive 'category' and twenty-five for the engineer 'category' of officers. On previous occasions when the engineering personnel question was in the limelight, there was a serious falling off in the number of candidates. We hope that this will not be the case now. The Navy never stood in greater need of the pick of our schools than to-day, and though parents and guardians may view with distrust the policy of the present Board of Admiralty, we believe that, in spite of the temporary set back it is suffering, the engineering branch of the Royal Navy has an ever-increasing national duty to fulfil.

AT the invitation of the Prime Minister of the Commonwealth of Australia, Sir Frank Heath, head of the Department of Scientific and Industrial Research in Great Britain, has for some time been inquiring into those problems presented by Australian primary and secondary industries which call for thorough scientific investigation. His object has been two-fold: to discover directions in which work in Australia may be linked with that now being carried on in Britain, and to advise the Government as to the most effective way of reorganising the Commonwealth Institute of Science and Industry. In his several public speeches on the subject of industrial research, Sir Frank has emphasised three points. The first is the present lack in Australia of thoroughly trained investigators, which is accentuated by the slight opportunity afforded to university science teachers for extensive research work; the second is the urgent need for thorough understanding and co-operation between Commonwealth and State governments; the third is the necessity for concentrating at first upon problems of the primary industries. He has also emphasised the fact that the magnitude of the Australian continent greatly increases the price which Australia must be prepared to pay for adequate scientific investigation of her numerous problems. The distance factor, indeed, makes the general Australian problem of organisation very different from, and in some ways much more difficult than, that which is being met in England by the Department which Sir Frank Heath superintends.

THE Friday evening discourse at the Royal Institution on March 19 was entitled "Chips from a Sculptor's Studio," and was given by Mr. John Tweed, who designed the equestrian statue of Sir George White in Portland Place. As a practical sculptor Mr. Tweed told how a statue is made. The size and material are chosen to suit the surroundings—bronze being the most suitable if the statue is to be exposed to the weather. Expression is first conveyed to the clay sketch. The material is on a skeleton form. The process the Egyptians first used was the plaster cast and then the finished work in the material chosen. The thinness of the bronzes used by the earlier artists cannot be attained at the present time, and there is need for science to discover a more suitable bronze for statuary. In sculpture proper, carving in marble is done with a specially designed instrument by a carver, and then the sculptor completes the work. The material naturally used by the Greeks was marble. The artist gets his inspiration by studying Nature, that he may show the aspect of Nature in his work. Photographs of examples of Egyptian and Grecian sculpture in various materials were shown.

ACCORDING to a dispatch from the *Times* correspondent at Delhi, the Assembly on March 18 rejected the proposal of the Government of India to vote a sum of 375,000*l.* to the Institution of Archæological Research Fund. The proposal was strongly opposed by several Hindu members, who put forward the claims of university and medical education, and by English unofficial members, who argued that the establishment of an equivalent British Museum fund would remove archæological investigation from the annual criticism of the legislature. As no provision had been made in the Budget for archæological research in the expectation that the proposal would be accepted, it was agreed that a supplementary demand for 15,375*l.* should be submitted on the following day. The decision of the Assembly will cause profound disappointment to those who appreciate the importance of the work which is now being carried out by the Archæological Department and are acquainted with present conditions in India. It had been anticipated with some confidence that

this vote would place archæological studies in India on a sound basis and would enable a scheme of research covering a period of years to be framed, affording an opportunity of training workers in the principles and methods of archæological investigation—a matter of supreme moment now that the discovery of a centre of prehistoric culture in the Indus Valley is likely to give investigations in this area an importance in the history of civilisation at present incalculable. Sir John Marshall in a recent speech, in referring to the discoveries at Mohenjo Daro and Harappa, spoke of the possibility of inviting co-operation from outside; but whatever form such co-operation might take, there should be some assurance that India itself will be prepared in the main to accept responsibility for the continuance of this important work by competent and fully trained archæologists.

THE forthcoming polar flight of Captain R. Amundsen was the subject of a recent lecture in Rome by Col. U. Nobile, who will command the dirigible airship of the expedition. The lecture is now published in an illustrated pamphlet containing maps of the route. From a study of weather conditions in the Arctic regions, Col. Nobile believes that spring offers the best chance of steady weather and long range of visibility. He thinks that the flight should be made not later than May. The route will be from King's Bay, Spitsbergen, where mooring-posts for the airship are now being prepared, to Point Barrow in Alaska. This route crosses the heart of the unknown area in the Beaufort Sea, and should lead directly across Crocker Land, if that land exists. A problem of some importance is the selection of a route to Spitsbergen from Rome. The alternatives are Rome, London, Pulham, Trondhjem, Spitsbergen; or Rome, Fredericks-haven, Leningrad, Murmansk, Spitsbergen. The second route is 500 miles longer than the first, but offers greater probability of quiet weather conditions, and would appear at present to be the route selected. Col. Nobile expresses great confidence in the prospects for a successful flight.

WITH the object of giving the American public a bird's-eye view of the services rendered by the National Bureau of Standards, a special circular has been prepared in which its activities are described in non-technical language. It contains 113 pages, 86 illustrations and a plan of Washington showing how the Bureau may be reached. The visitor is supposed to be taken through the various departments in turn, and is told the main purpose of each and how it is attained. In many cases some striking result which has followed from the work done in the department is mentioned, as for example the scientifically designed gas burner which gives an efficiency four times that of the usual burner and will effect a saving of 50,000*l.* per day to the United States; and the standardisation being gradually introduced into industry which will reduce the number of unnecessary sizes and varieties of products. The circular forms an interesting and important document and should remove any misgivings as to the great value of the Bureau as a national investment.

MR. C. LEONARD WOOLLEY'S monthly progress report of excavations in Mesopotamia on the site of the temple of the Moon Goddess at Ur, which appeared in the *Times* of March 16, records several discoveries of exceptional interest. Among these is a small chamber containing three stelæ inscribed with the name of Bur-Sin, apparently a shrine for the cult of the deified founder of the temple—a find unique in Mesopotamian discoveries. There is also a diorite statue of the goddess Bau, patroness of the poultry-yard, in the form of a squat seated figure in an elaborately flounced dress, which is the first female statue of early date to be found in Mesopotamia. An alabaster lunar disc dedicated by a daughter of Sargon of Akkad (2750 B.C.) shows in relief a sacrifice to the goddess by a priestess, who may be the princess herself; while a limestone plaque dating from well before 3000 B.C., an excellent example of the early art of the country, carved in relief in two registers, shows sacrificial scenes in which in one case the king, and in the other a priest and priestess, pour libations to the god.

VOL. 69 of the Memoirs and Proceedings of the Manchester Literary and Philosophical Society contains the inaugural Ludwig Mond Lecture delivered in the University of Manchester on October 20, 1924, by Prof. H. B. Dixon. Prof. Dixon traces in an interesting manner the rise of the alkali manufacture and the share which Ludwig Mond had in its development. In partnership with John Brunner, Mond started the Solvay ammonia soda process at Winnington in 1873, and in the face of really imposing difficulties they made the process, which had failed in the hands of previous technical men, a success. Mond's contributions to pure and applied science are recorded, and his generosity in helping research is especially commented upon. Ludwig Mond was an example of a rare combination of keen interest in pure science with great ability in its application to the problems of industry.

SOME account of Russian scientific exploration in Arctic Russia and Novaya Zemlya is given in several recent issues of the *Weekly News Bulletin* of the U.S.S.R. Society of Cultural Relations with Foreign Countries. For the past four years an expedition under Prof. Samoilovitch has been at work in Novaya Zemlya, and succeeded last summer in rounding the northern end and exploring the little-known north-east coast, discovering several new gulfs and making minor changes in the charts. A site has been chosen for a radio station, for meteorological purposes, at the northern end of the north island. Another expedition under Prof. Suvorov has been exploring the little-known Cheshskaya Gulf of the Kanin Peninsula and examining the fisheries of the coast. Investigations in biology and anthropology have also been conducted in Kolguev and the Kola peninsula, and experiments have been made in several districts of the north in the use of a serum against anthrax in reindeer. All these and other researches are to be continued next summer.

IN the National Museum of Wales at Cardiff there are two important collections of British Lepidoptera, the Vivian and the Griffith, which together comprise more than 50,000 specimens. The authorities of the Museum have recently issued a "Guide" (price 6*d*.) to these collections, which directs attention to many interesting and scarce specimens of which no previous record has been published. The occurrence and distribution of various Lepidoptera in Wales are also indicated in this pamphlet, while a number of the rarer species are illustrated on two coloured plates. The booklet will prove of interest to collectors and others with respect to unique or very rare specimens contained in the collections, since it gives the localities and other data associated with them. So much is heard respecting the disappearance of rare or local Lepidoptera that it is refreshing to learn from this pamphlet that, at any rate, the white-letter Hairstreak, *Thecla w-album*, appears to be extending its range in so far as Wales is concerned.

THE "Report of the Health of the Army for 1923," recently issued, contains details of some interest. Judging by the invaliding rate, the health of the Army was better in 1923 than in the previous two years, but not so good as in the period 1906–13. It is surprising to learn that tonsillitis takes third place, with 5566 cases, as a cause of admission to hospital, malaria with 13,158 cases and venereal diseases with 10,807 cases being first and second respectively. No definite reason could be assigned for this high incidence of tonsillitis. At the head of the list of diseases which cause the greatest amount of invaliding out of the Army comes inflammatory conditions of the middle ear, with 451 cases—nearly half a regiment! The Royal Army Medical College, in addition to courses of instruction and research work, now prepares all the bacterial vaccines and allied substances employed in the Army, which were formerly purchased, at a saving estimated at 12,650*l*. for the year.

DR. R. E. M. WHEELER, since 1924 Director of the National Museum of Wales, has been appointed Keeper, Secretary, and Accounting Officer of the London Museum, in succession to Mr. F. A. H. Oates, who has retired.

