NATURE

SATURDAY, JUNE 15, 1929.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3111, Vol. 123]

Science in the Public Service and Industry.

WE commented last week upon the appointment of a committee to inquire into matters affecting the functions and staffs of certain research and experimental establishments of departments of Government. This inquiry is, of course, separate from that of the Royal Commission on the Civil Service which Mr. Baldwin recently announced would be appointed. We trust that the change of Government will not mean that this Commission will be dropped. A really wider issue than that of the position and functions of the technical expert in the Civil Service is involved ; indeed, the time is ripe for an inquiry into matters affecting the position and responsibilities of the man of science and the technologist generally, in industry as well as in the public services.

For some considerable time a suspicion has existed that matters affecting the status and responsibilities of the technical expert are very far from satisfactory in Great Britain. As regards the public services, it is possible nowadays, more or less, to gauge the situation, owing to the existence of the many specialised vocational associations which have, in recent times, been formed within the Civil Service and the Local Government Service for the purpose of protecting the interests of their members ; practically all these associations periodically issue publications dealing with their activities, and thereby give an insight into the nature of the problems to which attention has been devoted. Furthermore, the Royal Commission on Local Government appointed on Feb. 14, 1923, under the chairmanship of Lord Onslow, has during the past twelve months taken evidence from some of these vocational associations, particularly in relation to the duties and status of the technical offices under the local authorities ; in this evidence the practice of the central government has been touched upon, and its attitude towards its technical officers has been contrasted with that of the local authorities towards their chief officers who are engaged mainly on technical duties.

In industry, no institutions with objects identical with those of the vocational associations referred to above exist ; consequently, it is more difficult to obtain generalised information regarding the status and responsibilities of those engaged on the technical side of industrial and commercial undertakings. In view of the great national importance of the subject, individual inquiries have been addressed in relation thereto to a number of persons engaged on technical duties in some of our

industries. As might be expected, the information collected shows that in industry the conditions vary very widely, and also that the attitude of the chief officials responsible for the conduct of the affairs of various important concerns differs to some extent in relation to the status and responsibilities which should be assigned to the section of the staff which deals with the technical work. In some cases the chief officials are unresponsive to the changing conditions of the times (needless to say, to the detriment of the businesses they control), whilst on the other hand, happily, many such officials are broad-minded, progressive, and ever ready to meet the altered, and altering, conditions imposed by the more intense trade competition arising from the more exacting requirements due to increased scientific knowledge and to the high technical skill and ability of the staffs of their foreign competitors.

Our inquiry into this subject has disclosed the fact that in industry old prejudices are gradually dying, and that, in recent times, a considerable improvement has taken place in the status of the men of science and the technologists who follow their careers in the commercial world. There is still room, of course, for further improvement, which will no doubt come about in time; the matter seems to depend upon two factors, namely, on the introduction in our industrial enterprises of an organisation adapted to meet the very complex technical requirements of to-day, and on the willingness of the technical expert fully to qualify himself for the more important administrative posts by devoting his time not only to the study of subjects of a strictly scientific and technical kind, but also of those bearing on the administrative and economic aspects of his work.

The improvement in the status of the man of science and technologist to which attention has been directed is due, it has been suggested, to the rise and growth of the electrical industry. It has been pointed out that many of the successful businesses connected with this industry have been founded, developed, and managed by men who have had the advantage of a scientific education and of a technical training; many of the most important posts are still held by a type of man with similar qualifications. Being an entire newcomer, and probably also by reason of the fact that much technical knowledge was involved in almost every decision, this industry was not hampered at its birth by some of the harmful traditions that have tended to limit the sphere of usefulness of the technician in the same way as has been, and still is to some extent, the case in some of the older ones. The new policy has very greatly benefited the electrical industry and has enabled it to reach a flourishing condition.

Now, a very cursory examination of the information contained in books of reference indicates that the improvement in the status of the technician is not confined to the electrical industry; almost simultaneously with its birth an infection seems to have spread to other industries. It is on record that in 1883, when the late Sir William (afterwards Lord) Armstrong first founded his famous Tyneside shipbuilding works, he entrusted the organisation and the directing of this establishment to a technician, who some years later became Director of Naval Construction and Assistant Controller of the Royal Navy. At subsequent dates, some of our railway companies selected officers from the technical side of their undertakings for high administrative posts. Again, the chemical industry affords instances of chemists who have risen to the control of huge interests and have done well as administrators. Men with technical knowledge and experience are also now occasionally appointed as directors on the boards of companies; this is so not only in the cases alone of those concerned with activities of an industrial kind, but it also applies equally to those whose interests are mainly financial or commercial.

Apart from the government services and industry, there are the great municipal services. The Royal Commission on Local Government now sitting has received a considerable volume of evidence on the aims and objects of the various vocational associations by witnesses representing them, and questions have also been raised by other witnesses as to the desirability, or otherwise, of arranging for interchanges of duties on the part of civil servants and local government officers by temporary transfers of staff from government departments, particularly the Ministry of Health, to the offices of local authorities, and vice versa. Moreover, a proposal involving a fundamental change in the constitutional fabric of municipal government has also been put forward, namely, one relating to the appointment in our municipalities of a 'chief officer' corresponding to the burgomaster, who is supreme in relation to municipal affairs in certain continental cities, or of a person possessing the authority and the responsibilities of the city manager who is now in charge of municipal affairs in many important American cities. Neither proposal, however, is given much support by local government officers.

The town clerk, who is generally a member of one of the legal professions, is, by an almost immemorial custom, recognised as the principal officer of the Local Authority; he is *primus inter pares*, and, apart from the particular duties of his own department, co-ordinates the various services of the council, in order to avoid overlapping and to prevent a course being taken by one department without consideration for its effect on another department. It is, however, recognised that it would be most improper for a town clerk to criticise or interfere with a technical officer in the carrying out of the technical duties assigned to him; that is to say, the technical officers under a local authority severally exercise their functions independently of the town clerk. The practice of local authorities differs, therefore, very widely from that of government departments; in the latter case, the technical branches are elaborately controlled by the secretary's department.

Some of the members of the Royal Commission appear to have been exercised in their minds with regard to the difference of treatment meted out to the two types of officers, the administrative and the technical, in the national civil service and in the local government service; in consequence, questions were put to some of the witnesses with the view of eliciting the reasons why in the latter service it is those with technical qualifications who hold the positions of 'chief officers', and it is considered that there is no field in it for the person without technical qualifications—the 'skilled administrator'—although in the case of the Civil Service the former type of official "did not get to the top of it", whereas the latter type did so invariably.

It has been pointed out that the difference in the treatment of the two types of officers in the two services may be accounted for historically; whereas the first services entrusted to a municipal corporation were of a character which required technicians at the head of them, on the other hand, the responsibilities of government departments originally involved the consideration of problems in which the administrative aspect predominated. It is further suggested that county and municipal councillors themselves do the administrative work, and rely directly on their officials for technical advice. A century ago, ministers of the Crown were able to do, and personally did, a great deal of the administrative work of their departments, but, with the increasing complexity of the problems to be dealt with, the methods then in vogue went out of date and had eventually to be abandoned. The system which was introduced later for dealing with the work of government departments has, in its turn, become obsolete.

In the evidence given before the Commission, strong adverse criticisms have been made regarding the narrow rules of the Civil Service, which, as a matter of practice, prevent an officer on the technical side, however well fitted and qualified he may be for the position, being promoted to the higher administrative posts. In view of the fact that administrative ability of the first rank is so rare, the policy which prevails in the Civil Service in relation to this matter has been characterised as being inexpedient, short-sighted, and unjust.

It is essential that ministers of the Crown should frankly recognise that government departments have completely outgrown the organisation with which they are now endowed, and even that their own positions therein, and the functions they are attempting to exercise, which are very similar to those of a general manager, no longer conform with the requirements of the day.

Alterations of a far-reaching character are, in consequence, needed in the organisations of our government departments. One of the principal features of the reconstruction of such departments should be such as to provide that the functions assigned to ministers in charge of government departments shall correspond with those of a chairman of a board of directors, or of a commission, and that they shall be aided directly by a body of highly qualified technical experts occupying positions somewhat similar to those of the directors of a company, and be given a distinctive title; for example, they might appropriately be called 'commissioners'. If such a reform was carried out in a whole-hearted manner, ministers would be placed in a better position than at present to obtain the technical advice required in connexion with the formulation of their policies, since it would reach them at first-hand. If, further, each of these 'commissioners' was also charged with responsibility for both the administration and the technical work of the various specialised branches of a government department, immediately under the direction of the responsible minister, the management of the public services under the central government would be more efficient and economical than is the case to-day; and the ministers themselves would also be placed in a position to exercise their proper functions more effectively, and, consequently, their usefulness and the value of their work to the State would be enormously increased.

Shellfish Pollution.

Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol. 10, No. 1, 1928: *Report on Mussel Purification; being an Account of the Establishment of a System of Purification of Polluted Mussels; of the Experimental Work upon which it is based; and of certain General Considerations and Suggestions regarding the Sewage Pollution of Shellfish in its Public Health Aspect.* By Dr. R. W. Dodgson. Pp. xvi + 498 + 16 plates. (London: His Majesty's Stationery Office, 1928.) 21*s*. net.

THIS encyclopædic summary and critical analysis of our knowledge of shellfish pollution will long remain the standard work of reference on a difficult problem hitherto baffling even the experts. It is thus an essential addition to every up-to-date public health library. But to public health authorities it is also a conspicuous milestone of progress, in that it records how scientific research, by evolving a method proved reliable through a dozen years of extensive practical trial, has solved the problem of purifying sewage-polluted shellfish. Seldom, indeed, does an official report on practically applied science reveal so many and so varied abilities as this: its erudition, lucid presentation and scientific interpretation of facts, shrewd judgment, and sound business sense—all are so freely interspersed by touches of 'pawky' humour as to make its perusal a keen pleasure.

Initially, Dr. Dodgson reviews fully the literature on the existence and classification of human diseases attributed to eating shellfish. 'Mussel poisoning', which is very fully discussed, is classified into three categories: the erythematous, the paralytic, and the bacterial food-poisoning type. The characteristics of the first two, and the points to which attention is to be directed in making a differential diagnosis, are clearly set forth. There should in future be no excuse for the confusion which has hitherto existed in some quarters in connexion with these conditions. Dr. Dodgson's analysis of the evidence establishes two points of much importance to the consumer, namely, that the erythematous type ('musselling') is never fatal, whilst the danger of contracting the fatal paralytic type is, if elementary precautions and common sense are exercised, for practical purposes negligible.

The author then considers the correlation of shellfish pollution and certain human infections. His initial six months' study of the physiology of the mussel was rewarded by the discovery of the cardinal fact that it filters from the water passing through it all suspended solids—including infective germs discharged by sewers into estuaries, which are most grossly polluted at low tide when shellfish are gathered. Following up the trail of infection, he found untreated sewage entering estuaries from many forgotten sewers, the pollution from which was, in some cases, particularly pernicious; for example, that from isolation fever hospitals. In one instance excreta from an enteric patient were discharged from a sewer mouth within 50 yards of a mussel-bed on to which they flowed so rapidly that germs might enter the mussels within three minutes of being voided by the patient! This fully evidences the risk of human infection by the 150,000 cwt. of mussels eaten annually, mostly uncooked, in Great Britain, particularly when, as Dr. Dodgson indicates, the fresher the fish the greater is the risk of its retaining and passing on infection.

The general position is summed up as follows (p. 119):

"As long as dirty food—*polluted* shellfish—is used for human consumption, a serious gap must exist in the defences erected by public health effort against typhoid and other serious disease. This gap is not only serious, but is one of the most pernicious of all possible gaps, for it means that we are permitting the infective material from typhoid fever patients and typhoid carriers, and that responsible for other grave diseases, to be poured on to a living article of food, so constituted as to be capable of collecting and concentrating within itself such infective material from an enormous volume of water; and, having permitted this to happen, we allow the concentrated infection to be distributed all over the country, just when we had hoped and believed that we had safely got rid of it, once and for all."

A review of remedies previously proposed shows the impossibility of keeping all sewage from all edible shellfish, and the impracticability of sterilising polluted shellfish by heat or by chemicals. While urging that sewage from hospitals housing such cases as enteric should be compulsorily sterilised, chemically or otherwise, prior to discharge into any watercourse, the author shows that this method cannot be reliably or economically applied to the host of other sewers now discharging into our estuaries. This section concludes with an able and comprehensive review of existing legal powers, which are shown to confer upon local authorities means of enforcing the simple and effective method of shellfish purification described below.

The practical outcome of apparently abstract

research is aptly illustrated. To aid in studying the course of water-currents within the mussel, Dr. Dodgson coloured water with fine carmine powder, and thus discovered that, as the water circulated within them, the mussels filtered off all the carmine, and extruded it firmly entangled in mucoid threads (fæces and pseudo-fæces) which resisted disintegration for more than a month in still water. Experiments proved that bacteria were similarly filtered off, and that even heavily polluted mussels rapidly freed themselves from polluting germs in water of suitable salinity and at ordinary temperatures. Even at freezing-point or thereabouts similar results were obtained during the night or in artificially produced darkness. In running sterile water three hours might suffice for the elimination of all bacteria.

This remarkable result is largely achieved by the mussel's gills, which consist of a network of fine ciliated filaments. The ciliary currents cause the water to circulate between the filaments: suspended matter, including bacteria, being filtered off and becoming entangled in sticky mucus, finally to be extruded from the shell either via the gut (as fæces) or directly via the marginal recurrent ciliary stream (as pseudo-fæces). As a single large mussel may thus pass through its body in 24 hours as much as 14 gallons of water, this purifying process is obviously a most powerful factor, and its cleansing action is not aided by the use of water containing active chlorine, because any disinfectant strength of chlorine inhibits or actually arrests the physiological activities of the mussel—thus leading to the retention of bacteria in the mussel-body, which would otherwise have extruded them.

The practical outcomes of these researches have proved of the utmost value, alike to consumers and purveyors of shellfish and to public health authorities. That value lies in the discovery and proof of the fact that there is available a trustworthy, cheap, and simple process, whereby shellfish—although gathered from polluted estuaries—may be rendered as nearly safe for human consumption as any reasonable authority can require. The stages of that process, as regards mussels, for example, are as follows:

(*a*) Sea-water, pumped into a tank, is sterilised from all germs by adding to it 3 parts per million of active chlorine derived from bleaching powder.

(*b*) Any residue of active chlorine remaining after a night's exposure in the tanks having been removed by hyposulphite, the water is then run into other tanks containing mussels spread two-deep upon wooden grids (the mussels having initially been hosed with high-pressure fresh water to remove adherent mud). In this sterile, unirritating water, the mussels function perfectly, and eject practically all infective germs from their bodies during the ensuing night.

(*c*) The water is then run off, and the ejected mucoid fæces and pseudo-fæces are hosed away. As an extra precaution, stages (*b*) and (*c*) above are repeated.

(*d*) Any germs on the outsides of the shells are removed by exposing the mussels to a bath of water containing active chlorine in solution (3 parts per million).

(*e*) The mussels are loaded into sterilised sacks, which are sealed before dispatch to market with lead seals stamped 'M.A.F. Conway', and bearing the date of dispatch.

