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Pleistocene Man in China.

NEWS arrived by cable on Dec. 15 of the discovery in the cave at Chou Kou Tien of the fossilised fragments of ten more examples of *Sinanthropus*, certainly the most remarkable find of early Pleistocene human remains that has ever been made. Amongst these is said to have been a complete skull with both the cranial and facial bones perfectly preserved. This discovery was made by a group of geologists and anthropologists representing the Geological Survey of China and the expedition endowed by the Rockefeller Foundation.

The credit of recognising the importance of the site where these fossils have been found belongs to Prof. J. G. Andersson, the Swedish geologist, who, in conjunction with Dr. Grainger, the palæontologist of the American Museum of Natural History, surveyed the field in 1927. Continuing the investigation, Prof. Andersson, in association with his fellow-countryman Dr. Birger Bohlin, who is now a member of Sven Hedin's expedition in eastern Asia, found the first tooth of the Peking man for which Prof. Davidson Black, of the Peking Union Medical College, created the new genus and species *Sinanthropus pekinensis*. This discovery, and also that of a second tooth, have already been described by Prof. Davidson Black in our columns (NATURE, Nov. 20, 1926, p. 733, and Dec. 31, 1927, p. 954). A year ago fragments of two skulls, one of a child and one of an adult, including parts of the jaws and of the brain cases, afforded a definite confirmation of the validity of Davidson Black's new genus. Now comes the astounding discovery of remains of ten individuals, which should provide the material for the study of early Pleistocene man such as anthropologists hitherto had scarcely ventured to hope to find.

In a recent letter Dr. Davidson Black stated that before Aug. 31 a number of interesting finds had been made at Chou Kou Tien, including six beautifully preserved teeth of *Sinanthropus* forming part of an additional individual, that is, additional to the two originally discovered and some yards away from the spot where they were found. Father Teilhard and Mr. Young have almost completed the preliminary report on the geology of the deposit, and it was hoped to have this report, for the writing of which Father Teilhard is responsible, published before Christmas. This very important step in the programme of research will be followed by a revised and extended list of the fauna which it is expected will be ready before next spring. The material which is now prepared for investigation is

so rich that most of the doubts about the identification of the species of animals will be cleared up and many additions will be made to the earlier list prepared by Dr. Zdansky.

The work has grown to such proportions that it has been necessary to extend the laboratories at the Peking Union Medical College to make room for no less than twenty-five technical assistants who are engaged in developing the fossil remains of the associated fauna. Prof. Davidson Black himself is doing all the preparatory work on the human material, which will take many months to develop. His communication, to which reference has already been made, was written six weeks before the new material announced by cablegram on Dec. 15 came to light. With this extraordinarily rich material we are promised a most important contribution to our knowledge of one of the three earliest members of the human family that have so far been discovered. On Dec. 29 Prof. Davidson Black will make an official statement on the new discoveries.

Science in Crop Production.

The Application of Science to Crop Production: an Experiment carried out at the Institute of Plant Industry, Indore. By Albert Howard and Gabrielle L. C. Howard. Pp. v + 81 + 12 plates. (London: Oxford University Press.) 9*s*. net.

IN many countries, up to the War period, the career of agricultural research was one of struggle and piecemeal growth. Exceptions were to be found in the steady evolution of research institutes in some European countries; the United States had inaugurated a wide organisation; and in India an interesting feature was the establishment of certain 'central' research stations. Tropical agricultural research was, in general, under neglect. The decade now ending will always stand out as a period of informed interest and of determination to develop agriculture by application of the sciences. It is of the British Empire that this is particularly true, and the Imperial Agricultural Research Conference of 1927 may prove to merit a permanent place in the history of agricultural development.

Movement has been in a number of directions. Apart from expansion of existing centres, there has come 'industry' research as exemplified in the Empire Cotton Growing Corporation's Research Station in Trinidad and the Rubber Research Institute in Malaya. The new Amani Institute in East Africa represents a novel form of 'central' research station, while the Imperial College of Tropical Agriculture in Trinidad gives the Empire its first tropical training ground. Agricultural research councils have recently been set up for the non-self-governing colonies and for India. From this new activity are emerging many problems, ranging over finance, the sciences, organisation, and local political situations, and extending down to the recruitment, training, and status of the research worker. This is pre-eminently, therefore, a time which makes welcome any logical survey of the methods of inaugurating and conducting agricultural research on a large scale.

In the volume before us, Mr. and Mrs. Howard relate the story of the genesis, scope, and experimental work of the recently founded Institute of Plant Industry at Indore, Central India. Central India, a group of Indian States, is a large tract in which 'black cotton soils' predominate. In 1919 it was decided to found an agricultural research station for the whole area, and Mr. Howard became Director of the Institute and Agricultural Adviser to States in Central India and Rajputana. Gifts of land and money were made by the States, and in 1924 the recently formed Indian Central Cotton Committee provided buildings and equipment and guaranteed a substantial annual income. By 1928 the Institute was incorporated and made fully autonomous; it is now financed by subscription and controlled solely by the subscribers. Thus was removed one of the difficulties of organised research, and one which the authors believe to have been a grave defect in British India, namely, the oppressive official control of work and organisation by way of official control of funds. The circumstances of Central India made the broad task of the Institute clear. Work was concentrated upon cotton and along the following main lines: fundamental investigations on cotton, especially in relation to the characteristics of black soils and the production of improved varieties for those soils; the training of post-graduates and others; and the general stimulation of agricultural development in Central India.

General policy and development at Indore are of especial interest when taken as an illustration of the general case. The major considerations which are steadily associating themselves with large-scale agricultural research are grouped round experimental policy; organisation including finance; and the means of projecting research results into farming practice.

Upon experimental policy there are two rather divergent schools of thought. One would content itself with finding really competent research workers in the various sciences and giving them full working

facilities and full freedom. It argues that all fundamental advances must in time inspire improvements of practice and that economic applications arise, and may be left to arise, unexpectedly from unfettered research. In contrast, the second school favours a survey of the economic situation and the practices of production, in the light of which a limited number of urgent but approachable problems should be selected. Experimentation should then be specifically directed to these problems. It should commence with a strong ' applied ' bias and gradually find its way into the underlying fundamental scientific problems. In support of this it could be urged that any crop or domesticated animal offers literally infinite scope for experiment ; that resources are limited ; and that, therefore, the direction of research must to a fair extent be prescribed. In brief, the problem of guiding experimental policy is to maintain a live connexion with the practices of agriculture without depriving research of that measure of freedom which is vital to all scholarship. Flexibility of outlook is the fundamental necessity, for time and circumstance are bound to give suitable scope to both the alternative attitudes. At Indore, it is clear, faith in the man rather than the organisation has been the guiding principle ; and yet the economic bias has not been forgotten, for science is being applied to crop production by progressive analysis of a number of clearly defined practical problems.

The organisation of a research institute involves finance, government, internal administration, staffs, buildings, and equipment. In connexion with each of these, current practice varies widely among agricultural research centres. Indore, by reason of the agricultural and political circumstances of Central India, is saved from many of the difficulties familiar elsewhere. It is, none the less, an extremely interesting example. In finance there is complete autonomy, and to this the authors attach great importance. By most praiseworthy restraint the Board of Governors has been limited in number to seven, of whom one, the Agent to the Governor-General in Central India, is *ex-officio* president. Three of the members represent the constituent States and three the Indian Central Cotton Committee. This body, small, and directly concerned in the ultimate aims of the Institute, may perhaps be looked on as, in principle, ideal of its kind. For it is unlikely to lose touch with essential aims by dissipating itself into committees the time of which is taken up by the *minutiæ* of internal administration. One of the most interesting chapters in the volume describes the lay-out and development of land and buildings, the stock, the equipment, and the working material in general. It is a rare and valuable guide for future undertakings.

How to project research results into agricultural practice is the remaining major consideration. Its great importance has in the past rarely been appreciated either by the research worker or by government or other financing body. In England it has been by no means neglected, and yet there are many farmers who, in such familiar practices as the use of fertilisers, still fail entirely to profit from the clear-cut principles which have long been familiar to science. At Indore the general problem has been resolved into liaison on one hand and the scope and status of the Station on the other. Students trained and sent out into the States are regarded as the most effective agents for liaison with the supporters of the Institute. With the help of a certain number of scholarships, it has been possible to commence the training of Indian university graduates as specialists in cotton. Agricultural officers and subordinates are urgently needed for the contributing States, and arrangements have been made to train present occupants of these posts and to recruit new ones. The aim is not so much to afford a knowledge of agricultural science as to stimulate an informed interest in the development of the countryside. A novel and most valuable feature has been a short course for a certain number of State officers connected with the revenue departments. Training, or the making of liaison agents, is extended even to the cultivator. The labour staff of the Institute is maintained as a fluid body from which trained men are gradually drafted to the districts where, in various capacities, they are expected to become the foci of an improved agriculture.

Indian experience has made clear, the authors feel, that a ' central ' research station as formerly conceived, cannot succeed. Unless it produces results of economic value it will sink in the general estimation and lose financial support. But if it produce such results, how is it to ensure that they are adopted in practice ? In British India the provincial stations are the only medium available. These, however, have duties, interests, and researches of their own, and, in effect, cannot subserve the central station. It is urged, therefore, that, together with the central station for any ' area ', there should be established demonstration farms in the component ' districts '. These should engage in no scientific work, but concentrate on inducing the cultivator to adopt the improvements emanating from the central station. Indore is conceived

upon these lines and the States are providing the necessary demonstration farms. It is, perhaps, a fair criticism that in some countries this simple partition of ' research ' and ' demonstration ' would offer difficulties. Men sufficiently competent and interested to have charge of demonstration farms and propaganda would not always be willing to eschew investigation and subdue originality. Moreover, for areas varying sharply from place to place in soil and other circumstances, full experimental confirmation of central station results in representative districts would be essential.

Of actual experimental achievement, despite the short life of the Institute, there is a good deal to show. The comprehensiveness of the policy is a noteworthy feature, and the essential aim is to study the cotton plant as actually grown by the cultivators. Improved varieties usually offer, in circumstances of somewhat backward husbandry, the readiest chances of advancing agriculture, and, provided a seed supply be organised, they are the swiftest means of gaining the cultivator's good will. But, even in India, increases in yield from improved varieties are usually of the order of only 10 per cent. Far more substantial increases may be effected by cultivational improvements, and the authors hold that on the black soils better methods may be expected to double the output per acre of cotton. With plant breeding are therefore linked extensive studies upon weed eradication ; upon the control of water during the monsoon to prevent erosion and soil deterioration ; upon soil permeability ; and upon the organic matter content of black soils. It is believed—and the experiments now bear witness —that in these four questions are to be found the essential limitations to output per acre. Well-irrigation, the maintenance and improvement of stock, and appropriate ploughs, crushing mills, and other mechanical appliances, are further subjects of investigation. To ensure that improvements in these directions pass into practice, the Institute arranges supplies to cultivators on simple financial terms.

In each of the fields selected the experimentation projected or in progress is very comprehensive. Moreover, while closely regarding the underlying fundamental scientific questions, it is directly linked with the circumstances of husbandry. Plant breeding is based upon a study of all obtainable forms of Indian cotton, to which will be added, later, other Old World cottons. Botanical surveys of Indian cottons have already been made, but these, for plant breeding and husbandry, are of no more than cataloguing value. The quality or manufacturing characteristics, the adaptation to soil, season, and cultivational practice, and resistance to diseases and pests, are of first importance. To all of these close attention is being given, and this wide survey must inevitably assist improvement in many branches of crop production.

The Indore Institute is itself an experiment. Its avowed aim—the application of science to crop production—is clearly reflected in both general organisation and experimental policy. Some of its features are novel, and some have been pre-determined by the circumstances of the area it serves. As an agency—the central agency—in the agricultural advancement of Central India, its strong potentialities are already manifest. As a new model it will claim the close interest of all to whom it falls to create or maintain centres of agricultural research.

F. L. ENGLEDOW.

Sir Ronald Ross and Malaria.

(1) *Studies on Malaria.* By Sir Ronald Ross. Pp. xii + 196 + 4 plates. (London : John Murray, 1928.) 5*s*. net.

(2) *La découverte de la transmission du paludisme par les moustiques.* Par Sir Ronald Ross. (Une grande page de l'histoire de la médecine.) Préface et traduction de l'anglais par Dr. Charles Broquet. Pp. 175. (Paris : Norbert Maloine, 1929.) 20 francs.

(3) *Letters from Rome on certain Discoveries connected with Malaria.* By Dr. T. Edmonston Charles, and Addenda, consisting of an article by S. Calandruccio, letters from Robert Koch and A. Laveran, and a statement by Lord Lister. Edited, with a Preface and Remarks, by Sir Ronald Ross. Pp. 78. (London: Sir Ronald Ross, Ross Institute and Hospital for Tropical Diseases, 1929.)

(1) SIR RONALD ROSS has prepared this summarised and readable account of his work on malaria for the benefit of numerous correspondents who desire a small and convenient volume on the subject. In the first chapter the earlier years of the author up to 1894 and the work of Laveran and Golgi are briefly reviewed, and in the second and third Sir Ronald describes the difficult conditions under which his observations on the development of the parasites of malaria in mosquitoes were begun and carried on in India. The next chapter is a re-statement of the unfortunate controversy with the late Prof. Grassi and his colleagues.

In 1899, Ross arrived in England and was

appointed lecturer on tropical medicine in Liverpool, and almost at once went out on the first expedition to Freetown. He describes his observations and the lack of response on the part of the Colonial Office to representations in regard to measures based on these observations, and the cheering effect of the gift of £2000 from Mr. Coats for a year's trial of the plan for mosquito control. The second expedition to Freetown was then planned as an object-lesson in mosquito reduction, and an account follows of the work of Dr. Logan Taylor there. Visits were made to Lagos and the Gold Coast, where Sir Ronald records that he had a more appreciative reception, and to Ismailia, where methods for mosquito reduction were entirely successful. Visits followed to Panama, to see the results of the work of Gorgas, and to Greece and Mauritius.

Ross resigned in 1912 the chair of tropical medicine in Liverpool, which he had held for ten years, and commenced practice in London. War service, the petition by the author for a monetary compensation for his work, and the foundation of the Ross Institute in 1923 are briefly dealt with, and in a final chapter is a summary of the main facts about malaria. A list of 108 references is appended.

(2) This is a translation of "Researches on Malaria", prepared by Ross for his lecture in Stockholm in December 1902, when he received the Nobel Prize, and reprinted in the *Journal of the Royal Army Medical Corps*. Ross's drawings of the stages of the malaria parasite in the mosquito are reproduced in nine plates and seven text figures. In the preface Dr. Broquet gives a short biography (28 pp.) of Ross and a review of his chief works.

(3) The letters from Rome were first privately printed in 1900, but only a few copies were issued —in February 1901. The present edition is prepared for "those who study the history of medicine and who prefer truth to fiction". The letters, eight in number, were written from Rome by Dr. Charles to Major Ross in Calcutta between Oct. 4, 1898, and Jan. 14, 1899. Dr. Charles reported to Major Ross the investigations on human malaria then being carried out in Rome by Prof. Grassi and his colleagues, and he obtained from Ross specimens of the mosquitoes studied by him in India and from Manson one of Ross's microscopic slides showing zygotes of *Proteosoma*—the organism of bird malaria the cycle of which was the subject of Ross's work in India. These specimens and others sent by Ross to Charles were shown to Grassi and his colleagues. Dr. Charles, in fact, acted as the intermediary between Ross and Grassi for the ten weeks covered by the letters.

In the second of two postscripts, Ross states that "the whole of the Italian work depended on my discovery of the zygotes", and that when the Italians "took up the work it no longer presented any serious difficulties". That is Ross's position and is the reason for the republication of these letters. As Profs. Grassi and Bignami, the chief two Italian workers, are dead, it would be well to let the controversy cease.

Appended is a list of publications on the transmission of malaria, bearing dates from Dec. 8, 1894, to Dec. 22, 1898—the period concerned in the discussion of priority.

Reform of the Calendar.

(1) *Report of the National Committee on Calendar Simplification for the United States, submitted to the Secretary of State, Washington, August 1929.* Pp. 119. (Rochester, N.Y.: National Committee on Calendar Simplification, 1929.)

(2) *Thirteen-Month Calendar.* Compiled by Julia E. Johnsen. (The Reference Shelf, Vol. 6, No. 4.) Pp. 201. (New York: The H. W. Wilson Co., 1929.) 90 cents.

IF one may judge by the publications before us, the question of reforming the calendar has made considerably more headway in the United States than in Great Britain. The American National Committee was formed in response to a suggestion received in 1927 from the League of Nations. From the beginning, Mr. George Eastman, of the Eastman Kodak Company, took a keen part in its organisation, and became its energetic chairman. The composition of the committee was fairly representative of all interests, with one rather significant exception. It was not found practicable to include a section to represent the views of the various religious bodies, and the attempt was frankly abandoned.

The result of circulating a questionnaire and collecting already existing evidence on the subject is to show a wide interest in calendar reform on the part of a large body of American opinion. So far as this favours a particular plan, it is the fixed calendar of thirteen months which finds the largest measure of support. As this is the most drastic type of scheme and is open to the most obvious superficial objections, and alternative schemes are passed over very lightly, the impartiality of the committee may not appear above suspicion. But its practical conclusion is that a decision can

only be arrived at by an international conference, that the United States Government should express its willingness to participate at an early date, and that the American representatives should not be committed to any particular scheme of reform. No other view, except a purely negative one, is possible, for it may be taken as common ground of all enlightened opinion that any contemplated change must be introduced universally and simultaneously.

The extent of the propaganda behind the movement in favour of a calendar of thirteen months is shown perhaps even more clearly in the second volume, which gives in a clearly arranged form a summary of the arguments (for and against) reduced to heads, bibliographical notes, and excerpts from the literature of the subject. This should be found very useful and instructive. The desire for a change comes most urgently from the part of those concerned in business management, and naturally from those quarters where it has been found most convenient to adopt a month of four weeks as the unit of accounts. Perhaps the arguments based on experience in this connexion sometimes overshoot their mark. Thus the comptroller of the Western Clock Company has pointed out very cogently the advantages which have followed from adopting this system in his business. But these have been gained by a domestic arrangement equally open to others, with little or no hindrance arising from the anomalies of the present calendar. There is much scope for the judicious use of a private calendar, designed for special needs, without waiting for a revolution which may be a long time in coming. In the domain of meteorological statistics, for example, it is conceivable that the adoption of some world-wide scheme by agreement would confer greater advantages than those which may be expected to follow automatically from the introduction of a new civil calendar.

The movement is not free from the two-edged and even sordid type of argument to which the ardent propagandist is prone. A specimen may be quoted:

"It should increase your business. When the new calendar is in general effect all monthly periodicals would be issued thirteen times a year instead of twelve.

"There will be an increase in the amount of printing of bills, statements, etc."

Such arguments may account for some of the definite support behind the movement, but they will scarcely advance the case. Nor is the argument that a reformed calendar would be more scientific in the least impressive. To smooth out the existing irregularities of the present calendar is too simple a task to present a scientific problem, and men of science will be the last to allow their own interests any excessive weight in the solution of it. The question is mainly social and religious, and must be decided by political and religious agreement. In the meantime, the fixing of Easter within narrow limits, a simple object of some importance to many, seems likely to be hindered indefinitely by the search for an ideal calendar acceptable to all interests.

H. C. P.

New Six-Language Technical Dictionary.

Pitman's Technical Dictionary of Engineering and Industrial Science in Seven Languages—English, French, Spanish, Italian, Portuguese, Russian and German. Compiled by Ernest Slater. Vol. 1: *A-Dec.* Pp. x+581. Vol. 2: *Dec-Knu.* Pp. iii+582-1155. Vol. 3: *Lab-Rib.* Pp. iii+1156-1727. Vol. 4: *Rib-Zon.* Pp. iii+1728-2211. (London: Sir Isaac Pitman and Sons, Ltd., 1928–1929.) 4 vols., £8 8*s.* net.

THIS monumental work is more than a mere dictionary, and certain of the preliminary sections might be read with advantage by all who have to do with the translation of technical matter into foreign languages or have business relations with firms abroad.

The book originated with a small group of translators—most of them trained engineers—who took as their basis a list of terms collected abroad during some years and amplified this by reading and marking journals and text-books of the various countries in question. This procedure, supplemented by correspondence with engineers in other countries, has given the foreign equivalents, not merely for ordinary engineering terms, but also for many workshop slang expressions.

The first intention was to treat of each branch of engineering in a separate volume, the inclusion of the whole in a single book being decided on when it was found that about 60 per cent of the entries for any branch must consist of more or less general engineering terms. Thus, the volume on steam engines would not be complete without considering pipes and pipe-joints, which would be equally essential when treating of water or gas engineering, and such matters as plates, rivets, bolts, and girders figure in many departments of engineering.

The dictionary proper is preceded by several

sections in which special difficulties are discussed. Section 1, "The Art of Technical Translation", furnishes useful information as to the way many of the expressions in common use are to be converted into the corresponding foreign phrases. Section 2, on "Alternatives, Refractory Idioms, and Peculiar Phrases", considers the correct renderings of: alternating, back gear, booster, coal of various grades, control, efficiency, head, jam, oil, patch, soldering and brazing, temper, tool, weir, and a number of other terms, of which the translation into certain languages demands special care.

Section 3 gives a record of untranslatable English words adopted in their original form into other languages, while Section 4 indicates how phrases referring to mechanical motion, relation, position, cause and effect, are expressed in each language; idiomatic forms commonly used in advertising are also included here. In Section 5 there is laid down a guide to common engineering abbreviations, and to technical and scientific signs, contract conditions, specification matter, engineering slang, shop terms, etc.

The dictionary itself extends over more than 2100 pages ($9\frac{1}{2} \times 7$ inches), each of four columns, one side being devoted to English-French-Spanish-Italian and the opposite one to English-Portuguese-Russian-German. This arrangement has involved duplication of the English column, but it prevents the confusion that might arise from faulty alinement. Every page contains from forty to fifty entries.

As regards most branches of engineering, the book appears to be as nearly complete as it is possible to make it. Entries relating to air, for example, occupy six, to coal more than six, to oil six, and to sugar four sides. On the other hand, although the sub-title includes the word chemistry, the list of terms relating to chemical engineering subjects is not nearly so full as might be desired. To take the important question of distillation alone, the terms reflux and drip-pipe are missing, and for bell the French equivalent is given only as 'cloche', 'calotte' not being mentioned. Such terms as cream of tartar, nitre, soda ash, and pyroligneous acid are found, but salt cake, vinegar, brewing, and a number of others are absent.