PROBABLY no division of biology has so many journals devoted to its various aspects as entomology. A new American periodical, *The Pan-Pacific Entomologist*, a quarterly journal of general entomology, was inaugurated last year. The first volume, consisting of four numbers, has been completed and vol. 2 is now appearing. The journal is published by the Pacific Coast Entomological Society in collaboration with the California Academy of Sciences. Although primarily intended for furthering an interest in the entomology of the coastal region of the Pacific side of America, papers of broader significance are not precluded. The annual subscription is 2 dollars for the U.S. and Canada, and 2·25 dollars for elsewhere. Sample copies are obtainable from Mr. F. E. Blaisdell, 1520 Lake Street, San Francisco, California.

REFERENCE has frequently been made in the columns of NATURE to the difficulty experienced in central European countries, since the War, in gaining access to outside scientific proceedings and publications. In many of the smaller Continental universities this condition still prevails, and cannot be ameliorated owing to the lack of funds for the purpose. Much valuable assistance could be rendered in this matter, however, if workers in the various branches of science were to make a point of sending reprints of their publications to the leading Continental exponents of the subject concerned. In physics, the need of such an arrangement is particularly acute at the present time, when two "Handbücher" of physics are in preparation. Prof. K. W. F. Kohlrausch has been entrusted with the volume on "Radioactivity" in one of these "Handbücher," and he has written to us suggesting that workers in radioactivity forward to him their publications in this subject, so as to enable him to bring his work completely up-to-date by first-hand reference to original papers. He would be very grateful if the authors of such papers would assist him in this manner, by sending reprints to: I. physikalisches Institut, Technische Hochschule, Graz (Austria).

AT the Southampton meeting of the British Association in August last year, a number of papers were read by officials of the Ordnance Survey. These papers are now collected and printed in full in Professional Papers, New Series, No. 10 (H.M.S.O., price 9*d*.), and include an admirable general account of the work of the Ordnance Survey by Col. E. M. Jack; a paper on recent productions by Capt. J. G. Withycombe, in which announcement is made of a new three-sheet map of Great Britain on a scale of 10 inches to a mile; a paper on archæology and the Ordnance Survey by Mr. O. G. S. Crawford; and an account of the present state of the international 1/M map by Maj. M. N. Macleod. The publication gives a useful summary of the present state of the survey and maps of Great Britain.

MESSRS. Gurney and Jackson announce the early publication of "A Text Book of Organic Chemistry," by Prof. Julius Schmidt, translated by Dr. H. Gordon Rule; and "A Text Book of Inorganic Chemistry," by Prof. Fritz Ephraim, translated by P. C. L. Thorne.

CATALOGUE No. 398 of Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, will appeal to zoologists and geologists, especially if they are interested in rare and choice editions, for it contains particulars of nearly 1800 works, many of which are out-of-print and scarce.

MESSRS. H. K. Lewis and Co., Ltd., have recently issued two interesting lists of second-hand books dealing respectively with "Early Scientific Works and Biographies," and "Early Medical Works—Medical History and Biography." Either list, or both, can be obtained free upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant to carry out research work on miners' electric

lamps—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (April 9). A junior chemist at the Building Research Station, Garston, near Watford, for investigations on the heating and ventilation of buildings—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (April 10). A professor of zoology in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (April 14). A professor of physics in the University of Tasmania, Hobart—The Agent-General for Tasmania, Australia House, Strand, W.C.2 (April 15). A junior scientific officer for work connected with aeronautical instruments at the Royal Aircraft Establishment—The Superintendent, R.A.E., South Farnborough, Hants (April 17) (quoting Ref. A. 107). A principal of the Sir John Cass Technical Institute — The Correspondent, Sir John Cass's Foundation, 31 Jewry Street, Aldgate, E.C.3 (April 24). A junior lecturer in mathematics, a lecturer in geography, and a lecturer in geology and palæontology at Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (May 8). A professor of natural history in University College, Dundee—The Secretary and Registrar, The University, St. Andrews (May 8). A professor of physics in the University of Dacca, Bengal—The Registrar, University of Dacca, East Bengal, India (June 30). A test assistant for aircraft and instrument test work at the Aeroplane and Armament Experimental Establishment, R.A.F., Martlesham Heath—The Secretary of the Air Ministry, Adastral House, Kingsway, W.C.2 (quoting S. 2/R. 461). An assistant lecturer and demonstrator in botany at the South-Eastern Agricultural College, Wye, Kent—The Secretary. A pathological laboratory assistant for the Veterinary Department of the Government of Nigeria—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/14292).

Our Astronomical Column.

PENUMBRAL LUNAR ECLIPSES.—The January issue of *L'Astronomie* contains an article by M. Gaetan Blum on this subject. Consideration of these eclipses is necessary to make the theory complete; when they are included there must be one lunar eclipse at every passage of the sun through either node, and there may be two. The almanacs as a rule do not give predictions of penumbral eclipse, but they have done so occasionally by some caprice. Eclipses in which the moon penetrates deeply into the penumbra are quite readily observable, it being obvious that a portion of the moon is dimmed by a smoky veil. There will be an eclipse of this kind on December 19 next, full moon being at $6^h\ 8^m$ A.M., so that it will be visible in Great Britain. The least distance of the moon's limb from the umbra will be less than a minute of arc. The article notes that the phenomenon is rendered more noticeable if the moon's light is weakened by reflection at an unsilvered glass surface.

A very instructive diagram shows all the eclipses of a Saros cycle (1908 to 1926), different symbols being used for each species of eclipse. It brings out clearly both the approximate 4-year cycle of recurrence and the much more exact one in 18 years 11 days.

The same publication contains a photograph of the solar eclipse of January 24, 1925, taken by Prof. Slocum at Middletown, and a diagram showing the exact position of the southern boundary of totality across New York as deduced from the observations made there.

THE JOHANNESBURG 24-INCH REFRACTOR.—This instrument is now in full working order, and is giving satisfaction. The outer portion of the lens is less good than the rest, so a slightly diminished aperture is employed.

Dr. Van den Bos, of the University of Leyden, is engaged on an exhaustive search for southern double stars with the instrument. He has already found more than 180 new pairs, while according to a message which was published in the *Times* some weeks ago, the star β-Tucanæ has been found to consist of three separate pairs, making a splendid sextuple system. This rapid increase of the known southern binary systems calls for a new general catalogue of these objects, which is now in course of preparation at the Union Observatory. It is being printed by a typewriter and will be issued in separate sheets, so that new pages can easily be inserted.

It is noted that the planet Pallas appeared on a recent occasion exactly like a close binary star, and was for a time mistaken for one.

THE TEMPERATURE OF SUNSPOTS.—A preliminary paper on this subject by Prof. V. Bjerknes appears in *Comptes rendus*, **182**, 48, 1926. The author has contributed largely to the dynamics of meteorology, and his important investigation on the "Dynamics of the Circular Vortex" will be found in *Geofysiske Publikationer*, vol. 2, No. 4, Christiania, 1921. In the present paper the general principles previously established by him are applied to the problem of sunspots, in which the relative coolness is considered by him as an analogous phenomenon to the relatively low temperature in terrestrial cyclones. He postulates a fluid medium possessing a free surface and the properties of a gas with density increasing downwards more rapidly than would result from compression. For a horizontal vortex in such a medium, Prof. Bjerknes develops an expression for the fall in temperature ($\Delta T = T - T_0$) in the central part of the vortex—nat. log $T/T_0 = 2D/H$, where D is the depth of the depression of the free surface, and H is the depth to which vortical motion extends. Applying this formula to a sunspot vortex, given $T = 6000°$, the following depressions of temperatures are given:

$D/H =$	0·001	0·01	0·1	0·2	0·3	0·4	0·5
$\Delta T =$	12°	120°	1100°	2000°	2700°	3300°	3800°

It is found as a corollary that the velocities in corresponding vortices should range from a fraction of a kilometre to 20 km./sec. The theory is stated not to be invalidated by the possible absence of a free surface in the sun, so long as there is a rapid change in the densities of the solar gases from photosphere outwards.

It may be added that the temperature of a sunspot at photospheric level is generally considered to be about half that of the photosphere itself. Prof. H. N. Russell, in a "Note on Cooling by Expansion in Sunspots" (*Astrophysical Journal*, 54, 293, 1921), gives as the temperature of the photosphere 6000° C.; of the spot at the same level, 3500° to 4000° C.; at base of the spot vortex, probably 20,000° C. (rough estimate).

Research Items.

STONE IMPLEMENTS FROM NIGERIA.—The Geological Survey of Nigeria has issued as Occasional Paper No. 4 a communication by Mr. H. J. Braunholtz, describing a number of stone implements of palæolithic and neolithic types found in the alluvium of the Bauchi Plateau. Their discovery is a by-product of the tin-mining industry, which necessitates removing and sifting large quantities of alluvial deposit in river valleys. The depth at which they are found varies from a few feet to 30 feet. Unfortunately this affords no criterion of age, and further, the exact location of the finds has not always been recorded. In some cases, however, the depth and situation taken together seem to argue a considerable antiquity such as, *e.g.*, a site "under 20 feet of alluvial and 85 yards from the recent river edge." The implements are, with one possible exception, of local rock and of local manufacture. The palæolithic implements are made of a quartz porphyry, the neolithic of basalt (dolerite). Many of the former are much rolled. Allowing for differences due to the employment of a different material, the palæolithic implements resemble western European types of the Chelles to Le Moustier epochs, but not of the later palæolithic times. While the neolithic types are widely distributed in Nigeria, the Bauchi Plateau is the only site in the provinces up to the present on which palæolithic implements have been found. The absence of late palæolithic forms suggests either an isolation of Nigeria from ultra-Saharan Africa at this period, or lack of stone suitable for finer flaking, or, possibly, a more recent origin than their typological affinities in North Africa and Europe.

PAINTED POTTERY FROM MESOPOTAMIA.—Mr. W. F. Albright, of the American School of Oriental Research, Jerusalem, describes in *Man* for March interesting results obtained from a surface examination of mounds in the Middle Euphrates region which throw a light on the comparative ceramics of the æneolithic and Early Bronze periods. The site of the finds, Tell Zeidân, is a mound about 500 metres in length stretching along the eastern bank of the Balîkh river. It is covered with potsherds and flint artefacts, the former being nearly all of a creamy white or light buff, covered with geometric designs in black or reddish brown, applied both with and without a slip, in the former case on the buff ware. Only one polychrome sherd was found. It showed alternating bands of black and brownish red on a white slip over a light buff paste. The result of a comparison of this pottery with that from Abû Shahrein, Tell el 'Obeid, and other sites in which the proto-Mesopotamian ware has been found, and a study of the material as a whole, suggests a similarity, which almost amounts to an identity, in all the pottery from north-western Mesopotamia, Babylonia, and southern Susiana in the pre-monumental age. Its place is taken by incised ware in the third millennium. A possible dating may be given by taking Susa I. as falling in the first half of the fourth millennium, Tell Zeidân about the middle, the early occupation of Eridu and Tell el 'Obeid as slightly later, and the painted ware of Kerkut as belonging to the second half of the fourth millennium.