As thus carried out, this process is so effective that mussels so polluted as to contain 600 sewage germs per cubic centimetre (about a salt-spoonful) of their substance, are so purified that this number is reduced in many instances to none; in most cases to less than three; and in almost all to less than five. In comparison with the gross bacterial pollution of various articles of food which are consumed uncooked, such a degree of freedom from germs is truly remarkable, as initiating a new standard of cleanliness for foods.

From the business aspect no objections are forthcoming, for the process may be deemed capable of paying for itself on the basis of an output of 8000 bags per annum, and a charge of 1*s*. 6*d*. per bag of 140 lb. of mussels purified; the capital expenditure varying from £3000 to £4500 according to site chosen. From the administrative point of view, the working and control have been proved, by some years of trial, capable of being carried out with smooth effectiveness by an adequately trained tank superintendent and one unskilled assistant.

This valuable report thus introduces a notable contribution to our means for preservation of the public health, and, as such, will be welcomed by all upon whom that responsible duty falls. That, however, is by no means all the story, for, as Dr. E. S. Russell, the Director of Fishery Investigations, observes in his preface: "It is significant that the real key to the problem was found in direct and minute observation of the normal physiology of the mussel." Not only has a solution of a difficult practical problem been found by scientific research, but that research has also added a most interesting chapter to our knowledge of molluscan physiology.

Perhaps a still more important contribution to

science has been rendered by Dr. Dodgson in this comprehensive report by his skilful and courageous criticism (in Part 3) of bacteriological principles and methods of some antiquity and much in need of the caustic consideration which they receive. Here again, research and the original discovery that glucose is formed from the tissue-glycogen of shellfish pointed the way to criticism of certain bacterioscopic methods depending on the fermentation of lactose, which, though based on perfectly sound general principles, may be quite misleading when applied to the particular case of shellfish analysis. But the "cogent evidence" to which Dr. Russell refers in respect of this phenomenon and of the errors likely to be introduced by the element of chance in the interpretation of results is as resistant to concentration in a review as it is important from the point of view of the experts. It will require an extensive reply from the strictly orthodox.

Babylonian Astronomy and Chronology.

The Venus Tablets of Ammizaduga: a Solution of Babylonian Chronology by Means of the Venus Observations of the First Dynasty. By Prof. S. Langdon and Dr. J. K. Fotheringham. With Tables for Computation by Carl Schoch. Pp. vi + 109 + xvi. (London: Oxford University Press, 1928.) 35*s*. net.

THIS is a work of great interest to students both of archæology and of astronomy. The story of the many stages that were necessary before a full understanding was reached of the astronomical value of the tablets is as fascinating as a romance. The tablets that have come down to us were copies made in the eighth or seventh centuries B.C. of originals more than a thousand years earlier. We are fortunate in possessing a number of different copies of the originals; the calendar dates recorded in duplicate copies are not in perfect agreement; it is a familiar fact both in ancient and modern times that numbers are particularly liable to erroneous transcription. We can reasonably ascribe the few discordances that remain in the solution to this cause.

The tablets are in the form of omens, stating that such and such configurations of Venus (Ninsianna is the name used) on given calendar dates will be followed by such and such events on earth. *A priori*, such documents would seem void of astronomical value, but convincing reasons have been found for believing that the omens were based on experience, and that such configurations and subsequent events had actually occurred. The date of the originals was not even roughly known until Father Kugler announced in 1912 his discovery that a Sumerian phrase that had hitherto been misunderstood meant "The year of the golden throne", and was the date formula of the eighth year of Ammizaduga, commemorating his placing a golden throne and a statue of himself in a Babylonian temple. This fixed the date within two centuries or thereabouts, and it was now possible to calculate the positions of Venus for different possible years. The fact that transits of Venus usually occur in pairs, separated by 8 years less $2\frac{1}{2}$ days, is well known. Any configuration of Venus with respect to the earth recurs after a similar interval of time. But when a lunar calendar is used, the recession of the date after 8 years is 4 days, so this calendar is more sensitive than the solar one to a change of date. However, an interval of 56 years would bring back the event to the same day of the month; but this would be the month preceding the original one. Since the beginning of the year was somewhat elastic in those times, this might bear the same name as the original month; the same thing might even happen after a second period of 56 years; if the dates were given somewhat roughly, or the days of the month wrongly copied, there might be further uncertainty of one or two multiples of 8 years. Thus we find that Kugler first adopted the year 1977 B.C. as the first of Ammizaduga's reign, but later he made it 176 years later in consequence of some arguments of Weidner.

Dr. Fotheringham then took the matter up at Prof. Langdon's request. He improved Kugler's calculation in two ways: first, by taking into account the accelerations of the sun and Venus which had been found from discussion of ancient eclipses and in other ways; secondly, by noting that the duration of the invisibility of Venus at conjunction with the sun depends on its latitude, which in turn depends on the date in the solar year. He reached the date 1921 B.C. as the first year of Ammizaduga; it is a curious coincidence that the A.D. date of its first publication was only two years different (1923).

The date 1921 B.C. is retained in the present publication, and the arguments in its favour have been considerably strengthened. With the view of locating the months of the lunar calendar in the solar year, a number of contracts relating to the harvests of corn and of dates have been discussed. Kugler made a beginning in this research, but it has been extended. Also Herr Schoch devised a

new method, based on the lunar months which were recorded as having had 30 days ; this method would not be in itself decisive, but it gives some clue to the actual dates of new moon ; it is found to support the above solution. Another confirmation is found in the accord between the chronology based on this date and that based on Schoch's identification of the lunar eclipse that preceded the fall of Ur with the one that occurred on Mar. 8/9 (Julian) in 2283 B.C. The record of that eclipse, like the Venus tablets, is in the form of an omen.

The book contains a complete chronological list of the kings of Sumer and Accad, Babylonia and Assyria ; it combines the deductions from the Weld-Blundell prism with those of the present volume. It is well to direct attention to the note on p. 83 that all the dates of the table before 2300 B.C. should be made 19 years later, since these had been set up before Schoch's date for the fall of Ur had been adopted. Sargon of Agade reigned from 2732 to 2677, and Narâm-Sin from 2652 to 2615. Thus Nabu-na'id, the last king of Babylon, made an error of some 1100 years in saying that Narâm-Sin preceded him by 3200 years.

The book also contains discussions on the occurrence of intercalary years, both in Ammizaduga's and neighbouring reigns ; these seem to have depended largely on the whim of the monarch. There are tables, prepared by C. Schoch, for finding approximate positions of the planets, and for obtaining the date of new moon at any epoch between 3500 B.C. and A.D. 2000.

The full text of the tablets is also given, both in cuneiform and transliterated, with translation and comments by Prof. Langdon.

A. C. D. CROMMELIN.

World History since the War.

1918–1928 : a Short History of the World. By C. Delisle Burns. Pp. 447. (London : Victor Gollancz, Ltd., 1928) 16*s*. net.

FOR those who desire a compact and trustworthy survey of world history since the War from the political point of view, there is nothing to be had to compare with this book. It relies mainly on the much fuller accounts given in the several volumes issued by the Royal Institute of International Affairs, and it adds to them where they have not yet dealt with the particular problem. The view suggested is, on the whole, hopeful, and would be more so but for the one serious defect to be mentioned later. It points out, for example, the improved stability of Germany since the War. " The German Reich is now much more powerful as against any of the local patriotisms of Germany than it was before the war "; and again, " whereas the unity of the Russian people was dissolved by the war, that of the German people was confirmed". The real reason for this difference, however, is not hinted at, and it will be found in the defect to be referred to below.

There is a wholesome protest, often repeated, against disparaging the increased attention given since the War to the economic aspect of politics. " The increase of wealth and decrease of the incidental burden in producing it, is not in the least ' materialistic '. The life of the body is the life of the spirit. There are not two lives in the common man." The ' common ' man, by the way, occurs with rather tiresome iteration and provokes the inquiry who he really is. " The neglect of food supply and its incidentals—finance and commerce—by rhetorical politicians and diplomatists is not a sign of their superiority, but of their blindness to the importance of these basic factors on which their own comparative freedom from economic insecurity rests." So far, of course, as these persons do these things, they are open to Mr. Delisle Burns's censure. But surely they are doing it very little now ?

These signs of a somewhat jaundiced eye are trifling and rather interesting blemishes on an excellent piece of work. But a word must be said on the really serious point. How can anyone, above all anyone of Mr. Delisle Burns's knowledge and breadth of mind, offer us " A Short History of the World " without a word on the enormous development and influence of science, and that at a time when its development and influence have been greatest ? It is not, as might be urged, a question of limiting the field, for other matters, desirable for a complete view, may be left out without essential damage to the main argument. One can write a history of the last ten years without mentioning the poetry and art of the period. It would be incomplete, but not vitally mutilated. One cannot do so without science, because science is at the base of that shrinkage of the world and that permanent establishment of international relations of which Mr. Delisle Burns is as conscious and as firm a defender as anyone. To take two crucial examples from the book itself. It is because Germany was a scientifically organised and educated country that she survived the War as she did and has increased her coherence, and because Russia was not that she went down ; and, on the largest issue which arises in the period, it is because the nations of the West are the guardians of this

scientifically organised society that they must maintain their position *vis-à-vis* of the East and the less developed peoples of the globe.

It is almost unnecessary to add that these last ten years have also witnessed the most amazing extensions of the scientific spirit, above all in astronomy and physics, that humanity has ever gained. These belong to all mankind, they afford the easiest means of binding the nations together, and they lift the mind above the atmosphere of jealousy and discord which are so painfully apparent even in a generally hopeful book such as Mr. Delisle Burns has given us. F. S. M.

Our Bookshelf.

Voyages of Exploration to Judge of the Bearing of Hybridisation upon Evolution. By J. P. Lotsy and W. A. Goodijn. 1: *South Africa.* (*Genetica: Nederlandsch Tijdschrift voor Erfelijkheids- en Afstammingsleer*, onder redactie von Dr. J. P. Lotsy en Dr. H. N. Kooiman, vol. 10.) Pp. viii +315+11 plates. ('s-Gravenhage: Martinus Nijhoff, 1928.) 35 guilders.

DR. LOTSY has undertaken during recent years many voyages of exploration seeking evidence of the frequency of hybridisation in Nature in order to assess its rôle in the creation and perpetuation of the diversity in characterisation so abundantly observable. Recently, with his colleague, Dr. Goodijn, he visited South Africa, and in the volume under notice gives an account of the many things they saw. The first part of the story concerns itself with forty-three plant hybrids distributed over thirteen families.

Thereafter the authors turn to a much more interesting topic, that of hybrids between different human races, so very common in South Africa, and yet, save for the classical work on the Rehobosh, hybrids so far unrecorded. The investigation was perforce somewhat hurried, and much of that which is written is copied directly from other books which would seem to be mainly impressionistic and uncritical. However, the chief native races are divided for purposes of discussion into Bantu, Bushman, and Hottentot linneons, and it is suggested that there exist some eight tribes which have had their origin in the crossing of these. Quite interesting, but definitely anecdotal accounts are given of certain white × black crosses. The origin of the de Buys people, the Bastaards and Griquas, and the Cape coloured is discussed, but no really satisfactory conclusion is reached.

Finally, a number of family histories, illustrated with useful photographs, is given, and these may permit the enthusiast and the expert to identify the ancestry by recognising segregation among the progeny. This is always a simple matter in the absence of any standard type. Similarly, the coloured plates (in a separate folder) illustrating the plant and human crosses, are of more artistic than scientific value.

Science and Personality. (The Terry Lectures.) By Dr. William Brown. Pp. ix+258. (London: Oxford University Press, 1929.) 12*s.* 6*d.* net.

THIS volume contains the substance of three lectures which were given by Dr. Brown in the United States in 1928 and were delivered in connexion with the Dwight H. Terry Foundation. The material there presented has been amplified by the inclusion of a selection of other papers relevant to the general theme, which is broadly a consideration of religion in the light of science and philosophy.

Dr. Brown commences by a brief survey of the present state of the physical sciences, and he then proceeds to examine the condition of the biological and psychological sciences. Continuing, he deals shortly with the problems of mental unity as contrasted with mental dissociation, insisting that here is to be discerned a direct relation to the problems of unity and dissociation in the physical and physiological spheres. He then proceeds to consider the various theories which have been advanced to explain the phenomena of suggestion, passing on to an examination of the claims of psycho-analysis and other forms of psycho-therapy. The book ends with a discussion of personality in relation to the alleged supernormal phenomena which form the subject matter of psychical research, and in this section a full report of a sitting with the medium Mrs. Osborne Leonard is printed in order to illustrate the bearing of the trance utterances upon the general question.

Although it is obvious that Dr. Brown is in favour of trying to reconcile the claims of science with those of religion, it is not quite clear in what sense he uses the latter term. Again, the relation of religion to what he calls the 'universe', and the concept of value which he considers an integral part of his argument, are not sufficiently worked out to illustrate the problem of personality, and the inclusion of some very dubious examples of 'clairvoyance' towards the close of the volume tends rather to obscure than to clarify the fundamental issues.

It is to be hoped that Dr. Brown will return to the same theme in another place and develop individual points in his theory more fully than he has found possible in the present volume.

Vorlesungen über theoretische Physik an der Universität Leiden. Von Prof. Dr. H. A. Lorentz. Band 4: *Die Relativitätstheorie für gleichförmige Translationen (1910–1912).* Bearbeitet von Dr. A. D. Fokker. Übersetzt von Dr. H. Stücklen. Pp. ix+180. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 13·80 gold marks.

THIS volume is substantially a translation of the lectures delivered by Prof. Lorentz in 1910–12 on what is now called the special theory of relativity, with one omission and a few additions. The part omitted dealt with gravitation, and has been withdrawn as being superseded by Einstein's general theory. One addition is an account of later experimental work on the mass of a moving electron. The results of Guye and Lavanchy (1916) on

cathode rays of high velocity are described very fully, as they are regarded as removing any possible doubt as to the truth of the Lorentz transformation formulæ. Another addition, taken from later lectures, discusses a few specially difficult questions concerning tension, momentum, and energy.

The special theory is so well known now that the book calls for little comment. The style, as might be expected, is excellent. It is characteristic of the author's modesty that he dismisses in a single sentence his own researches which preceded those of Einstein.

There is one point in Prof. Lorentz's presentation that is rather puzzling. On p. 17, and again on p. 27, he strongly maintains that the contraction of a moving rod is a real effect, and not merely apparent. This seems to be in direct conflict with the opinion of Eddington (cf. "The Mathematical Theory of Relativity", p. 26). On p. 28, Prof. Lorentz supports his view by saying that the contraction can be photographed. This perhaps establishes it as a real effect of the relative motion between the rod and the camera, but scarcely as a real property of the rod itself. H. T. H. P.

Probability and its Engineering Uses. By Dr. Thornton C. Fry. Pp. xiv+476. (London: Macmillan and Co., Ltd., 1928.) 30*s.* net.

UNDER the impact of numerous scientific developments, physical, biological, and engineering, the subject of probability is gradually finding a position of first importance among mathematical studies. Beset as it has been with its own natural difficulties and with the conflict of views regarding its foundations held by various sections, no authoritative treatise has so far appeared that has been accepted without question by all sides. Many text-books on the subject in the past have at best been a mere collection of examples with little or no co-ordination. The present volume is the result of a course given at the Bell Telephone Company and at the Massachusetts Institute of Technology on the theory of probability as applied to electrical problems, in particular those problems that arise in the work of the telephone exchange. Although the book bears clear evidence of its origin, its utility is not in any sense limited to this field, and its applications in numerous directions are to real and useful things.