The book has been well produced and opens well at any page. The type in the main body of the dictionary, although clear, is rather small, but this is doubtless due to the necessity for keeping the bulk within reasonable limits. In the Russian column the old spelling, not that now in use in Soviet Russia, has been adopted. A few minor misprints have been noticed, but in general great care has been taken in the correction of proofs.

The dictionary may be cordially recommended for purposes of technical translation from English into any of the other six languages, but it does not serve for translation into English. To this extent it is less useful than the Deinhardt and Schlomann series of illustrated six-language technical dictionaries, which contain complete indexes, although they do not comprise Portuguese.

A Modern Platonist.

Matter, Life and Value. By C. E. M. Joad. Pp. xviii + 416. (London: Oxford University Press, 1929.) 18*s*. net.

THIS book, which is Mr. Joad's philosophical confession of faith, is an interesting and very readable work. The author is opposed to the tendency prevalent among philosophers of reducing the number of real independent entities in the universe in the supposed interests of logical consistency. Mr. Joad argues forcibly against various types of monistic philosophy, and for himself is prepared to admit the existence of the three types of entity mentioned in the title and to base his system of philosophy on this division in spite of any logical difficulties that may arise.

The style of writing is always lucid and pleasant and sometimes eloquent. The views of others are well and fairly discussed. The author's own views are stated modestly without trying to disguise the difficulties involved or pretending that only a fool could think otherwise. Along with these qualities the book has marked defects which appear to be the result of carelessness and haste. Many books on scientific subjects are of necessity written in a hurry because their interest is ephemeral, but a philosophical work, if it is worth reading at all, is equally worth reading in ten years' time and is none the worse for a little care and deliberation. The intervention of an editor armed with a large blue pencil might have worked wonders. Among other things, he would have eliminated the first chapter or had it rewritten. This chapter professes to give a criticism of classical scientific materialism and to state the scientific evidence in favour of admitting life as an autonomous principle or activity distinct from matter. It is quite the worst thing in the book and is likely, standing where it does, to prejudice the reader against the rest of the book. The author apologises for his first chapter, it is true, but it is not apologies that are needed. The defects are not

fundamental; that is to say, the author has an intelligible view to put forward; they are chiefly a matter of looseness and carelessness of expression. The most glaring error, though in its context it is trivial, is the statement that ". . . the principle of entropy was not known to nineteenth-century physics" (pp. 9-10).

Another example of careless expression is seen later on where the question of 'values' is being discussed. The author in stating his æsthetic theory deals primarily with the subject of music—an interesting and, to the reviewer at least, an illuminating discussion. Having explained that music is not properly concerned to represent or symbolise either objects of the physical world or human activities or relations, and that it is therefore in a quite definite sense meaningless, he then produces the startling definition that music which produces its proper and intrinsic effect is to be called 'significant music' (p. 285). The definition is harmless if the reader keeps in mind that the word 'significant' does not mean significant, in fact does not mean anything; but it is very careless. The reason for the use of this unsuitable word appears to be that Mr. Joad has been bemused by that catchword of the second-rate art critics, 'significant form' (pp. 299-304). Lastly, the book as a whole is too long for the amount of matter it contains, and many passages are rambling and diffuse.

Mr. Joad is a Platonist, as many English philosophers have been. He is generally at his best when he is most purely Platonic; his ideas then are clear and firmly developed. But when he draws on the theories of modern thinkers—and he does this in a curiously promiscuous way from Schopenhauer, Bergson, Whitehead, and Bernard Shaw—the reader gets the impression of confusing eddies and cross currents breaking up a smooth current of thought. It is as though he cannot bear to let go any philosophical idea that appeals to him, but must add it to his collection, however incongruous it may be. A. D. R.

Our Bookshelf.

A School Certificate Chemistry. By G. H. J. Adlam. Pp. x + 334. (London: John Murray, 1929.) 4*s*. 6*d*. net.

DURING the last few decades much attention has been given to the methods of teaching science, especially chemistry. Definite courses of instruction have been framed for educational purposes, and they have tended to become stereotyped in conformity with the requirements of examining bodies. The subject matter of the science, however, has not received a similar careful scrutiny, and, whilst in the outside world epoch-making advances have been made, they have passed unheeded in the classroom. There is thus a danger that a distinction may soon be drawn between chemistry and 'schoolmaster's chemistry'. It is with this in mind, evidently, that Mr. Adlam has written his volume for elementary students, in which recent industrial methods receive preference over the obsolescent, uneconomic preparations of the average elementary text-book.

Mr. Adlam sees no reason why the newer, large-scale methods of producing inorganic substances should not be adapted for teaching purposes. Thus, the steaming of red-hot iron is preferred to the action of zinc on sulphuric acid for preparing hydrogen. For lecture purposes this is excellent, but for a class of young students it is impracticable. Oxygen is prepared (p. 18) from sodium peroxide and water, whereas the usual laboratory method, by decomposing a mixture of potassium chlorate and manganese dioxide, is only mentioned incidentally, emphasis being placed upon the fact that it affords a good example of catalytic action. Again, the synthesis of ammonia from nitrogen and hydrogen (from water gas) is simple enough in theory to take its place beside the decomposition of ammonium salts with lime. Nitric oxide and nitrogen peroxide are now made synthetically as intermediates in the manufacture of nitric acid, so that the complicated reactions of nitric acid with various metals are only given a subsidiary place in Mr. Adlam's book.

From a perusal of this work, it is readily apparent that the author has endeavoured to turn to account for teaching purposes the modern large-scale methods for the manufacture of common chemicals. The traditional laboratory methods, which are also included, are relegated to the background.

In African Game Tracks: Wanderings with a Rifle through Eastern Africa. By F. L. Puxley. Pp. 320 + 8 plates. (London: H. F. and G. Witherby, 1929.) 12*s*. 6*d*. net.

ONE is frequently being reminded that the reading public cares little for precision of detail. So long as it seems interesting and the author's style makes for easy reading, any book on African sport or travel has apparently a successful life, while one dealing with actual fact and truly related incident is a slow seller. The book under notice is probably to be placed in the former category. Its author has had a long and varied experience in many spheres of African life since 1896, mainly, as he says in his foreword, in regions lying between the Sudan and the Cape, but from what he says about "Sese Island" in Lake Victoria and the sitatunga, which he spells sitatungu, he writes of one place at least which he has not visited. The islands of the Sese group are for the most part fairly high and wooded, not surrounded with wide and deep papyrus swamps, as he states, nor are they suited to the sitatunga, which inhabits a small island much farther out in the lake.

The first half of the book deals with incidents, things, and people belonging to South African his-

tory, about which much has been written, but it is nevertheless all interesting reading. The chapter on whaling off the Durban coast is especially so, for little has appeared in print on the subject, probably for the reason that when the animal has been sighted, chased, and harpooned, the excitement changes to butchery and malodorous operations. The information given on tsetse flies, sleeping sickness, and kindred subjects reads like knowledge of long ago, but in spite of its inaccuracy of detail, the book, with its wealth of hunting incident and descriptions of bush life, is a very readable one.

Physics of the Air. By Dr. W. J. Humphreys. Second edition, revised and enlarged. Pp. xii + 654. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1929.) 30*s*. net.

THE first edition of "The Physics of the Air" was reviewed at length by Sir Napier Shaw in NATURE of Mar. 17, 1921. Prof. Humphreys has taken advantage of the opportunity offered by a second edition to meet some of the criticisms levelled at the first. A great deal of recent work has been incorporated, and what is even more important, numerous references have been added as footnotes to serve as guides to further reading. The book seems smaller than its predecessor, but that is an illusion, for the decrease in size has been brought about by cutting down the over-generous margins of the first edition. The amount of text has actually been considerably increased, while the volume is certainly handier. None of the original matter has been deleted, though much of it has been rewritten in the light of the latest investigations.

One of Sir Napier Shaw's criticisms concerned the omission of the important subject of meteorological acoustics. That has now been remedied in a section of 33 pages containing two chapters, the first dealing with effects of meteorological conditions on sound transmission, and the second with sounds of meteorological origin, such as thunder and the howling of the wind. The reflection and refraction of sound are discussed mathematically on similar lines to the reflection and refraction of light rays, leading, for example, to the theory of 'acoustical mirage', which is examined in detail. On the other hand, the remarkable phenomena of the 'zone of silence', beyond which sounds may be heard to abnormal distances, are dismissed very briefly, and no actual examples are quoted.

The new edition of Prof. Humphreys' work should be in the possession of every meteorologist, and of other men of science whose work deals in any way with the domain of the atmosphere.

Penrose's Annual: the Year's Progress in the Graphic Arts. Edited by William Gamble. Vol. 32. Pp. xvi + 168 + 70 + 80 plates. (London: Percy Lund, Humphries and Co., Ltd., 1930.) 8*s*. net.

THE general impression on looking through this volume is that it shows a larger proportion of examples of work in colour, and that of a rather superior quality, when compared with the annuals of the last few years. Of course it is impossible to say more than this, and to judge more precisely of the success of the colour imitation, unless the original and the copy are seen side by side.

We have the editor's dictum that though the past year has not been notable for any striking new developments in printing or process methods, there has been quiet and steady progress in almost every branch of the graphic arts. Perhaps the greatest advance has been in the method of the chromium plating of printing surfaces. It has been found that the current density may be reduced to about a third of what was considered necessary, and that the best deposit is obtained at 68°-70° F.

The effect of colour in advertising is shown in some very interesting results; for example, where the only variant was the tint of the paper used in a circular, for every hundred orders resulting from white paper, blue produced 120, buff 130, green 150, pink 180, but it must not be supposed that pink paper would always be the most advantageous. Scientifically considered, the most interesting of the numerous examples is a four-colour reproduction of colour photographs on Agfa plates of four pathological human eyes taken by Dr. L. D. Redway of New York City by means of a special apparatus devised by him, the exposure in each case being one-fiftieth of a second.

Photographic Emulsions: their Preparation and Coating on Glass, Celluloid and Paper, Experimentally and on the Large Scale. By E. J. Wall. Pp. viii + 256. (London: Chapman and Hall, Ltd., 1929.) 21*s*. net.

MR. WALL was specially fitted to write and compile such a work as this because of his varied experience as a manufacturer and as a teacher, his enthusiastic study of the subject, and his excellent memory. An index would have added to the convenience of consulting the book, though the detailed table of contents somewhat makes up for this deficiency. The book is full of the descriptions of practical methods of formulæ old and new, though formulæ that are obviously obsolete are not given.

The subject is treated in a thoroughly practical manner; the book does not pretend to give theories, though the reasons for the procedure described are given, and also the unfortunate results of the omission of proper precautions. The author says that "as a field for experiment emulsion making is extremely fascinating. As a means of spending money it is only equalled by dabbling in stocks". The information is based on many years of practical experience, but Mr. Wall acknowledges that there are little points which can only be learnt by continued experiment. If the subject is to be attacked seriously, the mere coating and exposure of a few plates and bits of paper will lead nowhere. Accurate photometric testing methods must be used, and the various factors varied one at a time, and it is utterly hopeless to expect good results by working in a dark room that has been used for the ordinary operations of

developing, fixing, etc., because it is impossible to keep such an apartment scrupulously clean. The information given must be regarded as sign-posts, indicating the way, rather than as milestones giving definite certainties.

Textile Microscopy. By L. G. Lawrie. Pp. 144. (London: Ernest Benn, Ltd., 1928.) 25*s.* net.

THE technique employed in the microscopical examination of textile fibres forms the subject of this book, not the appearance and characters of the fibres, as the title might imply. Special methods applicable to the microscopical examination of textiles are in fact found only in the last 45 pages, the first 86 pages being devoted to a description of the microscope and its optical principles and of other apparatus, with an occasional reference to the special subject.

This first part gives a full though simple account of the microscope and its use, such as would serve as an introduction to any branch of microscopy. These pages, on the whole, are good, but the author is not always so careful in his statements as he might be. For example, alluding to the use of the draw-tube for increasing magnification, the fact that objectives are corrected for a particular tube-length is not mentioned, and though true for critical work, it is an exaggeration to say that the Abbe condenser is "quite unsuitable for high-power work" or that the lack of perfect centration of a nosepiece "causes considerable inconvenience" with high powers.

In the second part of the book a great deal of information is given on the reactions, staining and others, of textile fibres, that it would be difficult to find except in scattered papers. The pages on the microscope and apparatus are profusely illustrated, the large page and glazed paper ensuring excellent reproductions, and three plates of photomicrographs of textile fibres are included. These last named features may account for the seemingly high price of the book.

Climate: a Handbook for Business Men, Students and Travellers. By Dr. C. E. P. Brooks. Pp. 199. (London: Ernest Benn, Ltd., 1929.) 10*s.* 6*d.* net.

IN view of the importance of a knowledge of climate in numerous activities and in many lines of research, it is remarkable how few authoritative volumes exist on the subject. For this reason Dr. Brooks's volume will be welcome, although we could wish that it had been a little fuller. To cover the climates of the world in two hundred pages, of which several are filled with statistical matter, is summary treatment. But Dr. Brooks wastes no words and manages to compress a great deal into a small space. In order to economise space, he plunges direct into the description of climates based on geographical distribution. He omits all preliminary discussions of physical processes and general meteorological considerations. But this does not mean that the treatment is solely descriptive.

Lucid explanations are given in places, sparingly perhaps for the student, but no doubt often enough for the other categories of readers for whom the book is intended. Under each climatic area, meteorological data are given for selected stations, temperature and rainfall for every month of the year, daily range in January and July, extremes, relative humidity for January and July, cloud amount and number of days with rain, snow, and thunder. There are only three diagrams. A few bibliographical references are given for each part of the world.

The Growth of the World and of its Inhabitants. By Prof. H. W. Swinnerton. Pp. 211. (London: Constable and Co., Ltd., 1929.) 5*s.* net.

As a sardine might be shy about biting a whale, one feels diffident at the very idea of criticising Prof. Swinnerton. Yet he makes the author of "Principles" and "Elements of Geology" sole father of that science. Surely Sir Charles Lyell would rather have given Hutton credit for the geology of fire, and Werner for the geology of water; and Hutton would have referred to his master, Black, whose theory of latent heat was the first clue to the story of the rocks.

Again, it is disconcerting to find the theory of land bridges still held in equal esteem with that of continental drift. Some of us took the trouble to visit countries like Greenland, on the so-called North Atlantic bridge. We picked harebells there, and were quite prepared for Suess with his Atlantic rift. It was Greenland which opened Wegener's eyes to the land bridge theory as a superstition; but here it haunts Prof. Swinnerton like a belated ghost.

To do Prof. Swinnerton justice, rarely does he venture into fields of controversy. So far from looking for trouble, he is painfully cautious. He is very lucid, always trying to use simple words, only occasionally blundering into the Græco-Latin jargon which chokes the general reader and so limits the sales of scientific books. Until a Homer or a Shakespeare comes to write these glorious themes, we should be well content with books like this one, sincere, cautious, accurate, written by men of broad views and profound scholarship.

An Introduction to Geography. By Prof. H. J. Fleure. (Benn's Sixpenny Library, No. 91.) Pp. 80. (London: Ernest Benn, Ltd., 1929.) 6*d.*

PROF. FLEURE defines with swift ease the fields of geographic research, and uses each as setting for one or two examples, gems of exposition. There is more in this brief pamphlet than in many a stately book, but finest of all is the description of that oceanic climate wherein the chemistry of heat and moisture creates the humid brown earths in which the beech tree grows, the area of mixed farming and of parliamentary government in nation States, bordered by a broad margin of dictatorships. Human affairs in terms of natural law are almost a new field of research.

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.*]

Action of Low Velocity Electrons on Micro-Organisms.

THAT ultra-violet light has a definite lethal action on certain micro-organisms is well known. The nature of this lethal action is being studied extensively, but hitherto (so far as is known) no work has been done to determine the action of low velocity electrons of known energy on micro-organisms. Since electrons and radiant energy seem to be so closely related, it was considered worth while starting a series of experiments in this field. It is the purpose of this note to present an outline of the results obtained to date.

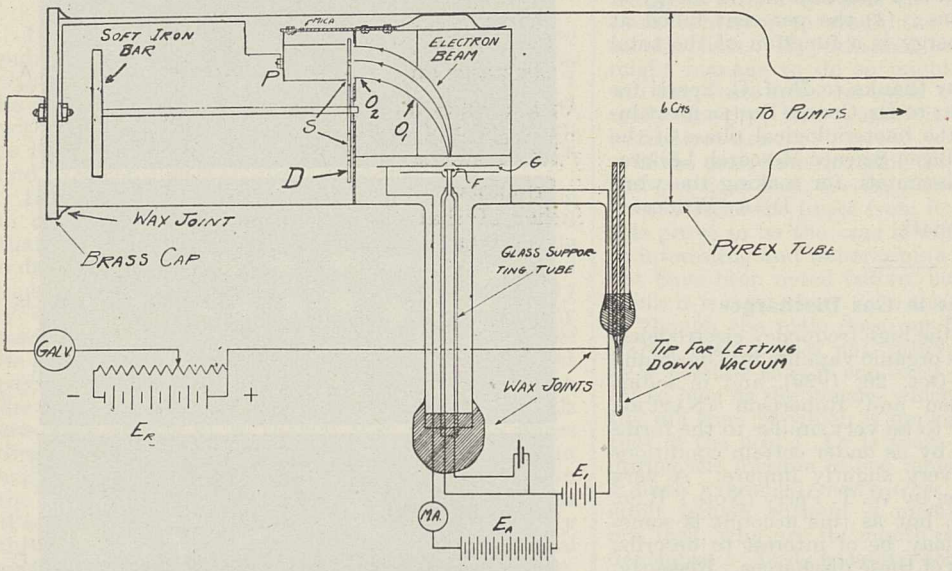

FIG. 1.

Apparatus and Experimental Method.—Fig. 1 shows the apparatus used, together with a diagram of connexions. Electrons from the oxide-coated filament F are accelerated to the metal plate G by a potential E_A of about 90 volts. Those passing through the opening in G are retarded in passing to the next baffle and enter C with an energy per unit charge equal, very approximately, to E_1. Thus by varying E_1, electrons of any desired energy can be made to enter C. After entering C, the beam, deflected in a circular path by a magnetic field, passes through the circular openings O_1 and O_2, striking the platinum slide S, on which there is a thin smear of the organism to be bombarded. The beam is deflected in a circular path for the purpose of eliminating soft X-radiation produced in the vicinity of the filament which preliminary experiments showed is intense enough to kill the organisms. The Faraday pail, P, mounted as shown, served to determine the number of electrons striking unit area of the bombarded portion and also to determine the energy distribution of the beam.

Distribution curves were taken with each exposure. These curves showed very good homogeneity of the beam; the curves in each case falling from maximum to minimum within a range of 1·5 volts or less. The vacuum throughout the work was maintained at a pressure of approximately 5×10^{-6} mm. Four exposures were made without breaking the vacuum by mounting four slides on the face of the disc D, which was turned with a magnet.

Staphylococcus albus was chosen as the organism with which to work. A light smear of this organism in beef broth solution was placed on the platinum slides S. This, when dry, was placed in the apparatus, and the area (a circle of approximately 0·8 sq. cm. in diameter) in front of the opening O_2, Fig. 1, was bombarded for a definite length of time with electrons of known energy. The slides were then removed from the vacuum and, after being carefully covered with strips of moist solidified agar, were incubated.

Results.—A series of eighteen exposures with electronic energies ranging from 19·5 volts to 30 volts have been made. In every case exposures in the range of 19·5 volts to 25 volts showed little or no killing, while exposures at higher electronic energies showed definite killing, the total energy falling on unit area of the bombarded surface in each case being constant at 13×10^7 ergs. The photographs reproduced as Fig. 2 show four typical exposures made with electronic energies of 25, 27·5, 29, and 30 volts. The photograph taken at 30 volts shows almost complete

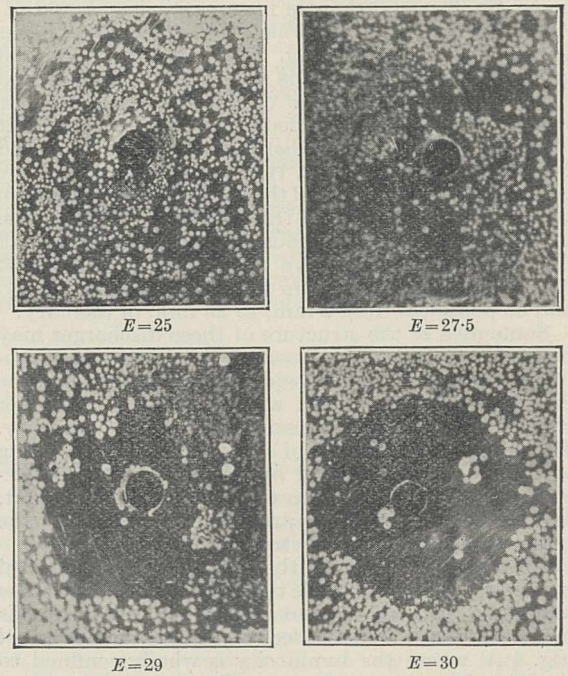

FIG. 2.—Photographs showing the action of various electronic energies E. Total energy per unit area of bombarded surface in each case was approximately equal to 13 joules.

killing over the circular area bombarded. Another series of exposures at 30 volts with various values of total energy showed definitely that the lethal action is a function of the total energy per unit area of the bombarded surface. Whether the organisms would be killed at the lower voltages by greatly increasing the total energy remains to be shown by further experiments.

Summary of Results.—The results of this work indicate that: (1) *Staphylococcus albus* can be subjected to a vacuum of 5×10^{-6} mm. of mercury for so long as eight hours without showing signs of killing; (2) it may be killed by the action of low velocity electrons; (3) under the conditions of this experiment, the lethal action is a function of the energy of the individual electrons; (4) the per cent killed at constant electronic energy is a function of the total energy of exposure.

I wish to express my thanks to Prof. G. Sperti for suggesting the problem; to Dr. George Burger for valuable assistance with the bacteriological phase of the problem; and to the Basic Science Research Laboratory, University of Cincinnati, for making the work possible.

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Spiral Forms in Gas Discharges.

THE spiral forms of the high frequency electrodeless discharges observed in organic vapours by Ghosh and Chatterjee (NATURE, Oct. 26, 1929), and in iodine vapour by MacKinnon and Robertson (NATURE, July 13, 1929), appear to be very similar to the forms of discharge observed by us under certain conditions in argon which was very slightly impure. A very brief account was given by W. T. Perry (Note: B.Sc. Thesis, Oxford, 1928), but as this account is somewhat inaccessible, it may be of interest to describe some of the properties of these discharges. Recently, P. Johnson has observed the same type of discharge under similar conditions in neon.