YOUNG FISHES.—The literature on the behaviour of aquatic animals by day and night receives a contribution from Dr. A. C. Johansen, who discusses the diurnal vertical movements of the young of some fishes in Danish waters (*Meddelelser fra Kommissionen for Havundersogelser. Serie Fiskerie*. Bd. 8, Nr. 2, 1925). Dr. Johansen produces observations obtained from catches made with a stramin ring-trawl. The paper contains results of a serial collection taken every two hours throughout the twenty-four on April 20-21, 1925, in the southern Kattegat, and a comparison of a number of hauls taken at different stations in the Kattegat, Belt Sea, and western Baltic in the same month by day and night. Two water-layers were sampled, the surface and an intermediate layer estimated as being at a depth of about 16 metres. The catches showed that the average number of post-larvæ of any one species caught was greater at night than in the daytime in the upper water layers, and the same held good for the number of fish species. This demonstrates the necessity for stating the time at which hauls are made when studying the horizontal and seasonal distribution of young fish. The writer considers that, at any rate for the smaller stages, the results represent an actual migration from deeper layers at night, and that in the day-time the majority keep down below 16 metres; but that for the larger more swiftly moving forms, there is a probability that they can avoid the net in the daylight, so that no definite conclusions can be drawn. A short report is given of the plankton results obtained, and also of previous work and theories as to causes of vertical migration. Perusal of this paper only emphasises the need for more observations at sea.

THE FAUNA OF SARAWAK.—The *Sarawak Museum Journal* for December 1925 is devoted to a series of papers describing the collections made by Dr. E. Mjöberg in northern Sarawak. It is a region which affords great opportunities to the biologist, and the fact that the collections include many new species is to be expected from a part of the world so little explored. Among the insects, Dr. H. H. Karny reports on the katydids (Tettigoniidæ), cricket-locusts (Gryllacridæ), and Copeognatha. Dr. R. Hanitsch, in dealing with the Blattidæ, lists no less than 55 species, among which 24 are described as new to science: perhaps the most interesting feature with respect to this family is the almost entire absence of cosmopolitan forms—a fact probably associated with the absence of the white man in the region concerned. The Collembola form the subject of a paper by Dr. H. Schött and, with one exception, all the 12 species recorded by him are new, and three new genera are also erected. The Amphibia and Reptilia from Mt. Murud comprise only 14 species, and of these, five are described as new by Mr. Malcolm H. Smith. The discovery of a new lizard allied to Phoxophrys is of particular note, as is also that of a tree-frog (*Philautus mjöbergi* sp. nov.) which was found depositing its eggs and breeding in the pitchers of Nepenthes. In a second paper Mr. Malcolm Smith reports on the more extensive collections made over a wider area of Sarawak during the past two years. They comprise some 700 specimens representing 95 species. The most noteworthy are a diminutive form of toad allied to Megalophrys, which appears to represent a new genus, and an undescribed ground-gecko of the genus Gonatodes. There are two short notes on birds: Dr. E. Hartert describes a peculiar form of flycatcher, and Mr. Einar Lönnberg directs attention to an apparently new race of flowerpecker.

ANATOMY OF HENDERSONIA.—Mr. H. Burrington Baker has been studying and gives a minute description of the anatomy of *Hendersonia occulta* (*Acad. Nat. Sci. Philad.*, 77), which he considers to be the most primitive living example of the family Helicinidæ. His conclusion is based on the fact that

Hendersonia retains a right auricle and a metamorphosed right kidney in both sexes. With respect to the first of these characters, Hendersonia is fully as generalised as any neritid, while as to the second it seems even less specialised. The Neritidæ cannot be considered as in any sense ancestral to the Helicinidæ, although their aqueous habitats have permitted them to retain certain markedly primitive characters, while the terrestrial life of the Helicinidæ can be correlated with an increase in specialisation along several lines. While the homologies between the Rhipidoglossa and the Pulmonata are extremely hypothetical, the genitalia of Hendersonia and the Helicinidæ perhaps can be tentatively regarded as representative of an intermediate stage between those of the less specialised members of the former group and those of the latter. Both the Helicinidæ and the Pulmonata show a marked tendency towards the concentration of the cerebral, pleural, and, to some extent, the pedal ganglia. The nervous systems of these two pulmonate groups actually prove the more usual conception of separate evolutions from common, probably marine, ancestors.

A BOT-FLY PARASITIC ON MONKEYS.—Under the title *Zoopathologica*, the New York Zoological Society has recently established a journal devoted to the publication of its scientific contributions dealing with animal diseases. In vol. 1, No. 7 (January 1926), Messrs. R. C. Shannon and C. T. Greene record the occurrence of larvæ of Cuterebra in certain primates. One lot of material consisted of the neck portion of the skin of a howling monkey (*Alouatta palliata inconsonans*) from Darien, Panama. It was so heavily infested with larvæ that the skin is described as resembling a collection of cells in a bumble-bee's nest. The other lot of material consisted of two bred flies and a number of larvæ taken from a red howling monkey at Kartabo, British Guiana. Probably all the material belongs to the same species of Oestridæ which is described as *Cuterebra baeri* sp. nov. from that obtained at Kartabo. Little is known of the habits of Cuterebra, but, from what is known, the eggs are probably laid about the haunts of the hosts, possibly on the leaves of the plants. It is suggested that if the leaves be eaten by the host animal, the larvæ hatch in the mouth and, boring their way through the tissues, eventually reach the skin of the throat region. Here they make breathing holes and remain in subcutaneous pockets until fully grown. When mature they work their way out and fall to the ground where they pupate.

FERTILISATION IN A CYCAD.—Prof. A. Anstruther Lawson, of the University of Sydney, publishes in the *Transactions of the Royal Society of Edinburgh* (vol. 54, part 2, No. 6, 1926) a most interesting account of the processes preceding, accompanying, and following fertilisation in the cycad genus Bowenia. This Australian cycad has not been readily accessible to botanists, but the selection of the district in which the plant is native as a centre for fruit-growing, has enabled Prof. Lawson to obtain an uninterrupted supply of cones, collected twice weekly throughout the year. The result is a very full account of the cytology of the reproductive organs and of the process of fertilisation. The massive sperms, with spiral ciliated band bearing thousands of cilia, have actually been seen moving in living material, as they swim in the archegonial chamber. Prof. Lawson describes the dilated neck cells of the archegonium as excreting a fluid which adds to the liquid in which the sperms are moving, and also as acting as 'swinging gates,' which are forced apart by the entrance of the sperms, to close again behind them. Interesting figures of nuclear structure following fusion also suggest that the chromatin of the male and female nuclei remains distinct; the spindle in the first division after fertilisation is a broad one of double organisation, maternal and paternal chromosomes dividing and separating independently.

FLOW OF SWEDISH RIVERS.—In Band 3, No. 5 of *Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt*, Dr. G. Slettenmark gives a mass of data on the flow of the chief Swedish rivers, illustrated by a map showing the location of the gauging-stations. The first table gives a list of the 187 stations, the area of the lake basins on the river, and the total area of the river basin. This is followed by tables giving the mean and extreme value of the flow during each month of the year and other useful values calculated from these figures. Many of the stations date back to 1910, but others are of more recent origin. The publication affords exhaustive information on the hydrography of the Swedish river systems. The very brief discussion of the data is in Swedish.

DOES A FARADAY CYLINDER MEASURE ELECTRON CURRENTS?—We have grown so accustomed to measure electron currents by means of a Faraday cylinder through a hole in which the electrons entered, that a short note in the January issue of the *Proc. Nat. Acad. of Sci.*, Washington, throwing doubt on such measurements, is somewhat disconcerting. It is by Mr. E. O. Lawrence, a National Research Fellow working at Yale University under Prof. Swann, and gives an account of measurements of the currents entering a Faraday cylinder 2·2 cm. diameter through a hole of 1 cm. diameter when the length of the cylinder and the accelerating or retarding potential between the tungsten filament emitting the electrons and a plane anode between the filament and cylinder were varied. The anode was placed 4 cm. from the filament and the electrons passed through a hole 0·2 cm. in diameter in it. Curves of current received in terms of the retarding potential and length of cylinder show that a Faraday cylinder does not retain all the electrons which enter it, and it follows that measurements of the speeds of electrons depending on retarding potential observations require revision.

SOAP-BOILING PROCESS.—A further contribution to the knowledge of the equilibria underlying the soap-boiling processes has been made by J. W. McBain and W. J. Elford by a study of the potassium oleate–potassium chloride–water system, described in the *Journal of the Chemical Society* for February. The solutions were examined in polarised light, and from the results, equilibrium diagrams for the systems water–potassium oleate and water–potassium oleate–potassium chloride were constructed, clearly showing the limits of existence of the various soaps.

VAPOUR PRESSURES OF ARSENIC TRIOXIDE.—The determination of the vapour pressures of arsenic trioxide up to 500° C. made by E. R. Rushton and F. Daniels, is described in the *Journal of the American Chemical Society* for February. The apparatus consisted of an evacuated Pyrex flask, fitted with a Gibson diaphragm and heated electrically in a metal bath. The published data include the melting and transition points, heats of fusion, vaporisation, and transition of the various allotropic forms of arsenic trioxide. The exact relation between the amorphous glassy form and the crystalline forms has always been rather obscure, and it is to a large extent cleared up by this work.

The Geographical Distribution of Fresh-water Eels.