The introductory chapters contain a very sound exposition of the fundamentals of the subject, and the author is at great pains to bring out the circumstances in which the purely abstracted problem of probability may or may not be expected to have its application in the real world. In later sections, averages and distribution functions, as they occur most frequently in engineering statistics, physics and actuarial science, are handled with interesting and detailed discussions on traffic density and adjustment of traffic flow, especially in relation to the work of telephone exchanges. For physicists a chapter of especial interest is that giving a concise treatment of the kinetic theory of gases, with the numerous applications of probability in that field clearly set out. The book is at once clear, bright, readable, instructive, and accurate, and is certainly to be recommended.

Vertebrate Zoology: an Introduction to the Comparative Anatomy, Embryology and Evolution of Chordate Animals. By G. R. de Beer. (Text-Books of Animal Biology.) Pp. xx+505. (London: Sidgwick and Jackson, Ltd., 1928.) 15*s.* net.

A NUMBER of topics of considerable interest in comparative anatomy and embryology have been dealt with in the researches of recent years, but, despite their importance, they have been slow in finding their way into text-books, particularly in the English language. The present volume is largely concerned with these, although more generally available conclusions of fundamental importance are also included. They are discussed clearly in a series of separate chapters, some of which might be expanded with advantage, and occupy just over a third of the book.

The chapters on the embryology of *Amphioxus*, the frog, the chick, and the rabbit as illustrating different types of development, and those on the evolution of the various classes of chordates, are written in an interesting manner. The early chapters, giving descriptions of nine different forms, are very brief and will not be of much service to the student although they may help the layman to appreciate the discussions in the subsequent pages. Some of the illustrations are not up to the standard that might be expected in a work of this description, and here and there are statements that are ambiguous or incorrect.

The book furnishes the general reader with a good review of the present ideas in chordate morphology, and the student of zoology will also find much that is of interest and use to him in his studies.

A Study in Tubercle Virus, Polymorphism, and the Treatment of Tuberculosis and Lupus with Oleum allii. By Dr. William C. Minchin. Third edition. Pp. xvi+110+26 plates. (London: Baillière, Tindall and Cox, 1927.) 25*s.* net.

THE main thesis of this book is that the bacillar one is not the only form of the tubercle bacillus, and that minute spherical granules are extruded from the bacillus, which undergo a cycle of development consisting of division, budding, and protrusion of tubular structures. As regards the granules, the author's observations are probably correct and are confirmatory of those of Spengler, Much, and others, and of the more recent work which suggests that there is a 'filterable' stage of the tubercle bacillus. The development cycle seems much more problematical and needs confirmation. For the treatment of tuberculous conditions, the author extols an old remedy, oil of garlic, and produces sufficient evidence of its clinical value to suggest that it is worthy of more extended trial. The book is illustrated with a number of excellent plates, though it is questionable if the high magnification (×4000-5000) employed in the photomicrographs is of much value, as resolution is not increased thereby and there is some loss in definition.

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.*]

Distribution of Temperature in the First 25 Kilometres over the Earth.

IT is with much pleasure that I notice in NATURE of June 1, p. 834, Dr. Ramanathan's amplification and correction of the tropical portion of my diagram of distribution of temperature in a vertical section of the atmosphere of the globe from the summer pole to the winter pole. I hope the time is not far distant when some other enterprising meteorologist will render a like service for the polar regions of that diagram. It is badly needed.

While, however, we are waiting for that amplification, it would be very helpful if Dr. Ramanathan would supplement his contribution by additions and corrections within his knowledge to another diagram, namely, that of lines of equal entropy in a similar section which will be found on p. 116 of the volume to which he refers.

My reason for asking for this particular service is that, in order to deal with the physics of the upper air, the distribution of temperature alone is not sufficient; the corresponding values of pressure come into consideration too; and the best form in which the information about pressure can be conveyed is by a corresponding diagram of isentropic lines which can indeed be superposed without risk of confusion upon the isothermal lines already drawn.

In explanation let me say that everybody recognises that convection is a primary feature of weather; and we are accustomed to think of temperature enhanced beyond that of the environment as the natural preliminary to convection. So it is; but it is temperature in relation to pressure—entropy, in fact—that really counts. It is entropy which decides the equilibrium position of a sample of air, whether it will rise or sink or stop where it is in a particular environment. Entropy depends on temperature and pressure. It is reduced by reduction of temperature, but enhanced by reduction of pressure in accordance with algebraical formulæ which are quite easy to work, and are set out in the report of the recent Leipzig meeting of the International Commission for the Exploration of the Upper Air. The physical significance of an isentropic surface in the atmosphere is that air cannot pass upward from it without access to a supply of heat, nor downward without getting rid of heat. Circulation along an isentropic surface on the other hand can take place without any communication of heat, no matter whether the controlling surface be horizontal or vertical at the position of the sample. Convective equilibrium is the name which our predecessors gave to an isentropic condition in the vertical, and no energy is required for motion where there is convective equilibrium. We are accustomed to think of convective equilibrium as characteristic of a considerable horizontal area; but that can scarcely be so—differences arise from variations in surface-temperature, height, or solarisation, and the minutest difference in a region of convective equilibrium is dynamically operative.

Hence the lines of equal entropy in a vertical section are a guide to the conditions of the circulation of air and may be regarded as essential to the comprehension of the physics of the atmosphere.

Doubtless, in order to deal with particular conditions, diagrams of isentropic surfaces for the particular occasions are necessary, and they can be provided as soon as we can get maps of the distribution of pressure and temperature at successive levels. The diagram of normals is not the final step; but it is at least a first stage, and an important one in the prosecution of productive inquiry; I trust that Dr. Ramanathan will find an opportunity for providing it. Personally, I require the information for tracing possible tracks of air elevated by convection in the tropical regions and descending somewhere else. I have a place ready for it, and if he will supply it I shall be correspondingly grateful.

NAPIER SHAW.

10 Moreton Gardens, S.W.5,
June 3.

An Ancient Spearhead.

IN the British, London, and Aylesbury Museums are a few iron spearheads, presumably of the Early Iron Age, and evidently copied from the cast-bronze spearheads of the late Bronze Age, which ended about 800 B.C. in Britain. All of these were found in England. Mr. Reginald A. Smith, Keeper of British and Medieval Antiquities, British Museum, informs me that their occurrence has long been a mystery; that, on one hand, it is difficult to account for their

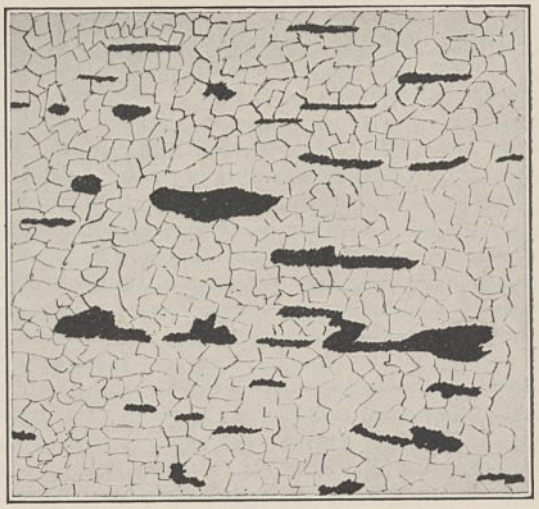

FIG. 1.

shape in wrought iron by reason of the high degree of technical skill required for their manufacture in this way, and that, on the other hand, cast iron, of which they may possibly be composed, is supposed to have been unknown even in medieval times.

I was recently approached by him to know whether it would be possible to put this matter to the test, and a specimen in the British Museum from Golden Lane, City of London, was selected for this purpose. The weapon in question is a narrow leaf-shaped spearhead of Bronze Age type, 7½ inches in length, having a short round socket with flattened sides which are pierced by two holes for a rivet. The blade has a mid-rib extending to the tip, and inside the socket tapers for a length of 5½ inches. Its approximate date is 7th century B.C. It may be a century or two later, but scarcely earlier.

There was no difficulty about preparing a surface suitable for microscopic examination, although owing to the regulations the specimen itself could not be taken out of the Museum, and the necessary work had to be done there. For this reason it was not

possible to photograph the actual structure obtained. The section examined was parallel to the surface of the spearhead and about half-way between the tip and the broadest point. A sketch of the microstructure was made with great care by my assistant, Dr. J. M. Robertson, and from this the accompanying photograph (Fig. 1) was prepared. The structure shown is at a magnification of 120 diameters. It is typical of wrought iron. The black elongated areas with somewhat serrated and rough edges represent the slag threads which have been elongated in the direction of working. The small irregularly shaped polyhedra are the crystals of iron. There is no doubt, therefore, that this particular spearhead consists of wrought iron, and not of cast iron.

Without a complete examination and consequent destruction of the spearhead, it is impossible to ascertain how the forging was done, but there are certain features of the specimen itself which suggest two possible methods of forming. The hollow centre of the rib extends to within a short distance of the point of the spear and tapers with the rib, so that the metal of the rib is of approximately the same thickness throughout its length. It would appear that this hollow in the rib is a consequence rather than an object of the method of forging, and it indicates that the forming was carried out on a mandril of metal or stone. Two alternative methods of forming may be considered. In the first the spearhead could have been made from a long strip bent back over the mandril and forged down at a welding heat. In this way the head would be formed from one piece of metal; the leaf-shape would be obtained by chipping or grinding; the joints would correspond with the edge of the spear and a mandril would be necessary to form the central rib. In the second, the mandril may have been used to pierce a billet of suitable size and have served as a means of holding the metal during forging and as an aid in forming the rib.

Whatever method of forging was in fact adopted, the crystal structure of this spearhead is very similar to that of a wrought iron produced at the present time. It is impossible not to admire the skill of the earliest iron workers who produced results such as this.

H. C. H. CARPENTER.
Imperial College of Science and Technology,
South Kensington, S.W.7.

The Dehydration of Benzene.

PROF. H. B. BAKER has shown that prolonged contact between benzene and phosphorus pentoxide results in a marked rise in the boiling-point of the liquid. From this we may safely infer that corresponding and concurrent variations in other physical properties, such as the refractivity, freezing-point, and specific volume, take place during the process of dehydration.

To test the accuracy of this supposition, I have during the past year carried out many determinations of the refractivity of benzene in the presence of pure phosphorus pentoxide. For this purpose use was made of (*a*) a hollow prism and refractometer readable to 1″ of arc, and (*b*) a Jamin interferometer by Hilger capable of measuring to within $\frac{1}{8}$th of a fringe. For each series of experiments the benzene bought as 'pure' was re-purified and subjected to a preliminary drying by calcium chloride.

After introducing the benzene into the prism or interferometer, a first determination of the refractivity was made. Pure phosphorus pentoxide was then placed in the liquid, and additional and periodic measurements of the refractivity effected. Data thus obtained during an interval approximating six months, proved that as a result of exposing the benzene to the action of the dehydrating reagent the refractivity changed continuously. On plotting refractivities against time, the resultant graph consisted of two distinct portions or limbs, both smooth, but having very different directional values. A study of the whole graph has led to the conclusion that the first limb represents the rate of the removal of the mechanically admixed water, and that the second limb offers a measure of the rate of the withdrawal of water in actual combination with benzene. In other words, the first limb of the graph is indicative of the rate of drying as ordinarily understood, and the second the rate of true dehydration. Whence it appears that during my experiments the benzene under observation behaved as does a wet crystallised salt, such as copper sulphate when exposed to air.

The results so far obtained clearly indicate that, within some as yet undetermined range of temperature, benzene firmly combines with water, and thus forms one or more hydrates. This conclusion is strengthened in consequence of some preliminary measurements of the specific volume of benzene in the presence of phosphorus pentoxide. This physical 'constant' is found to be dependent upon the temperature to which the benzene has been exposed *immediately before* the determination is carried out. For example, I find that the normal specific volume at 18° C. is lessened by a preliminary cooling of the benzene in melting ice, and increased when the liquid is first heated to 21° C. Whence it appears, first, that during crystallisation, combined water is ejected from the benzene and taken up by the phosphorus pentoxide; and secondly, as the temperature is raised from 0° to 21° C., the process of dehydration is reversed so that the benzene is rehydrated by the withdrawal of water from the newly formed metaphosphoric acid. From this it follows that the drying power of anhydrous benzene is, within certain limits of temperature, greater than that of phosphorus pentoxide.

During precisely similar experiments conducted with benzene in the absence of phosphorus pentoxide, the changes in the specific volume, although in kind the same, were relatively quite insignificant.

These investigations are being extended, and in due time I hope to give a detailed account of the work elsewhere.

J. J. MANLEY.
Daubeny Laboratory,
Magdalen College,
Oxford.

The Intensive Drying of Liquids.

THE well-known work of Prof. H. B. Baker on the properties of liquids and solids which have stood for long periods of time in closed vessels with phosphorus pentoxide is of the greatest importance to chemists. Since the publication of Prof. Baker's 1922 paper, in which he reported a remarkable change in some of the physical properties of ten liquids which had been dried for from eight and one-half to twenty-eight years with phosphorus pentoxide, the problem of the influence of traces of water on pure chemical substances has been of controversial interest. Several authors have described experiments which are interpreted as confirming Prof. Baker's work (Smits, *J. Chem. Soc.*, **125**, 1068; 1924: Mali, *Z. anorg. Chem.*, **149**, 150; 1925: J. W. Smith, *J. Chem. Soc.*, 867; 1928), while I have not been able to check this work (Lenher and Daniels, *Proc. Nat. Acad.*, **14**, 606; 1928) with benzene and carbon tetrachloride which had been dried for from four to four and one-half years (1923–1928). The difficulties of repeating Prof. Baker's experiments are very great, because

experiments carried out in a drying time less than that taken by him, which do not effect a change in the dried liquids, can always be met with the practically unanswerable criticism that intensive drying had not been obtained.

I have no reason to believe that the liquids described by me in the *Proceedings of the National Academy of Sciences* were not intensively dried. In fact, if one accepts the work of Smits (loc. cit.) the liquids which were sealed up with phosphorus pentoxide in 1923, and were examined in 1928 by me, were certainly intensively dried, though no change in the physical properties of these liquids was observed. As I could see no explanation of my results other than the obvious conclusion that the boiling point of dried liquids and undried liquids is the same when superheating is effectively prevented, there remained the difficulty of explaining Prof. Baker's remarkable results. Experiments were performed to see if the effects reported by him could not be obtained under similar experimental conditions with ordinary liquids. These experiments, a full description of which will be published shortly in America, show that ordinary pure benzene, carbon tetrachloride, and water give apparent boiling points as high as 27° above the normal boiling point when measurements are carried out in a reproduction of the apparatus described by Prof. Baker and Prof. Smits. I have repeated the crucial experiment of Baker and Smits (Smits, loc. cit.; Baker, *J. Chem. Soc.*, **123**, 1223; 1923) with exactly the apparatus and procedure described by them, using ordinary benzene, and I have observed the same phenomena. There can be no doubt that what is interpreted by these authors as a fractional distillation of dried benzene is superheating of benzene, for the same effect is obtained with ordinary pure benzene.