The conditions under which these discharges occur appear to be the following. They occur in neon and argon only when the gas is very slightly impure, and especially when the trace of impurity is a metallic vapour. In carefully purified inert gases we have never observed any striations other than the types described by us in NATURE (Jan. 12, 1929). The pressure of the gas must be fairly high and the current flowing through the tube must be large—of the order of 20 milliamperes. They occur, with continuous wave oscillations, at all the wave-lengths we have tried from 11 metres to 320 metres; in tubes from 0·5 to 4 cm. in diameter, and at pressures from 2 mm. to 20 mm. of mercury.

Some idea of the structure of these discharges may be gathered from a study of the photographs reproduced in Fig. 1 A, B, C, D, which show typical forms the discharge may assume in a tube 3 cm. in diameter containing argon at a pressure of 7 mm. of mercury. The oscillatory potential of a frequency corresponding to 11 metres was applied by two external wire electrodes wrapped round the tube about 10 cm. apart, and the changes were produced by altering the potential between the electrodes.

With small currents there is a diffuse general luminosity filling the whole tube between the electrodes and some distance beyond them. As the current is increased there is a sudden change to the form of Fig. 1 A, where the luminosity is wholly confined to the line of luminous spheres. The size of the spheres seems to be almost independent of the diameter of the tube and inversely proportional to the pressure of the gas. Unlike the striations in the positive column, they are little affected by a strong magnet.

Further increase in current imparts a motion to the line of spheres which begins to move toward one electrode and around the axis, giving the line a helical form, and generally other lines of discharge appear (Fig. 1 B and C).

With larger currents more lines of discharge appear, the luminosity being entirely on the outside, the axial region being comparatively dark. The pattern is then very symmetrical, the lines of the discharge at high pressures being very close together and comprising ten or more parallel helices (Fig. 1 D). If this discharge be viewed with a spectroscope, the lines of

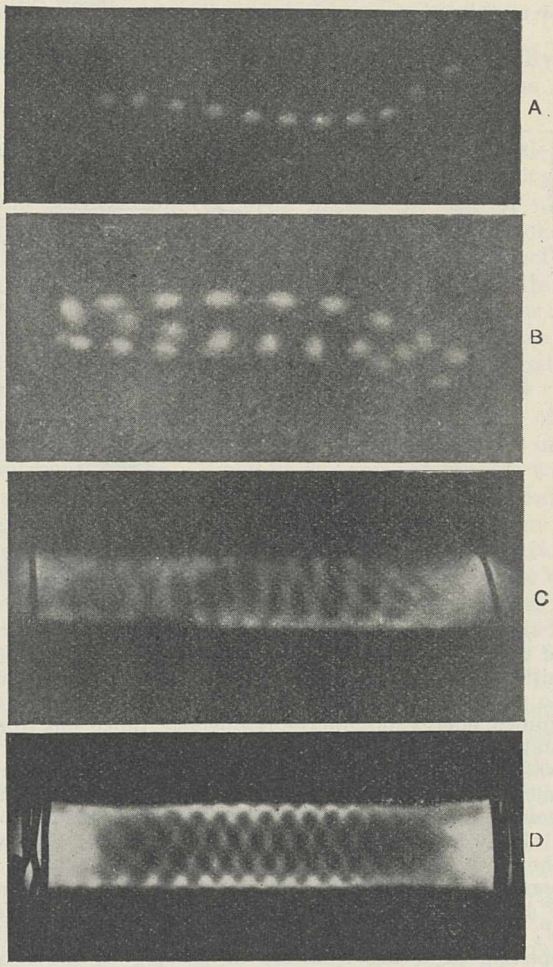

FIG. 1.

impurity appear to have become more prominent, in comparison with the argon lines, and sometimes the discharge is coloured with momentary flashes of light characteristic of them.

This type of discharge has not been observed by us in hydrogen, nitrogen, or air, possibly because it is difficult to maintain a discharge in these gases at a pressure greater than one millimetre of mercury with continuous waves. It would be interesting to know the conditions of wave-length, pressure, and current in the experiments of Messrs. Ghosh and Chatterjee.

What precisely is the mechanism of these discharges is very difficult to determine. It seems probable that the form is in some way connected with the distribution of the more easily ionised impurities which would be expelled by the space charge to the outer parts of the tube. The discharge takes two or three seconds

usually to settle down to a definite form, and this would support such a suggestion.

Note.—Spiral forms of discharge in ordinary vacuum tubes using direct currents appear among the many observed by de la Rue and Muller so early as 1877 (*Phil. Trans.*). They also noted the prominence of the mercury lines in such a discharge. Gassiot (*Phil. Trans.*, 1858) also makes mention of a spiral discharge.

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Mode of Feeding of the Bopyridæ.

IN connexion with a study which I am about to publish on the effects of one of the Bopyrid isopods, *Gyge branchialis*, on its host, *Upogebia littoralis*, I have become interested in certain questions concerned with the mode of feeding of the Bopyridæ which seem to have been neglected by students of these animals and to which I wish to direct attention.

It may be recalled that the Bopyridæ are parasitic in the branchial cavity of decapod crustaceans, and that they normally occur in pairs, a large female individual and a minute and less highly modified male, which leads a sedentary existence on the body of the female. The latter, at any rate, obviously feeds by sucking the juices of the host by means of its piercing and suctorial mouth-parts, but from what part it sucks them appears, if one looks critically into the literature, to be by no means clear. The animals are often spoken of as though they suck the juices directly from the thorax of the host. Such an eminent authority as Bonnier, in his monograph on the Bopyrids (*Travaux de la Station Zoologique de Wimereux*, tome 8; 1900), seems clearly to imply this, for he speaks definitely (p. 50) of the animal sucking "les liquides viscéraux", and again (p. 104), "les liquides de la cavité viscérale de l'hôte". Yet when one reflects that the ventral surface of the parasite, on which the mouth-parts open, is turned towards the branchiostegite of the host and away from the latter's body, these statements appear difficult to accept literally. It would seem that the only way in which the animal could suck "the liquids of the visceral cavity of the host" would be for it to protrude its mouth-parts for a relatively great distance, and at the same time to twist them round to an extraordinary extent, so as to drive them into the host's body, from which they are normally turned *away*. The conformation of the mouth-parts does not suggest that such a proceeding is possible.

The only alternative seems to be to suppose that the animal sucks the juices from the inner membrane of the branchiostegite. So far as I know, however, this is nowhere definitely suggested in the literature, though Dr. Calman, to whom I have appealed, tells me that he has always supposed that this is what happens. The membrane is certainly often quite well vascularised, though sometimes, as in the *Upogebia* upon which I have been working, it is so thin that one would not suppose it to be a very satisfactory source of nourishment for a suctorial parasite. It appears to me that, unless I have overlooked some important contribution to the subject, no one has really demonstrated clearly and definitely from what part of the host the parasite does extract its food, a curious omission in a group of animals which have received a very fair amount of attention.

This is not all: there are difficulties also in connexion with the male. The larval form which first invades the branchial cavity of the host develops into the large female form. Afterwards another arrives, settles down on the body of the first and becomes a male. There are two, probably related, questions concerning this second arrival to which I can find no clear answers, namely: How does it feed? What causes it to become a male? Apparently the larvæ are equipotential with regard to sex. If No. 2 did not feed at all, the difference in its subsequent development as compared with No. 1 would be accounted for. But the mouth-parts are perfectly well developed like those of the other sex, and some of Bonnier's remarks certainly seem to imply that it does feed. But neither Bonnier nor anyone else, so far as I know, explains how a minute animal leading a sedentary existence on the female's ventral surface, which is turned towards the branchiostegite of the host, contrives to reach the host's body with its mouth-parts. Hypothetical acrobatics by which it might manage to do so might be suggested, but I will not waste space on these. The point is that if it really does so, it is worth while taking the trouble to find out how.

If the male does not suck the host's juices directly, and yet does feed, the only alternative is to suppose that it sucks the juices from its own female. Should this prove to be the case it would be surprising that so interesting and remarkable a state of things should not have been noted before, but personally I do not think it is very likely. On the whole, it rather looks as though the male does not feed, but if it can be shown that it does not, other questions are raised. Is it possible that it can exist entirely without food for so long as the female, which feeds vigorously and the life span of which is apparently coincident with that of the host? Or is there a succession of males during the lifetime of one female? (I may say that I have examined many *Gyge* and never found an adult female without a male). If the male does not feed, why are its mouth-parts and gut so well-developed? Is it, speaking teleologically, so that it can start feeding and develop into a female if the original female dies? I could add other questions.

What I have said will have been sufficient to suggest that present knowledge of the biology of the Bopyrids is scarcely commensurate with the knowledge of their structure. The points I have raised ought not to be beyond the ingenuity of someone having access to living material to settle. I hope I may have an opportunity of doing something in this direction myself at some future time. But my immediate object is to inquire whether there is no zoologist who can now from experience already obtained throw some light on these questions, which seem so obvious and yet seem to be carefully avoided or slurred over in all the literature with which I am acquainted.

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Behaviour of the Mercury Line 1849·57 ($1^1S_0 - 2^1P_1$).

UTILISING an arrangement which permits working in an atmosphere of nitrogen and a Hilger quartz spectrograph model E/37 with Schumann plates (see details in *Contrib. Estd. Ciencias Fis. Mat. Serie matemáticofísica*, **4**, 102; 1927, La Plata) we have investigated the persistence of the mercury line 1849·57. In the spark spectrum, using Gramont's fulgurator with solutions of mercury salts, $Hg(CN)_2$ or $Hg(NO_3)_2$, it is only possible to register photographically the mercury line 1849·57 when working in an atmosphere of nitrogen (Fig. 1). In the arc spectrum, using McLennan's vacuum arc lamp and operating in a normal atmosphere, and in a nitrogen

atmosphere, using carbon electrodes impregnated with the same mercury salts, the experimental results are strictly the same. These facts support the objection formulated by Gerlach (*Phys. Berichte*, **10**, 429; 1929) with regard to my note published in *Comptes rendus* (**187**, 761; 1928). Operating in the conditions above described and with progressively diluted

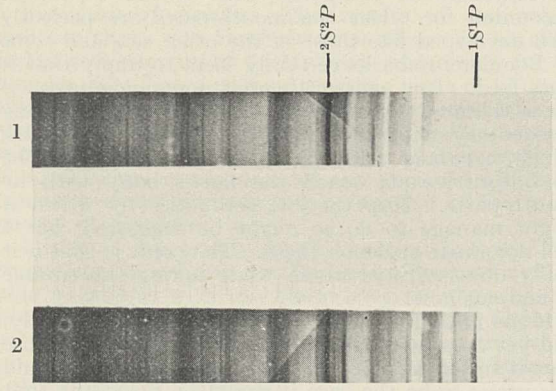

FIG. 1.—1, Spectrogram using normal atmosphere; 2, spectrogram using nitrogen atmosphere.

solutions of mercury salts, the persistence of the lines 2536·52 ($^1S^3P$) and 1942·0 ($^2S^2P$, Hg^+) is much greater, in all conditions, than that of 1849·57. The latter line is a theoretical but not an experimental 'raie ultime'; the true 'raies ultimes' of Hg are, in all conditions, 2536·52 and 1942·0. For this reason we consider that Meggers is mistaken in supposing ("Critical Tables", **5**, 323) that the line 1849·57 is the most persistent.

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Universidad de La Plata,
R. Argentina, Nov. 12.

Scattering of Electrons by Gold.

A METHOD has been developed by Born by which the scattering of electrons by single atoms can be worked out on the wave mechanics. The method has been used to calculate the variation of elastic scattering with angle for helium, using the atomic fields worked out by Hartree, and fair agreement is obtained with the experiments of Dymond on the scattering in helium gas (NATURE, May 11, 1929, *Proc. Camb. Phil. Soc.*, **25**, p. 304).

The theoretical formula for the scattering can be put in the following form. The proportion of a beam of electrons scattered elastically per unit length of the beam, per unit solid angle, by a gas containing n atoms per unit volume, is $n\,|f(\theta)|^2$ where $f(\theta)$ is $\frac{e^2}{2mv^2}(N-F)\operatorname{cosec}^2\theta$. N is the atomic number of the scattering atom, 2θ the angle of scattering, and F the atomic scattering factor familiar in X-ray diffraction, calculated from the Schrödinger charge distribution. F is a function of $\sin\theta/\lambda$, where λ is the de Broglie wavelength of the electrons. The corresponding formula for the scattering of X-rays by an atom is $\frac{e^2}{mc^2}F$ for plane polarised waves, in the plane perpendicular to the electric vector. The close resemblance between these two expressions can be accounted for as follows. In calculating the scattering of X-rays we assume that each element of charge $d\rho$ in the atom scatters a spherical wavelet of amplitude, $e^2d\rho/mc^2r^2$, according to the classical formula of J. J. Thomson. The total scattering is obtained by considering the interference of these wavelets. We may suppose, analogously, for de Broglie waves that each element of charge in the atom scatters a spherical wavelet of amplitude $\frac{ed\rho}{2mv^2}\operatorname{cosec}^2\theta$. We should expect this according to the theory of inverse square law scattering, if the element of charge were held rigidly at rest; presumably, in a collision when this is not the case, the atom is excited. The nucleus also scatters a wave of amplitude $-\frac{Ne^2}{2mv^2}\operatorname{cosec}^2\theta$, the negative sign meaning opposite phase. A consideration of the interference of these waves leads to the formula given above. It will be noticed that the scattering is a function of $\sin\theta/\lambda$.

G. P. Thomson has recently published a curve for gold, deduced from his experiments on the diffraction of cathode rays by thin foils. The curve in Fig. 1 gives

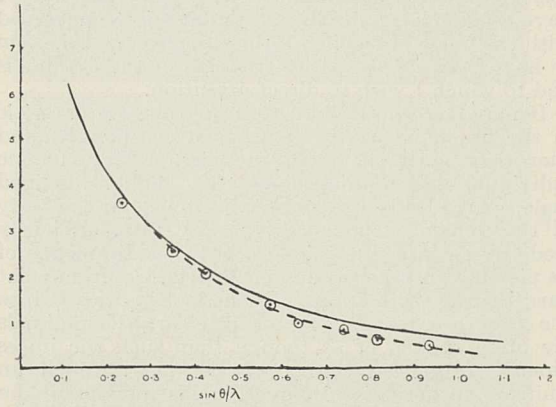

FIG. 1.—Electrons scattered by a gold atom. Number scattered per unit solid angle given by square of the ordinate. Full line, calculated curve; dotted line, curve corrected for heat motion in the crystal; circles, experimental readings, from G. P. Thomson's paper.

the relative scattering for varying $\sin\theta/\lambda$, for 30,000 volt electrons. The full line in the figure is $(N-F)\lambda^2/\sin^2\theta$ in arbitrary units, plotted against $\sin\theta/\lambda$; the dotted line is the same, corrected for heat motion in the crystal. The encircled points are the experimental points fitted to the dotted curve at $\sin\theta/\lambda = 0{\cdot}32$. The F curve was calculated from the atomic field of Thomas, which for heavy atoms has been found sufficiently accurate in the X-ray case.

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A Theory of Tracheal Respiration in Insects.

IT has been shown by Krogh (*Arch. f. Ges. Physiol.*, vol. 179; 1920) that the laws of diffusion of gases will explain the supply to the tissues of insects of those quantities of oxygen which they actually consume. This theory is satisfactory so far as it goes, but it makes no provision for such increased demands for oxygen as must arise locally in active tissues. It is the purpose of this letter to outline a theory, complementary to that of Krogh, which will satisfy these requirements, and to indicate the experimental evidence by which this theory is supported.

If it be assumed that the terminal portions of the tracheal tubes are bounded by a membrane which is semipermeable with respect to lactic acid and similar metabolites, then, during normal conditions of rest, liquid will be drawn from the tissues up the tracheal tube by capillarity until its progress is arrested by the osmotic pressure of the tissue fluids. During increased activity of the tissues, lactic acid will be

produced, and the osmotic pressure will rise. Hence liquid will be absorbed from the tube, and the column of air will extend more deeply into the tissues. Moreover, this change will take place first in those regions where the need for oxygen is greatest.

This theory is based chiefly upon experiments with the larva of the mosquito, a detailed account of which will be published shortly. Briefly, it has been found: (i) That in the resting condition the terminal portions of the tracheal tubes are filled with liquid; (ii) that during asphyxiation this liquid is absorbed, and the column of air extends rapidly towards the actively contracting muscles — more slowly and much later towards inactive tissues (for example, the rectal gills); (iii) that on readmission of air the level of liquid slowly rises to its original level; (iv) that during asphyxiation an excess of lactic acid is present in the tissue fluids; (v) that hypertonic solutions of sodium chloride and of sodium lactate introduced into the living larva cause a similar extension of air down the tracheal tubes; (vi) that hypotonic fluids (distilled water) are without effect, or cause a slight rise of the liquid in the tracheæ.

It is clear that the mechanism described will serve as a 'fine adjustment' for tracheal respiration in insects, just as changes in the capillary bed serve as a 'fine adjustment' for the internal respiration of vertebrates.

V. B. WIGGLESWORTH.

London School of Hygiene and
Tropical Medicine, Dec. 5.

Chemical Biogenesis and the Development of Secretion Cells.

DR. LEEMANN'S interesting letter (NATURE, Dec. 21, p. 946) emphasises once more the gains which are bound to accrue from an increasing correlation between organic chemistry, biochemistry, and certain branches of purely biological science. As one who was privileged to obtain a first-hand acquaintance with the classical phyto-chemical researches of R. T. Baker and H. G. Smith on the Australian flora, I am of opinion that such correlation is often realised most effectively by active collaboration between investigators in the related fields. Thus, it may be justly asserted that collaboration between the histologist and the organic chemist has now become desirable in attacking the engrossing problem of chemical biogenesis (that is, chemical origin *in vivo*) in the terpene series. Nevertheless, one would hesitate to endorse Dr. Leemann's sweeping dictum that the study of such problems "should *only* [my italics] be done in close connexion with cytology and cell development". The purely organic chemical aspect of the subject must not be dismissed too lightly. At the present day, after researches extending over half a century, the study *in vitro* even of such familiar and fundamentally important substances as menthol and menthone is regrettably incomplete. Moreover, of how many essential oils can it be claimed that our formal chemical knowledge is full and adequate?

There is little doubt that a knowledge of the precise cytological origin of the terpenes would be a valuable aid in deciding whether they are derived from carbohydrates (cf. Stewart, "Recent Advances in Organic Chemistry", 1927, vol. 2, pp. 240 and 266), or from protoplasm via amino-acids. Dr. Leemann's suggestion that they originate from protoplasm, rather than from the cell wall, appears to accord with the histological occurrence of fixed oils; while from the chemical point of view leucine offers an attractive approach to the fundamental structural unit (*iso*pentane nucleus) of terpene molecules.

JOHN READ.

The University, St. Andrews.

Hydrolytic Adsorption at Colloid Surfaces.

THE outstanding work on hydrolytic adsorption has been carried out with purified charcoal (see, for example, Bartell and Miller, *J. Am. Chem. Soc.*, **44**, 1866; 1922: **45**, 1106; 1923), and definite positive results have been obtained. The measure of the hydrolytic effect in the case of the numerous negative hydrophobic (acidoid) sols, such as colloidal mastic, platinum, gold, arsenious sulphide, etc.—all of which are remarkably alike in structure and in reactions—is complicated by the well-established phenomenon of catalytic interchange. For example, in the presence of salts, such as barium chloride, the hydrogen ion at the colloid surface suffers an interchange with the added barium ion, and the corresponding increase in acidity is superimposed upon any change in acidity due to the hydrolytic action at the surface. It has become the general practice to ascribe the whole of the increase in acidity of acidoid sols (on the addition of neutral salts) solely to the cationic replacement, and to neglect any probable hydrolytic effect. That the latter effect is real is evident from the following consideration.

Colloidal platinum has a great affinity for bases, particularly bases of higher valence such as barium hydroxide, and no measurable affinity for the common inorganic acids such as hydrochloric acid (*J.C.S.* 551; 1928: 618, 623; 1929). This action I have ascribed to the acidic nature of the oxidised platinum which constitutes the greater part of the colloidal platinum surface. It follows from obvious chemical principles, that when a salt such as barium chloride is added to a platinum sol, the barium hydroxide must distribute itself between the hydrochloric acid and the 'acid' surface of the colloid, or in the usual terminology, barium hydroxide must be hydrolytically adsorbed by the platinum. The hydrochloric acid is, of course, a very strong acid, but the affinity of the platinum surface for barium hydroxide has also been shown to be very great. Work recently carried out by me, and to be published in due course, shows clearly that in the case of colloidal platinum (1) such a distribution does take place, (2) its effect is not negligible when compared with the cationic interchange, and (3) it plays an important part in coagulation and reversal phenomena. The same conclusions will probably apply, in varying degree, to the other acidoid sols.

S. W. PENNYCUICK.

Adelaide, South Australia,
Nov. 5.

The "Encyclopædia Britannica".

As a contributor to the new edition of the "Encyclopædia Britannica", may I beg the hospitality of the columns of NATURE in order to disclaim responsibility for certain statements that appear in one of the articles over my initials? In the article "Acanthocephala" the short passage commencing with the words "the larva of *Echinorhynchus gigas* . . ." and ending at ". . . found in the seal" is not mine.

I should like to add that the editor of the "Encyclopædia", with whom I have been in communication, has expressed his sincere regret at the unfortunate interpolation, which appears to have occurred in some way during the final making-up of the page, and has undertaken to delete it in future printings of the edition.

H. A. BAYLIS.

British Museum (Natural History),
Cromwell Road, London, S.W.7,
Dec. 17.

Past Climates.

By Dr. G. C. SIMPSON, C.B., F.R.S.

THERE are only three factors which can affect the climatic zones of the world: (*a*) the amount of solar radiation; (*b*) the horizontal transfer of heat from one part of the earth to another; and (*c*) the characteristics of terrestrial radiation. If we examine each of these factors, we find that terrestrial radiation is not affected by the amount of carbon dioxide in the atmosphere, and, while dust might affect it, there is no real evidence that changes in climate are correlated with volcanic activity. The horizontal transfer of heat could only be affected by changes in oceanic currents due to a redistribution of land and water; but a comparison of the temperature of corresponding zones in the northern and southern hemispheres shows that a climatic zone is little affected by the amount of land and sea which it contains. Small changes in solar radiation may produce appreciable effects on the climate, and a theoretical investigation shows that an increase in solar radiation is accompanied by:

(*a*) an increase in temperature in all parts of the world;

(*b*) an increase in the temperature difference between the equator and the poles, and probably an increase in all other temperature differences which now exist;

(*c*) an increase in the general circulation of the atmosphere, that is, a general strengthening of the trade winds, the monsoons, cyclonic storms, and winds in general;

(*d*) an increase in the cloud amount and a consequent increase in all forms of precipitation.