THERE is scarcely anything in Nature more wonderful than the facts concerning the migrations and life-histories of the fresh-water eels of Europe and America brought to light by the long and persevering researches of Dr. Johannes Schmidt. He has now completed a general survey of what is known concerning the distribution of all the species of the genus Anguilla. The first part of this survey, including only the Atlantic Ocean and adjacent areas, was published sixteen years ago. The memoir under notice [1] is the second part and is devoted to the Indo-Pacific region, but it contains certain important additions to the information contained in Part I., and references to the chief general conclusions of that part.

The species of Anguilla seems as a rule to be geographical species, though in some cases two or more occur in the same locality. In the Atlantic region there are only two, *A. vulgaris* on the eastern side, *A. rostrata* on the western, the former having a larval period of three years, the latter of only one year. Dr. Schmidt tells us that in the Indo-Pacific region, at the beginning of his inquiry, the determination of species was generally uncertain, the distribution obscure, and the biology altogether unknown. Some of the uncertainty with regard to species has been remedied, but the thorough investigation of the bionomics still remains for the future.

The world distribution of the whole genus shows some curious features. In the Atlantic the contrast is between north and south. On the eastern side eels are found on all the coasts of Europe and North Africa from near the Tropic of Cancer to the White Sea, including all the Mediterranean and Black Seas and the Baltic. On the east side, the range of the American species extends from Labrador to the West Indies, and includes a short stretch of the South American coast at the mouth of the Orinoco. No eels occur on the east coast of South America south of this part, or on the west coast of Africa south of the Tropic of Cancer.

In the Pacific, on the other hand, there are no eels on the east side at all from Alaska to Tierra del Fuego, while on the west they are found, often in great abundance, from Japan along the coast of China, in the Philippines, on the northern coast of New Guinea, the east coast of Australia, in both islands of New Zealand, and in nearly all the western islands of the Pacific. From the Sandwich Islands and the Galapagos farther east they are absent.

Eels occur on most of the coasts of the Indian Ocean, except the Arabian Sea and the south-west coast of Australia. With the exception of the short extent of coast from the north of Norway to Archangel, and an unimportant occurrence in Greenland, there are no eels in the Arctic or Antarctic regions. Another curious contrast is the entire absence of these fish from the shallow sea (less than 100 fm.) bounded by Siam, the Malay Peninsula, Sumatra, Java, and Borneo, while they pass in very large numbers over the bank at a similar depth on which the British Islands are situated. Dr. Schmidt concludes that the eel-fry immigrating from the depths of the ocean are, in the case of the Indo-Malayan species, inferior in migratory powers to those of the Atlantic species. Eels do not migrate through shallow sea-areas in the larval stage, but only after the metamorphosis, when they have reached the elver stage.

Although eels are so abundant in individuals in temperate regions, the greater number of species belong to the tropics, and Dr. Schmidt believes that the genus originated somewhere in the equatorial Pacific, and that the species have radiated out from this centre. The most widely distributed of the tropical species seems to be *A. mauritiana*, which occurs in the islands off the east coast of Africa, in the Philippines, and in many of the islands of the Pacific. In the Philippines it reaches a large size, some specimens measuring 2 m. in length and 46 cm. in circumference. The oceanic larva or leptocephalus of this species was obtained and identified by Schmidt at Celebes in 1925. The ascent of great swarms of elvers from the sea to fresh water seems to be as familiar a sight in Japan as in Europe, and to occur at about the same time of year.

Apart from Europe and North America, Japan is the only country where eel fisheries have developed to a large and important industry. In New Zealand two species have been distinguished, *A. australis* and *A. aucklandi*, and specimens occur up to 6 ft. in length, 20 in. in circumference, 46 lb. in weight. They are used as food only to a slight extent by the European inhabitants, but are caught and eaten in considerable numbers by the Maoris.

The memoir concludes with a section entitled "General Observations," in which the author discusses the probable life-history of *A. japonica*, and the absence of a species of eel on the eastern side of the Pacific. He considers that the Japanese eel resembles the American *A. rostrata*, having a larval period of about one year, and spawning in the region of the ocean to the south of Japan, where the temperatures at 400 m. are higher than elsewhere in the North Pacific. He suggests that the reason for the absence of eels on the eastern side of the Pacific is the absence of a species having a larval life sufficiently prolonged to enable it to make the long migration from the same spawning region to the eastern side of that ocean, since both *A. rostrata*, the American species, and the *A. vulgaris* of Europe, have been shown by Schmidt to carry on their reproduction in the western part of the North Atlantic. This does not, however, explain the absence of eels from both the east and west shores of the South Atlantic.

Like other publications of Dr. Schmidt on his researches into the characters and bionomics of fresh-water eels, this memoir shows his mastery of his subject, his command of the English language, and his skill in clear and orderly statement. J. T. C.

[1] On the Distribution of Fresh-water Eels (Anguilla) throughout the World. II. Indo-Pacific Region. A Bio-geographical Investigation. By Johs. Schmidt. *Mém. de l'Akad. Roy. de Danemark. Section des Sciences*, 8me série, t. 10, No. 4.

The Construction of Regular Polygons.[1]

JUST as the sequence of propositions arranged by Euclid to form the first book of his "Elements" reaches its climax in the proof of Pythagoras's theorem, so those in the three succeeding books culminate in the construction of a regular pentagon. In the eyes of the Pythagorean school of Greek mathematics, the five regular solids were considered to be symbols of perfection. So one of the aims of the first four books of the "Elements" was to supply accepted reasoning that would lead to the construction of regular polygons of three, four, and five sides—the only ones which can be the faces of a regular solid.

No further advance in the theory of constructing

[1] "The Scientific Construction of the Regular Heptagon with Angles Correct to Ten Seconds, derived from Two Crossed-Parallelograms of a Semi-Ellipse." By T. Alexander.

regular polygons was made until the time of Gauss, who, at the end of the eighteenth century, showed that the construction of a regular p^m-sided polygon, p being prime, depends on a succession of algebraic equations the degrees of which are the prime factors of $p^{m-1}(p-1)$. Any quadratic equation being solved by the intersections of a line and a circle, it follows that a regular polygon of 2^m+1 sides, when this number is prime, can be constructed by Euclidean geometry. The chain of quadratic equations leading to the value of $\cos(2\pi/17)$ in radicals was fully discussed by Gauss ("Disq. Arith.," § 354). Various writers have dealt with the geometrical construction of a regular 17-gon, and it seems unlikely that any improvement in Richmond's construction (Hudson's "Ruler and Compasses," p. 34) will be possible. Richelot (*Crelle's Journal*, Bd. 9) dealt with the sequence of seven quadratic equations which give $\cos(2\pi/257)$ in radicals, and the same problem has been treated geometrically by Affolter and Pascal (*Napoli Rendiconti*, 1887). Euclid's argument which leads to the construction of a regular quindecagon can be extended to apply to regular polygons of 680 and $255 \times 256 \times 257$ sides, so, in theoretical discussions, it is sufficient to consider regular polygons of p^m sides.

There are at least three methods of approximately constructing a regular polygon of any number of sides by Euclidean geometry. First, since

$$\frac{1}{n}=\frac{a_1}{2}+\frac{a_2}{2^2}+\ldots+\frac{a_m}{2^m}+R_m,$$

where $a_r=0$ or 1 and $0\angle R_m \angle 2^{-m}$, an angle $2\pi/n$ can be constructed by m repeated bisections of a right angle with an error less than $\pi/2^{m+1}$. Bisection of very small angles can be avoided by a rearrangement of the expansion for $1/n$.

The second method depends on the formula

$$b^2+c^2-a^2=2bc\cos A,$$

or an equivalent one, in which appropriate rational values of a, b, c render $A \sim 2s\pi/n$ as small as may be desired. Until data are available an element of chance enters into the application of this process, there being no rule for obtaining *small* rational values of a, b, c to give A within a prescribed limit of error of $2s\pi/n$.

In the third method a diameter AOB of a circle, radius r, is divided into $n-1$ equal parts at points of which K is the second from B. Then C being a point on the perpendicular diameter such that $OC=\frac{1}{3}\pi r$, CK cuts the circle at Q (beyond the diameter) and $\angle BOQ=\alpha=2\pi/n$ with an error of the order $1/n^2$. A more accurate construction is given by

$$KB=4r/(n-\tfrac{1}{2}\pi^2+4)=4r/(n-0{\cdot}93),$$

the discrepancy in α then being comparable with $1/n^3$. (A curious but widespread fallacy, of which it would be interesting to know the origin, is that, in the same figure,

$$OC=r\sqrt{3},\quad OK=r(n-4)/n.$$

This rule does not even give a good approximation to a regular figure, the error in α being about 10 per cent. when n is large. A much better approximation, avoiding the introduction of π, is given by

$$OC=\tfrac{1}{2}(\sqrt{2}+\sqrt{3})r,\quad OK=r(n-5)/(n-1),$$

this reducing the error in α to $\frac{1}{6}$ per cent. for sufficiently large values of n.)

When n is such that the ruler and compasses allowed by Euclid fail, the vertices of a regular n-agon inscribed in a circle can always be obtained as the intersections of algebraic curves with the circle. The curve used to deal with an algebraic equation of degree q, a prime factor of $p^{m-1}(p-1)$, should be one which can be constructed by some simple mechanical means and crosses a curve already drawn in q new points. A cubic equation being always soluble by the intersections of a conic section with a circle, one conic, combined with ruler-compasses geometry, is sufficient when $n=7, 9, 13, 97, 193$, whereas two conics are needed for $n=19, 27, 37, 73$ and three when $n=81, 109$. A suitable conic is an ellipse the foci and major axis of which can be constructed by Euclidean geometry, the usual string and pins process then being available.

Prof. Alexander, in the pamphlet now before us, attempts to construct a regular heptagon, and a reviewer must examine what success has attended his effort. In the first place, his constructions, all of which require intricate figures, are approximate: a more accurate approximation to $2\pi/7$ could certainly be obtained by drawing a triangle with suitable rational sides a, b, c. Secondly, one construction involves the use of a point P on an ellipse such that $\angle PAA'=2\angle PA'A$, A and A' being the foci: this point P is not defined as the intersection of the ellipse with a line or a circle. Thirdly, in the most accurate construction, two ellipses are needed to give an approximate value of the angle of a regular heptagon, whereas one ellipse combined with ruler and compasses should give the vertices of the heptagon exactly. So, for three distinct reasons, we are unable to accept Prof. Alexander's constructions as the final word on the question of the regular heptagon.