The conditions which are favourable to this apparent rise in boiling point have been studied and will be described at length elsewhere. Some of these conditions are: (1) the use of a heating bath; (2) the immersion of the thermometer bulb in the liquid the boiling point of which is being measured; (3) allowing a liquid to stand in contact with a flocculent solid, such as redistilled phosphorus pentoxide, which will remove dust particles (Spring, *Rec. Trav. Chim. Pays-Bas*, **18**, 233; 1899); and (4) distillation of the liquid into a clean flask before determining the boiling point, which tends to free the liquid of dust particles which act as centres for the formation of bubbles to initiate boiling (Martin, *J. Phys. Chem.*, **24**, 478; 1920).

I have repeated and extended Prof. Baker's experiments on benzene which has been subjected to a high direct current potential (*J. Chem. Soc.*, 1054; 1928). The boiling point of benzene subjected to a potential of 450 volts direct current for more than twenty-four hours in a reproduction of Prof. Baker's apparatus was found to be unchanged, namely, 80° to 80·2°, when heating was carried out with a platinum wire heating element under conditions where it is known there is less than 0·03° of superheating. When boiling point determinations were carried out both on benzene subjected to the direct current potential and ordinary benzene with no potential applied in an identical apparatus, using a heating bath (Prof. Baker seems to use a heating bath in his boiling point determinations), no difference which could be attributed to the influence of the potential was observed; both tubes were easily heated 10° to 25° above the boiling point of benzene before ebullition began. One is forced to conclude not only that there is no real change in the state of liquids subjected to a high direct current potential, but also that the original measurements were carried out under conditions where superheating is practically unavoidable.

It does not seem necessary here to consider the theories of Prof. Baker and Prof. Smits on the intensive drying of substances, but this matter, together with additional experiments and a review of the published evidence for the change of some of the physical properties of liquids on prolonged drying, will be dealt with in the forthcoming paper referred to above.

S. LENHER.

Experimental Station,
E. I. duPont de Nemours and Co.,
Wilmington, Delaware.

X-ray Evidence for Intermolecular Forces in Liquids.

DIFFERENT mathematical methods[1-5] have been used to express the conception of the 'structure of a liquid' in exact formulæ, mainly with the intention of accounting for the X-ray diffraction pattern. The different treatments, however, have a common principle, which for our purpose may be stated in the following way. The arrangement of the molecules in the liquid, and of the electrons in the molecules, causes a non-uniform distribution of scattering power in the liquid. This distribution may be resolved in a continuous range of periods in a way analogous to, but not identical with, ordinary Fourier analysis. In X-ray terminology these periods may be called 'spacings'; if properly defined each of them is related to a certain diffraction angle by the well-known Bragg relation, and their strength is measured by the corresponding intensity in the diffraction pattern.

We will confine ourselves to molecules which do not differ *very* much in shape from spheres. Then the most prominent spacing is due to the mutual distance of neighbouring molecules, and it is indeed this spacing which accounts in most cases for the 'principal halo', as has been put on firm ground for the first time by an experimental study of Keesom.[1]

The interpretation of the diffraction pattern *outside* the principal halo is complicated by the fact that here the 'inner structure' of the molecule, mentioned above, may also play a part. On the contrary, I wish to emphasise that this influence must be negligible in the region of the pattern *inside* the principal halo. This arises from the fact that if the inner structure is resolved into 'spacings', these are of course mainly shorter than the intermolecular distances. Therefore it may be stated that *the diffraction pattern of liquids inside the principal halo is only related to the mutual arrangement of the molecules.*

This circumstance suggests the possibility of applying some theoretical considerations. First, it has been shown[2,4] that for the case of *very* small diffraction angles the intensity must approach a definite limiting value, which may be calculated from the compressibility of the liquid, and is ordinarily about five per cent or less of the intensity that would result if the scattering of all molecules were incoherent. But we may perhaps go a little further, at least when the intermolecular forces may be neglected (except of course in so far as they prescribe a definite volume for a definite quantity of molecules). To this end we compare our problem with the analogous one-dimensional case,[4] where the required calculations are easily carried out rigorously, and show that, when we proceed

[1] W. H. Keesom and J. de Smedt, *Proc. Amsterdam*, **25**, 188; 1922. W. H. Keesom, *Proc. Amsterdam*, **30**, 341; 1927.
[2] C. V. Raman and K. R. Ramanathan, *Proc. Ind. Assoc. for Cultiv. Science*, **8**, ii. 127; 1923.
[3] P. Debye, *Jour. of Math. and Phys.*, Massachusetts, **4**, 133; 1925; and *Phys. Zeitschrift*, **28**, 135; 1927.
[4] F. Zernike und J. A. Prins, *Zeitschr. f. Phys.*, **41**, 184; 1927.
[5] G. W. Stewart, *Phys. Rev.*, **32**, 558; 1928.

from the principal maximum to smaller angles, the intensity falls off continuously and rather rapidly to the limiting value already mentioned. There is no reason to suppose that this should be radically different in three dimensions.

With the view of testing these points I have recently examined the diffraction pattern of many liquids at small diffraction angles and have arrived at some results that seem interesting enough to communicate to NATURE. As an example let us take water (here it is chiefly the arrangement of the oxygen atoms that determines the diffraction pattern). It is well known that the principal halo of water lies at a diffraction angle to which corresponds a spacing of about 3 A., in good agreement with the mean intermolecular distance. I have found, however, that at the inner side of this halo the intensity is rather strong and roughly constant till a very small angle is reached, corresponding to a spacing of about 17 A. At this angle the intensity falls off rapidly, and for still smaller angles approaches a limiting value which may be assumed with some reason to agree with the theoretical limiting value considered above. But how are the spacings between 3 and 17 A. to be explained? We have already seen that we certainly must look for an explanation in the arrangement of the molecules. A closer examination shows that this arrangement must be of the following kind: in the immediate neighbourhood of every molecule the mean density must be greater than at greater distances. This arrangement may be described as a 'tendency to association', though I think this is mostly to be understood in a dynamical rather than in a statical sense. The reason of this arrangement is, of course, to be found in the nature of the attractive intermolecular forces.

The same strong scattering inside the principal halo is found with many other liquids, and recently it has also been remarked by Krishnamurti [6] that with liquids classified from other reasons as 'associating' it is often so strong as to give rise to an 'inner ring'. This agrees with the explanation given above.

I should like, however, to point out, that a scattering inside the principal halo, stronger than the limiting value, though much weaker than in the previous cases, is present also with liquids, as benzene, carbon tetrachloride, carbon bisulfide, and others,[7] which are usually not called 'associating'. Indeed the only exception known to me is that of mercury. From this it would seem that in the X-ray pattern we have a much more sensitive method for studying the intermolecular forces than in many other methods. Perhaps we may hope in due time to be able to draw more definite conclusions from it. In this respect it might even sometimes serve us better than the diffraction pattern of the solid state.

J. A. PRINS.

Natuurkundig Laboratorium der
Rijks-Universiteit te
Groningen.

X-ray Pattern of Metallic Crystals.

WHILE reading the literature on diffraction of X-rays, I came across interesting photographs of X-ray patterns for a few metallic foils—aluminium, cadmium, copper, lead, silver, thallium, tin, zinc, and several kinds of brass—at different temperatures (Nishikawa and G. Asahara, *Phys. Rev.*, 1920). The most interesting fact one finds from this paper is that there is a remarkable change in the nature of the pattern for a metal as time elapses after the rolling process. Silver and tin, for example, gave ill-defined patterns immediately after the rolling process, but these gradually changed during the following two or three weeks to the distinct spot patterns characteristic of annealed samples. Nishikawa and Asahara conclude from this that for these samples the crystal growth which accompanies annealing takes place at room temperatures.

We had in our laboratory a few metal foils kept at room temperature for about twenty years. This is indeed a sufficient time for the complete recovery of the foils after the process of their production, and a beautiful spot pattern was expected. Patterns for a few metallic foils were therefore taken. For this purpose a Hadding tube with a copper anticathode was worked at about 85 kv. and 10 ma. A strong beam of X-rays was allowed to pass through the material. The pattern was recorded on a photographic plate kept at a distance of 3 cm. from the leaf. Silver and gold gave a ring pattern; the rings were quite continuous and there was no indication of any spots on the plate. In the case of tin (grey) the pattern was mostly similar to No. 27 of Plate 1 of the paper quoted above, and not spots as in No. 27′. For gold and silver the rings were not only of similar nature but were also of identical diameter. The diameter of the inner ring was 3·7 cm., and that of the outer one 4·5 cm. The intensity of the inner ring was about ten times the intensity of the outer one. From these facts one is tempted to draw the following conclusions:

(*a*) For silver and gold the lattice is the same, and is the same in magnitude. This is borne out by the experiments made by L. Vegard in a different way (*Phil. Mag.*, 32, 1920). (*b*) These metals do not recover from the effects of the process by which the leaves are made, using the terminology of Nishikawa and Asahara. (*c*) It is more proper to regard a thin metal leaf as an assemblage of metallic crystals as in the case of powders, for which by Hull's method we always get a ring pattern.

Taking d as the lattice constant responsible for the production of both the rings, we find that $\sin\theta/\sin\theta' = 0{\cdot}87$, which is about the same as $\mathrm{Cu}(K\beta)/\mathrm{Cu}(K\alpha)$. It thus appears that the two rings are due to $K\beta$ and $K\alpha$ lines of copper.

G. B. DEODHAR.

Department of Physics,
University of Allahabad,
Allahabad (India).

Emission Lines in the Spectrum of the Solar Corona.

IT seems very improbable that the bright line spectrum of the inner corona can be attributed to thermal excitation of the coronal matter. We may seek its cause in the process of photoelectric ionisation and apply then, as a first and rough estimate of its brightness, the same analysis as Dr. Zanstra has done in the case of diffuse nebulæ (*Astrophys. Jour.*, **65**, No. 1). Thus we assume in this approximation that the emission spectrum of the corona is due to a mechanism of recombination of free electrons with atoms, ionised by the high quantum radiation, emerging from the sun, acting as a black body radiator; and that the corona consists only of monoatomic hydrogen. We have to suppose, further, that the high quantum radiation is completely absorbed by the coronal material, and that all the freed electrons recombine with the ionised hydrogen atoms.

[6] P. Krishnamurti, *Ind. Jour. Phys.*, Calcutta, **2**, 491; 1928. In another paper Mr. Krishnamurti has also studied solutions from the same point of view as I did in a previous letter to NATURE (*Ind. Jour. Phys.*, Calcutta, **3**, 209; 1928; NATURE, **123**, 84; 1929).

[7] As a curious fact it may be mentioned that organic iodides seem to show an inner ring while bromides do not, even if the molecules are rather long (for example, C_{13}-dibromide). For the longest spacing of C_{13}-dibromide in solid state I found 12·6 A.; this low value probably indicates that the CH_2-chain is not straight in this compound.

With these assumptions we can apply Zanstra's formula for the ratio of the integral brightness of the corona to that of the sun :

$$L \sim \int_{x_0}^{\infty} \frac{x^2}{e^x - 1} dx \Big/ \int_{x_1}^{x_2} \frac{x^2}{e^x - 1} dx, \quad x = \frac{h\nu}{kT},$$

where T is the sun's effective temperature; h and k are well-known constants; ν_0 will be in our case the frequency corresponding to the head of the Lyman series ($32{\cdot}84 \times 10^{14}$); ν_1 and ν_2 are the limits of frequency for photographic rays ($\nu_1 = 5{\cdot}95 \times 10^{14}$ and $\nu_2 = 9{\cdot}10 \times 10^{14}$). Expressing L in differences of stellar magnitudes Δm we get :

T.	Δm.	m_c.
6400	18·0	− 8·0
6200	99·1	− 6·9
6000	20·0	− 6·0
5800	20·8	− 5·2

(m_c is stellar magnitude of the corona ; $m = -26{\cdot}0$ mag.)

We can conclude from these data that even in the case of lowest admissible effective sun's temperature, we should obtain on the plates the effect of a relatively faint but characteristic bright line spectrum, superposed on the continuous spectrum of the corona (Russell, Dugan, Stewart, " Astronomy ", vol. 2, p. 507).

It should be noted that the proposed explanation of the bright coronal lines is related to a fact noticed by Balanovsky and Perepelkin (*Mon. Not. Roy. Ast. Soc.*, **88**, p. 747), namely, that the coronal material seems to be attracted by the solar prominences. This may be due to the fact that a part of the high frequency quanta, being absorbed by the prominence, does not reach the coronal matter and produces a darkening of the corona over the prominences. In that case the coronal emission lines ought to weaken considerably above a prominence ; and such an effect, if observed during an eclipse, would afford a proof of the photoelectric origin of the coronal emission spectrum.

W. ZESSEWITSCH.
University Observatory,
Leningrad.

W. NIKONOW.
Astronomical Institute,
Leningrad, April 29.

Growth-gradients and the Axial Relations of the Body.

IN previous communications (see Huxley, 1927, *Biol. Zentralbl.*, **47**, 151) it has been pointed out that in Crustacea the presence of a centre of active growth,

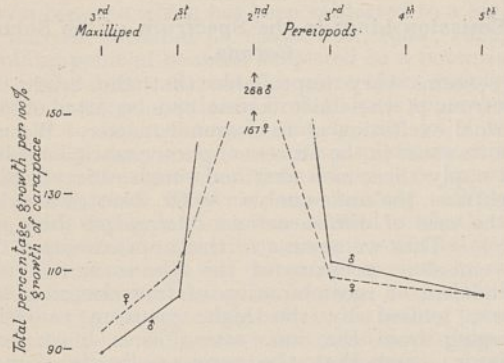

FIG. 1.—Amount of growth in length per 100 per cent growth of carapace-length in male and female prawns (*Palæmon carcinus*).

for example, in a male chela, is associated with excess growth of the other walking legs. The third maxilliped, however, is not affected in this way, but appears to be slightly decreased in the male. The question arose whether this was a positional effect, appendages anterior to the growth-centre being inhibited in their growth, those posterior being accelerated, or whether, since the maxilliped was an appendage of different type from the pereiopods, its growth was not correlated with theirs.

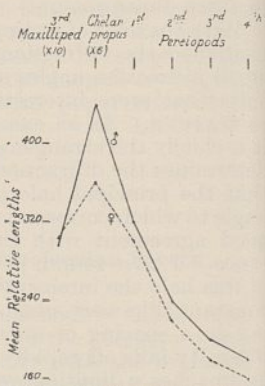

FIG. 2.—Relative lengths (in per cent of carapace-length) of male and female spider-crabs (*Inachus dorsettensis*). After M. E. Shaw, *Brit. Jour. Exper. Biol.*, **6**, 145.

To settle this question, measurements have been made on a large Indian species of *Palæmon* (*P. carcinus*) in which the second pereiopod, not the first, is enlarged as the male chela. The material was presented by the Zoological Survey of India, through the kindness of Col. Seymour Sewell.

The results appear quite definite. For 100 per cent increase in carapace-length, the percentage increase in length of the various limbs measured are as follows :

	Maxilliped.	Pereiopod.				
	3rd	1st	2nd	3rd	4th	5th
♂	89·0	103·2	*268·0*	*112·2*	*107·8*	*103·2*
♀	*94·6*	*111·1*	167·0	108·1	105·2	103·1

The accompanying diagram (Fig. 1) shows the results graphically. Fig. 2 shows the effect in *Inachus*, where the first pereiopod is the large chela. Other methods of analysing the figures confirm this conclusion; namely, that exceptionally active growth in one appendage is correlated with a slight acceleration of growth in the appendages posterior to it, a slight retardation in those anterior.