THE LATE PALÆOZOIC GLACIATION.

The geological evidence is quite conclusive that during Upper Carboniferous or early Permian times, great ice action took place in many localities, especially in the southern hemisphere. South America, Africa, India, and Australia all exhibit unmistakable evidence of ice action which is far too extensive to be mere Alpine glaciation. In India especially, the evidence is conclusive that the ice sheet extended to sea-level. I think all geologists are agreed that at this period extensive ice sheets occurred within the present tropics in South America, Africa, and India, and at one place at least on the present equator.

Let us assume for a moment that we may accept this evidence at its face value and see what it would mean. Ice at numerous places in a zone of latitude indicates a mean annual temperature characteristic at present of polar regions. Thus at the time in question the present tropical zone had the conditions of the present frigid zone, and this could not possibly be brought about by any rearrangement of land and water.

If the change in climate was not the consequence of a redistribution of land and water, was it due to a radical change in solar radiation? Let us assume that the solar radiation decreased until the mean temperature of the equatorial zone was 0° C., which is approximately the present temperature of latitude 60°. I have already shown that the zonal temperature must decrease in all circumstances from the equator to the poles, hence every other zone of the earth must have had then a mean temperature below 0° C., which simply means that every part of the earth's surface would have been subject to conditions now met with only in polar regions. The glacial conditions of the equator would extend over both hemispheres with increasing severity right to the poles. These conditions could not have occurred without a total obliteration of the organic life which was already highly developed in Carboniferous times. A change in solar radiation does not therefore afford a solution of the problem.

I have noticed a tendency amongst geologists in discussing the climate of this period to assume that the climatic conditions could be very different in the two hemispheres. A picture is drawn of a great continent in the southern hemisphere, highly glaciated and sending out glaciers and ice sheets right across the equator into the northern hemisphere; while at the same time farther north there were lands covered by the luxuriant vegetation typical of the Carboniferous period.

Not only does this picture violate our conclusion that the climatic zones in the two hemispheres are always similar, but also it gives an inverted temperature gradient with the temperature rising from the ice-bound tropics to the region of rank vegetation in higher northern latitudes. To me, at least, an ice-bound tropics with rank vegetation in higher latitudes is a physical impossibility, and I can see no explanation of such a situation along meteorological lines. If, as I am prepared to admit, there was at one time ice in the present tropical zone and simultaneously sub-tropical vegetation in the present temperate zone, then I am forced to conclude that Wegener is right and there has been a considerable shift of the continents relative to the pole and the climatic zones.

THE PLEISTOCENE ICE AGE.

I will now turn to a changed climate of a more recent date, namely, that of the last great Ice Age. I do not propose to discuss the extent of surface affected by this Ice Age or the low latitude to which the ice extended. Personally, I am convinced that Wegener is right in displacing the north pole and shifting the North American continent nearer to Europe; only by some such means can the excentric position of the glaciated region with reference to the present position of the pole be explained.

However, let that be as it may, there is another

[1] Abridged from the Alexander Pedler Lecture of the British Science Guild, delivered before the Literary and Philosophical Society of Manchester on Nov. 26.

feature of the Ice Age which is of much more interest to a meteorologist: that is the occurrence of several interglacial periods during the period covered by the Ice Age. In these periods there is good evidence that, even if the ice did not entirely disappear, there was a great contraction in the ice-covered area and that temperature conditions in some of the interglacial periods were as mild, if not milder, than they are to-day. Now neither Wegener nor any geologist, so far as I know, has suggested that these interglacial periods were brought about by changes in the physical features of the earth's surface. It is inconceivable that the pole could have wandered away and returned during the relatively short interval of an interglacial period, and there is no evidence of rapid changes in the distribution of land and sea during the interglacial periods. Hence we are thrown back on to changes of solar radiation as the only possible cause. We are therefore led to examine what would be the effect on a polar climate of changes in solar radiation.

To fix our attention, we will consider what would be the effect of a change in solar radiation on a region which at present is glaciated because the summer temperature is below the freezing-point.

We will first examine the consequence of a reduction in the solar radiation. We have already seen that the temperature in all latitudes falls when the solar radiation decreases; therefore the mean temperature at our station will also fall. We also saw that a decrease in solar radiation results in less cloud and precipitation. In our case the precipitation decreases for two reasons: first, the air carries less moisture because the temperature is low; and secondly, less moisture is carried to the station because the general circulation of the atmosphere has decreased. Thus the net result of the decrease in the solar radiation is a lower mean temperature and less snowfall. In consequence, the thickness of the ice covering would decrease, and if the reduction proceeded far enough, large areas might even become free from snow.

If the solar radiation increased, we should have a reverse effect. The mean temperature would rise and the precipitation increase, and the result would be an increase in the thickness of the snow covering and all glaciers would increase in thickness and length.

In a recent paper, Meinardus has discussed a similar problem from an entirely different point of view. Starting from the observed fact that the ice covering in the antarctic was once much thicker than at present, probably two or three times as thick, Meinardus discusses all the factors which could have affected the snow covering, and reaches the conclusion that the former thickness of the ice can only be explained by a higher temperature accompanied by an increase in the general circulation of the atmosphere. He calculates that for the outflow of the ice from the present antarctic continent to have been three times as great as at present, the mean temperature must have been 4° C. higher and the circulation doubled.

This is strong independent support of the conclusion that an increase of solar radiation would increase the glaciation of the region we are considering. This, however, would only be the initial effect of increasing the radiation; if the increase progresses, there will come a time when the increased temperature produces melting in the summer. From this point on, melting becomes more and more important, until finally the annual

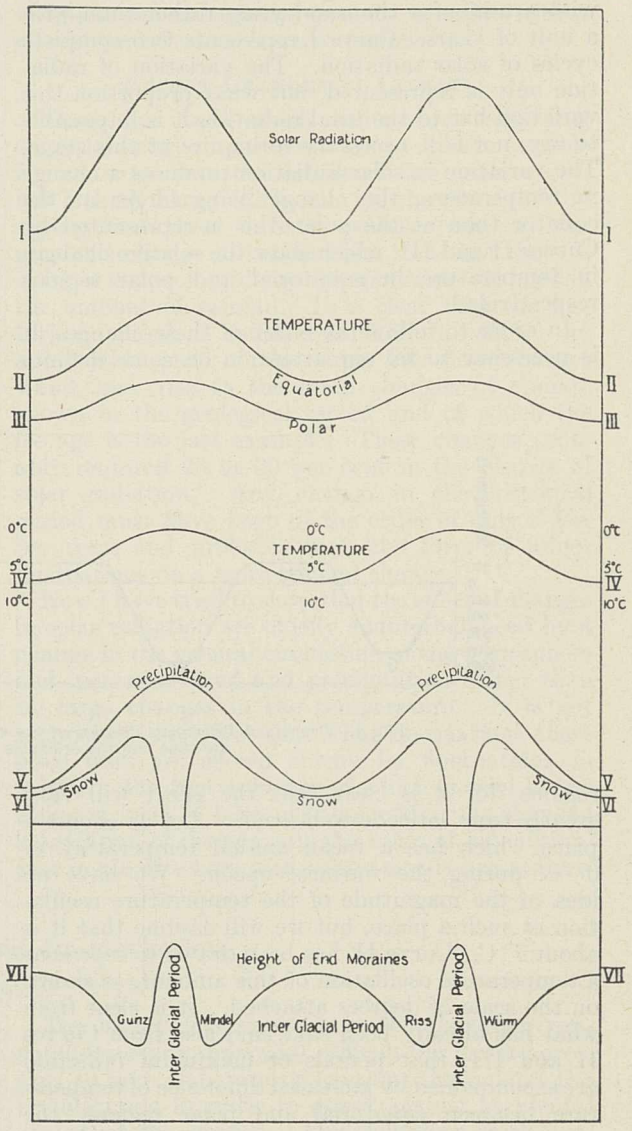

FIG. 1.—Effect of two cycles of solar radiation on glaciation.

melting might be as great as the annual snowfall, when the ice covering would disappear. This comes about in two ways: (1) the period of snowfall would be reduced owing to the raising of the mean annual temperature, and (2) the summer melting would be increased in intensity and continue for a longer period.

It appears to me that these considerations give us a possible clue to the meteorological conditions during the great ice ages in the Pleistocene Period.

We have already seen that changes in solar radiation can produce changes which materially

alter the amount of glaciation, and obviously the next step is to follow through the whole sequence of changes which would result from one or more complete cycles of change in solar radiation. To do this I have prepared a diagram based on two cycles of solar change. In Fig. 1 the abscissæ represent time, but no scale of years is attached as we have at present no clue to the absolute time involved : it is sufficient to say that we are dealing with a unit of a thousand years rather than with a unit of years. Curve I represents two complete cycles of solar radiation. The variation of radiation only is represented, but what proportion this variation has to the total radiation it is impossible to say, nor is it necessary to inquire at this stage. The variation in solar radiation produces a change in temperature, the change being larger at the equator than at the pole : this is represented by Curves II and III, which show the relative changes in temperature in equatorial and polar regions respectively.

In order to follow the effect of these changes, it is necessary to fix our attention on some definite

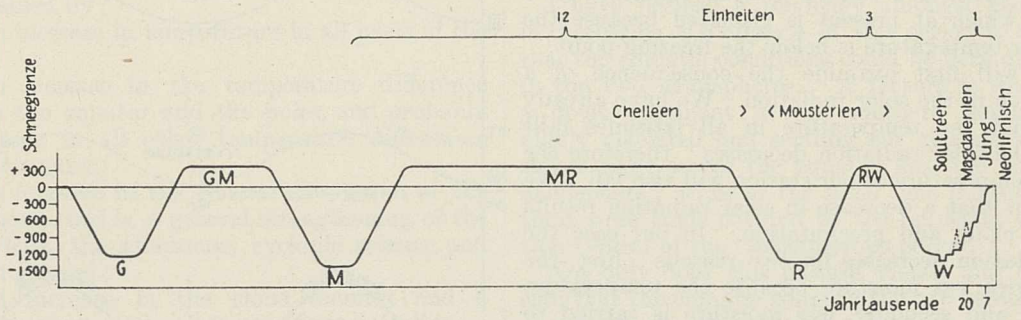

FIG. 2.—Penck and Brückner's diagram of the succession of ice ages in the Alps. The abscissæ are time and the ordinates the height of the snowline.

regions, for it is clear that the effect will vary greatly from latitude to latitude. Let us choose a place which has a mean annual temperature of 0° C. during the warmest epoch. We have no idea of the magnitude of the temperature oscillation at such a place, but we will assume that it is about 7° C. Curve IV has been drawn to represent a temperature oscillation of this amount, as shown on the scale of degrees attached. It is clear from what has already been said, and also from Curves II and III, that periods of maximum radiation are accompanied by increased difference of temperature between equatorial and polar regions, the consequence being greater general circulation of the atmosphere, more cloud and more precipitation, if not in all latitudes at least in equatorial and polar regions. Thus there would be variations in precipitation in our region in step with the changes of solar radiation and temperature. This is shown diagrammatically in Curve V, which, however, is not drawn to any scale, so that the absolute value of the oscillations is not indicated on the diagram.

At the epoch of minimum temperature—the extreme left of the diagram—the mean annual temperature is −7° C.; by hypothesis, therefore, the summer temperature will probably rise to the freezing-point and there will be a certain amount of melting. Curve VI, which represents the annual accumulation of snow, therefore starts somewhat below the curve of precipitation. With the increase of temperature the proportion of the total precipitation which remains as snow decreases, and when the mean annual temperature, as shown on Curve IV, approaches the freezing-point, the melting exceeds the snowfall and there is no residual snow to accumulate. Thus the accumulation of snow increases from the epoch of minimum radiation, until a point is reached beyond which the continued rise in the radiation produces a rapid diminution in the snow accumulation, which in the particular conditions we are discussing entirely disappears at the epoch of maximum radiation. As the radiation decreases from its maximum, the same changes take place in the reverse order.

The significance of these changes is best realised by considering that the locality we are investigating is a mountainous region. In this case the snow which accumulates year by year flows off the mountains through glaciers. The thickness and length of a glacier depend much more on the amount of snow which accumulates than on the temperature of the region into which it flows. Thus each glacier will descend far down the mountain-side during each period of accumulation, and this is shown by Curve VIII, which represents the height on the mountain slopes where the end moraines of the glaciers would be met with at each period. This diagram shows us that with the two periods of solar radiation we should have had four distinct advances and retreats of the glaciers and that the advances occur in pairs, the interval between two pairs being considerably greater than the interval between the members of each pair.

Now there can be no doubt that during the great Ice Age the glaciers of the Alps did advance and retreat just in the manner here described. This is best shown by reproducing a diagram prepared by A. Penck and E. Brückner to illustrate the conclusions of their great investigation of the glaciers of the Alps during the Ice Age (Fig. 2). The similarity between this diagram and my Curve VIII is unmistakable, and I feel justified in adding to my diagram the names Gunz, Mindel, Riss, and Würm to the four maxima of glaciation and to describe the intervals between them as interglacial periods.

So far, we have considered only the conditions

in or near the polar regions where glaciation is the predominating evidence of change of climate. What changes should we expect to see in other regions of the world? Changes of temperature are difficult to recognise geologically, except in polar or desert regions, but changing precipitation leaves a very clear record in the strand lines of lakes and inland seas. Now it is generally recognised that during the ice age there were great variations in the levels of lakes, so much so that the term pluvial periods has been introduced to specify these periods. Is there any relationship between these pluvial periods and the ice ages? In the 'Great Basin' in North America there is clear evidence of the pluvial periods. According to Gilbert and Russell, both Lake Bonneville and Lake Lahontan show two periods of high level between which both lakes were completely dried out and desiccated. They also found clear evidence of glaciers entering the enlarged lakes, showing that one at least of the maximum epochs of the lakes coincided with one of the North American ice ages. The pluvial periods have also left clear traces in equatorial Africa, and here again the evidence points to two main pluvial periods, the first of which, according to Wayland (see NATURE, Aug. 17, 1929, p. 279), corresponds to the Gunz-Mindel Ice Age and the second to the Riss-Würm Ice Age. Thus in both North America and in Africa there have been during the Pleistocene Period two main pluvial periods, while in polar regions there have been four ice ages.

Whether the theory of the cause of the interglacial periods which I have sketched here will prove to be correct or not can only be determined after years of research, and, in discussing it, account must be taken of possible movements of land masses and possible shifts of the poles. I do not propose to go into any further details here, but will simply direct attention to several consequences of the theory which should be touchstones for testing it:

(*a*) The four glacial ages occurred during periods of relatively high temperature in all parts of the world.

(*b*) There are two kinds of interglacial periods: (1) warm interglacial periods which occur between the two members of each pair of glacial periods; (2) cold interglacial periods corresponding to the interval between the occurrence of the pairs of glacial periods.

(*c*) Each pair of glacial periods, with the intervening warm interglacial period, coincides with a pluvial period in unglaciated regions.

RECENT CHANGES IN CLIMATE.

There has been much controversy regarding climatic changes in historical times. It is impossible for me to go into the details of this controversy, but I think I may fairly sum up the discussion by saying that there is little evidence for any appreciable change in temperature, but that there is quite a mass of evidence for moderate changes in the amount of rainfall. It is clear that the historical period is much too short to show any appreciable part of the large but slow changes which give rise to the main changes of climate shown in the geological record and of which the ice age is the last example. These changes probably required 20 or 30 per cent in the change of solar radiation. Any change in the historical period must have been of the order of only a few per cent, and probably took the form of minor fluctuations on a more general change.

Now I have tried to show that the effect of changes in solar radiation are chiefly counterbalanced by a change in the general circulation of the atmosphere and increased cloud and precipitation rather than by large changes in the temperature. It is not surprising, therefore, that what fluctuations there have been are shown chiefly by fluctuations in rainfall; the best evidence of which is seen in the changed level of lakes without efflux, the changed boundaries of deserts, and the relics of old cultivation in places where now cultivation is impossible.

Dog Distemper and Immunisation.

By P. P. LAIDLAW, F.R.S.

SOME seven years ago the *Field* Distemper Fund was inaugurated with the object of encouraging the study of dog distemper, in the hope that the ravages of this disorder might be mitigated through the discovery of some preventive measure or some satisfactory method of treatment. The *Field* Distemper Council, which body administers the *Field* Distemper Fund, joined forces with the Medical Research Council for the purpose of this study, and a scientific committee, composed of veterinary and medical men, was formed to supervise the research work. The Medical Research Council is interested in dog distemper as it is an example of an acute infectious fever, comparable in many respects to such diseases as influenza or measles in man, and it was hoped that the study of the canine fever would ultimately lead to a better understanding of such infectious fevers in man.

The highly infectious nature of distemper rendered the study somewhat difficult, for it was necessary to take elaborate precautions throughout the investigation in order to guard against accidental spread of the disease. New buildings were constructed for the work and dogs were bred, in the strictest possible isolation, for the purposes of experiment. Progress was thus inevitably slow, but it is now clear that without the special equipment and in the absence of the rigid precautions against accidental infection, it is highly probable that little progress would have been made.

The demonstration of the fact that ferrets were very susceptible to dog distemper was of great assistance to the work, for it was found to be possible to experiment in the first instance with this species, which is relatively easy to maintain in close confinement and strict isolation, and reserve the specially

bred dogs for crucial experiments. The facts disclosed in the study of the disease in ferrets have been shown to be applicable to the disease in dogs with only minor modifications.

At the time the work for the *Field* Fund was commenced, the nature of the infectious agent in dog distemper was not firmly established. Carré, in 1905, came to the conclusion that the disease was caused by a filterable virus. He quoted experiments to show that the contagium would pass through the pores of filters specially designed to hold back all ordinary bacteria, and he found that the disease could be transmitted with material in which no structures resembling bacteria could be detected under the microscope and from which no bacterial cultures could be secured. Carré's view did not meet with general acceptance, and from time to time various visible bacteria, which were regarded as causal organisms, were secured from distemper cases. That infection with ordinary bacteria did occur very frequently in distemper cases was undoubted, but it was by no means clear which of the several bacteria recovered from diseased animals should be regarded as the primary cause of the disorder and which the secondary, or if, under the view put forward by Carré, all the visible bacteria were really secondary infective agents and the true contagium was an ultramicroscopic virus.

The workers for the *Field* Fund confirmed Carré's findings in all essential particulars and showed that the disease could be transmitted, at will, by the blood and tissues of distemper cases through an indefinite series of animals. The infective material appeared to be sterile in all the usual laboratory culture media and no bacteria could be demonstrated by microscopic examination. Further, the infective principle was shown to pass through bacterial filters of standard type and proven quality. It thus seems established that dog distemper is primarily a virus disease and that all the bacteria which can be recovered from distemper cases are really secondary invaders of damaged tissue. It was further obvious that preventive measures should be directed against the virus infection in the hope that, if this could be eliminated, the secondary invading organisms would be deprived of their aggressive ally and rendered almost, if not quite, impotent.

It was found that distemper virus could be inactivated or killed in a number of different ways and that, provided the treatment to which the virus was submitted was not too drastic, the inactivated virus formed an efficient vaccine. That is to say, a large dose of inactivated virus could be injected into an animal with complete impunity and, after the lapse of some days, the recipient of the vaccine developed a resistance to injections of fresh living virus. Supplies of virus cannot be secured by artificial culture methods, as is the case with ordinary bacteria, and recourse was therefore made to the tissues of distemper animals as a source of crude virus. The lymph glands, spleen, and liver of distemper animals nearly always have a high virus content and they can be converted into an efficient vaccine, without much difficulty, by means of small doses of formaldehyde. It was found to be possible to immunise more than 90 per cent of ferrets by giving them a single injection of vaccine made from distemper ferret tissue. Similarly, it was found to be possible to render dogs resistant by means of a single dose of vaccine made from tissues of a distemper dog. The resistant state which develops in a dog or ferret after the injection of vaccine is converted into a solid and durable immunity by the injection of living virus. Animals so treated have been given massive doses of distemper virus and they remained unaffected; they have been deliberately placed in contact with severe cases of natural distemper, complicated by secondary infections and without complications, and they have not developed the disease.

After the method had been shown to be almost uniformly successful under experimental conditions, the method was extended to the field and several hundreds of foxhounds and other breeds of dogs were first vaccinated and then given a small dose of living virus. It was hoped that this procedure would give as solid and as durable an immunity as that which follows a recovery from the natural disorder and yet be comparatively free from risks. It was realised that the injection of living virus could never be made absolutely safe, but the immunity which follows recovery from the natural infection, however mild, is so firm and so durable that a final dose of living virus should guarantee real immunity in the vast majority of instances. The resistance set up by vaccine alone, though very definite and significant, was scarcely great enough to be called immunity, and it was doubtful if it would, by itself, render a dog immune for life. The results of this extended field trial were satisfactory in that the great majority of the hounds and dogs came through the immunisation process with no trouble and afterwards proved to be immune to epizootic distemper, which caused severe illness and even death in their unvaccinated companions. In a small percentage of cases the living virus caused a severe reaction in the vaccinated dog, but this was usually of short duration and was followed by complete recovery. In less than one per cent of cases death followed the administration of the virus. The production of the prophylactic has now been undertaken by a commercial firm in Great Britain and by another in the United States of America, and several thousand doses have been issued.

It is not possible to pass any final judgment on the method at the present time. It is clear that the use of living virus carries with it some risk, for its inoculation causes, even in the vaccinated dog, a considerable strain on bodily health, and unless the recipient is free from all forms of infection grave harm may ensue. It is also necessary to remember that the immunisation against the virus disease is no guarantee against infection by bacteria, which may cause bronchitis, pneumonia, gastro-enteritis, and so on, but on the other hand, immunisation should diminish the incidence of these diseases, for it seems clear that the virus frequently weakens the dog's resistance and thus assists bacterial invasion.

Immunisation should prevent, in large measure, the epizootic disease which causes such heavy losses year by year in the canine population.

It may be noted here that this vaccination against distemper is merely a special case of protection against a virus disease by means of inactivated or dead virus. Very similar results have been recorded recently in other diseases such as rabies, rinderpest, fowl plague, and foot-and-mouth disease. In the case of foot-and-mouth disease the matter is complex, for it is now clear that there are at least three strains of virus causing this disorder, and immunity to one strain does not carry with it immunity to either of the others. So far as information goes, there appears to be only one strain of distemper virus, and a dog or ferret which is solidly immune to a virus from one source is immune to strains from other sources.