W. E. H. B.

The Malthusian Principle and Sociology.[1]

THE variations of the birth rates and death rates in the different countries are most easily studied from the diagrams made of them by Dr. C. V. Drysdale, the president of the Malthusian League. Birth rates remained high, except in France and Ireland, until 1876. Then the birth rate of England, Belgium, Holland, Germany, Austria, and Switzerland, and of Europe as a whole, suddenly began to fall. This sudden onset of declining fertility must have been due to contraception. The death rates fell with the birth rates, and in such close correspondence as to show that the fall of the death rates was closely related to the fall of the birth rates. That the progress in medical science and sanitation reduced the death rates in such close parallelism with the birth rates can scarcely have been a coincidence. Moreover, when one examines the vital statistics of Rumania, Chile, and Jamaica, and of Russia from 1881 to 1901, and of Ireland from 1886 to 1911, one finds a horizontally-oscillating or fairly stationary birth rate and a similar death rate. Why were not medicine and sanitation reducing the death rate of any of these countries when their birth rate was stationary? Furthermore, Bulgaria, Ceylon, and Japan had a rising birth rate and a rising death rate from 1881 to 1911. Why did these countries then have a rising death rate notwithstanding medical progress?

Evidently, as Malthus believed, the populations of all the long-settled countries were pressing on their means of subsistence—that is, were not increasing their food supplies fast enough for their needs. For example, consider England. In 1876 the birth rate and death rate were still very high and the average duration of life only about thirty-five years. Then the birth rate fell or new mouths were added more

[1] Abstract of a paper read by Mr. Binnie Dunlop, M.B., on February 23, to the Sociological Society.

slowly, and there steadily declined the proportion of persons dying prematurely from diseases consequent upon under-nutrition; thus the death rate fell steadily and the average duration of life rose. The under-nourished are doomed to premature death no matter how efficient and active the health services may be; nothing can make a population increase faster than the food supply; if there be ten additional persons, and only food for eight, two must soon die. The high correlation between the birth rate and the death rate continued up to 1913; therefore, food shortage was still the cause of what was excessive in the death rate up to 1913. Thus the whole of the fall of the death rate from 1876 to 1913, the big reduction of poverty, and the rise in the average duration of life from about thirty-five years to more than fifty years, must be attributed to the decline of the birth rate steadily reducing the amount of the food shortage.

In all the other old countries, and not excluding France, one may similarly infer that up to 1913, notwithstanding the extent to which the birth rate had fallen in some of them, the population was still pressing on the means of subsistence. The main conclusion is most encouraging and is as follows: Virtually the sole economic difficulty which besets man is that he can only increase his food supply very slowly; consequently, small families and willing work would eliminate poverty.

University and Educational Intelligence.

CAMBRIDGE.—The Allen Scholarship has been awarded to Ralph Cooper, of Trinity College.

The list of those who have recently passed the qualifying examination (in elementary mathematics and mechanics) for the Mechanical Sciences Tripos shows that twenty-three per cent. of those who were successful had not yet come into residence. The curriculum for this examination can usually be dealt with at school, and it is of some satisfaction to realise that the slow but steady rise in the standard attained in the schools is gradually relieving the university of the load of elementary teaching, for which it is often not too well equipped, and with which it really ought not to be encumbered.

Sir Alfred and Lady Yarrow have offered to endow an Eric Yarrow lectureship for the study of Assyriology.

Dr. D. Stockdale, of King's College, has been elected to a fellowship at that College. He has taken both parts of the Natural Science Tripos and was elected to a Senior "1851 Exhibition" studentship in 1923.

MANCHESTER.—The following have been recommended for the honorary degree of D.Sc.: Mr. S. L. Pearce, Electricity Commissioner, formerly Consulting and Chief Engineer and Manager, Electricity Department, Manchester Corporation; Prof. A. C. Seward, Vice-Chancellor of the University of Cambridge, professor of botany there; Dr. A. E. H. Tutton, formerly H.M. Inspector of Schools (Technological Branch), Board of Education.

THE British American Tobacco Co., Ltd., has sent a donation of 105*l.* to the funds being collected for the development of the Imperial College of Tropical Agriculture, Trinidad. Other recent donations and promises include: 250*l.* from The Manchester Cotton Association, Ltd.; 105*l.* each from the Royal Mail Steam Packet Co., Ltd., and Messrs. Alfred Holt and Co.; and 100*l.* each from Lord Queenborough, M.P., and C. H. Gray, Esq. These donations, together with the sum of 15,000*l.* recently granted by the Imperial Government, will be devoted to the building of a hostel for the students, and the provision of an estate where the business side of farming may be taught. A further 25,000*l.* is, however, still urgently required. Contributions may be sent to Mr. Algernon Aspinall, Secretary, 14 Trinity Square, London, E.C.3, or to Barclays' Bank (Dominion, Colonial, and Overseas), 30 Gracechurch Street, E.C.3.

WIDESPREAD interest will be aroused by the publication of the report of the Departmental Committee on the University of London (H.M.S.O. Cmd. 2612). This Committee was asked to consider the final (1913) report of the Royal Commission on University Education in London, and to make recommendations as to changes in the constitution of the University which may now be desirable. The terms of reference were wide, and the Committee, in its discretion, decided to make no recommendations on the questions of the site of the University and the external examination system. One of the main recommendations is that a council of sixteen should have the final control of finance, if and when the Senate approves of the educational policy implied. Nine of the sixteen are to be University representatives—the chancellor and the chairman of Convocation, the vice-chancellor and six others from the Senate; four will be nominated by the Crown, and two by the London County Council; one will be co-opted. As regards the constitution of the Senate, it is suggested that the present 'nominated third' should be replaced by a collegiate council consisting of the vice-chancellor and the principal of the University, and the heads of the seven chief schools and colleges, together with two representatives of the medical schools, and a few others representing minor schools. The chief function of this council will be the supervision of inter-collegiate affairs. The total membership of the Senate is to be reduced from 56 to 49.

UNIVERSITY COLLEGE, Reading, has now received its Royal Charter conferring upon it the full status of a university. This was announced on Saturday, March 20, by Mr. H. G. Williams, M.P., who congratulated the Lord-Lieutenant of Berkshire, Mr. J. H. Benyon, on becoming the first chancellor. This latest addition to the family, now numbering seven, of twentieth-century universities of England, is descended from "The University Extension College, in conjunction with the Schools of Science and Art, Reading," which was opened in 1892 and incorporated under the Companies Acts in 1896. Of its sister universities the youngest is Bristol, chartered in 1909. The University has an endowment of 285,000*l.*, of which 200,000*l.* came from the Palmer family and 50,000*l.* from Lady Wantage. The first principal was Mr. H. J. (now Sir Halford) Mackinder, then a student on the foundation of Christ Church, Oxford. The present principal, Mr. W. M. Childs, has held office since 1903. There are a strong faculty of agriculture and horticulture, and departments of fine arts, music, and domestic subjects, in addition to faculties of letters and science. The National Institute for Research in Dairying forms part of the University. The number of full-time students as shown in the University Grants Committee's returns for 1923-24 is 578, distributed as follows: Arts 339 (including 287 women), pure science 104, agriculture 135. A cardinal principle of the policy of the College from its earliest years has been to stress the importance of the corporate life of its members. This is reflected in the large proportion (70 per cent.) of its full-time students in halls of residence. In other modern English and in Scottish universities a large majority of the students reside in lodgings or at home.

Contemporary Birthdays.

March 27, 1844.	Maj.-Gen. Adolphus W. Greely.
March 27, 1857.	Prof. Karl Pearson, F.R.S.
March 27, 1855.	Sir J. Alfred Ewing, K.C.B., F.R.S.
March 29, 1840.	Sir John Scott Keltie.
March 29, 1853.	Dr. Elihu Thomson.
March 29, 1860.	Prof. William B. Benham, F.R.S.
March 31, 1890.	Prof. William L. Bragg, F.R.S.
March 31, 1854.	Sir Dugald Clerk, K.B.E., F.R.S.
March 31, 1870.	Sir William J. Pope, K.B.E., F.R.S.
March 31, 1859.	Sir Frederick W. Andrewes, F.R.S.

Maj.-Gen. GREELY, polar explorer and telegraphist, was born at Newburyport, Mass. He served in the Civil War, 1861–65, and, we believe, was the first volunteer private soldier to reach the grade of brigadier-general, U.S.A. In 1881 he was placed in command of the United States official expedition to establish one of a chain of thirteen circumpolar stations; his party of twenty-five reached farther north than any previous record, discovered new land north of Greenland, and crossed Grinnell Land to the Polar Sea. The final story of the Greely Expedition was one of disaster: there were only seven survivors. General Greely was the United States delegate at the International Telegraph Conference, London, 1903. Under his supervision 3900 miles of telegraph lines, submarine cables, and wireless were installed in Alaska, 1900–4.

Prof. KARL PEARSON was educated at University College School, London, and King's College, Cambridge. He was called to the bar, Inner Temple, 1882. Galton professor of eugenics in the University of London, and editor of *Biometrika*, he has written many memoirs on the mathematical theory of evolution and on heredity.

Sir ALFRED EWING, president of the Royal Society of Edinburgh, was born at Dundee. Formerly professor of mechanism and applied mechanics in the University of Cambridge, he was afterwards (1903–16) Director of Naval Education. Since then he has been Principal and Vice-Chancellor of the University of Edinburgh. He was awarded a Royal medal by the Royal Society, in 1895, for researches on magnetic induction in iron and other metals.

Sir JOHN SCOTT KELTIE was educated at Perth, and the Universities of St. Andrews and Edinburgh. For a number of years he was assistant editor of NATURE. Sir John was secretary of the Royal Geographical Society, 1892–1915.

Sir DUGALD CLERK was born in Glasgow. He is universally known as an investigator in the problems of internal combustion engines. The Albert medal of the Royal Society of Arts was allotted him in 1922, "in recognition of contributions . . . to the development of the internal combustion engine, which in its latter forms has rendered aerial navigation possible, and is also extensively employed in the motor-car and in the submarine." Sir Dugald was a Royal medallist of the Royal Society in 1924.