It has previously been established that the heterogonic growth of an appendage takes place most rapidly in a 'growth-centre' near its tip, and that there is a 'growth-gradient' down from this region towards the trunk. It would thus appear that when the local growth-gradient of the appendage reaches the trunk, it is influenced by the axial relations of the whole animal, and affects the regions posterior to the appendage in a different way from those anterior to it. No view has as yet been put forward as to the mechanism of this influence, and we should welcome any suggestions bearing upon it.

J. S. HUXLEY.
M. A. TAZELAAR.
Zoological Department,
King's College, London.

Growth and Longevity of Whales.

ACCORDING to Mr. N. A. Macintosh (British Association Report, 1928) Blue whales and Fin-whales grow quickly and probably reach maturity in the short space of two years; Mr. Macintosh's statement implies that, in favourable circumstances, these great animals might increase in number fairly quickly, but that they die without attaining any great age.

In the case of the Greenland whale the duration of gestation and lactation are unknown, but the following facts suggest that it takes more than two years to reach maturity, that it multiplies very slowly, but that it attains a considerable age.

1. So far as can be ascertained now, the Greenland

whale is 14 or 15 feet long at birth, is about 20 feet long and its whale-bone less than 2 feet long when it is weaned, but is not sexually mature until its length is about 50 feet and its whale-bone exceeds 10 feet.

2. As stated in my letter on the "Extermination of Whales" (NATURE, Mar. 2) in the Greenland Sea in the period 1860–1909, only a small number were killed by the whalers, including those that may have died after breaking loose, two or three less than ten a year, and that notwithstanding this small mortality at the hands of their human enemies in these years they showed no signs of increase. It might be objected that the whalers were not the only enemies of the Greenland whale and that others came to an untimely end in other ways; but of this there is no evidence. In the Greenland Sea the Killer whale, its most likely enemy, is not found amongst the ice, and as far as I saw the whales do not appear to suffer or die from disease. Only those that died from harpoon wounds were found floating dead.

3. Harpoons were sometimes found in whales, which the animals appear to have carried about buried in them for a long time.

In the Greenland Sea, in 1863, my father killed a large whale in which he found an old harpoon marked 'Pow and Fawcus, Newcastle, 1839', and in 1872 he killed two others, also large, in each of which he found old harpoons (Buckland's "Log-book of a Fisherman", etc., p. 247).

In Davis Strait in 1894 the *Terra Nova* killed a large whale (12 feet bone), in the blubber of which was found embedded a harpoon bearing the name 'Jean of Bo'ness', and dated forty years back. The *Jean*—a well-known whaling ship—was lost in Davis Strait in 1857 (*Zoologist*, 1895, p. 94).

ROBERT W. GRAY.

8 Hartley Road,
Exmouth.

Reduced Flowers of *Ranunculus*.

I AM glad my letter to NATURE (April 13, p. 568) has been the means of eliciting from Mr. Marsden-Jones and Dr. Turrill a very interesting joint communication (NATURE, May 25, p. 798) on the above subject. I hope I have not unwittingly been attempting to steal their thunder!

The references to the literature they give are very welcome. Apparently these buttercup plants with reduced (female) flowers have hitherto failed to interest British field botanists—an instance perhaps of the lack of sympathetic feeling and co-operation between the systematists and the geneticists.

As yet I have not come across in this district the reduced form of *Ranunculus bulbosus*, but shall keep my eyes open now that the buttercup season is with us. Plants of *R. acris* with the small flowers and aborted stamens are appearing as usual.

If there be evolutionary significance in these reduced flowers, then seeing there are all grades between plants with completely hermaphrodite flowers and those with no functional stamens, it looks as if there is here an example in support of the view of "the inevitability of gradualness" (to adopt a famous phrase used in another connexion) in evolution.

The writers of the joint letter express surprise at my not mentioning a freak plant of *Ranunculus acris* I found here in the middle of a pasture field a few years ago. Reference to such a plant did not appear germane to the subject matter of my former letter, for I regard it as a sport which has no bearing on the evolutionary trend of the species. Others naturally may take a different view. It is pleasing, however, to know that it is of value to these workers on the genetics of the genus, especially as they have proved it to be functionally male only—a point which was not obvious to me at the time of its discovery. The original plant is still in the garden here. It does not grow nearly as strongly as the ordinary or reduced (female) form of *Ranunculus acris*; consequently in the wild state it might soon have failed to hold its own and been squeezed out of existence. It was a frail affair when I lifted it from the pasture. A feature of it not mentioned in the Marsden-Turrill letter is the distinctive character of its foliage. The leaves are somewhat crested and less sharply cut than those of the type, so that the plant can readily be recognised when not in flower.

J. PARKIN.

Blaithwaite,
Wigton, Cumberland,
May 29.

Nervous Impulse in *Mimosa pudica*.

IN a letter under the above heading (NATURE, April 13, 1929) Prof. Hans Molisch describes certain experiments which appear to confirm the earlier work of Sir J. C. Bose. Space does not permit of a full discussion of these results, but it is rather surprising to find that Prof. Molisch regards the experiment of Bose on the supposed reflex arc as satisfactory evidence, since the fallacy in this experiment has already been demonstrated by K. Umrath (*Planta*, 5, 1928, p. 295, footnote).

As Umrath points out, and as I also have found, the serial reactions of the pinnæ take place in the same way, whether one stimulates a pinna of a leaf attached to a shoot or one from which the main pulvinus has been removed. This fact disposes of the contention that an afferent impulse is changed into an efferent one in the main pulvinus. Further, neither Sir J. C. Bose nor Prof. Molisch mentions the reactions of the secondary pulvini. I have noticed that if one stimulates one pinna, either electrically or by cutting, in the large majority of cases the secondary pulvini of the other pinnæ react *before* the main pulvinus, thus showing that the excitation has already reached them. As Umrath points out, there is a delay in the transmission between the secondary pulvinus and the basal pair of pinnules. This delay allows time for the excitation to reach the main pulvinus, which thus reacts before the excitation is apparent in the pinnules on the unstimulated secondary petioles.

Occasionally I have observed the excitation beginning to pass up the unstimulated pinnæ before the main pulvinus reacts, but usually the time which has elapsed is not sufficient for it to pass beyond the secondary pulvini.

It is therefore apparent the transition of the excitation from one pinna to another takes place at the apex of the petiole and not through a reflex arc passing through the main pulvinus.

NIGEL G. BALL.

Ceylon University College,
Colombo, May 7.

The Ratio of the Mass of the Proton to that of the Electron.

IN a recent paper (*Proc. Roy. Soc.*, 122, p. 358; 1929) Prof. A. S. Eddington reached the conclusion that the value of the physical constant $ch/2\pi e^2$ is given by the integer 136. His theory reduces the evaluation of this constant essentially to the counting up of symmetrical elements in a square array. The numbers

of such elements in arrays arising in this connexion are 10, 136, etc.

In this light, it is interesting to speculate if at least some of the dissimilarities between the proton and the electron are not somehow bound up with the question of degrees of freedom, and, in particular, if another important non-dimensional physical constant, namely, the ratio of the mass of the proton to that of the electron, M/m, cannot be accounted for by counting up elements and by performing simple operations with the numbers so obtained. If so, it is plausible to assume that M/m should depend on two such numbers, one of them being 136. The other number here taken is 10, as the absence of protonic spin hints at the smaller value. With these two integers on hand, and with the observed value of M/m (1840, roughly) in mind, it is tempting to write :

$$\frac{M}{m} = \frac{(136)^2}{10} = 1849{\cdot}6.$$

I am aware of no proof of this relation. But as I do not, at present, know of any reason for ascribing the numerical result, without at least some hesitation, to a mere coincidence, I believe that the numerical agreement in this ' empirical ' relation warrants notice.

V. ROJANSKY.

Washington University,
St. Louis, U.S.A.,
April 26.

Freshwater Medusæ in England.

IN NATURE for Jan. 12, Prof. Hickson has recorded freshwater medusæ and their polyps from Mr. V. B. Poulton's aquarium at Boscombe. Afterwards these were assigned to *Craspedacusta sowerbii* after comparison with drawings made at the British Museum of polyp stages of that species found last summer on *Pandanus* roots in the *Victoria regia* tank of the Royal Botanic Society and exhibited at a meeting of the Zoological Society.

The Boscombe polyps afford additional confirmation of the evidence for linking up Sir Ray Lankester's Regent's Park medusa with the polyps of Bourne, Parsons, and Fowler, since they bear medusa-buds.

In case any other amateur should observe freshwater medusæ in England it is to be hoped that it will occur to him to communicate with the British Museum. It seems highly probable that *Craspedacusta* occurs in a wild state in British river systems, and it would be well if a sharp look out for it were maintained.

A. K. TOTTON.

British Museum (Natural History),
London, S.W.7, May 13.

The Crystal Structure of Nickel Films.

FILMS of nickel deposited on rock salt by spluttering in residual gas or argon, show an unexpected structure on removal from the rocksalt and examination by the cathode ray diffraction method. As is well known, the normal structure of nickel is face centred cubic, as found both by X-ray and electron diffraction methods. The new structure turns out to be hexagonal, the values of the axes being $c = 4{\cdot}06$ A., $a = 2{\cdot}474$ A. ratio 1·64, which is near enough to the ratio 1·633 for closest packing. Nickel thus resembles cobalt in crystallising in both cubic and hexagonal closest packing. The density calculated from the above axes is 8·86, in good agreement with that of the metal in bulk. The structure is thus different from an hexagonal form found by Bredig and Allolio (*Zeit. f. Phys. Chem.*, **126**, p. 53 ; 1927) by spluttering in hydrogen. The latter had a density of only 7·04 and is probably a hydride. The above is, I believe, the first case of a new crystal form found by electron diffraction.

G. P. THOMSON.

University of Aberdeen,
May 31.

A Proposed Survey of the Burnet-moths.

I AM at present undertaking a survey of the variations in the male and female genitalia and in the wing patterns in the genus *Zygæna*, or Burnet-moths. This necessitates the collection of specimens from as many parts as possible of the British Isles and continent of Europe. I should therefore be very grateful if specimens could be sent to me this summer. They should be taken *in pupa* and, if possible, at least two dozen from one locality or colony. It is very necessary that pupæ from neighbouring or different colonies should be kept separate. Details as to the position and extent of the colonies would be welcome so that they can be identified afterwards on Survey maps. Pupæ may be taken on the grass stems, packed in a small box and sent to the address below. Due acknowledgments to the collectors will be made of course in resulting publications.

H. R. HEWER.

Department of Zoology,
Imperial College of Science and Technology,
South Kensington, London,
S.W.7.

The Emission of Positive Ions from Metals.

DURING the study by me of critical potentials in metallic vapours (*Phys. Rev.*, August 1928), it was noticed that positive ions were given off by heated metals and that these ions persisted for very long periods of heat treatment. A determination of e/m of the positive ions from heated metals gives the following results. Copper, iron, nickel, and platinum when heated, give alkaline ions only, as has been found by other observers. Tungsten, molybdenum, and tantalum when heated to a temperature where vaporisation becomes appreciable, give ions the atomic weights of which agree with that of the metal emitting them. Other metals are under investigation.

H. B. WAHLIN.

University of Wisconsin,
Madison, Wisconsin, U.S.A.

Adder or Nether.

IN his note upon dragonflies in NATURE of June 1, Dr. Tillyard asks whether the adder is still called the ' ether ' in any part of England. I cannot answer for England, but ' nether ' is good Lowland Scots for ' adder ', and is given in that sense in Jamieson's " Dictionary of the Scottish Language ". Among examples given by Skeat of initial *n* shifting from the noun to the indefinite article, or from the article to the noun, he mentions *addere* and *naddere* as interchangeable forms in Middle English ; but he says nothing on the question whether ' adder ' comes from Anglo-Saxon neoðera, nether—the lowly one.

HERBERT MAXWELL.

Monreith, Wigtownshire.

The Hormones of the Sexual Glands.

RECENT work on the internal secretions of the gonads illustrates the fact that progress is only rapid when a simple specific test for the principle under investigation is available. The earlier reports of the isolation of an ovarian hormone failed to arouse the interest of more than a few workers, since the test of activity used, the growth of the female genital tract following injection of the extract into an immature or adult normal animal, was liable to the fallacy that such growth might have occurred naturally, whilst even in spayed animals the end-point of the reaction was indefinite: in either case the test animal must be killed.

The discovery by Stockard and Papanicolaou that the particular stage of the œstrous cycle in a living guinea-pig could be easily determined by taking a smear of the vaginal contents was soon applied by Long and Evans and by Allen to the rat and mouse, and the method of following the activity of ovarian extracts by observing the appearance of œstrus after injection of the preparation under test in ovariectomised animals by means of the vaginal smear technique was quickly developed. In the case of testicular extracts no such simple test is available, with the result that our knowledge of the hormones of the ovary, incomplete though it is, is in a much more advanced state than that of the secretions of the testis.

The Ovary.

A very good review of the physiology of ovarian activity has been given by A. S. Parkes (*Biol. Reviews*, vol. 3, p. 208; 1928), to which those interested in this subject may be referred. At the present time opinion generally favours the view that the ovary secretes at least three different hormones; one controls the development of the secondary sex organs, the uterus, vagina, etc., before puberty, one is responsible for the œstrous symptoms, whilst the third is secreted by the cells of the corpus luteum.

It is possible that the prepubertal growth of the secondary organs is due to the secretion of the œstrus-producing hormone, a view, however, which presupposes an abrupt change in its mode of action at puberty. On the other hand, the œstrous reaction of ovariectomised animals following an injection of 'œstrin' appears incomplete, in that copulation is only infrequently observed, and in the spayed bitch the hormone only produces symptoms of pro-œstrus, so that possibly the missing factor may be the hormone responsible for the initial development of the accessory sex organs. The cause of the first œstrus at puberty appears to lie outside the ovary, and recent work suggests that a hormone from the anterior lobe of the pituitary gland is concerned both in stimulating the first œstrus and maintaining the regularity of the œstrous cycle. However, since injection of an extract of a young male pituitary will produce œstrus in an immature female with intact ovaries, the actual reason for the sudden development of œstrus at puberty still remains obscure.

By far the greater amount of recent work has been devoted to the extraction and physiology of the œstrus-producing hormone or 'œstrin,' as Parkes and Bellerby have named it. At present two widely different methods of extraction have been utilised, resulting in the production of the hormone in an oil-soluble or water-soluble state. In the first method fat solvents are used for the extraction: thus the minced ovaries may be thoroughly extracted with alcohol, the filtrates concentrated to a small bulk, again taken up in alcohol, filtered, and set aside for the separation of fats and cholesterol. The filtrate is then taken to dryness, dissolved in ether and lipoids precipitated by addition of acetone (F. Dickens, E. C. Dodds, and S. Wright, *Biochem. Jour.*, vol. 19, p. 853; 1925). Material obtained by such a process is a brownish oil, soluble in fat solvents and thermostable: the activity remains in solution when sterols are precipitated by digitonin. A dose of about 1-10 mgm. is necessary to produce œstrus in 50 per cent of a series of ovariectomised rats.