The study of distemper has not so far proved illuminating as regards the infectious fevers of man. Vaccines made from homologous tissues are clearly not available in the case of man, and yet the hope is raised that if only artificial cultures could be secured, we might make from them vaccines which would do much to minimise the disharmonies produced by the infectious fevers.

Obituary.

PROF. CHARLES CHILTON.

DR. CHARLES CHILTON, whose death on Oct. 25 is reported from Christchurch, New Zealand, had a career which was in several respects noteworthy. He overcame a physical handicap that might have excused a somewhat passive attitude to life, and he practised in turn three different professions without failing of success in any of them.

Chilton was born at Leominster, Herefordshire, in 1860 and was taken to New Zealand as a child. In his boyhood an accident led to the loss of a leg and incapacitated him from following his father's occupation of farming. It was on this account that he became a student at Canterbury College, where he studied natural science and came under the influence of Capt. Hutton and Sir Julius von Haast, afterwards graduating with honours in zoology. He was a schoolmaster for some fifteen years, first at Christchurch and later at Port Chalmers, where he became headmaster of the High School. He found, however, that the demands of the teaching profession left little opportunity for the pursuit of his favourite studies in zoology, and in 1895, when already approaching middle age, he did what few men would have ventured to do ; he resigned his position and came back to Great Britain to enter as a medical student at Edinburgh. His stay in Edinburgh was punctuated with medals and scholarships, and in 1898, after a period as house surgeon in the ophthalmic ward of the Royal Infirmary of that city, he travelled on the Continent, studying diseases of the eye at Heidelberg and Vienna, and returned to Christchurch, where he set up as an ophthalmic surgeon.

All this time Chilton had been giving his spare hours to zoology and had published a series of important papers on the Crustacea. When the late Prof. Dendy received a year's leave of absence from his chair at Christchurch, it was natural that Chilton should be appointed to take his place. Dendy, however, did not return, for during his absence he received a call to King's College, London, and Chilton became professor of biology in Canterbury College. He at once made his mark as a teacher and also as an investigator, although the administrative side of academic life absorbed, as it always does, more and more of the time that should have been given to research. In 1921 he was appointed rector of his college, a position which he held until the end of 1927, when he had to resign following a breakdown of health due to overwork. Recent letters spoke of his health as completely restored, and his death after a few days' illness of pneumonia was unexpected.

Chilton had a high sense of the scientific man's duty to the community in which he lived, and although he never sought municipal honours, he was prominent in the affairs of his city and province, taking the lead in many movements relating especially to education and the public health. He revisited Great Britain in 1912 as one of the representatives of New Zealand at the Congress of Universities of the Empire, renewing old friendships in scientific and medical circles and receiving the honorary degree of LL.D. from the University of Aberdeen. A heavy blow fell on him when his only son was killed at Gallipoli.

Living in a country of which the invertebrate fauna is still very imperfectly explored, Chilton took the view that the most immediate need of biological research was the thorough exploration of this fauna and the study of its ecological and geographical relations. He early specialised on the Crustacea, and most of his published work refers to this group. In 1891 he published, in the *Records of the Australian Museum*, a paper on "A New and Peculiar Freshwater Isopod from Mount Kosciusko" in New South Wales. This was *Phreatoicus australis*, the first fully described member of a new sub-order now known to contain a considerable number of species in the freshwaters of Australia, Tasmania, and New Zealand. The more recent discovery of a species at the Cape has afforded striking additional evidence of faunal affinity between the South African and Australasian regions. Chilton, as a result of his detailed study of the structure of *Phreatoicus*, pointed out "that the group must be of very considerable antiquity", and thirty-five years later he had the good fortune to confirm his own prediction by describing a fossil *Phreatoicus* from the Triassic rocks of New South Wales.

Another subject to which Chilton gave much attention was the fauna, and especially the Crustacea, of subterranean waters. His memoir on the

subterranean Crustacea of New Zealand, published in the *Transactions of the Linnean Society of London* in 1894, revealed the existence of a very peculiar fauna, including a blind species of *Phreatoicus*—which had been briefly described some ten years before—and other forms the affinities and probable origin of which were discussed in detail.

In 1907, Chilton took part in an expedition to the sub-antarctic islands of New Zealand, organised by the Philosophical Institute of Canterbury, and he edited the volumes in which the results of the expedition were recorded, as well as contributing the section on Crustacea. One of the many enterprises in his later life was the establishment of the mountain biological station of Canterbury College at Cass, originally suggested by Dr. L. Cockayne, for the investigation of the ecology of the New Zealand Alpine flora and fauna. W. T. C.

By the death of Prof. Naomasa Yamasaki, geographers and seismologists are deprived of an active and very able colleague. A notice of his life and work appears in *Proc. Tokyo Imp. Acad.*, vol. 5, pp. xviii-xx, 1929. Born on Mar. 10, 1870, he was educated in the College of Science in the Imperial University of Tokyo, and in 1899 he was sent by the government to Europe for three years to study geography. In 1902, on his return, he was appointed lecturer, and in 1911 the first professor, in geography in the College of Science. As a young geologist, he was keenly interested in the eruption of Bandai-san in 1888 and the Mino-Owari earthquake of 1891. Later, he published reports on Yakedate, Miharayama, and other Japanese volcanoes, in which their structures and morphological developments were explained in detail. His last work was one, in collaboration with Prof. Imamura, on the tilting movement in the blocks of the Fuji volcanic zone bordering the Japan Sea. To seismologists, Prof. Yamasaki is best known by his valuable memoirs on the physiographical relations of the recent Kwanto, Tajima, and Tango earthquakes. During the last year of his life, Yamasaki suffered from heart disease, from which he died on July 26.

We regret to announce the following deaths :

Dr. E. W. Allen, chief of the office of experimental stations of the U.S. Department of Agriculture and vice-president in 1920 of Section M of the American Association for the Advancement of Science, on Nov. 11, aged sixty-five years.

Prof. Leonard S. Austin, metallurgical engineer and chemist, at one time professor in the Michigan College of Mines, on Oct. 29, aged eighty-three years.

Mr. William Hewitt, formerly director of technical education in Liverpool, who was keenly interested in the regional survey work of the University and in 1922 published a book on the Wirral peninsula, on Nov. 27, aged seventy-eight years.

Dr. Frederick Montizambert, C.M.G., I.S.O., formerly Director-General of Public Health and Sanitary Adviser to the Canadian Government, the doyen of the public health service in Canada, on Nov. 3, aged eighty-six years.

The Hon. Athelstan John Henton Saw, Chancellor of the University of Western Australia, on Nov. 28, aged sixty-one years.

News and Views.

Prof. Robert Robinson, the new Waynflete professor of chemistry in the University of Oxford, may be aptly described as the most brilliant pupil of his illustrious predecessor, the late Prof. W. H. Perkin. His association with Prof. Perkin began in Manchester, and he remained in communion with his former teacher throughout an academic Odyssey which led him in turn to chairs in the University of Sydney (1912), Liverpool (1915), St. Andrews (1921), Manchester (1922), and London (1928). A long-continued collaboration with Prof. Perkin was directed mainly towards the solution of outstanding problems in the chemistry of alkaloids ; and the researches of Perkin and Robinson on narcotine, harmine, harmaline, etc., have become classical. Prominent among Prof. Robinson's independent work in this group is a masterly paper, published in 1917, detailing possible ways in which many of the familiar alkaloidal skeletons may be conceived to originate in the plant by means of comparatively simple reactions. The elegant simplicity which is a characteristic feature of Prof. Robinson's synthetic work is illustrated by his production of tropinone through the direct interaction of succindialdehyde, methylamine, and acetone—a veritable ' test-tube reaction ' which supplanted a laborious synthesis of some twenty steps.

In a series of later studies, dealing largely with the structure and synthesis of other plant products, Prof. Robinson has made notable advances in the chemistry of the anthocyanins and related substances ; in general, also, his work has thrown much new light on the possible mechanisms of plant metabolism. In another direction he has exercised his influence upon the development of industrial organic chemistry in Great Britain ; while, among his numerous contributions to pure theory, specific mention may be made of his application of the electronic theory of valency to organic chemistry. His highly original and distinctive work was recognised by the Chemical Society in the award to him of the Longstaff Medal in 1927. It is fortunate that British organic chemistry, at a critical juncture in its development, should be able to provide a master of synthesis, endowed with a profound knowledge and command of natural organic products, to succeed to this important ' key ' chair at Oxford.

Very hearty congratulations will be extended to Prof. Sydney Howard Vines, eminently distinguished in botanical science, who celebrates, on Tuesday next—the last day of the year—his eightieth anniversary of birth. A Londoner, he was educated at private schools, graduating in due course at Christ's College, Cambridge. Vines enjoyed the privilege of personal association with Huxley through the courses of instruction in general biology devised by the latter and conducted in the early 'seventies at South Kensington. When an undergraduate of Christ's College, he was

offered an appointment there as demonstrator in the teaching of botany, and fulfilled duty jointly with Thiselton-Dyer and others. Of those early experiences Prof. Vines has recorded that "it was a great, almost oppressive, honour to be introduced to Huxley as one of his junior assistants". Fellow of Christ's College, 1876–88, Vines was University reader in botany, 1883–88, following which he was appointed Sherardian professor of botany in the University of Oxford, retiring in 1919, after thirty-one years' service. He was president of Section K (Botany) at the Bradford meeting of the British Association in 1900, when he gave, in his address, a summary of the position and progress of botany in the nineteenth century. Prof. Vines was president of the Linnean Society, 1900–4, a term of office memorable for the sanction of a supplemental charter enabling the election of women to the fellowship. In 1906 a body of subscribers presented his portrait to the Society, painted by the Hon. John Collier; it hangs in the Society's meeting room at Burlington House.

AN announcement of very great importance to students of ancient man has been made by Prof. Sergio Sergi, of the Anthropological Institute of the University of Rome. He has just published in the *Revista di Antropologia*, vol. 28, p. 3, a preliminary note on the skull of a Neanderthal woman discovered in a pit or quarry situated in the north-eastern outskirts of Rome. The pit lies in the valley of the Aniene, a tributary of the Tiber, and exposes deposits of the Quaternary period. Although the culture of Neanderthal man—the Mousterian culture—has been found in many parts of Italy—particularly in the lower valley of the Aniene—hitherto no trace of the fossil remains of Neanderthal man has been discovered. The skull was found embedded in a stratum of gravel which is rich in the remains of pleistocene mammals, including *Elephas antiquus*, *Hippopotamus major*, and *Rhinoceros Mercki*, a fauna indicating a mid-pleistocene date. The geological evidence points definitely to the stratum wherein the skull was found, which at other places has yielded Mousterian implements, as having been laid down in the interglacial period which preceded the last great glaciation—the Riss-Würm interglacial. From the photographs published in Prof. Sergio Sergi's preliminary note, it can be inferred that the Aniene skull is almost a duplicate of the original Gibraltar skull, with the same cranial capacity of about 1200 c.c. Anthropologists will look forward to the publication of the full account of this skull—one of the most complete specimens ever found. Prof. Sergio Sergi is the son of the distinguished Nestor of anthropologists, Prof. Giuseppe Sergi of Rome.

THE National Institute of Industrial Psychology is making a public appeal for £100,000 to assist in its research and educational work. The Institute was founded in 1921 as a scientific association, and therefore can make no profits. Much of its work is concerned with the carrying out of special investigations in factories on the many problems that arise in connexion with the human side of industry. These investigations are paid for by the firms concerned, but if the Institute's services are to be of the greatest value the scientific basis of its work must be maintained by fundamental research. Moreover, there is an ever-increasing demand for the dissemination of the specialised knowledge the Institute's investigators have acquired by their research and experience. Such educational work cannot be made self-supporting, but unless it is systematically undertaken, much of the knowledge gained by the Institute will fail to be of practical value. The Institute has already received very generous support for its research work from the Carnegie Trustees and the Laura Spelman Rockefeller Memorial, but the time has now come when it must make a wider appeal if its efforts are to be fruitful of the best results. The Institute has made such rapid progress since its inception that there can be little doubt that it fulfils a very real need in national industrial life, but it is clear that its future progress can only be assured if it has adequate funds for research and education.

AN appeal for funds is being made on behalf of the excavations which are now being carried out by Mr. and Mrs. Guy Brunton at Badari in Middle Egypt. The excavations in this area were initiated by the British School of Archæology in Egypt at Qau in 1922, when Mr. Brunton was in charge of the expedition. During the last two seasons the expedition, which since the operations of the School have been withdrawn from Egypt has been working independently, has brought to light remains of the various predynastic cultures, and has discovered the first evidences of the Tasian civilisation, a culture which apparently is the oldest known in the Nile Valley. The Badarian and Tasian cultures have provided us with evidence of agriculture, weaving, and metal working at a date long before these could have been expected. Unfortunately, tomb robbing is particularly prevalent in the area, and unless immediate advantage is taken of the opportunity, scientific investigation will before long be impossible. Up to the present, the expedition has had little support and the expenses have been met privately. As it is not possible to carry on the work indefinitely without assistance, an appeal is now made for subscriptions. The expedition works under the auspices of the British Museum, which receives the greater part of the objects found in so far as these are not retained for the Cairo Museum by the Egyptian authorities. Subscriptions should be sent to the Director of the British Museum.

THE more detailed reports of Col. and Mrs. Lindbergh's archæological survey by air in the southwest United States and Maya area of Central America, which have now been issued by the Carnegie Institution of Washington, suggest that this instrument of research, which has proved its value in the archæology of Britain and the Old World generally, is likely to be of even greater assistance to American archæologists. Two reconnaissances were made by the Lindberghs with the co-operation of the Pan-American Airways and the Carnegie Institution. In the first, several days were spent in flights from the well-known archæological site of Pecos, New Mexico, as base. More than a hundred photographs were taken,

and while flying over the Cañon de Chelly, several hundred miles from Pecos, a number of small ruins were discovered which, though not far distant from one of the archæologists' camps, had not previously been found, or apparently ever visited by a white man. On the second expedition, Belize was made the base, and in flights extending over four days the principal Maya sites were visited, some hundreds of miles of impenetrable forest were traversed, and at least four entirely new and unvisited Maya cities were discovered.

FROM these two reconnaissances by air it is evident that the employment of the aeroplane holds out advantages of the greatest moment to American archæologists. It affords a means of rapid transport—transport being one of the greatest difficulties of the archæological explorer, especially in the tropical forest of Mexico. The journey from Tikal to Uaxactun, usually a long day's journey by mule train, was accomplished in six minutes. Further, it can pass over forests practically impenetrable on foot, thus leading to new discoveries and transporting workers to those sites which cannot or at any rate have not yet been reached. Lastly, it will make possible a survey and accurate map, not only of the ruins themselves, but also of the surrounding geographical features which cannot now be observed from the ground. These latter, it need scarcely be pointed out, are of vital import in the attempt which American archæologists are now making to reconstruct the social and economic life of the earlier cultures of the region.

THE most remarkable rains in the British Isles during the past forty years were dealt with by Dr. J. Glasspoole in a paper entitled " The Areas Covered by Intense and Widespread Falls of Rain ", read at the Institution of Civil Engineers on Dec. 17. The engineer dealing with town drainage is concerned mainly with intense rains of at most a few hours' duration, while in the case of large catchment-areas prolonged rains lasting, with breaks, as long as a week are likely to be more disastrous. Three variables, therefore, have to be dealt with, namely, rainfall-quantities, the duration of rainfall, and the areas covered by these rains. The heaviest orographical rains spend their force on the mountains, giving little rain in the adjacent low-lying regions. Cyclonic rains are not so restricted, and the whole of a catchment-area may be equally affected. Both types are generally sustained rather than intense. Intense rains in the British Isles are confined especially to England, more particularly central, southern, and eastern districts. Further, more intense rains have occurred in London than in any other region of similar size. They are typically thunderstorm rains of five hours' duration or less, long sustained falls being relatively rare there. Little information is available concerning the areas covered by intense falls of one hour or less. In such cases it seems more likely that determinations could be obtained from the measurements of the discharge from small areas than from the records of rain-gauges.

THE attention of all systematists is invited to an appeal by Dr. Handlirsch (*Zool. Anz.*, **84**, p. 85 ; 1929) against the excessive splitting of systematic groups. As he rightly says, *Systematik* is and must remain the backbone of zoology, but it is an exacting study which is apt to absorb the whole energy of the systematist and to leave him little time, or perhaps inclination, to look around him at his fellow-workers in zoology. It is often not realised that the excessive splitting of genera and species leads, as Handlirsch points out, to the obliteration of clues to phylogeny, and makes systematics more and more a study of its own, confined to a narrow professional class. He gives examples among insects of the splitting of genera, and others could be found in every group. One might say that one ceases to be able to see the wood for the trees. As a matter of practical convenience, there is much to be said for the reduction of large genera to more manageable dimensions, but phylogeny is best expressed by retaining the original name and separating subgenera within it. The indefinite multiplication of names has introduced immense difficulties, not least of which is the application to them of nomenclatural rules. Handlirsch gives the example of the gorilla, orang, and chimpanzee. If these are separated as genera, there arises dispute as to which should retain the name *Simia*. Would it not be better if all were included in the old genus and distinguished when necessary as subgenera ?

THE Report of the Industrial Fellowships of the Mellon Institute at Pittsburg University for 1928–29 relates to the eighteenth year of the working of the late Prof. Kennedy Duncan's foundation. On Feb. 28, 1929, there were 62 Industrial Fellowships in operation, employing 145 research specialists and assistants, and about £160,000 was paid during 1928–29 by the fellowship donors in support of researches in the Institute. These statistics furnish eloquent evidence of the permanent success of the scheme. A recent development has been the establishment of a pure research department, but judging from the investigations in progress in this department, many of which are medical and pharmacological, its name does not appear to be specially appropriate. The Report gives a schedule of the researches in operation during the year, with names of the fellows and their assistants. In addition to the Report, we acknowledge with thanks receipt of the pamphlet containing the list of books and bulletins, journal contributions, and patents by members of the Institute during the year 1928, copies of which are available for chemists, librarians, and teachers.

THE speed of transport by road has enormously increased during the last few years. A similar speeding up of electric express trains is now noticeable abroad. In the *Bulletin Oerlikon* for November, there is a description of four locomotives for the Paris-Lyons-Mediterranean Railway (P.L.M.) which have just been completed. The most noticeable characteristic is that the maximum speed has now been increased to 80·7 miles per hour. The first of these locomotives was put into service at the end of June on the Mont Cenis line. These locomotives have the highest output of any yet built, being rated at 5400 horse power. The locomotives are no less than 78 feet long, have 18 wheels, and weigh 156 tons. They are capable of giving a

total tractive effort at the wheel rims of 40,000 pounds weight. The body of the locomotive is mounted on two bogies, each having three driving axles with corresponding twin motors. There are thus twelve motors on a locomotive, and they can be grouped together in various ways so that a large number of economical running speeds can be obtained. The closed-off driver's cabs at each end are connected together by two lateral gangways. The sides and roof of the central compartment which contains the electrical apparatus can be detached for inspection when necessary. All the parts of the equipment which are not dangerous to handle are arranged along one of the gangways. All the high-tension switch gear is mounted along the other gangway and is unprotected as the entrance doors to it can only be opened when the current collectors are lowered and the main switch is open. The current is collected from the overhead line by two pantograph collectors and is returned to the third rail by means of four contact shoes on each side of the locomotive.

WITH the issue of the December number *Antiquity* completes its third year of publication. This is an achievement upon which we offer the editor our hearty congratulations. Those who have any conception of the difficulties which beset the production and publication of a periodical which, while being popular in the best sense of the term, maintains a high scientific standard as well as a topical interest in its articles, will appreciate the courage which was required to start it and the indefatigable energy which has been necessary, not merely to maintain the initial aim, but even to go beyond it. In his introductory remarks to the December number, the editor points out that the very success of his publication constitutes its danger, as it has now come to be looked upon as established, though this is far from being the case. The contents for December strongly reinforce the editor's plea for further support from the public. They all deal in an authoritative, but not too technical, manner with matters which are more or less to the fore in archæology at the moment, and, above all, they are fully illustrated. The editor himself, in an article entitled "Woodbury", describes two photographs which "represent the culminating point of archæological air-photography"; Miss Caton-Thompson gives the first illustrated account of her excavations at Zimbabwe to be published in England; Dr. Oscar Reuther here makes the first report on the German excavations at Ctesiphon, which are opening up a new world; and Mr. G. Brunton describes the Badarian and Tasian civilisations—the most ancient civilisations of Egypt. These are some only of the contents of an excellent number, in which the news items are not the least entertaining and informative feature.

THE second meeting of Australian physicists, organised by members of the Institute of Physics, was held in Melbourne on Aug. 20–23; fifty delegates from all parts of the Commonwealth attended. The meeting was clouded by the sudden death, just before, of two of the most prominent personalities at the previous Conference at Canberra—Dr. Bieler, of the Imperial Geophysical Experimental Survey, and Dr. Duffield, Director of the Commonwealth Solar Observatory. There was a liberal and varied programme of papers. A discussion on seismic prospecting was opened by Prof. A. O. Rankine, whose short stay in Australia happily included the time arranged for the meeting. A preliminary account was given by Major Booth and Mr. R. L. Aston of the progress of experiments in New South Wales on the possibilities of the seismic method, which had been included in the scope of the geophysical survey at the suggestion of the Canberra meeting. Dr. N. B. Lewis spoke on work with the gravity balance, and a preliminary description of a gravity balance of new design was given by Prof. T. H. Laby. Prof. Kerr Grant, of Adelaide, described an improved type of Kater pendulum, in which the planes on which the pendulum swings are spaced by an end rod of Johannsen type. Astronomical contributions were made by the Melbourne and Mt. Stromlo Observatories, and meteorological papers from the Carnegie Institution Magnetic Observatory at Watheroo (W.A.) were read. Papers on X-rays, ionic mobility, heat, were given by the University of Melbourne, Natural Philosophy Department, and some papers on various phases of wave mechanics by Mr. H. S. W. Massey. Mr. A. H. Turner, recently appointed physicist in charge of the Commonwealth Radium Laboratory, described arrangements made for the safe housing of ten grams of radium, and gave an account of accurate methods of measuring quantity. Mr. Z. A. Merfield described some modifications carried out, with Sir Thomas Lyle, of the Grayson ruling machine.