Sir WILLIAM POPE, professor of chemistry in the University of Cambridge, is a Londoner. He was educated at Finsbury Technical College and the Central Technical College, City and Guilds of London. After a professorial career at the University of Manchester, he became head of the Chemistry Department, Goldsmiths' Institute, New Cross. Sir William was Longstaff medallist of the Chemical Society, 1903, and Davy medallist, Royal Society, 1914.

Societies and Academies.

LONDON.

Royal Society, March 18.—S. **Chapman**, J. **Topping**, and J. **Morrall**: On the electrostatic potential energy, and the rhombohedral angle, of carbonate and nitrate crystals of the calcite type. Calculations have been made of the electrostatic potential energy of ionic lattices of the calcite type and for the sodium nitrate crystal, in which the lattice is of the same geometrical type, though the ionic charges are different. It seems probable that, owing to the fourfold positive charge in the C ions, the O ions of the CO_3 group will be distorted from their natural symmetrical form, and consequently the electrostatic centre of the O ion will be nearer to the C nucleus than the O nucleus is. The calculations indicate that the electrostatic centre of the O ion is 0·9 Å.U. distant from the centre of the C ion, compared with the value 1·25 Å.U. given by X-ray measurements for the distance between the O and C nuclei. A similar result is obtained for $NaNO_3$.—G. I. **Finch** and L. G. **Cowen**: Gaseous combustion in electric discharges. Pt. I. Steady direct current electric discharges are passed through electrolytic gas at 20-100 mm. pressures, and the rate of steam formation measured for varying conditions. It is found that the rate of combustion is determined only by the current, and up to a certain limiting current, combustion is confined to the cathode zone, depends upon the cathode material, and is directly proportional to the current. On exceeding this limiting current, combustion commences *abruptly* in the inter-electrode zone and is superposed upon cathodic combustion. This inter-electrodic combustion is also proportional to current, but, unlike the cathodic, is independent of the electrode material, and dependent upon gas pressure and separation of the electrodes. Little or no combustion takes place in the anode zone. Combustion seems to be primarily determined by ionisation of the gaseous medium for the current. The abrupt superposition of inter-electrodic combustion suggests a quantum effect, combustion in the inter-electrode zone depending upon a certain limiting potential fall being attained.—C. N. **Hinshelwood** and W. K. **Hutchison**: A homogeneous unimolecular reaction: the thermal decomposition of acetone in the gaseous state. The temperature range used was 506° to 632° C. The heat of activation is 68,500 calories, and the results can be summarised by the equation $l_n k = 34·95 - 68,500/RT$. Calculation shows that the number of molecules reacting per second is about 10^5 times greater than the maximum number that could be activated by collision. The absolute rate at 835° Abs. is the same as that of the nitrogen pentoxide decomposition at 328° Abs.—H. **Lamb**: On wave resistance. The case considered is that of a solid of dimensions small compared with the depth below the free surface, travelling horizontally under water. Various particular cases of this have been worked out. There appears to be room for a more general investigation in which no assumption is made as to the form of the solid. The device employed for calculation of the resistance is to introduce small frictional forces, and to equate the work done against resistance to the dissipation of energy.—C. E. **Eddy** and A. H. **Turner**: The L emission series of mercury.—G. R. **Goldsbrough**: The properties of torsional vibrations. In order to bring out clearly the nature of the torsional vibrations in reciprocating engine shafts, a simplified model is chosen which emphasises the main characteristics. Even when friction is great, there are two critical

speeds of shaft rotation corresponding to each term in the externally applied force.—E. T. **Hanson**: The theory of ship waves. The oscillations of a fluid under gravity, when the depth is variable or very great, have been worked out in two special cases. The theory is now extended very generally to cover a series of cases in which the fluid may be treated as a sea, bounded by a sloping shore on one side and extending indefinitely on the other. It is shown that, whenever the inclination of the shore to the horizontal is a submultiple of a right angle, the problem can be completely solved, and in each case there is a doubly infinite number of possible modes of motion under gravity. This extension makes it possible to calculate the precise effect of a sloping shore upon the formation of the beautiful wave pattern which often follows in the wake of a ship.—A. O. **Rankine**: The effect of temperature on the viscosity of air. The values of the viscosity of air obtained by Williams (*Roy. Soc. Proc.*, A, vol. 110, p. 141) in the lower part of the temperature range are seriously in error. The conclusion that Sutherland's law of the variation of viscosity with temperature becomes invalid for air at the relatively high temperature of 250° C is not justified.

Geological Society, February 24.—Gertrude Lilian **Elles**: The geological structure of Ben Lawers and Meall Corranaich (Perthshire). The country dealt with lies between Loch Tay on the south and Glen Lyon on the north, and between the Loch Tay fault on the east and the Ericht-Laidon-Tyndrum fault on the west. The line of junction between the Ben Lui schists and the Ben Lawers schists is a mechanical one of the nature of a folded slide, the Ben Lawers slide, the rocks above this slide constituting a veritable nappe, the Ben Lawers nappe. The metamorphic condition of the rocks indicates that the folding now exhibited by them is a relatively late feature of the structural story, and obscures their original relationships, which seem to demand inversion of the beds on a large scale such as would be brought about by recumbent folding.

Physical Society, February 26.—A. **Ferguson** and I. **Vogel**: On the hyperbola method for the measurement of surface tension. When a liquid lies between two plates inclined to one another at a small angle, its surface has a hyperbolic section, from which the surface tension can be calculated. The method has recently been improved by Grünmach. Errors arise, however, from the difficulty of determining the horizontal and vertical axes of co-ordinates. This is met by plotting two linearly related functions of the observations, the surface tension being deduced from the co-ordinates of the resulting mean straight line and the angle between the plates. The latter may be measured either directly or by calibration with a liquid of known surface tension.—E. A. **Owen** and A. F. **Dufton**: The application of radiography to the study of capillarity. The X-ray shadow of a tube has previously been used for determining the diameter of the bore. A similar method has been used successfully for capillarity measurements, and observations were made of the rise of mercury in copper and steel tubes and between vertical copper plates.

Society of Public Analysts, March 3.—B. S. **Evans** and S. G. **Clarke**: An accurate method for the determination of mercury in solution. The mercury (in solution as mercurous nitrate) is deposited on copper and then sublimed. The mercurous solution is percolated for 1½ to 2 hours through a special apparatus (see below), the filter tube of which contains a layer of copper filings. The copper, with the deposited mercury, is washed with water and then with acetone, and afterwards dried, and the mercury is sublimed on to platinum and weighed. Accurate results are obtained in the presence of arsenic antimony or bismuth, and large amounts of copper and nitrates. Hydrochloric acid interferes with the deposition, and must be removed.—B. S. **Evans**: An apparatus for continuous percolation and for filtration in neutral atmospheres. The liquid is made to percolate through a filter tube, with the aid of pressure or suction, into a flask, an open return tube ensuring that the pressure in the main funnel and the flask is the same. When the liquid in the flask reaches the end of the return tube, a difference of pressure is established and the liquid is driven back to the main funnel. For filtration in an inert atmosphere a cylinder of the desired gas can be used as the source of pressure.—A. L. **Bacharach**: Notes on the determination of moisture, calcium and phosphorus in the bones of rats. Conclusions as to the influence of diet, etc., on calcium and phosphorus metabolism are largely based on analyses of the bones of experimental animals. Standardised methods are therefore desirable; a routine method is described, and attention is directed to several possible sources of error.

CAMBRIDGE.

Philosophical Society, February 15.—A. V. **Hill**: Irreversible phenomena in muscular shortening.

March 1.—F. A. **Potts**: The development of a harpacticid Copepod.—J. **Gray**: The growth of fish during the phase of yolk-sac nutrition.—J. **Needham**: Intracellular oxidation-reduction potential and anaerobiosis. The intracellular oxidation-reduction potential of *Amœba proteus* appears to be widely independent of the external concentration of oxygen. *Nyctotherus cordiformis*, an anaerobic protozoon normally living in the frog's large intestine, possesses an internal *p*H of 7·1 and an internal *r*H of 19·0-20·0 under aerobic conditions, while under anaerobic conditions the latter value changes to *r*H 9·5-10·5. Nyctotherus can therefore reduce strongly electronegative indicators. It is significant that the amœba, the *r*H of which is independent of the environmental oxygen concentration, cannot adapt itself to an anaerobic life and dies in conditions under which Nyctotherus will live.—Sir J. **Larmor**: Insular gravity and oceanic isostasy.—R. **Hargreaves**: (1) Relativity in connexion with axial rotation. (2) The problem of relativity in reference to several bodies.—R. **Vaidyanathaswamy**: The general (m, n) correspondence.—S. **Goldstein**: The stability of a strut under thrust, when buckling is resisted by a force proportional to the displacement.

PARIS.

Academy of Sciences, March 1.—The president announced the death of Prof. Kamerlingh Onnes.—Gaston **Julia**: The domain of existence of an implicit function defined by an integral relation $G(x,y) = 0$.—H. **Krebs**: A geometrical representation of some transformations of partial differential equations.—H. **Milloux**: A property of meromorph functions at asymptotic value.—A. **Kovanko**: The necessary and sufficient conditions of the integration of suites of functions capable of summation term by term.—Edgar B. **Schieldrop**: The non-holonome deviation.—R. **Dugas**: The geometrical interpretation of the method of Jacobi in the case of a point of variable mass.—Louis **Roy**: The propagation of waves on the elastic line with six parameters.—E. G. **Barrillon**: A mechanical apparatus for tracing hydrodynamical

fields.—Marcel **Jacob**: The utilisation of measurements of rotatory magnetic polarisation in the analysis of mixtures. In order to circumvent the difficulty introduced by unavoidable changes in the intensity of the magnetising current, a compensation method was arranged, details of which are given.—A. **Dauvillier**: Researches on electric discharge in gases and the radiations which accompany it.—M. **Aubert** and E. **Aubrée**: An extension of the method of critical solubility temperatures for the analyses of petrols. The calculations are based on measurements of the critical solubility temperatures of the petrol in two different solvents—aniline and benzyl alcohol.—André **Job** and André **Samuel**: Complexes produced by the oxidation of the nickelocyanides in the presence of hydroxylamine. The violet complex compound produced by the oxidation in air of potassium nickelocyanide in the presence of hydroxylamine can be converted into a blue compound by the action, in neutral solution, of mercuric chloride, one cyanogen group being removed. Probable formulæ for these coloured complexes are discussed.—J. **Bougault**: An ether-oxide example of a ketone hydrate.—P. **Billon**: Combinations of oximes with zinc chloride. In the preparation of oximes with Crismer's salt, the zinc chloride is usually eliminated at the conclusion of the reaction by the addition of water. In the absence of water, an intermediate compound containing zinc chloride can be isolated from the reaction between Crismer's salt and a ketone, and these substances in contact with water decompose, giving the oxime and zinc chloride.—Georges **Mouret**: The coal basin of Haute-Dordogne. The exactitude of the results obtained by Amiot in this field is confirmed, the exact extent of the basin defined, and the character of its limits recognised.—A. **Maige**: Variations of the threshold of amylogen condensation in various cells of the plant.—Antonin **Nemec**: The humification of the dead layer of forest soils.—L. M. **Bètances**: The diffuse lymphoid formations of the vertebrates.—Auguste **Lumière** and Mme. **Montoloy**: Anthrax infection and immunity by the peritoneum.