A variety of methods has been used to obtain the hormone in a water-soluble form. Dodds has obtained it in the form of a hydrochloride by extracting minced ovaries with picric acid and acetone or minced placenta with hot hydrochloric acid and precipitating the picrate in the filtrate, the picrates being converted into hydrochlorides by solution in acid alcohol followed by precipitation of the hydrochloride by acetone: the material thus obtained is of about the same activity as that extracted by the use of fat solvents. More recently the same investigator has described a method for obtaining the water-soluble hormone in a purer state (H. Allan, F. Dickens, E. C. Dodds, and F. O. Howitt, *Biochem. Jour.*, vol. 22, p. 1526; 1928). Placenta is used as source rather than ovary: it is heated with baryta and the filtrate concentrated and extracted with butyl alcohol by shaking: the extract is evaporated under reduced pressure almost to dryness, and the residue dissolved in hot water and filtered; the precipitate and filtrate are both extracted with ether, the extracts washed with water and concentrated to an oily residue. This is dissolved in alcohol and then suspended in water and extracted with ether; the ethereal extracts are washed with hydrochloric acid and water. After removal of the ether the residue is suspended in water and heated with baryta: the activity passes into the filtrate from which barium is removed as sulphate or carbonate. The material appears to be in true (or colloidal) solution, since it is filterable and dialysable: about 0·02 mgm. solid matter will produce the œstrus response on injection. There is no relationship between the nitrogen content and activity of the solution: Millon's reaction is positive, but the biuret test is negative.

There is an important difference between the reactions of the hormone in solution in oil and in water: a single dose of an oily preparation will induce œstrus in an ovariectomised rat or mouse,

whereas a single dose of an aqueous solution may be entirely without effect: a series of six injections spread over forty-eight hours will, however, in the case of an active solution, produce œstrus on the third or fourth day. The necessity of multiple injections of aqueous solutions was first stressed by Laqueur and has been fully confirmed by Dodds.

The œstrus-producing hormone occurs in the follicles and stroma of the ovary but is absent from true luteal tissue: it is present also in placenta, urine, and probably blood. It is probably produced by the cells of the ovarian stroma, whence it finds its way to the other situations in which it is found: the follicle is certainly not an essential source, since ovaries sterilised by exposure to the X-ray still produce it, animals thus sterilised passing through the cyclic changes of œstrus in a perfectly normal manner. As regards its presence in the placenta, it is possible that this organ withdraws it from the circulation in order to protect the fœtuses from its influence.

Œstrus supervenes after an injection of œstrin in about two days, and ovariectomy may be followed by œstrus 36-48 hours later, indicating that under natural conditions the stimulus to the vaginal reaction is already active about two days before the reaction occurs. Examination of the ovaries indicates that follicular maturation occurs during the 48 hours before œstrus, that is, after the stimulus has become active; so that both processes appear to depend on the same stimulus, and the view that the follicle is the source of the œstrous reaction becomes untenable (F. W. R. Brambell and A. S. Parkes, *Quart. Jour. Exp. Physiol.*, vol. 18, p. 185; 1927). Injection of a large amount of œstrin has no effect on this latent period, but prolongs the period of œstrus even up to about a fortnight. Ovariectomised animals are usually fat and sluggish: œstrin restores activity and reduces weight; rats show a period of maximum activity at the time of œstrus. The work that has been carried out on the effect of ovarian extracts upon metabolism indicates that in some animals (dogs), especially after castration, the nitrogenous metabolism is increased, whilst the gaseous exchange is diminished: injection of extracts of corpora lutea has the opposite effect on the nitrogen output. In other species, for example the rabbit, little change in the metabolism has been observed following the injections (V. Korenchevsky, *Brit. Jour. Exp. Path.*, vol. 6, p. 6; 1925). L. Mirvish and L. P. Bosman have found that alcohol extracts of ovary reduce the blood calcium of rabbits and human beings of either sex after injection, the effect reaching a maximum in twenty-four hours with a return to normal in forty-eight hours (*Quart. Jour. Exp. Physiol.*, vol. 18, pp. 11 and 29; 1927).

The influence of the menstrual cycle upon the mental and muscular efficiency and general functional activity of women has been investigated by S. C. M. Sowton, C. S. Myers, and E. M. Bedale (Industrial Fatigue Research Board, Report No. 45; 1928). The direction of any change in efficiency at the menstrual period appears to be influenced by the social status of the subject studied, University students showing no change or a greater efficiency. As regards functional efficiency, there appears to be a periodic heightening in the late intermenstrual phase with a corresponding reduction shortly before or at the onset of menstruation. Since ovulation in the human female occurs about the middle of the cycle, this result is parallel to the greater activity observed in the rat at the time of œstrus.

The changes in the uterus after œstrus do not appear to depend on the presence of œstrin: in fact, prolongation of the action of œstrin hinders them, and injected during pregnancy, abortion is produced. Although probably responsible for the pro-œstrous bleeding which is seen in some animals, the post-œstrous bleeding which occurs in primates appears to set in when the action of œstrin wears off. Thus hæmorrhage from the genital tract has a different significance in different species. F. H. A. Marshall considers that menstruation in the human female represents a pro-œstrous and a pseudo-pregnant degeneration of the uterine mucosa telescoped into one phenomenon: in other words, each cycle commences before the previous one has completely finished: a similar overlap is observed in the cycles of the cow (*Quart. Jour. Exp. Physiol.*, vol. 17, p. 205; 1927).

In several species, for example the guinea-pig and opossum, a certain amount of mammary development occurs during œstrus and can be produced in ovariectomised animals by an injection of œstrin or by grafting an ovary into a castrated male, but such development must be distinguished from that occurring during pregnancy. In general it may be stated that post-œstrous changes in the secondary sex organs depend on the influence of the corpus luteum developed by the ingrowth of cells into the ruptured Graafian follicle after ovulation, the actual degree of development of this body depending on whether the ovum has been fertilised or not, and also upon the species.

In the rat and mouse the development of the corpora lutea of ovulation is very slight, in the guinea-pig and cow more marked, whilst in the dog, ferret, and rabbit it is so considerable that the changes brought about in the accessory organs simulate those of pregnancy. A sterile copulation in the rat or mouse is followed by a more prolonged development of the corpora which become functional. Histological differences between corpora of ovulation and pregnancy have been described by A. Ostrčil and O. Bittmann (*Publ. Facult. Médicine*, Brno, vol. 4, p. 217; 1926).

The functions of the corpus luteum, so far as they are at present known, are four in number: the inhibition of œstrus and ovulation, sensitisation of the uterus for reception of the fertilised ovum, the maintenance of pregnancy and the development of the mammary glands preliminary to lactation. Removal of the corpora of ovulation in animals in which they are functional results in an earlier appearance of the next œstrus; prolongation of the functional life of these bodies causes its prolonged disappearance. A single body in one ovary can produce this effect, and injections of extracts are stated to inhibit ovulation in rabbits (W. P. Kennedy

Quart. Jour. Exp. Physiol., vol. 15, p. 103 ; 1925). Conversely, Parkes and Bellerby have found it possible to produce œstrus during lactation in mice by injection of œstrin, the amount required depending on the number of young suckling above two (when spontaneous œstrus may occur). The inhibition to the action of œstrin is abolished in a lactating mouse unilaterally sterilised by exposure of one ovary to the X-ray, by removal of the opposite ovary, containing the corpora lutea, indicating that the inhibition is certainly due to a secretion from these bodies.

A functioning corpus luteum is associated with a sensitiveness of the uterine mucosa to stimuli, either the fertilised ovum or an artificial stimulus, resulting in the production of decidual tissue, in which the ovum, if present, can be embedded. Artificial stimulation of the mucosa is without effect in animals such as the rat or mouse with a short œstrous cycle, in which the corpora of ovulation are probably functionless ; but the uterus can be made sensitive by inducing pseudo-pregnancy and is also sensitive during lactation ; in both of these states the life of these organs is considerably prolonged. Their influence is probably hormonic in nature, since a grafted uterus can be sensitised.

The presence of a functioning corpus luteum is essential for the maintenance of pregnancy, or at any rate its greater part. In unilaterally sterilised mice, removal of the ovary containing the corpora invariably resulted in abortion, whilst removal of the sterile ovary was without effect : hence the presence of ovarian tissue *per se* is without influence on pregnancy, the corpus luteum being the essential organ (Parkes). In the cow the corpus can be expressed manually : its removal results in abortion within a few days (O. Zallmann, *Publ. biol. Haute École Vét.*, Brno, vol. 1, p. 255 ; 1922). Towards the end of pregnancy the corpora lutea atrophy ; evidence has been brought forward which suggests that during pregnancy the sensitivity of the uterus towards the oxytocic principle of the posterior lobe of the pituitary gland is diminished and returns to normal when the corpora atrophy : also injection of extracts, obtained from ovaries at the end of pregnancy, stimulate the secretion of this hormone, suggesting a mechanism whereby the corpus luteum both maintains pregnancy and allows parturition at the proper time.

The presence of functioning corpora lutea is associated with a degree of mammary gland development which is not observed in their absence, but it is not yet certain whether this stimulus alone suffices to bring these glands to complete lactation : it is possible that some product of conception is necessary for the final development. E. Homann has suggested that the uterus plays a part in the development of the mammary glands (*Berich. Naturforsch. Gesellsch. Freiburg*, vol. 26, p. 289 ; 1926).

(*To be continued.*)

Infra-red Spectra.[1]

By Sir ROBERT ROBERTSON, K.B.E., F.R.S.

HISTORICAL.

IN the year 1800 the elder Herschel, by placing a thermometer in the region lying beyond the visible red of the solar spectrum, gave the first experimental proof of the existence of radiation there by observing a rise in temperature of the instrument, and his son in 1840 described the existence of emission bands in the same region as shown by a discontinuous evaporation of alcohol from blackened paper placed in the same region.

To illustrate action beyond the visible red of the spectrum the following experiment was made. As it was impracticable to use the sun's spectrum, the beam from an arc lamp was dispersed by means of a large rock-salt prism, giving the usual spectrum visible to the eye. A card on which a phosphorescent powder (calcium sulphide with nickel as impurity) was first caused to glow brightly by subjection outside the theatre to ultra-violet light from a mercury lamp and then placed in the spectrum, when the existence of radiation beyond the visible was shown by the quenching of the phosphorescence for some distance past the red.

This region of the spectrum attracted much interest from the middle of last century and onwards when instruments of increasingly refined character were evolved to detect and measure effects of emission and absorption of radiation there. Thus photography was tried, and Abney succeeded in penetrating the region for a short distance, which has not been exceeded by more recent workers employing special sensitisers for their plates. Langley with the bolometer, Boys with the radiomicrometer, and Coblentz with the thermopile, succeeded in measuring quantitatively radiation in the infra-red ; the last two instruments are the principal ones employed to-day in that region which lies nearest to the visible. Still farther out, measurement of the energy in the beam dispersed by means of reflection from the polished surface of crystals gave important results in the hands of Rubens and his colleagues, while within the last year Raman by an entirely different technique, to be mentioned later, has indicated how infra-red radiations can be deduced from spectroscopic measurements in the visible spectrum.

ELECTROMAGNETIC WAVES.

The relationship of the infra-red region to other parts of the spectrum was illustrated by a diagram simplified from that prepared by Dr. F. E. Smith (see " Phases of Modern Science," 1925), in which the whole range of electromagnetic waves from γ rays to the longest radio waves, and only completed in recent years, is set forth. On this diagram (Fig. 1) were indicated the respective lengths of the waves from crest to crest in each region : the cosmic rays of Millikan, supposed by him to proceed from

[1] Synopsis of the Friday evening discourse delivered on Mar. 1 at the Royal Institution.

the birth of atoms such as helium, oxygen, silicon, and iron, in the profound depths of space at the lowest extremes of temperature and pressure, of a wave-length of about $2 \times 10^{-8}\ \mu$ ($\mu = 0{\cdot}001$ mm.); the highly penetrative γ-rays about $4 \times 10^{-6}\ \mu$, which accompany radioactive change; the X-rays about $1{\cdot}5 \times 10^{-5}\ \mu$, also penetrative of matter on account of their short wave-lengths; the ultra-violet rays, to about $0{\cdot}4\ \mu$, which promote many chemical reactions; the visible spectrum, from about $0{\cdot}4\ \mu$ to $0{\cdot}8\ \mu$; infra-red rays, from $0{\cdot}8\ \mu$ to about $23\ \mu$ (the near infra-red) or to $300\ \mu$ (the far infra-red); heat rays and short Hertzian rays to $1 \times 10^{8}\ \mu$; and then the rays used for wireless, the length of which may be measured in miles, 5XX, for example, being 1560 metres or about a mile long. It is a characteristic of all these waves, from the shortest to the longest, that they are propagated at the same speed, the speed of visible light, or 186,000 miles a second.

The clue to the properties of these waves was found by Faraday when he discovered rotation of the plane of polarisation of light in the magnetic field, a discovery of which Tyndall said: "I would liken it to the Weisshorn among mountains, high, beautiful, and alone". This in turn was translated by Clerk-Maxwell into the succinct notation of mathematics, and it formed the basis of his electromagnetic theory, the foundation of modern electromechanics. Since then, the likeness in character of these electromagnetic waves has been shown by their being capable of dispersion, interference, resonance, and by many other physical properties.

As to the effects of the radiations in different parts of the spectrum, it may be said that whereas in the shorter wave-length regions comprising the γ, X-rays, and visible spectrum, these are mostly electronic, in the infra-red region the transitions are caused by changes in the oscillatory states of the atoms in the molecule or of the rotational states of the molecule itself.

Quantitative Measurement of Infra-red Bands.

Dispersion by means of a grating having been referred to, a modern infra-red spectrometer of Hilger was then described as to its respective parts, the source of radiation (a Nernst filament), the slits, the reflecting mirrors, the dispersing prism (of quartz up to $3\ \mu$, fluorite up to $8\ \mu$, of rock-salt up to $17\ \mu$, or of sylvin up to $23\ \mu$), and the thermopile. Special reference was made to the thermopile, composed of bismuth-silver couples used in conjunction with a galvanometer for measuring the energy passing through the instrument. Its sensitiveness was illustrated by allowing a little compressed air to enter a sealed bell-jar containing the instrument, when by adiabatic compression of the air, the heat generated was registered by movement of a spot of light from a Moll galvanometer.

An experiment was then performed to illustrate the method of mapping an absorption band, ammonia being the gas employed. Two tubes were so arranged that they could alternately be thrown into the optical path between the source of radiation and the spectrometer, one tube being empty while the other contained ammonia gas. The energy passing through the respective tubes was measured by a galvanometer which threw a spot of light on a large scale on the wall of the theatre. At $1{\cdot}8\ \mu$ the difference between the throw of empty and gas tubes was small, but this difference increased up to $2{\cdot}2\ \mu$ and then decreased. These differences were noted and then plotted against wave-length on co-ordinates marked out on the blackboard, when a distinct band due to absorption by ammonia appeared in this region.

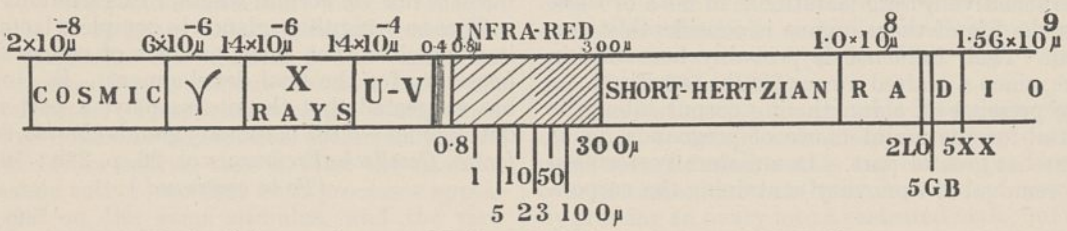

FIG. 1.—Electromagnetic waves. Velocity = 30,000,000,000 cm. per sec. = 186,000 miles per sec.