AN article on electrification in Russia, by Dr. Segal, which appears in the *Electrical Review* for Dec. 13, illustrates the ambitious programme of construction and extension which has been undertaken by the U.S.S.R. It is a continuation of the original programme initiated in 1920, which provided that by the year 1933 there would be 39 regional power stations working. This has now been increased to 48, having a total capacity of about three million kilowatts. It is contemplated that by 1934 the total capacity will exceed four and a half million kilowatts. The government considers that the progress of industry necessitates the acceleration of the construction of these stations. It has been decided to build a station on the Lukh river near peat bogs, so that the peat can be utilised as fuel. The power will be transmitted by high-tension lines to Nizhni-Novgorod, where a large motor-car factory, capable of producing 120,000 cars a year, is being constructed. The Chiatura manganese mines in Transcaucasia and sections of the Transcaucasian railway will be served by a large hydro-electric power station. In Leningrad three thermal stations are to be constructed in 1930. At present, one of the municipal stations is being extended. Leningrad will also be served by the huge Swir 180,000 kilowatt power station, the period of construction of which has been shortened. It is satisfactory to find that the increase in the electricity output is greater even than the increase in the number of stations under construction. The capital invested

in these undertakings during the current year is seventy million pounds.

AT the recent meeting of the British Association in South Africa, the general committee, learning with great regret that Dr. F. E. Smith would find it necessary to vacate the office of general secretary during the present winter, empowered the Council to appoint an acting general secretary during the period between the present month and the meeting of the Association at Bristol next year. The Council has now appointed Prof. F. J. M. Stratton, professor of astrophysics in the University of Cambridge, to this office.

SPECIAL free facilities are being offered at the cinema in the Imperial Institute, South Kensington, S.W.7, where an interesting programme of films of historical and general interest has been arranged for the Christmas holidays. The programme includes "The Epic of Everest", the official film of the Everest Expedition (Dec. 22–28); "Outposts of Empire", Hong-Kong, Palestine, Gibraltar, Malta, Fiji (Dec. 29–Jan. 1); "With Captain Scott in the Antarctic", the official kinematograph record made by Herbert Ponting of the story of Capt. Scott's immortal journey to the South Pole (Jan. 2–Jan. 4); "Palaver", a film depicting the life of a district officer in Nigeria, in which the native parts are played by the Aura and Angas tribes (Jan. 5–Jan. 11); "The History of Electricity"; "The Making of a Lead Pencil"; and "Denizens of the Garden" (Jan. 19–22). There are four sessions daily, at 10.15 A.M., 11.35 A.M., 2.15 P.M., and 3.35 P.M., and two performances on Sundays at 2.45 P.M. and 4.15 P.M.

BY courtesy of the president and council of the Linnean Society, a general meeting of British botanists will be held at the Society's rooms, Burlington House, Piccadilly, W.1, at 3 P.M. on Jan. 10, when the chairman of the executive committee of the Fifth International Botanical Congress, to be held at Cambridge on Aug. 16–23 next, will report the progress made in organising the Congress. All interested in the matter are invited to attend.

Two volumes from "The Thinkers' Library", published by Messrs. Watts and Co. at 1*s.* net each, have reached us. One is "A Short History of the World", by H. G. Wells (pp. x + 310), and the other is "On Liberty", by John Stuart Mill (pp. xiii + 144). No 'Thinker' should live in one little truth-tight compartment, studying the Arachnidæ, for example, until he behaves like a spider. To keep in perspective one needs a more general outlook, and works of reference are not so portable that one can take an encyclopædia to a dentist's waiting-room for temporary refreshment. So we have this little library, with Rodin's *Le Penseur* for its badge. Mr. Wells's "History" is a little disconcerting when we read that Solomon's Temple could be put inside a parish church. In any event, as a master of the art of synopsis, he has not been equalled by any writer in the English language.

Our Astronomical Column.

Naked-eye Sunspot.—The prevalence of mist or fog at the time of a large sunspot usually results in the discovery of such a spot by a number of people previously unaware of its appearance, or of the frequency of large spots at times of maxima of the 11-year solar cycle. The large spot which crossed the disc on Dec. 10–22 is a case in point. The big circular spot (area 1000 millionths of the hemisphere), together with its cluster of followers, constitutes one of the largest groups of 1929, but it is only about two-thirds the size of the largest groups of the present cycle. The meridian (long. 345°) passing through the centre of the group shows considerable disturbance; there is a small spot in lat. 20° N.; a small group in lat. 13° N.; whilst a long stream (area about 900 millionths) lies in lat. 3° S. The Greenwich magnetograph traces for Dec. 16 are disturbed, the range in declination amounting to 35′ between 18^h and 20^h. The table below follows from that which appeared in our issue of Dec. 7, p. 888.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
17	Dec. 10–22	Dec. 16·5	6° N.	1500
18	Dec. 10–22	Dec. 16·7	3° S.	900

Motions of the Planetary Nebulæ.—Prof. C. D. Perrine discusses the nature and motion of the planetary nebulæ in *Astr. Nach.*, No. 5670. He uses the photographs of the objects and their spectra obtained at the Lick Observatory by Prof. Campbell, assisted by Drs. Moore, Wright, and Curtis. He thinks that internal motion, both of a radial and a rotational character, is the key to many of the anomalies noted by them. Some of the nebulæ are concluded to be expanding and some contracting. The latter appear to have a harder and more definite outline. The assumption that most of the shift of the spectral lines arises from internal motion gets rid of the puzzle presented by the high radial velocities of these objects; if the motion is internal the system as a whole may not have a high velocity with respect to the galactic system.

A graph is given of radial velocities grouped in relation to the angular diameter of the nebulæ. The velocities are found to vary inversely as the fourth root of the diameters. This law is taken as strong confirmation of the conclusion that the velocities are internal, for such a relation is then explicable on gravitational grounds, but no reason can be imagined for the velocities of the systems in space following such a law.

Prof. Perrine adopts as the most plausible hypothesis the view that the planetary nebulæ are the results of former outbursts of novæ, and that they have now attained an approximately stable condition.

Reported New Comet.—*Harvard Announcement Card* No. 100 states that Mr. E. F. Carpenter found on Nov. 12 an image of a comet on a plate that he had exposed at Tucson, Arizona, Nov. 2·280 U.T., R.A. 2^h 25^m 2^s, N. Decl. 20° 8′ 57″, daily motion +14^s, −5′, magnitude, 16; length of tail, 30″. The direction of the motion was verified by the fact that the seeing was deteriorating during the exposure, and one end of the trail was fainter than the other. Dr. C. H. Smiley has deduced that the node is probably in the neighbourhood of 240° and the inclination small.

Mr. Carpenter has found another cometary image, also of magnitude 16, on a plate exposed by Mr. P. C. Keenan on June 17·240 U.T., 1928, R.A. 15^h 3^m 57^s, N. Decl. 2° 2′, daily motion 5·2^s, 0·2′ either E.N. or W.S. (*Publ. Astr. Soc. Pacific*, Oct. 1929).

Research Items.

Social Organisation in Africa.—Dr. Thurnwald concludes his survey of African social systems in *Africa* for October. The highest forms of social organisation in Africa are found in association with cattle and cultivation of the soil. Many crafts are practised in the home for the benefit of the family. Some callings are the monopoly of certain clans. Clans may either be equal or socially graded, while there is also gradation within the clan. In the larger units under a central authority the most diverse groups may exist side by side. Generally, the tribes which are engaged directly in procuring the means of existence are the most primitive. The higher organisation is based on the association of different tribes each specialising in an occupation. By this association, however, each tribe becomes more exclusive, as their livelihood depends more and more on the exchange of their products. Among tribes such as the herdsmen of East Africa, a graded society is directed by sacred princes, society being stratified upon agricultural clans and hunters. Among the herdsmen-farmers of South Africa, cattle-keeping is still the dominant factor. In the Sudan and West Africa the organisation is that of a stratified peasant-pastoral with three grades of freemen, dependents, and slaves. The final form to be distinguished is that of the net-like state uniting various races under a king—a type of state internally associated with sacred rites such as that of Abyssinia and Kaffa, with an aristocracy derived from cattle and horse herdsmen, great families with slaves, the use of the plough and professional craftsmen of various kinds, who are also recruited from aboriginal rulers and immigrants.

Sumeria and Oceania.—Dr. P. Rivet, following up his previous studies of the Oceanic group of languages in which he sought to show the influence the peoples of the Pacific had exercised on the Mediterranean and African worlds, now endeavours to trace a connexion between the Oceanic languages and Sumerian. He has published as No. 24 of the *Collection Linguistique* of La Société de Linguistique de Paris, a vocabulary which gives his identifications in Sumerian, Melanesian, Polynesian, Australian, Tasmanian, Indonesian, Mon-Khmer, Munda, etc. The work is entirely lexicographical and grammatical affinities have not yet been explored. The difficulty in the comparison of Sumerian and Oceanic vocabularies lies in the fact that the former are abstract, while the latter are concrete. There are also certain phonetic changes. Sumerian, for example, does not show the tendency to nasalisation which appears in the Oceanic languages, and especially Australian. There are many examples of borrowing between Munda and Sumerian which are explained as due to commercial relations between Euphrates and Indus three thousand years before our era. A certain number of roots common to the Sumerian and the Oceanic group also appear in Indo-European and Semitic. This is also due to borrowing. The hypothesis which is put forward in explanation is that there was a single linguistic family of which the centre of dispersal was south or south-eastern Asia, and this spread by stages from Japan, as shown by Ainu affinities, to Tasmania, and from the Mediterranean and Africa to America. This takes us back beyond the age of bronze, which at present bounds our knowledge of the Indo-European tongues, to a much earlier period five thousand years before our era, and to, at least, the neolithic age. The vocabulary remained stable in remarkable degree throughout this long period.

Increase of Elk in Sweden.—The European elk is strictly protected in Sweden, where the open season for shooting is restricted to four days. The result has been a rapid increase in numbers, so that during the four days' shooting this autumn, some 3500 animals were killed, against 3700 last year (*Daily Science News Bull.*, issued by Science Service, Washington, D.C.). While sportsmen and naturalists rejoice at the change in status of the elk, farmers and foresters are less favourably disposed to protection. Increasing numbers and competition for food have made the animals, formerly shy and elusive, extremely bold and occasionally ferocious. In certain parts of Sweden they have damaged crops and young trees, and in places not only have they refused to budge from fields and gardens when called upon, but also have actually attacked farmers protecting their own crops.

White-sided Dolphin in Scottish Waters.—Formerly the general opinion was that this species was rare in British seas. Records of strandings collected by Sir Sidney Harmer, however, indicated almost annual occurrences, and the observations of Charles Oldham during the last few years suggest that it is present in schools of considerable size (*Scottish Naturalist*, 1929, p. 133). Its range in place here would appear to centre about the northern North Sea, and the records are confined to the spring and summer months, so that this may be another example of a temporary influx from the Atlantic Ocean. It ought to be added, however, that a young specimen, received at the Royal Scottish Museum, was caught in the latitude of Buchan Ness about mid-November of this year.

Hay Rations for Dairy Cows.—The importance of making the best use of hay in the feeding of dairy cows is the subject of an article by R. Bontflour in the *Journal of the Ministry of Agriculture*, vol. 36, p. 707. A system of rationing is strongly advocated, and the economy, which will be of particular importance to the farmer in view of the shortage of supplies during the present winter, is convincingly shown to be of real benefit to the cow and to increase her yield of milk. The nutritional properties of hay vary considerably, a poor sample having only half the value of one of good quality. To obtain the best type of hay, early cutting is important, weathered hay if cut early being preferable to that got in under good conditions but cut late. Twenty pounds of hay a day is taken as the standard requirement for the maintenance of the average cow and for the sake of those whose supplies are insufficient to meet their needs, and who must use supplementary feeding stuffs, the equivalent ration of various substitutes are given. Of these sugar beet pulp and brewer's wet grains are specially recommended if purchase is necessary. However, it is pointed out that supplementary feeding may often be avoided if the hay is rationed and a pasture dressed with a hundredweight an acre of sulphate of ammonia in late January to secure an early bite. A cow allowed unlimited hay will consume more than she can digest, and a wastage of so much as one ton of hay per cow per winter may be accounted for in this way. It is equally important to ration hay fed in conjunction with concentrates or roots, for these may actually increase the cows' appetite for hay and decrease of milk yield will result from indigestion. As a conclusion a true story is related in which a prize for the higher milk yield was obtained by surreptitiously giving the opponent's cows an extra feed of hay.

Marine Hydrozoa of the Faroes.—Dr. P. L. Kramp gives a summary of all known hydroids from the Faroe plateau proper and the Faroe Bank in his "Marine Hydrozoa" (Zoology of the Faroes, Pedersens, Copenhagen, 1929). The recent investigations of 1925–27 have brought up considerable material which has, however, only added six species to the number previously known. Fifty-nine species are now known from the Faroe plateau proper, inside the 200 m. line. Three more species are added from the Faroe Bank. Some of the remarks on the distribution of the species are very interesting; for example, the capricious habit of *Clava squamata*, which occurs in some places abundantly and is absent from others which appear to afford exactly similar conditions, and *Dinamena pumila*, which only occurs when *Ascophyllum* is present, although it may grow also on certain species of *Fucus*. Maps and tables are given showing the distribution of the more important species found on the Faroe plateau, almost all of which occur on the British, Norwegian, or southern and western Icelandic coasts, and many being common to the Mediterranean and South European coasts. The evidence seems to show that the hydroid fauna of the Faroes is chiefly made up of species which have their main area of distribution in the more southerly regions, although there are arctic and boreal forms. The author explains that this is due to transportation by free swimming medusæ or of hydroids fixed to floating objects, or that the polyps can live in deeper water, so that the sub-marine ridges enable them to reach the Faroe plateau either from the north or from the south, and that in no case need we take into consideration the possibility of the survival from a time when the islands were more closely connected with other countries.

Non-Nucleated Blastospheres of a Spider.—Dr. E. Warren (*Annals Natal Mus.*, vol. 6, 1929) describes the incipient development of the eggs of three spiders (*Polystes natalius*) which were unable to produce eggs capable of full development. In one spider (*D*) the eggs were certainly, and in another (*C*) probably, unfertilised; in the third spider (*G*) the condition was doubtful. About 80 per cent of the eggs of spiders *D* and *C* shrivelled and died on the second day after laying—due to lack of resistance to desiccation—but the surviving eggs resisted desiccation in the normal manner. In the eggs of *D* no trace of formation of polar bodies could be detected, but a normal fertilisation membrane was formed in the eggs of all three spiders. The eggs of *D* underwent a certain progressive development; those of *C* exhibited at the time of laying a variable amount of development which progressed little further, the eggs of *G* appeared normal when laid and the central nucleus underwent mitosis, but there was complete inability to form a normal embryo. In the eggs of *C* and *D* no trace of mitosis was found. The cytoplasm of all three lots of eggs exhibited a marked activity, numerous well-defined bodies being produced which looked like cells except that they had no distinguishable nuclei. These bodies formed a perfect blastosphere—without a single nucleus being found in the epithelium—which flattened at one pole and produced by the proliferation of the non-nucleated masses a ventral plate. In the eggs of *G*, nerve ganglia were formed in a totally undifferentiated plasmodium.

New Varieties of Hops.—The twelfth report by Prof. E. S. Salmon, on the trials in 1928 of 102 new and commercial varieties of hops (*Journal of the Institute of Brewing*, **35**, 523; 1929), is of special interest in that those plants, originally raised in or selected from the Experimental Hop Garden at Wye College, are now sufficiently established at East Malling Research Station for their distinctive characteristics to be ascertained. The most outstanding features are the high yields of 20 cwt. or more to the acre obtained from 23 of the hops, and the high preservative qualities of certain of the new varieties. In particular, two of the latter gave values 1·52 and 1·21 per cent higher than that of the best hop obtainable in 1928, and there seems good grounds for believing that hops equal or superior in preservative value and flavour to the best American hops will be available for cultivation in England. In this connexion it is reassuring to learn that variety rather than soil or climate determines the brewing value of a hop. Investigations on the incidence of mosaic disease, which was high in 1928 though lower than in 1927, have shown that though many of the new varieties are themselves immune, they may act as 'carriers' of the virus, and so transmit the disease. Though this transmission has at present been demonstrated only by grafting, it is clear that it may take place rapidly in hop gardens by other means, and a number of formerly puzzling cases are thereby explained. A list of susceptible varieties is given. Observations of downy mildew confirmed the experience of previous years, namely, that a variety though severely attacked on its bines may be resistant on its cones, and conversely that severe attacks on the cones may occur while the bine remains healthy.

Bibliography of Tides.—A bibliography of tides for the years 1910–27 has been compiled by Prof. J. Proudman and published as *Bulletin* No. 12 of Section d'Oceanographie, Union Géodésique et Géophysique Internationale. The entries are chronologically arranged under ten headings. Only publications in a Latin or Teutonic language are included. Publications on the utilisation of tidal energy and ephemeral tide tables have been excluded.

New Zealand Earthquake of June 17, 1929.—Two preliminary reports on this interesting earthquake have recently been published, one by Messrs. H. T. Ferrar and L. I. Grange, the other by Mr. H. E. Fyfe (*N. Z. Jour. of Sci. and Tech.*, vol. 11, pp. 185-191, 192-197; 1929). The main centre of the earthquake appears to have been situated on the White Creek fault, which crosses the Buller River seven miles to the west of Murchison. The re-levelling of the district by the Public Works Department shows that the country on the east side of the fault has been uplifted. At a distance of nine miles from it, there is no appreciable change of level, but towards the fault the change increases though with some oscillations. At the fault, the east side has been raised 14 ft. 9 in., but, about 550 yards to the east of the fault, the uplift is 16 ft. 1 in. The course of the fault is marked by shattered ground and disturbed vegetation; trees lean over at all angles or are uprooted and split. The block on the west side of the fault has not yet been re-levelled.

Spectra of Xenon and Arsenic.—The November number of the *Journal of Research*, published by the Bureau of Standards at Washington, contains papers by W. F. Meggers, T. L. de Bruin, and C. J. Humphreys, on the arc spectra of xenon and of arsenic, both of which had been previously only incompletely described. Xenon has been studied in special detail, and is likely to furnish lines which are even better suited for standards of wave-length than those of krypton. The majority of the lines lying between 3000 A. and 10,000 A. which have been measured—three hundred odd—have been fitted into a term scheme generally similar to those already known for the lighter inert gases, but there are certain differences consequent on the high atomic number of xenon which

will almost certainly be found to an even greater extent in the spectrum of radium emanation, which is now under investigation. The analysis of the arsenic spectrum is less complete, and has been extended so far only to the infra-red and ultra-violet lines, new lines which have been found in the visible region not being included. These papers have been made very readable by the inclusion of histories of the older work on the elements in question, and contain good large-scale reproductions of the spectra.

Structural Stresses.—The Engineering Experimental Station of the University of Illinois has for some time been determining the stresses in structures of forms too complicated to admit of mathematical treatment by means of tests on models made of 'pottery plaster', which is plaster of Paris with an addition which delays its setting. *Bulletin* No. 195 of the Station contains an account of the tests of beams of circular, rectangular, triangular, and H section bent into U shape, carried out by Profs. F. B. Seely and R. V. James. In the first instance the legs of the U were forced together until the beam broke at the bend, then the two straight lengths were supported at the ends and loaded in the middle until the beam again broke. The results obtained show that the plaster model gives trustworthy information as to the maximum stress a structure will stand if five to ten tests are made and the mean taken. The H section beams broke at the abrupt change of section unless provided with a fillet of at least ½ inch radius.

Preparation of Telluric Acid.—Several methods of oxidising tellurium or its dioxide to telluric acid have been described. A new one is given by Mathers and Bradbury in the November number of the *Journal of the American Chemical Society*. Tellurium dioxide is mixed with five equivalents of calcium hydroxide and heated at 975° for one hour exposed to air. Complete oxidation was very nearly attained. The percentage of oxidation was smaller at lower temperatures or with less calcium hydroxide. The calcium tellurate was treated with an excess of concentrated nitric acid, whereby soluble calcium nitrate and insoluble telluric acid were formed. This telluric acid, after filtration or decantation, was dissolved in water and crystallised until pure.

Enantiomorphism in Organic Compounds.—The October number of the *Journal of the Chemical Society* contains an important paper by John Read, I. G. M. Campbell, and T. V. Barker, on the optically active diphenylhydroxyethylamines and isohydrobenzoins. The authors discovered that crystals of pure *d*- and *l*-isohydrobenzoin, when deposited from ethyl acetate, exhibit characteristic hemihedral facets; when chloroform is used as solvent, however, the distinctive facets are not developed. Pure *dl*-isohydrobenzoin, when crystallised from ethyl acetate, separates as a conglomerate of enantiomorphously related crystals, composed of *d*- and *l*-isohydrobenzoin respectively; but the crystals deposited from chloroform are morphologically indistinguishable from one another so far as plane faces are concerned. The latter crystals, however, have been shown by polarimetric observation to be also of two kinds, consisting again of the pure *d*- and *l*- forms; moreover, despite the absence of plane hemihedral facets, the two sorts of crystals can be segregated through the circumstance that either the right or the left side of each crystal displays a marked tendency to degenerate into curved boundaries. This diagnosis by means of curved surfaces is entirely novel, and is of great interest in connexion with the so-called 'Pasteur principle', namely, the establishment of molecular enantiomorphism from a study of crystal form. The authors point out that this principle cannot be accepted as generally true, for there is nothing in the undoubted enantiomorphism of structure of *d*- and *l*-isohydrobenzoin crystals which categorically demands plane-faced boundaries, still less facets indicating right- or left-handedness. At the present time, the only question which can be raised is that of the frequency with which enantiomorphism of structure unfolds itself on the surface. Enantiomorphous hemihedrism among organic compounds is a good deal rarer than is commonly supposed, since in many cases it stands revealed only after repeated attempts at crystallisation, possibly with changes of solvent.

Hydraulic Pneumatic Engineering.—The *Journal of the Royal Society of Arts* for Nov. 29, 1929, contains a paper by Mr. J. O. Boving on new developments in hydraulic pneumatic engineering, in which particulars are given of many interesting applications of hydrautomats in which falling water is used for compressing or rarefying air and for raising water. Simple forms of hydraulic air compressors have been built for centuries in the Vosges and Pyrenees for providing air for forges and the air lift pump is in common use. Research work, however, has led to great improvements in such apparatus and many installations are now in use for irrigation and other purposes. One compressor plant described is at Alston, Cumberland, where there is an available head of 180 feet. The falling water is led to a steel separator tank about 400 feet below the top of the intake pipe in an old mine shaft from whence it again rises to a tail-race. The entrained air becomes compressed to about 90 lb. per sq. in. and is used for drilling, etc. A typical plant lifting water from a drainage canal is that at Bambanwala on the Upper Chenab Canal, Punjab, where a syphon rarefier works in conjunction with a continuous vacuum lifter which drains the town of Bambanwala. Other installations described were those on the Rio Ebro in Spain, and at a tin mine in Nigeria. "There is", said Mr. Boving, "a wide field for applying the ideas to other uses, not yet fully explored."