ROME.

Royal Academy of Lincei, January 3.—O. M. **Corbino**: The electronic theory of thermomagnetic phenomena.—Livio **Cambi**: A supposed nitroprusside of bivalent iron. Doubt is expressed concerning the constitution of the compound to which Ungarelli recently attributed the formula, $Na_4[Fe(CN)_5 . NO],9H_2O$.—Carlo **Severini**: The convergence of the series of orthogonal functions.—Giovanni **Vacca**: New series for Euler's constant, C = 0·577 . . .—Mariano **Pierucci**: The total energy of the planets. The "energies" of the various planets may be obtained from that of Jupiter by dividing by simple powers of the prime factors 2, 3, and 5; the differences between the values thus calculated and those actually observed being of the same order of magnitude as the errors involved in the determination of the masses.—E. **Raimondi**: Transformation serving for the study of a current flowing between a sheet and an indefinite plane wall.—D. **Graffi**: Investigations on the accidental birefringence of colloids in movement.—C. **Jucci**: Parthenogenesis in silkworms as an illustration of the physiological capacity of individuals and of the race.—Giulio **Cotronei**: The biology of Petromyzon. (iii.) The phenomenon of contraction in the sexual maturity of *Petromyzon marinus*. The processes of sexual maturity in *P. marinus* are similar to those in *P. fluviatilis* and are also accompanied by contraction.—G. **Fadda**: A case of functional regeneration in *Cyprinodon calaritanus*.

Official Publications Received.

Cincuentenario de la Sociedad Científica Argentina (1872–1922). Evolución de la Ciencias en la República Argentina. 13: La Evolución de la Meteorologia. Por Guillermo Hoxmark. Pp. 30. (Buenos Aires.)

The British Mycological Society. Transactions, Vol. 10, Part 4. Edited by Carleton Rea and J. Ramsbottom. Pp. 233-344. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

República Argentina: Ministerio de Agricultura de la Nación. Oficina Meteorologica Nacional. Boletin Mensual. Año 7, 1922. Pp. 86+62 charts. (Buenos Aires.)

Egyptian Government Almanac for the Year 1926. Pp. viii+324. (Cairo: Government Publications Office.) 5 P.T.

Department of the Interior: United States Geological Survey. Water-Supply Paper 499: The Papago Country, Arizona; a Geographic, Geologic and Hydrologic Reconnaissance, with a Guide to Desert Watering Places. By Kirk Bryan. Pp. xviii+436+27 plates. 85 cents. Water-Supply Paper 533: Surface Water Supply of the United States, 1921. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+292+2 plates. 25 cents. Water-Supply Paper 545: Surface Water Supply of the United States, 1922. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. v+197+2 plates. 25 cents. Water-Supply Paper 556: Water Power and Flood Control of Colorado River below Green River, Utah. By E. C. LaRue. Pp. x+176+79 plates. 1 dollar. (Washington, D.C.: Government Printing Office.)

Department of the Interior: United States Geological Survey. Professional Paper 136: The Flora of the Ripley Formation. By Edward Wilver Berry. Pp. iii+94+23 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

Sixty-third Annual Report of the Secretary of the State Board of Agriculture of the State of Michigan and Thirty-seventh Annual Report of the Experiment Station from July 1, 1923, to June 30, 1924. Pp. 1030. (Lansing, Mich.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Technical Bulletin No. 69: The Fruiting Habits and Pruning of the Concord Grape. By N. L. Partridge. Pp. 39. Technical Bulletin No. 71: Growth of Lettuce as influenced by Reaction of Culture Medium. By John W. Crist. Pp. 25. Technical Bulletin No. 72: Potato Spraying and Dusting Experiments in Michigan. By J. E. Kotila and G. H. Coons. Pp. 15. Technical Bulletin No. 73: Adsorption by Activated Sugar Charcoal; with particular reference to Adsorption and Soil Acidity. By Elroy J. Miller. Pp. 60. Circular Bulletin No. 70: The Present Status of the European Corn Borer in Michigan. By R. H. Pettit. Pp. 14. (East Lansing, Mich.)

State of Illinois. Department of Registration and Education: Division of the Natural Survey. Bulletin, Vol. 15, Article 5: Changes in the Small Bottom Fauna of Peoria Lake, 1920 to 1922. By Robert E. Richardson. Pp. 325-388. Bulletin, Vol. 15, Article 6: Illinois River Bottom Fauna in 1923. By Robert E. Richardson. Pp. 389-422. Bulletin, Vol. 15, Article 7: Some Observations on the Oxygen Requirements of Fishes in the Illinois River. By David H. Thompson. Pp. 423-437. (Urbana, Ill.)

Aeronautical Research Committee. Reports and Memoranda, No. 976 (Ae. 190): Some Experiments on a Model of a B.A.T. "Bantam" Aeroplane with special reference to Spinning Accidents. Part 1: Longitudinal Control and Rolling Experiments, by H. B. Irving and A. S. Batson; Part 2: Experiments on Forces and Moments (including Rudder Control), by H. C. H. Townend and T. A. Kirkup. (A.3 g. Complete Models. 55, a, b, and c.—T. 1982, a, b, and c.) Pp. 22+16 plates. 1*s*. 3*d*. net. Reports and Memoranda, No. 988 (M. 31): The Air Bubble Viscometer. By Dr. Guy Barr. Pp. 10+2 plates. 9*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Cambridge Philosophical Society. Vol. 23, Part 1. Pp. 102. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Hull Museum Publications. No. 141: Record of Additions, No. 68. Edited by T. Sheppard. Pp. 51. (Hull.)

Leeds University. Twenty-first Report, 1924–25. Pp. 164. (Leeds.)

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1925. Pp. iv+448+121. (London: H.M. Stationery Office.) 12*s*. 6*d*. net.

Cornell University: Agricultural Experiment Station, Memoir 91: The Relation of Soil Moisture and Nitrates to the Effects of Sod on Plum and Cherry Trees. By T. L. Lyon, A. J. Heinicke and B. D. Wilson. Pp. 21. Memoir 93: A Study of the Oyster-Shell Scale, Lepidosaphes ulmi (L.), and one of its Parasites, Aphelinus mytilaspidis Le B. Part i: Biology and Morphology of the two forms of Oyster-Shell Scale; Part ii: Biology of a Parasite of the Oyster-Shell Scale. By Grace H. Griswold. Pp. 67. Memoir 94: Variations within and between Morphological Varieties of Oats and Barley. By R. G. Wiggans. Pp. 35. Memoir 95: An Explanation for the Relative Effects of Timothy and Clover Residues in the Soil on Nitrate Depression. By R. D. Wilson and J. K. Wilson. Pp. 21. (Ithaca, N.Y.)

Carnegie Institution of Washington. Annual Report of the Director of the Laboratory for Plant Physiology. (Extracted from Year Book No. 24, for the Year 1925.) Pp. 137-169. (Washington, D.C.)

Cornell University: Agricultural Experiment Station. Bulletin 439: Rearing Calves by the Use of Calf-Meal Gruel. By L. A. Maynard, L. C. Norris and W. E. Krauss. Pp. 23. Bulletin 440: An Economic Study of the Marketing of New York Potatoes. By M. P. Rasmussen. Pp. 172. Bulletin 441: Economic Studies of Dairy Farming in New York. 4: Grade B Milk with Cash Crops and mixed Hay Roughage, Crop Year 1921. By E. G. Misner. Pp. 76. Bulletin 442: Economic Studies of Dairy Farming in New York. 5: Cheese-Factory Milk. By E. G. Misner. Pp. 50. Bulletin 447: The Effect of some Legumes on the Yields of succeeding Crops. By T. L. Lyon. Pp. 20. (Ithaca, N.Y.)

Proceedings of the Ninth West Indian Agricultural Conference, Kingston, Jamaica, January 1924. Pp. 238. (Jamaica, B.W.I.: Government Printing Office.) 2*s*. 6*d*.

Western Australia. Annual Progress Report of the Geological Survey for the Year 1924. Pp. 22. (Perth: Fred. Wm. Simpson.)

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1925. Bearbejdet af (Prepared by) Kaptajn C. I. H. Speerschneider. Pp. 32+5 maps. (Kjøbenhavn: G. E. C. Gad.)

Abstract-Bulletin of Nela Research Laboratory, Incandescent Lamp Department, of General Electric Company, Cleveland, Ohio. Vol. 1, No. 4, December 1925. Pp. x+523-746+8 plates. (Cleveland, Ohio.)