Oscillation and Rotation Bands.

Bands due both to oscillation of the atoms in the molecule and rotation of the molecule itself are found in the infra-red spectrum. Oscillation bands were shown by Drude, from the phenomenon of dispersion in crystals, to be necessarily present, having wave-lengths such as occur in this region of the spectrum, if certain smaller charged particles (electrons) are concerned in the ultra-violet region. As the effect is one of resonance, the atoms in a molecule respond in their vibration to radiation possessing some particular frequency, and this was illustrated by a model in which a ball suspended on a spring from the end of a light rod supported on two nodes, was made to perform vertical oscillations, whereupon a ball similarly suspended at the other end of the rod picked them up and vibrated vertically in phase with the former ball. The electronic linking between the atoms prevents their oscillation being truly sinusoidal; harmonics may therefore be expected and are in fact found.

Molecules also undergo rotation, and this effect is reflected in their infra-red spectra. The main bands are due to oscillation, but in addition the rotation of the molecule also produces bands, of a simple character in the far infra-red, but in the near infra-red as fringes superimposed on the oscillation bands. Rayleigh, assuming on the basis

of classical mechanics a Maxwellian distribution of velocities, in 1892 showed that an oscillator emitting and absorbing at a frequency ν_0 due to its oscillations alone, would, when rotating about an axis perpendicular to its line of vibration with a frequency ν_r, emit and absorb at the new frequencies $\nu_0+\nu_r$ and $\nu_0-\nu_r$. This seemed at first to meet the case, as in some of the early bands, such as those of Burmeister, two broad areas occurred which the Maxwellian distribution of rotational velocities would require. In 1911, however, Nernst concluded that rotation must also be quantised, and in 1912 Bjerrum and E. v. Bahr resolved a band of hydrogen chloride into a series of small bands, which they ascribed to the effects of rotation of the molecule. This band has been better resolved by Imes and others, and from the spacing of the fringes the diameter of the molecule of hydrogen chloride has been calculated. Sommerfeld, applying the principle of Bohr, showed that the equal spacing of the fringes is best explained by quantising the moment of momentum, so that each quantum jump represents a change in the moment of momentum. If the moment of momentum $J\omega$ is taken as a whole multiple of $h/2\pi$, $J=mh/2\pi$ and $E_{\text{kin}}=\frac{h^2}{8\pi^2J}m^2$, by the Bohr-Einstein conception

$$h\nu=E-E_1=\frac{h^2}{8\pi^2J}[m^2-(m+1)^2]=\frac{h^2}{8\pi^2J}(2m-1),$$

whence the space difference is $h/4\pi^2J$, a result in accordance with facts. It will be seen that by putting the spacing difference $\Delta\nu=\frac{h}{4\pi^2J}$, the moment of inertia of the molecule can be calculated, and, from the moment of inertia, given the masses of the vibrating atoms, the length of the molecule.

Information given by Infra-red Spectra.

In the first place, we get the frequency of oscillation of the atoms within the molecule, and the frequency of rotation of the molecule itself. These have been shown for a simple molecule such as that of hydrogen chloride. In addition, with more complicated molecules, it is possible to construct models by taking into consideration the presence of absorption bands and assuming a law of force between the atoms in the molecule. Thus Hund considers that ammonia has a tetrahedral structure, and this is probably also the case with the analogous phosphine and arsine. With these gases at least three sequences of bands have been found in each, corresponding with three degrees of freedom of oscillation, one of the sequences in each gas having five or six harmonics. In this sequence the frequency of vibration gets slower as the weight of the atoms nitrogen $\longrightarrow$ phosphorus $\longrightarrow$ arsenic increases in the three gases.

It is interesting from the chemical point of view to see if any of these degrees of freedom correspond to the chemical bonds of the chemists, and some hint of this is obtained in one case at least. Thus by progressively substituting the H in NH_3 by CH_3, a certain band—the first harmonic of the main sequence mentioned above—disappears from the spectrum after the last H has been substituted, so this degree of freedom of oscillation has been identified as connected with the chemical bond N-H.

Again, as regards rotation, we have found two moments of inertia in ammonia, of which one can be attributed to rotation round the median line and the other round the centre of mass at right angles to the median line. Calculation of the length of the molecule, as above described, gives a value similar to, although somewhat smaller than that obtained by Rankine from measurements of viscosity of this gas. By the comparison of spectra of related compounds, as for example in the case of hydrocarbons, definite bands have been attributed to certain groups or radicles. In the case of solids, certain groupings such as NH_4^+ or CO_3^{--} have similarly been identified in the spectrum of salts.

In the hands of Coblentz, infra-red data and technique have been used to determine the quantity of radiation from the sun, stars, and planets, and he has also deduced the temperatures which prevail in these bodies, and even the differences in radiation from the hemispheres of Mars.

The knowledge of the infra-red spectrum of water vapour and of carbon dioxide is of importance in considering the nature and quality of energy reaching us from the sun, and only recently Dr. G. C. Simpson, by making use of the absorption coefficients of water and carbon dioxide in the infra-red, has deduced that an increase in solar radiation would result in increased cloud and precipitation, and even in the apparent paradox of an ice age. Further, Paschen's determination of the emission and absorption bands of these gases is fundamental in questions relating to combustion.

Future Work in the Infra-red.

Such are some of the results that spring from the consideration of infra-red spectra. On the more theoretical side it has thrown light on and given support to the quantum theory. It has passed into the hands of the still more modern exponents of the wave mechanics and found to be in accord with their predictions, as for example in connexion with the assumption of half-quantum numbers. This is a field in which its usefulness is only beginning.

Only last year, Prof. Raman of Calcutta, by imposing monochromatic radiation from a mercury lamp on gases and liquids, observed spectroscopically in the scattered light not only the original line but also others at frequency differences which he finds are equal to frequencies in the infra-red at which bands characteristic of the gas or liquid were known. This brilliant experimental confirmation of the quantum theory may prove of the highest importance from a theoretical point of view when it comes to be explained why in the Raman effect not all the bands found in the infra-red by the usual means appear, and why others appear to be disclosed only by the Raman effect.

Like the X-rays, the infra-red deals with the

structure of the molecule, but while X-rays reveal the molecule in its static condition and are especially applicable to solids, infra-red spectra reveal the dynamic characteristics of the molecule in gases, liquids, and to a restricted degree in solids. In the future it will undoubtedly be used to a greater extent in the determination of the nature of chemical linkages and generally for a solution of problems of chemical constitution.

As Garner and his school have shown, important deductions can be made as to the rôle of infra-red radiation in combustion, as for example in the effect of water, when it is present, in carrying off the energy of radiation produced when carbon monoxide combines with oxygen, and as the bulk of the radiation from flames is in the invisible part of the spectrum and mainly in the infra-red, there is here a wide field of work in clearing up the mystery of flame, and the same is true as regards the phenomena of explosion of both gaseous and solid explosives.

It is to be regretted, however, that more work is not being done in Great Britain in the exploration of this region. It is true that the technique is difficult, and there have been several investigations reported of an accuracy that leaves a good deal to be desired. Most of the work until now has been done in Germany and in the United States, little having so far come from British universities with the exception of Cambridge, where there is an embryonic school. The subject is perhaps scarcely one suitable for a young graduate to acquire the technique and embody a year's work in a thesis for some degree, but one for a more permanent staff, and I should like to make a plea for its greater consideration in Great Britain, as a field of experiment and study likely to assist in the solution of many physical and chemical problems, which in due course will have its reflection in the domain of technical application.

Sir J. J. Thomson has given us the electron, Rutherford the proton with its planetary electrons and the structure of the proton, the Braggs have elucidated the structure of many molecular fabrics, but the molecule as a dynamical entity has been comparatively neglected. For it is in the infra-red region of the spectrum that this behaviour can best be studied. In this aspect the problem is a physical one for the most part; the technique is difficult, but likely to be productive of much that is important in our conception of the structure of matter. It is for this reason that one would like to see in Britain a strong school arise which would have as its object the study of the dynamical behaviour of the atoms in the molecule and of the molecule itself.

Obituary.

PROF. WILLIAM KÜSTER.

DR. WILLIAM KÜSTER, professor of organic chemistry and technology at the Technische Hochschule in Stuttgart died suddenly on Mar. 5 of heart failure. From the pages of a recent issue of the *Chemiker-Zeitung* we glean the following details of his career.

Born at Leipzig in 1863, Küster received his early education in Berlin and studied later at the Universities of Tübingen, Berlin, and Leipzig. At Leipzig he worked under the direction of Wislicenus, with whom he remained for a while after graduation until he was appointed assistant to Hüfner at Tübingen, where he was given charge of the practical chemistry classes for medical students. In 1894 he published his first paper on salts of hæmatin. This was followed by an intensive study of the pigments of blood and bile, subjects which he made peculiarly his own and remained his chief interest throughout life.

In 1903, Küster was appointed professor of chemistry and pharmacology at the veterinary college at Stuttgart and lecturer on pharmaceutical chemistry at the Technische Hochschule. The duties attached to these offices were so burdensome that but little time was available for research. Moreover, at the veterinary college he found that no provision had been made by his predecessor for experimental work. In spite of these difficulties he succeeded during the next eleven years in publishing numerous papers on hæmatin, porphyrin, pyrrole, and bile-pigments.

On the retirement of Prof. C. von Hell, the department of chemistry at the Technische Hochschule at Stuttgart was completely reorganised and Küster was appointed to the chair of organic chemistry and technology. Under his direction the department was greatly enlarged, and in spite of the difficult nature of the work in which he was engaged, he attracted a great number of research students to assist him in his investigations. In this way Küster and his collaborators were able to make a large number of important contributions in the field of biochemistry. Later his interest extended to other branches of natural products such as sugar, albumen, lignin, etc. He also contributed to the well-known handbooks of Abderhalden and Thoms.

WE regret to announce the following deaths:

Prof. Jules Cornet, the distinguished geologist and professor in the University of Ghent and at the School of Mines at Mons, *correspondant* of the Paris Academy of Sciences, who was well known for his geological explorations in the Congo in 1892 and 1895, on May 17.

Mr. Stewart Culin, curator of ethnology in the Museum of the Brooklyn Institute, Brooklyn, N.Y., known especially for his comparative studies of the games of North American Indians and other races, on April 8, aged seventy years.

Prof. Charles Deperét, professor of geology in the University of Lyons and a foreign correspondent of the Geological Society of London, on May 17, aged seventy-four years.

M. Ulysse Gayon, a distinguished biologist and chemist, and honorary doyen of the Faculty of Sciences at Bordeaux, aged eighty-three years.

News and Views.

IN the short address which he delivered at the dedication of Darwin's home to the nation on June 7 (NATURE, June 8, p. 875), Sir Arthur Keith touched upon the relationship between sentiment and science. When sentiment enters a laboratory by the back door science takes the earliest opportunity to escape by the front, yet, since life is as it is, science cannot easily be cut adrift from personality. The value of such a gift as that which Mr. Buckston Browne has made to the British Association lies in the power of the personal associations of its material contents and surroundings to throw the visitor back into the very atmosphere of the century and of the place in which Darwin moved and thought. So a background of sentiment is formed which illumines and may help to interpret the development of the man's mind and the direction of his labours. Down House is a memorial, not to Darwin's science, which will outlast our buildings, but to his personality. It is especially appropriate, therefore, that the donor should have expressed the wishes that the house and grounds should be maintained in a state as near as possible to that in which Darwin modelled them, and that they should be used to advance the cause of science, in ways in which the Council of the British Association thinks best. "If any place can provide inspiration for research it should be Darwin's own gardens."

SIR ARTHUR KEITH'S presidential address at the annual congress of the South-Eastern Union of Scientific Societies on June 5 at Brighton was singularly happy both in subject and method of treatment. In demonstrating the racial characters of the pre-Roman inhabitants of Southern England, he was able to draw much of his material from discoveries on the South Downs relating to prehistoric man, and to refer to material evidence deposited in local museums. Taking the skeletal remains found in the neighbourhood of Brighton, the Maycroft skeleton, the Ditchling and Blackpatch (Worthing) finds, he linked them up with the crouched burial discovered at St. Catherine's, in the Isle of Wight, some three years ago. Hence by means of the identification by Mr. O. G. S. Crawford of a peculiar piece of pottery found in 1881 in a burial at Nunning, some ten miles from St. Catherine's and preserved in the Carisbrooke Castle Museum, he was able to relate the Brighton folk as kin to the Beaker folk who settled in Britain at the end of the neolithic and beginning of the Bronze Age some two thousand years before Christ, a relation to which the skeletal remains had pointed but for which cultural evidence indicative of a chronology had been lacking. It was outside Sir Arthur Keith's purpose to trace the Beaker folk back to their origin on the continent, but he did refer to the related flint miners of Belgium, this enabling him to offer an interesting suggestion of child sacrifice as a possible explanation of the discovery of skeletons of children buried with those of adults.

IT is unnecessary now to follow Sir Arthur further, when, pointing out the gap in our knowledge of the physical characters of the inhabitants of Britain after the settlement of the Beaker folk, he turned to trace the history of the people of Southern England back through the finds which could be dated to periods immediately preceding the Roman invasion. It may be noted, however, that here again he gave full weight to local investigation and also to those of Mr. and Mrs. Cunnington at All Cannings Cross and Woodhenge. In fact, throughout the whole address it was patent that he addressed a wider public than his immediate audience, and had in mind the broader aspects of the specific problems with which he was concerned. His brilliantly lucid reconstruction of the racial history of prehistoric Southern England was in fact a convincing demonstration of the methods of study of prehistory and an eloquent plea for a wider recognition of the value of archæology in the reconstruction of history. Sir Arthur Keith brought out, even if he did not specifically stress in every instance, the value to archæological studies of what may be termed localised research. It has been mentioned that his material was largely drawn from local investigations. Not only was this the case, but also it was by means of the correlation of local records and the examination of local evidence when housed in museums within reach of its original environment that this pregnant comparative study was made possible. Hence Sir Arthur Keith's address should provide a stimulus to all local archæologists and all local scientific societies.

AFTER the great paroxysmal eruption of Vesuvius in 1906 there followed seven years of obstruction and comparative repose. In 1913 the conduit became open and the normal type of external activity began. Since then the crater has been steadily filling from a succession of central conelets, and at intervals in recent years there have been minor crescendos of explosive and effusive activity. By far the greatest and most spectacular of these broke out in the early hours of June 3. The outburst began with tremendous explosions and the hurling into the air of masses of incandescent material. The central conelet split and collapsed. As it fell back into the crater lava welled out and occupied the north-eastern quadrant of the crater. Prof. Malladra announced on June 3 that he considered the eruption to be one of the periodic recrudescences of activity; that it was unlikely to last more than two or three days; and that a disastrous eruption of the culminating type—such as those of 1872 and 1906—was not yet to be expected.