Alternating Current Potentiometers.—Dr. C. V. Drysdale read a paper to the Institution of Electrical Engineers on Dec. 6, giving an historical account of the evolution of the a.c. potentiometer and describing some of its many practical applications. He pointed out that no department of electrical testing involves such difficulties and such costly equipment as that of accurate a.c. measurements. Most of the instruments suitable for these measurements have a very limited range, owing to the fact that their deflections obey a square law. The ranges to be covered vary from a few millivolts to hundreds of thousands of volts and from milliamperes to thousands of amperes. As polyphase measurements have also to be made, special wattmeters have to be used for power and phase measurements. The cost of suitable apparatus to make all these measurements accurately runs to thousands of pounds and is beyond the means of all but the wealthiest factories. The direct current potentiometer first suggested in practical form by Sir Ambrose Fleming so far back as 1885 is the most universally used apparatus for d.c. measurements, and so many attempts were made to construct an a.c. instrument which could fulfil the same functions. One of the best of these instruments is the Drysdale a.c. potentiometer. It is particularly useful for testing wattmeters and ordinary supply watt-hour meters. It can also be used for measuring the frequency of alternating currents and the magnetic fields which they produce. These instruments are much in demand in countries where facilities for obtaining special instruments are limited, but they are often in general use even in well-equipped laboratories.

Modern Mining Explosives.

DR. WILLIAM CULLEN, who took the presidency of the Institution of Mining and Metallurgy on Oct. 17 last, chose for his presidential address the subject of mining explosives, this being one with which the greater part of his life's work has been identified. The address, therefore, constitutes an exceedingly valuable summary of the present position of the explosives industry; it is so rich in material that it is practically impossible to give an abstract of it which will do anything like justice to the large amount of matter it represents, there being practically no aspect of explosives with which Dr. Cullen has not dealt.

Necessarily, Dr. Cullen devotes considerable attention to the use of nitro-glycerine and its products, which are used more extensively than any other mining explosive throughout the world to-day. He points out the dangers attending the handling of explosives in which the nitro-glycerine is frozen, and explains how of recent years this difficulty has been got over, there being two methods in use to-day. In one the glycerine before nitration is polymerised; the nitrated polymerised glycerine acts like ordinary nitro-glycerine in all respects except that it does not freeze. The second method consists in replacing nitro-glycerine by dinitroglycol, which again behaves in all respects like nitro-glycerine except that it is not liable to freeze in winter. Explosives in which one or other of these products replaces nitro-glycerine to a sufficient extent to prevent freezing are generally spoken of as low freezing explosives and are used in all circumstances where ordinary nitro-glycerine explosives might be liable to freeze.

Dr. Cullen deals briefly with liquid oxygen explosives, but would scarcely appear to do them justice; they are used extensively in some parts of the Continent and are also used in open-cast work in Great Britain, as Dr. Cullen indicates; he states, however, that their use is attended with an economy of about 10 per cent, whereas some of the most recent authoritative statements on the subject show an economy of 30-50 per cent.

As an all-round explosive, Dr. Cullen appears to favour explosives consisting essentially of nitrate of ammonia with a certain definite proportion of nitro-glycerine. He points out, however, that in coal mining special types of explosives must be employed because of the danger of initiating explosions of fire-damp or coal dust. It has long been known that gunpowder, for example, is exceedingly dangerous in this respect both because it gives a fairly hot flame and also because the flame is one of long duration. The latter consideration is a very important one, and in connexion with this matter Dr. Cullen points out that the ordinary mercury fulminate detonator seems to be incapable of igniting firedamp, whereas the more modern tetral detonator with lead azide primer contained in an aluminium tube will always explode a mixture of firedamp and air.

Dr. Cullen is a keen advocate for the simplification of the explosives industry; for example, he points out that there are at the moment no less than 71 explosives on the British 'permitted' list, whereas probably a dozen would be sufficient, and that standardisation is here clearly indicated as a means of lowering the cost of such explosives without in any way diminishing their efficiency or safety.

It may perhaps be of interest to add that Dr. Cullen's address concludes with a reference to the interchange of technical information concerning explosives that is in existence between Great Britain and the United States of America, and in this connexion he refers to the recent award of the medal of the Institution of Mining Engineers to Mr. George S. Rice, Chief Mining Engineer of the U.S. Bureau of Mines. He points out that with European countries relations are cordial but are not so accurately defined as they are with the United States. It is surely not too much to hope that before very long the question of safety in mines, in which a proper understanding of mining explosives must always play a leading part, will be looked upon and treated as an international question, and that definite arrangements will be made with all countries in which the mining industry occupies a prominent position to pool all information tending to safety, thus avoiding needless duplication of effort and expenditure and directing research along the lines where it will produce the maximum degree of usefulness to mankind.

Low Temperature Carbonisation in Power Station Practice.

THE Institution of Electrical Engineers arranged a discussion on Nov. 21 on the low temperature carbonisation of fuel in combination with the generation of electricity. Prof. P. Rosin dealt with German practice, S. McEwen with American, and E. H. Smythe and E. G. Weekes with English practice. As all these speakers have had ample opportunity of familiarising themselves with the problem, their opinions deserve close attention.

Prof. Rosin says that in Germany the original aim of carbonising bituminous coal for the sake of the tar and oil has met with disillusionment, and the principal object is now the production of a smokeless domestic fuel from fine coal slacks, while the utilisation of the gas receives increasing attention. Indeed, the only large low temperature plant working economically on coal is the K.S.G. plant at Karnap—a unit of which is now installed at a London gasworks.

In power station practice the size of the coke product is unimportant, the available boiler plant being capable of consuming anything from dust to lumps. No value can therefore be assigned to the coke in excess of that of cheap low-grade boiler slacks—the cheapest grade of coal. It is therefore much more difficult to couple precarbonisation of coal with power production than to make economical domestic fuel, which commands the highest price in the market. The capital costs must be very low and the yields of tar and gas high. In Germany, Rosin says these conditions cannot be realised, and "low temperature plants using pit coal . . . offer no prospect of remunerative operation at present". With brown coal the position is different because the raw material, got without mining, is very cheap and the tar more valuable than the coal. Much of this tar is now being converted into motor spirit, 200,000 tons of which will be made this year. Nevertheless, the by-products are regarded as an unstable item of revenue, and the revenue from the sale of electricity should be regarded as the basis of any successful enterprise.

S. McEwen, speaking of American experience, voiced similar views on the economics of power station carbonisation. Owing to the low value of the coke for steam raising, it is essential to reduce the capital and labour costs to a minimum. It was with this idea in view that the process of carbonising coal dust while falling through a vertical retort was developed by McEwen and Runge. The product

can be used directly as pulverised boiler fuel. After various technical difficulties had been overcome, it came to be realised that the gas should be utilised for town gas supply in order to give the process a chance of economic success—the gas being the most valuable product. This has necessitated embarking upon further modifications of the process so as to obtain a gas rich enough for distribution. This last stage in the development of the process is now in process of development.

The two British workers described the 'Babcock' process, which has been the subject of experiment for ten years at the Dunstan station of the Newcastle Electric Supply Co. In this case a Northumberland coal slack is subjected to heat by direct contact of a mixture of superheated steam and combustion products on its way to the grate of a stoker. As this plant is now in its third year of operation, no doubt is felt as to its practicability, and designs have been prepared for a unit capable of dealing with 160 tons of coal per day, which will be commensurate with modern boiler practice. From 1 ton of coal costing 11*s.* it is said that by-products valued at 8*s.* 11*d.* are obtained, and considerable optimism is displayed as to the future of the combination.

In this respect, these opinions are scarcely in accord with those of Rosin and McEwen. The former expresses the exact converse, while the latter regards the evaluation of the gas as a key to financial success. It may be remembered that the existing producers at the moment find coal tar oils an embarrassing drug on the market. It will therefore be wise to suspend judgment as to the future of pre-carbonisation of boiler fuel. No appreciable reduction, if any, of the cost of generation, is to be anticipated. There would be a gain in the abolition of smoke by the power station and better conservation of the chemical values of the coal. H. J. H.

Work of the Canadian School of Prehistory in France in 1929.

FOR four months, July to October inclusive, the Canadian School of Prehistory has been carrying on excavations in the classic hillside of Combe-Capelle, in the beautiful valley of the Couze—a tributary of the Dordogne, in which many *gisements* occur. It was there that some twenty years ago *Homo Aurignaciensis hauseri*, Klaatsch, was found. Mousterian, Aurignacian, and Solutrean materials, implements, engravings, etc., have also been found there, whilst a certain *terrasse* below the Plateau Ruffet appears to contain so many typical Acheulean hand-axes—*coups de poing*—that an Acheulean horizon seems indicated.

This is the fourth year of work by the Canadian School at Combe-Capelle, and one main *fouille* has yielded very interesting and practically unique types of tools of flint deserving special notice. Four collections of the very best found during this year's explorations were prepared for (1) The Musée national des Eyzies, Dordogne, headquarters of the School; (2) St. Germain-en-Laye; (3) Institut de Paléontologie Humaine; and (4) Le Musée Cartailhac, Université de Toulouse, Haute-Garonne.

Besides these collections, which were labelled carefully as to precise geological strata from which they came, from Beds No. I., No. II., No. III., No. IV., occurring at Combe-Capelle, of which some twenty-five cases were shipped to Canada after inspection by the Beaux-Arts of Paris, other series were obtained from (1) Le Moustier (Upper Cave), and from the Émile Bompson property near the classic *abri* of that name. Four district beds, older than the oldest Mousterian known at Le Moustier Abri up to last year, were searched, and valuable and new information gathered of prehistoric value.

By request, the Canadian School was engaged in two other sites during 1929, namely, at Gavaudun, la Grotte du Moulin du Milieu, Lot-et-Garonne, where new facts were recorded of geological, palæontological, and archæological significance; (2) at Le Ruth, in the Vézère Valley, close to some old Mousterian *atelier*, which yielded some typical Mousterian implements besides teeth and bones of reindeer, lion, great stag, bison, horse, and claw of an eagle.

The School also visited an Azilian-Tardenoisian site near Sauveterre Lalémance (Lot), where a phase of these two periods seems to give some foundation to M. Coulonges, digging there, in establishing a sauveterrian phase of the uppermost palæolithic of that region. Geometrical pieces, microliths in large numbers, occur, associated with an abundant fauna, all of which will no doubt soon be described. The caves, rock shelters, and museums of the Dordogne or Périgord District were visited by the director and students of the (Canadian) School of Prehistory, every facility being afforded by M. Peyrony, administrator of the Beaux-Arts, to study the paintings, drawings, sculptures, engravings, and industries of the different ages represented in that remarkable locality. Les Eyzies is the European headquarters of the School, and a few days were spent by some members of the School in the Ariège Caves, in the Grimaldi Caves of Italy, and in the Museums of Natural History in Toulouse and Marseilles, where excellent collections in prehistory are housed to advantage.

The School's record of finds in France, Italy, England, and Holland have enabled it during 1929 to furnish the University of Toronto, that of Alberta (Edmonton), of Saskatchewan (Saskatoon), and of Manitoba (Winnipeg) with systematic series covering most of the periods in prehistory of the old and of the new Stone Age. The headquarters of the School in Canada is in Ottawa, Laboratory of Geology and Palæontology, Elgin Annex, where the director of the School has his office. H. M. AMI.

The Biblical Manna.[1]

THERE has always existed among scientific workers a wide divergence of opinion as to the true nature and origin of the manna, believed to have fallen from heaven to provide food for the Israelites in the Sinai desert during the Exodus from Egypt. Some authors considered the manna to be a desert lichen, *Lecanora esculenta* Nees, while others connected it with desert shrubs of the genus *Tamarix* and considered it to be either a physiological secretion of the plant, or its sap flowing from the wounds caused by insects. In order to solve this problem, the Hebrew University in Jerusalem organised in 1927 a small expedition to the Sinai Peninsula, and the leaders of that expedition, Dr. F. S. Bodenheimer and Dr. O. Theodor, have just published a very interesting account of their investigations.

The expedition visited some classical localities where manna was recorded. In the course of investigations,

[1] Ergebnisse der Sinai-Expedition 1927 der Hebraischen Universität, Jerusalem. Pp. 143+24 tafeln. (Leipzig: J. C. Hinrichs'sche Buchhandlung, 1929.)

it was established beyond doubt that the appearance of manna is a phenomenon well known in other countries under the name of 'honey-dew', which is a sweet excretion of plant-lice (Aphidæ) and scale-insects (Coccidæ). Two scale insects mainly responsible for the production of manna were found, namely, *Trabutina mannipara*, Ehrenb., occurring in the lowlands, and *Najacoccus serpentinus* var. *minor* Green, which replaces the former in the mountains. Two other Hemipterous insects, *Euscelis decoratus* Haupt and *Opsius jucundus* Leth., also produce manna, but to a lesser extent. All these insects live on *Tamarix nilotica* var. *mannifera* Ehrenb.; no manna was observed on other species of *Tamarix*, a fact probably due to some physiological peculiarities of the former. The authors observed the actual excretion by the insects of drops of clear sweet fluid, and proved by experiments that the fluid is ingested by the insects from the vessels of the phloem. When in an experiment a twig bearing the insects was placed in water, and the bark was cut below the insects, the production of manna continued in a normal manner, but it stopped as soon as the flow of carbohydrate solution from the leaves was interrupted by cutting off the bark above the insects. The dry desert climate of Sinai causes the syrup-like fluid excretion to crystallise, and the whitish grains thus produced, which cover the branches or fall to the ground underneath them, constitute the true manna of the Bible.

A chemical analysis of the manna demonstrated the presence of cane sugar, glucose, fructose, and saccharose; pectines were also found, but there was no trace of proteins.

Detailed descriptions of the manna insects are given in the report, which includes very good photographs of various stages of the production of the manna. Notes on the course of the expedition and on the fauna of the Peninsula of Sinai in general provide very interesting reading on that still practically unexplored country.

Fauna of the Batu Caves.

THE Batu Caves, near Selangor, were discovered in 1879, and the general character of the caves and their fauna was made known in 1898 by H. N. Ridley, and subsequent faunal records were made by Annandale and others. Mr. and Mrs. Cedric Dover have recently explored the caves, the total length of which is about 2500 feet, and their collection is the subject of a series of papers in the *Journal of the Federated Malay States Museums* (vol. 14, 1929).

The animals now reported upon include Mollusca, Crustacea, Nematoda (a new species of *Dorylaimus*), Arachnida, and seven orders of insects. Of the four molluscs, all gastropods, the genus *Opeas* was common throughout the cave, especially on damp boulders and on the walls, and both the species found (described as new) have eyes in which the pigment is small in amount or absent. Two isopod Crustacea are recorded—*Armadillo intermixtus* and *Philoscia dobakholi*—the latter, first described in 1924 from the Siju Cave in Assam, has "somewhat imperfect" eyes and a light colour.

The late G. O. Sars has given a detailed description of a new species of *Parabathynella* taken from a small pool about 900 feet from the entrance to the cave. These examples have seven pairs of well-developed legs and a rudimentary eighth pair, as contrasted with only five pairs of legs in the European specimens of *P. stygia* in which the three posterior trunk segments have no limbs—probably owing to their immature condition. Prof. Sars did not accept Dr. Calman's view that the Bathynellacea are Syncarida; he placed them in the division Anomostraca of the Malacostraca, and regarded them as "very primitive forms, apparently constituting the still living remains of an antediluvian fauna". Their primitive characters include the uniform segmentation of the body, the sharp definition of the first segment of the trunk, and their primitive limbs, and it is suggested that the Bathynellacea are the predecessors of the Amphipoda.

The Arachnida include a Pedipalp, spiders of four genera, and a new species of the tick *Ornithodorus*. Among the insects recorded are two genera of blattids, a strongly pigmented new species of *Gryllotalpa* (the first mole-cricket to be found in a cave), an earwig, a Myrmeleonid, and five species of Microlepidoptera, one of which, a *Tinea*, is common in the cave and its larvæ are abundant in the bat guano. Of the ten species of Diptera collected, none shows any modifications for cave life. Two Reduviid bugs are recorded and a dozen beetles—none markedly modified for a cavernicolous habit. The discovery of many larvæ of beetles in the cave indicates that some at least of these beetles have found congenial conditions and are firmly established there.

University and Educational Intelligence.

LONDON.—The title of emeritus professor has been conferred on Dr. E. A. Gardner on his retirement from the Yates chair of archæology at University College, and on Dr. F. W. Oliver on his retirement from the Quain chair of botany at University College.

The following doctorates have been conferred: D.Sc. in chemistry on Mr. J. Bardhan (Imperial College—Royal College of Science), for a thesis entitled "I. The Chemistry of Balbiano's Acid; II. The Action of Cyanoacetamide with β-diketones"; Mr. K. Krishnamurti (University College), for a thesis entitled "Investigations on the Scattering of Light in Colloidal Solutions and Gels"; Mr. F. G. Mann (Battersea Polytechnic), for a thesis entitled "The Complex Metallic Salts of the Aliphatic Polyamines". D.Sc. in zoology on Mr. William Rowan (University College), for a thesis entitled "Experiments in Migration, including an Investigation of the Sexual Rhythm and Histology of the Gonads in Birds". D.Sc. in geography on Miss E. G. R. Taylor, for a thesis entitled "Studies in Tudor Geography, 1500–1583".

PORTSMOUTH Municipal College sends us a booklet issued on the occasion of the visit of H.R.H. Prince Arthur of Connaught on Dec. 9 in connexion with an exhibition commemorating the twenty-first anniversary of the opening if the college. Erected, equipped, and maintained by the Portsmouth City Education Authority, it serves the higher educational needs of a wide area surrounding the city, including the Isle of Wight and parts of Hampshire and West Sussex, whence come twenty per cent of the technical college students. It comprises departments of science, arts, technology (mechanical, civil, electrical, marine, motor, and other branches of engineering, building trades and pharmacy), commerce and domestic science, and, in addition, a school of art and a training college, affiliated to the University of Reading, for women teachers. It has thus, as pointed out in a foreword by the chairman of the governing body, the potential constituents of a university college. The work includes, on the technical college side, full-time academic courses leading to degrees of the University of London in arts, pure science, engineering, etc., and, more recently, in pharmacy and a wide range of other courses both full-time and part-time. The number of full-time students in this part of the College has increased from 66 to 507. The number of training college students has increased from 180 to 215.

COURSES in anthropology announced for the coming session in the University of Paris as usual cover a wide range, both in general subjects and in departmental studies. For the diploma and certificate in ethnology, M. Mauss lectures on descriptive ethnography, M. M. Cohen on descriptive linguistics, M. Rivet on physical anthropology, and L'Abbé Breuil on "Préhistoire exotique". There are also special courses on the ethnography and linguistics of Africa and further Asia, zoological and biological anthropology, quaternary geology and palæontology, and the psycho-physiology of man and the anthropoids. Practical instruction in each course is given in museums. Courses given at the constituent bodies of the University are as usual grouped under ethnography, sociology, human geography, prehistoric archæology, linguistics, and phonetics, physical anthropology and palæontology. The course in linguistics is specially varied, and the lectures have obviously been arranged with the requirements of French colonial administration in view. They include Annamese, Siamese, Cambodian, Amharic, Lao, Malay, Malagasy, the languages of Modern India, and Arabic. Among the courses in ethnography may be noted one which will deal with the folklore of medieval western Europe and the formation of the Ossianic cycle from popular legend (M. Marx), and one by M. Mauss on the belief in the efficacy of the spell in Australia and the relation of myth and rite in New Guinea. The civilisation of Central America and Peru will be dealt with by M. Raynaud, and M. Cabaton covers the Malay Peninsula and Indo-China.

THE Rhodes scholarships statement for 1928–29 shows that of 181 scholars in residence, namely, 96 from within the British Commonwealth and 85 from the United States of America, 58 were pursuing studies in law, 34 in natural science and medicine, 25 in English literature, 19 in philosophy, politics, and economics, 10 in Lit. Hum., 8 in mathematics, 7 in economics, and 10 in other schools. It will be noticed that a large proportion (32 per cent) of the scholars elected to study law. Moreover, this preference seems to have been most marked among the more brilliant, and especially so among the Americans. Seven out of twelve and seven out of thirteen who gained, respectively, first and second class honours, did so in the school of jurisprudence, the remainder being distributed as follows: natural science 5, modern history 3, philosophy, politics, and economics 2, and English 1. Of the eight American scholars who took firsts, six were in the school of jurisprudence. Most of the higher degrees and first and second class honours were won by scholars from the United States, as was only to be expected, having regard to the wealth of academic resources and the extent of the field of selection in that country as compared with those in the British Empire overseas. The statement includes interesting notes *de mortuis* and particulars of honours and appointments obtained by former scholars, and of new books published by scholars. A former German Rhodes scholar is actively and prominently engaged in political life in Germany as a member of the Nationalist group in the Reichstag. A notable event of the year was a gathering in Oxford last July of old Rhodes scholars to celebrate the twenty-fifth anniversary of the inauguration of the scholarships. The celebrations lasted from July 4 until July 11. Old Rhodes scholars to the number of 190, 99 of whom were accompanied by their wives, were present. The central event was a dinner in Rhodes House on July 5 (the seventy-sixth anniversary of the birth of Cecil Rhodes), at which H.R.H. the Prince of Wales was present, with Mr. Stanley Baldwin in the chair.

Calendar of Patent Records.

December 28, 1871.—Antonio Meucci is an Italian claimant to the invention of the telephone. Meucci settled in the United States in 1851, and worked at his invention for many years, an attempt being made to start a 'Teletrophone Company', though this did not attract more than a few dollars of public support. A caveat for the invention was lodged in the United States Patent Office on Dec. 28, 1871, but was not taken up and lapsed at the end of the following year. Bell's patent was applied for in 1876.

December 30, 1775.—John Arnold, the London watchmaker, invented the cylindrical helical form of balance-spring for chronometers and received a patent for the invention on Dec. 30, 1775. A watch with the new spring was sent to Greenwich for an official trial in 1779, and successfully withstood all tests for a period of 13 months. Its total error during this period was only 2½ minutes, whilst its daily rate never varied by more than 3 seconds.

December 30, 1797.—The self-acting hydraulic ram was first invented by Joseph Michel Montgolfier, the celebrated pioneer of ballooning, and patented in England in the name of Matthew Boulton on Dec. 30, 1797, the French patent not being granted to Montgolfier until six months later. The principle of the hydraulic ram had been first used for raising water by John Whitehurst of Derby, who sent a description of his apparatus to the Royal Society in 1770, detailing its application to a domestic water supply in which every time the tap was turned on and off in the kitchen a column of water was forced into a tank in the upper part of the house. The value of the apparatus for water-raising purposes was not recognised, however, until Montgolfier's invention.