Annals of the South African Museum. Vol. 16, Part 2, containing: 2. Contributions to a Knowledge of the Flora of South-West Africa. i: List of Grasses. By Miss S. Garabedian. Pp. 381-426+plate 8. 4s. Vol. 19, Part 4, containing: 10. New Species of Geometridae (Lepidoptera) in the Collections of the South African Museum, by Louis B. Prout; 11. Mycetophilidae and Bibionidae (Diptera) in the Collections of the South African Museum, by F. W. Edwards; Title, Index, etc., to Vol. 19. Pp. 579-616+xiii+plates 16-17. 5s. 6d. Vol. 20, Part 4, containing: 6. The South African Species of the Molluscan Genus Onchidella, by Hugh Watson; 7. Reports on the Marine Mollusca in the Collections of the South African Museum. i: Turritellidae, by J. R. le B. Tomlin. Pp. 237-316+plates 27-32. 10s. Vol. 21, Part 1, containing: A Monograph of the Marine Fishes of South Africa. Part 1: (Amphioxus, Cyclostomata, Elasmobranchii and Teleostei—Isospondyli to Heterosomata). By Dr. K. H. Barnard. Pp. 418+17 plates. 25s. Vol. 22 (Descriptions of the Palaeontological Material collected by the South African Museum and the Geological Survey of South Africa), Part 1, containing: 1. On some South African Fossil Woods, by John Walton; 2. Revision of the Fauna of the Bokkeveld Beds, by Dr. F. R. C. Reed; 3. Investigations in South African Fossil Reptiles and Amphibia (Part xiii), by Dr. S. H. Haughton; 4: Notes on some Cretaceous Fossils from Angola (Cephalopoda and Echinoidea), by Dr. S. H. Haughton. Pp. 288+15 plates. 20s. Vol. 23, Part 1, containing: 1. Contributions to a Knowledge of the Fauna of South-West Africa. iv: A List of the Heteropterous and Homopterous Hemiptera of South-West Africa. By Dr. A. J. Hesse. Pp. 190+8 plates. 12s. 6d. (Cape Town: South African Museum; London: Wheldon and Wesley, Ltd.)

Royal Botanic Gardens, Kew. Picture post cards. Set 9: Hardy Trees and Shrubs 6 cards in colour. 1s. Set 10: Stove and Greenhouse Plants. 6 cards in colour. 1s. Set 11: Rhododendrons (*Ericaceae*). 6 cards in colour. 1s. Set 13: Hardy Trees and Shrubs. 6 cards in colour. 1s. (Kew, Surrey: Royal Botanic Gardens.)

Canada. Department of Mines: Mines Branch. Investigations in Ceramics and Road Materials (Testing and Research Laboratories) 1924. Pp. ii+45. (Ottawa: F. A. Acland.)

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1925. Pp. iii+75. (Ottawa: F. A. Acland.) 15 cents.

Proceedings of the University of Durham Philosophical Society. Vol. 7, Part 2, 1924–1925. Pp. 59-106. (Newcastle-upon-Tyne.) 5s.

Report of the Broadcasting Committee, 1925. (Cmd. 2599.) Pp. 22. (London: H.M. Stationery Office.) 6d. net.

Report of the Royal Commission on the Coal Industry (1925), with Minutes of Evidence and Appendices. Vol. 1: Report. (Cmd. 2600.) Pp. xii+294. (London: H.M. Stationery Office.) 1s. net.

Proceedings of the Royal Society of Edinburgh, Session 1925–1926. Vol. 46, Part 1, No. 9: The Slow Oxidation of Phosphorus Trioxide. Part i: The Action of Water-Vapour on Phosphorus Trioxide. By Dr. Christina Cruickshank Miller. Pp. 76-85. 1s. Vol. 46, Part 1, No. 10: Note on Copper-tinted Flame Caps. By William Cooper. Pp. 86-89. 1s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

National Research Council. Organization and Members, 1925–1926. Pp. 59. (Washington, D.C.: National Academy of Sciences.)

XXXIII Jahresbericht des Sonnblick-Vereines für das Jahr 1924. Pp. 34. (Wien: Selbstverlag des Sonnblick-Vereins.)

Tanganyika Territory. Report of the Department of Agriculture for the Year 1924–5. Pp. 45. (Dar es Salaam.)

Agricultural Experiment Station, Kansas State Agricultural College, Manhattan, Kansas. Technical Bulletin 17: Studies of Inheritance and Evolution in Orthoptera. 5: The Grouse Locust, Apotettix eurycephalus Hancock. By Robert K. Nabours. Pp. 231. (Manhattan, Kansas.)

Memoirs of the Geological Survey of India. Vol. 51, Part 1: Indian Geological Terminology. By Sir Thomas H. Holland. Pp. iv+184+xx. (Calcutta: Government of India Central Publication Branch.) 2.8 rupees; 4s. 6d.

Verhandlungen des Naturhistorischen Vereins der preussischen Rheinlande und Westfalens. Zweiundachtzigster Jahrgang, 1925. Pp. xii+455+7 Tafeln. (Bonn.)

Report of the Twenty-third Annual Meeting of the South African Association for the Advancement of Science, Oudtshoorn, 1925, July 6-11: Being Vol. 22 of the South African Journal of Science. Pp. xliv+579+21 plates. (Johannesburg.) 30s. net.

Scientific Papers of the Institute of Physical and Chemical Research. No. 41: On the Separation of Germanium. By Isaburo Wada and Sechi Kato. Pp. 243-261. 30 sen. No. 42-43-44: Synthesis of the simplest Homologue of Urushiol, by Sin-iti Kawai; On a new Reaction between Triacetine and Phenol and an improved Method for the Preparation of Triacetine, by Sin-iti Kawai; On the Preparation of Catechol-Ortho-Carboxylic Acid and the Condensation between Catechol and Glycerol, by Sin-iti Kawai. Pp. 263-231. 30 sen. No. 45: The Effect of Atmospheric Humidity on the Dielectric Losses and Power Factors in Fibrous Insulating Materials. By Shoji Setoh and Yotsuo Toriyama. Pp. 283-323. 50 sen. No. 46: On the relative Nutritive Value of various Proteins contained in Japanese Food Articles. By Umetaro Suzuki, Yoshihiko Matsuyama and Nabetaro Hashimoto. Pp. 47. 60 sen. No. 47: The Crystal Structure of Iodoform. By Isamu Nitta. Pp. 49-58. 20 sen. No. 49: Radioactive Manganiferous Nodules from Tanokami, Oomi Province. By Satoyasu Iimori. Pp. 79-83. 20 sen. (Tokyo.)

The New University of Reading: some Ideas for which it Stands. By W. M. Childs. Pp. 64. (Reading.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 66: Seasonal Variation in Salinity of Water of some Drains of the First Circle of Irrigation. By R. Aladjem. Pp. 4+5 plates. (Cairo: Government Publications Office.) 5 P.T.

British Research Association for the Woollen and Worsted Industries. Annual Report, 1925. Pp. 27+4 plates. (Headingley, Leeds.)

Clifton College Scientific Society. Report for the Years 1924–25. Pp. 24. (Bristol.)

Diary of Societies.

SATURDAY, MARCH 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Rare Gases of the Atmosphere and their Importance in Atomic Theory (4).

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—P. S. Lea: Notes on Safety Lamps.—Discussion of Papers by J. T. Pringle: Housing of Workmen; and F. J. Johnston: The Use of Breathing Apparatus in Mines.

TUBERCULOSIS SOCIETY (jointly with Society of Superintendents of Tuberculosis Institutions) (at Cambridge). (Continuation.)

MONDAY, MARCH 29.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Institution of Mechanical Engineers), at 2.30.—To inaugurate the Association.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Canon A. Lukyn Williams: The Problem of the Septuagint and Quotations in the New Testament.

INSTITUTE OF ACTUARIES, at 5.—G. H. Recknell: The Bonus Earning Power of a New Business Fund.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Mr. Shattock: Demonstration of Specimens of Pathological Conditions of the Breast.

RAILWAY CLUB (at 65 Belgrave Road, S.W.), at 7.30.—W. J. Mitchelhill: Electricity in Railway Operations.

ROYAL SOCIETY OF ARTS, at 8.—W. F. Higgins: Thermometry (Cantor Lectures) (3).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Major T. G. Tulloch: Surface Combustion.

TUESDAY, MARCH 30.

ENGINEERS' CLUB (Manchester), at 1.45.—Annual General Meeting.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir Thomas Horder, Bart.: Endocarditis (Lumleian Lectures) (3).

INSTITUTE OF MARINE ENGINEERS, at 6.30.—E. Ford: Some Marine Researches and our Sea Fisheries.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—R. B. Matthews: Electro-Farming; or the Application of Electricity to Agriculture.

ILLUMINATING ENGINEERING SOCIETY (at Lighting Service Bureau, 15 Savoy Street), at 7.—H. Lester Groom and others: Discussion on Stage Lighting.

ROYAL PHOTOGRAPHIC SOCIETY (Kinematograph Group), at 7.

RÖNTGEN SOCIETY (at Royal Society of Medicine), at 8.15.—Sir John Thomson-Walker: Radiology in Urinary Surgery (Silvanus Thompson Memorial Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE (Indian Section), at 8.15.—A. F. Geddes: Some Villages of Western Bengal.

WEDNESDAY, MARCH 31.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—F. Nasmith: Fathers of the Machine Cotton Industry.—S. Daniloff: Some Unusual American Spinning Wheels.—R. E. Naumburg: Two American Textile Pioneers.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—E. V. Clark: Power Factor and Tariff.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Neville Hall, Newcastle-upon-Tyne), at 7.—A. Karl: The Analysis of Wave Making Resistance.

FRIDAY, APRIL 2.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at Glasgow), at 7.—Annual Meeting.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch, Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—L. Close: Boilers.

SATURDAY, APRIL 3.

SCOTTISH JUNIOR GAS ASSOCIATION (Annual Meeting) (at Royal Technical College, Glasgow), at 7.—Prof. T. Gray: Address.

PUBLIC LECTURE.

SATURDAY, MARCH 27.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. H. S. Harrison: Early Man and his Wanderings.

CONFERENCE.

TUESDAY, MARCH 30.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30 A.M.—The Culture and Manuring of Fodder Crops.—Sir E. J. Russell: Rothamsted Experiments on Root Crops.—W. A. C. Carr: Swedes and Kale.—J. C. Brown: Mixtures for Forage Crops.—C. Heigham: Mangolds and Sugar Beet.

CONGRESS.

APRIL 2 TO 23.

JERUSALEM AND BEIRUT, INTERNATIONAL ARCHÆOLOGICAL CONGRESS.