December 31, 1562.—The first patent in the English records for a machine for the draining of mines was granted for twenty years to John Medley on Dec. 31, 1562. The grant recites that "in oure counties of Cornewall and Devon as in diverse other places of oure Realme of England there be diverse mynes as well of tynne leade and other mettall as of sea-cole whiche through the greate habundance of waters rysinge in the same are drowned and all-together unoccupied", and that Medley has made "an engyne or instrument for the draynynge of waters not heretofore used in this oure Realme". It was the dependence of the mining industry on adequate water-raising devices that led to the invention of the steam engine.

December 31, 1790.—From the sixteenth century onwards patents for invention were granted intermittently by the French kings, but the first legislative enactment in France came into force in 1791, the Decree of the Assembly having been passed on Dec. 31, 1790. The first patent under the new law was granted in July 1791, and thirty-four were sealed before the end of the year.

December 31, 1842.—In the early days of the semaphore railway signal, which was introduced in England about 1841, many suggestions were made for combining it with a lamp for night signalling. Rudolf Treutler, who obtained a Prussian patent for six years for his invention on Dec. 31, 1842, proposed to attach to the semaphore arm a series of small mirrors all disposed in such a manner that they reflected the light from a lamp straight down the railway track for all positions of the arm, and thus illuminated the arm so that it was visible at considerable range. The arrangement was first used in 1844 on the Breslau-Freiburg railway and was adopted on a number of the Saxon lines, where it remained in use for many years.

Societies and Academies.

LONDON.

Geological Society, Dec. 4.—**Edward Greenly**: Foliation in its relation to folding in the Mona Complex at Rhoscolyn (Anglesey). The major, minor, and minimum foldings (with their thrustings) have each given rise to a foliation and developed in chronological order. The relations of major to minor folding furnish an explanation of the fact that the major cross-foliation, unlike a slaty cleavage, fails to traverse the pelitic beds. The foliation of the plutonic intrusions, and the tremolite-schists, are products of the major movements. The principal metamorphism is independent of, and older than, the major and subsequent movements. Its foliation is developed along innumerable thrusts, but these are at angles so acute to the bedding that, especially when thrown into rapid isoclines, they easily escape notice. This is the true explanation of 'monoplanic schists'. The early foliation is really the regional metamorphism. But the thrusting to which it is due, unlike those of the three later series, can be referred to no visible folding. Accordingly, its disentanglement goes to confirm the hypothesis that recumbent folding exists, and is the dominant structure of the Mona Complex.—**H. P. Lewis**: The Avonian succession in the south of the Isle of Man. The rocks described occupy a 'key' position in relation to Carboniferous rocks of the Irish Sea area. They lie within a basin, which is partly tectonic, between the Port St. Mary-Arbory fault on the north-west, and the line of the Langness Ridge on the south-east. The lithological and palæontological divisions have been worked out.

Linnean Society, Dec. 5.—**Mrs. E. S. Grubb**: The biological station of Alto da Serra, São Paulo, Brazil. This station consists of about 150 acres on the summit of the Serra do Mar, between the town of São Paulo and the sea. Von Ihering, in 1909, when he was director of the São Paulo Museum, had his attention directed to the rich and interesting vegetation, and, obtaining a concession of land, began the organisation of the Biological Station, which, however, he was unable to carry on, and sold to the Government. In 1923 it again became attached to the Museum. A valuable feature of the area is that it comprises not only mountain forest, but also stretches of open marshland and grass vegetation, all alike subjected to extreme and continuous humidity. The chief point about the Station is that no interference is allowed: nothing is taken out and nothing planted, and no clearance beyond cutting paths through the virgin growth to facilitate research and exploration. It is the object of the Director both to retain the original vegetation so far as possible and to give what assistance he can in its investigation.

Optical Society, Dec. 12.—**J. Guild**: The insensitivity and personal equation errors of optical settings. The paper contains the results of observations on the insensitivity, that is, mean difference of the individual observations of a large series from the mean of the series, in the case of X-type graticles set on vertical lines. The influence of the following factors was investigated: (1) Thickness of cross-wires (best thickness subtends 60″-90″ at the eye); (2) angle between cross-wires (best angle about 45°); (3) field brightness; (4) pupillary aperture (ordinary illuminations and apertures of 0·5 mm. and upwards have little effect on the insensitivity). Observations were also made of the magnitude of the 'personal equation' error in such settings.

Physical Society, Dec. 13.—**J. H. Awbery** and **Ezer Griffiths**: Apparatus for determining the specific heat of a material in powder form. A calorimeter suitable for heavy powdered materials, such as dry clay, is described. It utilises the electrical method, and embodies a special form of stirrer suitable for these materials.—**W. Edwards Deming**: On the determination of the parameters in an empirical formula. Some cautions regarding the use of the method of least squares were recalled. The method recently mentioned by Awbery is compared with those of least squares and zero sum, from the practical point of view. The method of zero sum appears to be the quickest and its results to be well in accord with common sense judgment.—**N. S. Alexander**: The *J*-phenomenon in X-rays. A series of experiments has been carried out with the view of repeating so far as possible the work of Barkla and others on the *J*-phenomenon. The results obtained in no case provide any evidence for this phenomenon, and, considered in conjunction with the work of Dunbar, Worsnop, and Gaertner, they suggest that it has no real existence as an X-ray absorption effect.

DUBLIN.

Royal Dublin Society, Nov. 26.—**J. H. J. Poole**: The thermal instability of the earth's crust. It has already been shown (*Phil. Mag.*, March 1928) that the thermal history of the earth's crust depends on the fact that the melting point curve for the crustal materials is, almost certainly, steeper than their adiabatic curve in the fluid state. The present paper is an attempt to solve the problem more completely, assuming that the crust may be treated as a crystalline solid with a definite melting-point. The stability of a liquid layer in such a crust is investigated. Taking the rate of transference of heat from the liquid to the overlying solid as proportional to their difference of temperature, two simultaneous differential equations are obtained, giving the rates of upward motion of the bottom and the top of the liquid layer, respectively. These equations can be solved for the portion of the crust below the equilibrium position of the melting-point geotherm, where the loss of heat by conduction is sensibly zero, owing to the smallness of the temperature gradient. When the layer moves upwards sufficiently to lose heat by conduction through the upper solid, the equations can be solved approximately if numerical values are inserted. This process has been carried out, and the history of the postulated system investigated.—**T. Donnelly** and **J. Reilly**: Low temperature carbonisation of peat. Specimens of Irish peat were subjected to low temperature carbonisation under conditions which prevented any appreciable cracking of the tars, and preserved the wax and heavy oil. A yield of 16·6 per cent of tar was obtained from an air-dried black peat; this tar contained 5·4 per cent phenol; unidentified higher acids; 4·4 per cent of 'resinals', and 0·9 per cent of 'resamines'. The peat also yielded 22·6 lb. of acetic acid and 17·4 lb. of ammonium sulphate per ton. This is nearly twice the usual yield for these products. The yield of gas obtained is low (8·6 per cent by weight) and the quality poor, 42 per cent of carbon dioxide being present. Wax and bitumen are present in the peat to the extent of 10·5 per cent.—**J. Reilly, T. V. Creedon**, and **P. J. Drumm**: The nitration of substituted phenylbenzylamine derivatives.—**M. Grimes**: A study of two new species of bacteria belonging to the genus *Chromobacterium*. In the course of the bacteriological examination of 36 samples of surface water, bacteria belonging to the genus *Chromo-*

bacterium were isolated in 17 cases. These cultures represent two new species named respectively, *Chromobacterium hibernicum* and *Chromobacterium cohaerens*.

PARIS.

Academy of Sciences, Nov. 18.—E. Mathias: Contribution to the study of fulminating material. The serpentine forms.—A. Bigot: The dome-shaped ridges of the Cambrian of Carteret and the *Chlorellopsis* ridges.—Charles Nicolle and Charles Anderson: The Moroccan recurrent spirochætes of the *hispanicum* group are not separable into species. The spirochæte of Mansouria is proved to be recurrent in man. Only one group of spirochætes appears to be transmitted by ticks, *Sp. hispanicum*.—G. Nicoladzé: The characteristic points of a curve belonging to a continuous system.—J. Favard: Researches on convex curves.—Georges Valiron: Some properties of algebroid functions.—Harald Bohr: A problem of M. Borel.—Gaston Julia: A development of holomorph functions.—Jacques Chokhate: The polynome of Tchebycheff of the best approximation.—Radu Badesco: The distribution of singularities. The solution of a linear integral equation.—Gr. C. Moisil: The theorem of infinite groups.—W. S. Fédoroff: The growth of analytical functions and their differentials.—Kourensky: The most general case of integrability of the equations of motion of a solid body in a liquid.—A. Lokchine: The bending of an anisotropic beam.—A. Danjon: The periodic displacement of the pole.—Pauthenier and Mallard: Contribution to the study of the cylindrical field in ionised air at the ordinary pressure. The experimental control. The results predicted by theory and found experimentally are compared graphically.—J. Peltier: The localisation of flaws in shafting.—P. Chevenard: The thermal treatment of ferro-nickels with two constituents.—René Delaplace: The disappearance of hydrogen in Geissler tubes. If the tube is separated from the rest of the apparatus by a Dewar tube containing liquid air and this allowed to remain for 24 hours, in the tube thus freed from traces of water and mercury vapours hydrogen does not undergo irreversible contraction and no trace of carbon monoxide or of methane could be found. This negatives the suggestion that the dissociation of the internal wall of the glass tube may give rise to carbon compounds. This is attributed by the author to the fact that when the tube is perfectly dry there is little or no production of atomic hydrogen.—Raymond Charonnat and Raymond Delaby: A new product derived from pyramidon. Description of a product obtained by the reaction of pyramidon and perhydrol: empirically, its composition is a pyramidon dioxide.—Georges Darzens: Hexahydrophenylethyl alcohol and some of its derivatives.—Marcel Faidutti: Transpositions of ethylene oxides in the terpene series. Camphene and nopinene oxides, prepared by Prilejaieff's method, on distillation in the presence of silica or pumice powder, are really transposed into aldehydes. Zinc chloride also causes the same change.—A. Grebel: Variations of the temperature of spontaneous inflammation of hydrocarbons in admixture with various substances, as a function of the proportion of these different substances in the mixture. The mixtures studied were petrol and absolute alcohol, and ternary mixtures of petrol, absolute alcohol, and benzene. The effect of small additions of acetone and of aniline was also studied.—E. Raguin: Has the vermicular bundle of Zermatt its homologue in the geological structure of the Haute-Marienne?—J. Thoulet: Submarine mineral springs.—Pierre Dangeard: Some new algæ containing iodine. 120 species of marine algæ have been examined by a microchemical method for iodine.—H. Labbe, Heim de Balsac, and R. Lerat: The theosterols of cocoa. Estimations of the sterols in cocoa butter, and in the beans, germs, and husk. The fat extracted from the husks was very rich in sterols, about twenty times the amounts found in the butter extracted from the whole bean.—Emile F. Terroine: The preparation of artificial milks for raising cattle.—André Mayer and Georges Nichita: The water emitted by vaporisation and its relations with the respiratory exchanges in homeotherms. The ratio H_2O/CO_2.—Loeper, André Lemaire, and Jean Patel: A method of recording graphically the pressure of the cephalo-rachidian fluid.—Fernand Mercier and Jean Régnier: Lævorotatory cocaine and dextrorotatory pseudococaine: the comparative toxicity and different destruction by the animal organism.—René Hazard: Researches on the antagonism of the base tropine (tropanol) and of pilocarpine on the heart.—Marcel Mascré and Maurice Herbain: The influence of formaldehyde on the precipitation of the nitrogenous matters of urine by trichloracetic acid.—E. Brumpt: The evolutive cycle of *Schistosoma bovis* (*Bilharzia crassa*), a spontaneous infection of *Bullinus contortus* in Corsica.—M. Belin: The presence of antibodies in the pus of the fixation abcess.

VIENNA.

Academy of Sciences, Nov. 7.—W. J. Müller and L. Holleck: The theory of passivity phenomena (7). The anodic behaviour of copper in sulphuric acid electrolytes. The behaviour of the copper was tested under varying conditions of concentration of acid, of saturation of copper sulphate and of temperature. The equation previously found connecting initial current density and time of passivation was confirmed. The first formed layer is of copper sulphate pentahydrate. Afterwards this is transformed, as shown by polarised light.—W. J. Müller and L. Holleck: The theory of passivity phenomena (8). The anodic behaviour of zinc in sulphuric acid electrolytes. Zinc shows surface passivity, at first due to zinc sulphate heptahydrate. A secondary transformation sets in the more rapidly the weaker the sulphuric acid.—W. J. Müller and K. Konopicky: The theory of passivity phenomena (9). The passivity of lead in sulphuric acid and the contribution to the theory of the formation of the lead anode. Results were obtained by measuring the current-time curves of lead in accumulator acid at constant potential. The passivation time is very short corresponding to the difficultly soluble lead sulphate. Current-time curves were measured with the oscillograph. An increase of solubility is explained by the hydrolysis of quadrivalent lead going into solution.—W. J. Müller and K. Konopicky (10): The time law of self passivation.—W. J. Müller and W. Manchu (11): The anodic behaviour and passivity of iron in sodium sulphate solutions. An oxidised film forms on iron both in air and in air-saturated solutions, and very rapidly. This introduces a difficulty in the determination of the passivation time for iron.—L. Moser and F. Siegmann: The determination of indium and its separation from the monoxides and sesquioxides. Indium has little analytical resemblance to gallium. $In(OH)_3$ is practically insoluble and may be precipitated with ammonia. In_2S_3 is completely precipitated by hydrogen sulphide in acid solution and allows of a quantitative separation of indium from iron and aluminium. Zinc, nickel, and chromium are separated from indium by potassium cyanate, cobalt by potassium cyanide.—N. Fröschl, J. Zellner, and H. Zak: Synthetic experiments in the sugar group (1). Some derivatives of fructose and lactose. With hepta-acetyl-bromlactose there were obtained good crystallising acetyl-lactosides of menthol, glycol, etc.—G. Machek: The linear pentacene series (18). Two

isomeric dibromo-derivatives of the linear pentacene-diquinone-5, 7, 12, 14.—F. Lieben and G. Ehrlich: The decomposition of glucose and fructose by *Bacillus coli*. Fructose is more rapidly attacked than glucose.

Nov. 14.—M. Beier: Results of a zoological expedition to the Ionian Islands and the Peloponnesus. (4) Myriopoda by K. Attems. (5) Reptilia, Amphibia, Orthoptera, Embidaria, and Scorpiones by F. Werner. —J. Mayer: The absolutely smallest discriminants of the biquadratic number-body.—G. Nöbeling: The theory of regular curves. The theory of universal assemblages. Remarks on a theorem by O. Schreier.

Nov. 21.—W. Figdor: The positive geotropism of the axial bulbs in *Gloriosa superba*.—H. Pettersson: The disappearance of radon in quartz capillary tubes during electrodeless discharge. To be compared with the disappearance of xenon in discharge tubes.—S. Schneidt: The electro-chemical behaviour of polonium in solutions of various hydrogen ion concentration. Polonium must be in the colloidal form in dilute solutions.—M. Hoschtalek: The conductivity on old and new rock-salt surfaces in damp air. The conductivity is first noticeable when the vapour pressure of the air is above 4·4 mm.—K. W. F. Kohlrausch: The calculation of chemical bonding forces from the frequencies of the Raman lines.—A. Steuer: The species of the Copepod genus *Acartia* in the Mediterranean province.

Official Publications Received.

BRITISH.

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1928-29. Pp. 30. (Aberdeen.)

Records of the Indian Museum. Vol. 31, Part 2, July. Pp. 81-159+plate 6. 2.12 rupees; 5*s*. Vol. 31, Part 3, September. Pp. 161-257+plates 7-11. 2.12 rupees; 5*s*. Vol. 30, Appendix: List of Literature referring to Indian Zoology (excluding Insecta) received in Calcutta during the Year 1928. Pp. xxvi. 7 annas; 9*d*. (Calcutta.)

Memoirs of the Indian Museum. Vol. 9, No. 3: A Revision of the Fissilabioidae (Cordulegasteridae, Petallidae and Petaluridae). Part 1: Cordulegasteridae. By Lieut.-Col. F. C. Fraser. Pp. 69-167+plates 9-12. (Calcutta.) 4 6 rupees; 7*s*. 6*d*.

FOREIGN.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 49: A New Index to Control Cable Endurance. By Taitiro Ogawa and Sigetake Suzuki. Pp. 243-258. 0.22 yen. No. 50: Air Flow through Suction Valve of Conical Seat. Part i: Experimental Research. By Keikiti Tanaka. Pp. 259-360+plates 13-16. 1.17 sen. (Tôkyô: Koseikai Publishing House.)

Regenwaarnemingen in Nederlandsch-Indië. Vijftigste Jahrgang, 1928. Pp. ii+133. (Weltevreden: Landsdrukkerij.)

Proceedings of the Imperial Academy. Vol. 5, No. 8, October. Pp. xvii-xx+307-402. (Tokyo.)

Diary of Societies.

SATURDAY, DECEMBER 28.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (1): The Elementary Use of Nature.

MONDAY, DECEMBER 30.

ROYAL SOCIETY OF ARTS, at 3.—Capt. C. W. R. Knight: The Golden Eagle (Dr. Mann Juvenile Lectures) (1).

TUESDAY, DECEMBER 31.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (2): Making a Home.

WEDNESDAY, JANUARY 1.

ROYAL SOCIETY OF ARTS, at 3.—Capt. C. W. R. Knight: Wild Life in the Treetops (Dr. Mann Juvenile Lectures) (2).

CHILD-STUDY SOCIETY (at University College), at 5.30.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, JANUARY 2.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (3): Building in Stone.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—

FRIDAY, JANUARY 3.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Eng. Vice-Admiral R. W. Skelton: Progress in Marine Engineering (Thomas Lowe Gray Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—J. G. Wellings and C. G. Mayo: Instrument Transformers.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.

SATURDAY, JANUARY 4.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—S. R. K. Glanville: How Things were done in Ancient Egypt (Christmas Lectures) (4): Boats and Furniture.

CONFERENCES.

JANUARY 1 TO 8.

EDUCATIONAL ASSOCIATIONS (at University College).

Wednesday, Jan. 1, at 3.—Prof. Winifred Cullis: The Lure of Investigation (Presidential Address).

EUGENICS SOCIETY.

Wednesday, Jan. 1, at 5.—Prof. E. W. MacBride: The Teaching of Biology in General Education.

CHILD-STUDY SOCIETY.

Wednesday, Jan. 1, at 5.30.—Dr. H. Crichton-Miller: The Study of the Child.

SCHOOL NATURE STUDY UNION.

Thursday, Jan. 2, at 3.—Dr. C. T. Green: Our Beautiful Wild Flowers.

NATIONAL COUNCIL FOR MENTAL HYGIENE.

Tuesday, Jan. 7, at 3.—Discussion: Preventable Mental and Physical Strains of School Life.

JANUARY 1 TO 4.

SCIENCE MASTERS' ASSOCIATION (at Imperial College of Science).

Wednesday, Jan. 1, at 8.15.—Prof. J. C. Philip: Presidential Address.

Thursday, Jan. 2, at 10.30 A.M.—A. F. Walden: Lecture on Liquids, with Discussion on Broadcasting.

At 6.—S. R. Humby: Lecture Experiments in Sound with an Electrically Controlled Source.

At 8.15.—Prof. W. A. Bone, assisted by R. P. Fraser: The Photographic Investigation of Flame Movements in Explosions (Lecture).

Friday, Jan. 3, at 9.30 A.M.—W. Corbridge: Lecture Demonstration on Some Home-Made Physical Apparatus.

At 10.45 A.M.—Dr. J. C. Munro: Industrial Biology (Lecture).

At 12.—Prof. Truscott and others: Discussion on Openings for College Trained Men in the Mineral Industry.

At 5.15.—Discussion with the Physical Society on Examinations in Practical Physics.

At 8.15.—Discussion on School Certificate Biology.

Saturday, Jan. 4.—Visits to the National Physical Laboratory and the Government Laboratory.

JANUARY 2 TO 6.

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Thursday, Jan. 2, at 11.30 A.M.—Sir Henry G. Lyons: Presidential Address.

At 5.—Discussions:—Village Survey Making. Opened by Miss J. K. Jones.—The Inter-Relation of History and Geography in Central Schools. Opened by Miss D. Sarjeant.—Land Utilisation Map of Northampton. Opened by E. E. Field.

At 6.15.—H. E. Raynes: Mortality of Europeans in Equatorial Africa—A Study of the Effect of Improved Conditions and Mode of Life (Lantern Lecture).

Friday, Jan. 3, at 10 A.M.—Discussions:—The Physical Basis of Geography in Independent Schools. Opened by B. B. Dickinson.—Geography and the Training of Teachers. Opened by T. Herdman.

At 11.30 A.M.—Col. H. L. Crosthwait: Air Survey (Lantern Lecture).

At 2.30.—The Geography I was Taught, by Members of the Association.

Saturday, Jan. 4, at 10.30 A.M.—Sir E. J. Russell: Agricultural Developments in South Africa (Lantern Lecture).

At 11.45 A.M.—Dr. Vaughan Cornish: National Parks.

JANUARY 6 AND 7.

MATHEMATICAL ASSOCIATION (Annual Meeting) (at London Day Training College).

Monday, Jan. 6, at 4.—B. L. Gimson and others: Discussion on Arithmetic of Citizenship.

At 5.30.—Prof. S. Chapman: The Use of Spherical Harmonic Functions in Mathematical Physics.

Tuesday, Jan. 7, at 10 A.M.—G. W. Spriggs and others: Discussion on Problems of Individual Education, with Special Reference to Work in Mathematics.

At 11.45 A.M.—Prof. W. M. Roberts: Gunnery and some of its Mathematical Problems (Lecture).

At 2.30.—Dr. W. F. Sheppard: Mathematics for Study of Frequency Statistics.

At 3.45.—Miss Hilda P. Hudson and others: Discussion on The Mathematician in Ordinary Intercourse.

EXHIBITION.

JANUARY 7, 8, AND 9.

ANNUAL EXHIBITION OF THE PHYSICAL SOCIETY AND THE OPTICAL SOCIETY (at Imperial College of Science), from 3 to 6, and from 7 to 10 (9).

Jan. 7, at 8.—Lord Rayleigh: Iridescent Colours in Nature from the Standpoint of Physical Optics (Lecture).

Jan. 8.—S. G. Brown: Gyro Compasses for Gun-Fire Control (Lecture).

Jan. 9.—Sir Ambrose Fleming: Television, Present and Future (Lecture).