ON the morning of June 4 it became clear that for a minor eruption the manifestations were more than usually violent. The interior of the crater now became a lake of effervescing lava some 500 yards in diameter. The lava overflowed into the Valle dell Inferno and escaped down the outer slopes into the valley of Cuppaccio and towards the little town of Terzigno, following the course of the 1834 lava-stream. After a short interval of quiescence from 2.30 to 7.30 P.M. there was a sudden paroxysm of activity for three-quarters of an hour. Incandescent matter rose

1500 feet above the crater and fell in glowing showers on the slopes of the volcano. Afterwards there were loud and frequent explosions, followed by an ash cloud that rose to still greater heights. From 11 P.M. on June 5 to 3 A.M. on June 6 there were further tremors and explosions, and columns of lava were thrown into the air to break into incandescent bombs. Since then there have been (at the moment of writing) no further reports of activity. The lava stream has extended five miles down the south-eastern slopes, widening to a frontage of 900 yards, destroying 110 acres of cultivated land and wiping out three small hamlets. Although Terzigno was evacuated with the prompt aid of the military, the township itself has fortunately been spared, the lava having halted 300-400 yards from the houses. It is estimated by Prof. Malladra that the volume of lava approaches half that emitted during the 1906 eruption.

THERE is a remarkable article in the June number of the *Realist* which will arouse interest and, it may be hoped, discussion in wider circles than even the readers of this journal. It is a merciless, and on the whole well-founded analysis—most people would call it an exposure—of Wordsworth's appreciation of Nature. Prof. Herbert Dingle in "The Analytical Approach to Wordsworth", shows by abundant quotations what was the actual mental attitude of the poet towards the Nature which he worshipped. It was not one of questioning or of interest in the changes or process of Nature but of passive meditation and happy acquiescence in scenes and thoughts which were familiar to him. He does not seek for truth but for a mystic sublimity of feeling of which the attainment was a solemn duty of man. He never therefore particularises either in describing a person or a natural object. Cliffs are simply 'lofty' and trees 'dark', just as his human beings are distinguished not by their interesting peculiarities but by their age or their occupation, things common to a host of people.

PROF. DINGLE scarcely does justice to the stimulus towards science given by the preface to the second edition of the "Lyrical Ballads" in 1800, which is one of the most admirable things in English criticism and puts the man of science and the poet in a friendly and natural relation together. Yet even in speaking of this, Prof. Dingle manages to put his finger on a weakness, or at least a limitation, of Wordsworth's attitude. The poet when speaking of the labours of the man of science regards him as isolated from the poet: it is only when finished products are reached that the poet can take them up and make use of them. Just as in science Wordsworth would make use of the finished product, so in human society he tends more and more to dwell on the past. His attitude is thus almost completely static, as Shelley's by his burning forward vision and exuberant imagination becomes vague and unreal. The whole question is of extraordinary interest and it is much to be hoped that critics interested both in science and poetry will take it up. Sully Prudhomme raised the same point in France about a hundred years later and lamented how little influence the strides of science had exercised on the inspiration of poets in the interval. Perhaps the growth in mass and specialism of science makes contact all the more difficult: what Prof. Dingle makes us desire is a greater community of spirit.

IN *Engineering* for May 31 is an illustrated account of the famous Carl Zeiss Optical Works at Jena, which owe their foundation to the partnership of Carl Zeiss (1816–1888), an instrument maker, and Ernst Abbe (1840–1905) the physicist, begun in 1866. At one time the works employed nearly 10,000 men and women, and in the article is a plan showing the development of the Zeiss Factory at various periods and the recent extensions. The original workshops were in the town of Jena, and in 1876, by which time the 3000th microscope had been sold, the present site was purchased. In the early 'eighties Otto Schott, the glass maker, became associated with Zeiss and Abbe, but the glass works, though administered by the Carl Zeiss Foundation, remains independent of the instrument factory. Brief accounts are given of Abbe's contributions to mathematical optics, of the manufacture of optical glass, and of the formation and working of the Carl Zeiss Foundation, and together with these are a few details regarding the planetaria constructed by the firm, and of the Zeiss double refracting telescope sent to the Lembang Observatory, Java, and of the 650-mm. refractor finished in 1914 for the Neu Babelsburg Observatory, Potsdam.

IN the same issue of *Engineering*, in a Supplement dealing with the exhibits at the North-East Coast Exhibition, Newcastle-upon-Tyne, opened by H.R.H. the Prince of Wales on May 14, is a short description of the 36-inch reflecting telescope made by Messrs. Sir Howard Grubb, Parsons & Co., for Edinburgh Observatory. Built to the specifications of Prof. Sampson, Astronomer Royal for Scotland, the telescope is mounted equatorially, three rates of motion being provided for both axes, the fastest giving one revolution in 3 minutes, while for fine setting the rate of movement is one revolution in two days and for guiding one revolution in 60 days. The optical system is that introduced by Cassegrain in 1672, the main mirror of parabolic form being 37 in. in diameter, 6 in. thick, and having a central aperture $3\frac{1}{2}$ in. in diameter. Its focal length is 15 ft. The Cassegrain mirror, near the upper end of the tube, is of hyperbolic section, 10 in. in diameter, and is designed to give an equivalent focal length of 54 ft. in conjunction with the main mirror. The instrument will be installed in Edinburgh Observatory at the close of the Exhibition.

THE eighty-second annual meeting of the Palæontographical Society was held in the rooms of the Geological Society, Burlington House, on May 31, Dr. F. A. Bather, president, in the chair. The annual report announced the publication at an early date of new monographs on Corallian Lamellibranchia, by Mr. W. J. Arkell, and on Cretaceous Terebratulidæ, by Dr. M. R. Sahni. It also made special reference to the death of one of its oldest members and most

valued contributors, Sir William Boyd Dawkins. Mr. A. J. Bull, Dr. O. M. B. Bulman, Dr. L. F. Spath, and Mr. S. Hazzledine Warren were elected new members of Council. Dr. F. A. Bather, Mr. Robert S. Herries, and Sir A. Smith Woodward, were re-elected president, treasurer, and secretary respectively. In a brief address, the president alluded to the numerous gaps in the series of monographs on British fossils which still existed, and made suggestions for future work.

THE Medical Research Council, after consultation with the Ministry of Health and the Board of Education, has appointed the following committee to inquire into the prevalence and mode of spread of minor epidemics in residential schools, especially those believed to be spread by 'droplet infection', and to report upon the means by which they may be prevented or restricted: Sir George Newman (Chairman), Dame Janet Campbell, Dr. R. H. Crowley, Surgeon-Comdr. S. F. Dudley, Dr. J. A. Glover, Prof. M. Greenwood, Mr. L. R. Lempriere, Miss E. M. Newbold, Prof. W. W. C. Topley, and Mrs. Joyce Wilson (Secretary).

DURING the past season the price of oysters has remained at a high level, owing mainly to the scarcity of stocks. In an article on British Oyster Fisheries published in NATURE of March 23, Dr. J. H. Orton discussed the various causes for this scarcity and indicated, in particular, the dangers of over-fishing. In this connexion it is worth while to direct attention to a "Report on a Survey of the Fal Estuary Oyster Beds" (November 1924) "With Notes on the Biology of the Oyster" (published by private subscription at Falmouth, 1926, but obtainable from the Marine Biological Association, Plymouth, price 2s. 6d.), in which Dr. Orton deals with a particular depleted fishery and suggests various measures to restore it to a productive state. The report is of great value to all concerned in the investigation and administration of oyster fisheries, but being privately printed it may easily escape the notice of those interested.

THE bird sanctuary at Duddingston Loch, in the Royal Park of Holyrood in Edinburgh, is making satisfactory progress, and the third Report of the Committee (Edinburgh and London: H.M. Stationery Office. 6*d*. net) shows that its members are keeping close watch on the development of the area. Further planting of trees has taken place, with the object of forming a screen to keep out engine sparks from the neighbouring railway, to which was due a disastrous fire in the spring of the previous year. One of the problems of the Loch has been the remarkably few aquatic species of birds which reared young to maturity in spite of the large number of nests, and this is attributed partly to the presence of many pike in the Loch itself, and partly to the frequent attentions of some lesser black-backed gulls. An attempt was made to reduce the former by dragging the loch; the latter emphasise the danger run by any policy of wholesale and indiscriminate protection. The entomological and botanical surveys of the area inaugurated in 1927 with the view of studying the interrelations between plant and animal life have been continued, and a short note on the entomology of the sanctuary, by P. H. Grimshaw, of the Royal Scottish Museum, concludes the report.

THE story of the Greenland whaling industry, in which Great Britain shared in the seventeenth and eighteenth centuries, has been traced in connexion with many of the seaports taking a major part in the 'fishery'. For the first time, however, an attempt has been made to give a consecutive account of the whaling of the port of Aberdeen, in an excellent article by James Pyper, in a recent issue of the *Scottish Naturalist* (p. 39). In 1749, for the first time, whaling vessels sailed from Scotland, and in 1752 Aberdeen entered the trade with two vessels. By 1814–17 the port stood only after Hull and London in the number of its whaling ships and its tonnage of oil. Five years later London had dropped out of the first rank, and Peterhead, with 16 vessels, stood second to Hull with 40, Aberdeen, with 14, following third. In the average tonnage of oil per vessel, however, Aberdeen now stood first, the total cargoes amounting to 1225 tons. It was a small return compared with the enormous catches of the present-day finner industry, but it spelt a season of prosperity for the northern seaport. The account gives a vivid notion of the ups and downs of the fishery. Of the ten ships which sailed in 1830, four were lost in the ice with six of their crews, two ships returned from the fishing 'clean', one had two whales, and the remaining three, a single whale each.

THE Report for the year 1928 of the National Physical Laboratory covers 284 pages, of which 200 are devoted to detailed accounts of the work carried out in the various departments. These accounts are well illustrated and show that the Laboratory continues to maintain its position as one of the most active centres of research into questions bearing on our national industries. The projected new physics building, which has been referred to in the annual reports for many years, is now under construction so far as its central block is concerned, and the scattered rooms in the basement and other parts of Bushy House previously occupied by the Physics Department are to provide accommodation for the Electrical Standards and other departments. Work on standards of measurement has been carried on actively during the year, and with the increase of test work for the industries has diminished the time devoted to general research. The high voltage equipment is nearing completion and will enable tests up to a million volts to be made. A useful addition to the report is a section of 20 pages giving precise definitions of the units and standards of measurement employed at the Laboratory.

IN his discourse on "Excavations at Ur, 1928–1929", at the Royal Institution on June 7, Mr. C. Leonard Woolley gave a short account of the final clearing of the great temple of the Moon-god Nannar, whose history was traced from the foundation of the building by king Ur-Nammu about 2300 B.C. until its last restoration by Nebuchadnezzar in the sixth century B.C. The main part of the lecture was devoted to a

record of the continued excavation of the prehistoric cemetery. More royal tombs were found, two of which gave entirely new information as to the ritual of a king's funeral; one of these was intact, and the tomb-chamber, the stone dome over which was found unbroken, contained some remarkable gold objects. Much richer than this was a 'death-pit' containing seventy-four bodies, many of them lavishly decorated with gold, and four harps and two statues; these are among the finest objects of art yet discovered in the cemetery. Other graves produced a very large collection of funeral furniture in gold, silver, copper, stone, and clay, of which the more important were illustrated. Finally, a description was given of the work carried on at a lower level than the graves, which resulted in finding evidence of the historical character of the Flood.

IN Basel on Oct. 8–12, 1928, was held an interesting short course upon the use of electrostatic methods in biochemistry and biology, in which a group of scientific workers gathered from various centres were introduced particularly to the work of the Prague school (Prof. R. Keller, R. Fürth, etc.). Some of the communications given at this 'school' are published in the *Kolloidchemische Beihefte*, vol. 28, 1929 (pp. 208-390). After general introductory papers by Prof. Spiro, of Basel, and Prof. Keller, papers were given upon methods of measuring electric potentials in the organism, upon the preparation of micro-electrodes, *p*H determination in living organisms, upon the use of vital staining in biology, upon dispersoid analysis by a new dialysing apparatus, etc. In all many new experimental avenues of approach to biological problems were discussed and some results obtained by these new methods briefly indicated. Many new fields of biological investigation are being actively pursued by this group of investigators, who are introducing physical methods into biochemistry and biology, and this collection of papers illustrating their outlook will be of interest to workers in widely different fields.

THE great demand for cheap electrical power for heating makes it necessary to raise the transmission voltage to the highest permissible limit, as otherwise the cost of the large amount of copper in the mains is prohibitive from the commercial point of view. Even to relatively short distances, a voltage of 132,000 is being used. In Berlin quite recently an overhead line several miles in length for transmission at 100,000 volts has been erected in the suburbs of the city. The question of carrying this line to the centre of the city is at present under consideration, and in all probability underground mains will be used. In Hamburg there are at present two cables, each nine miles long, working at 60,000 volts, and in Nurnberg there is an underground cable connecting two networks, which works at 110,000 volts. In the event of a fault to earth occurring on a high tension cable, a very large current will flow, and the cable will be seriously damaged for several yards on each side of the fault. An interruption of the supply will probably ensue. A method of preventing this is described in *A.E.G. Progress* for April. The high voltage underground networks are connected with Petersen arc suppressors. In the event of a fault occurring these devices allow a lagging current to flow through the fault. This combines with the 'capacity to earth' current at the point, making the voltage of the cable at the point practically zero and preventing a serious fault from developing. It prevents also the development of high frequency currents which arise when an arc ensues. These currents, as Duddell pointed out many years ago, may cause resonance voltages at points remote from the fault and so break down the insulation of the cable. In Great Britain and in America, steady progress is being made in the development of very high voltage cables, but we think more attention should be paid to developing devices to safeguard them when in operation.

THE Medical Research Council announces that, on behalf of the Rockefeller Foundation, it has made the following awards of travelling fellowships for the academic year 1929–30. These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine and surgery, and who are likely to profit by a period of work at a chosen centre in America or, in special cases, in Europe, before taking up positions for higher teaching or research in the British Isles: Olive B. Buckley, Dr. G. A. C. Gough, W. R. Henderson, Dr. D. Hunter, G. E. Lewis, Dr. M. M. Suzman, Janet M. Vaughan. Dr. Gough's fellowship is tenable at the University of Munich; the others at centres in the United States.

THE condition of St. Mary's Abbey has caused concern to the Council of the Yorkshire Philosophical Society, and following upon a thorough inspection and report by H.M. Office of Works, it has been recommended that certain steps should be taken to mprove the amenity of the site and to ensure the preservation of such portions as remain. The estimated cost of the work proposed is £3370.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in economic history and economics at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (June 19). Two forest officers under the Forestry Commission—The Secretary, Forestry Commission, 22 Grosvenor Gardens, S.W.1 (June 20). Two temporary investigators and a temporary assistant under the Department of Agriculture for Scotland, in connexion with an inquiry into the marketing of livestock and other agricultural produce in Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (June 21). A teacher of agricultural science under the Londonderry and Limavady Regional Education Committee—The Principal and Secretary, Education Office, Limavady, Co. Londonderry (June 22). A Paterson research scholar in the Cardiographic Department of London Hospital—The House Governor, London Hospital, E.1 (June 22). An advisory officer in agricultural botany at the Edinburgh and East of Scotland College of Agriculture

—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (June 28). A lecturer in geography at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (June 28). An assistant part-time lecturer in the biology department of the Plymouth and Devonport Technical College—The Education Office, Rowe Street, Plymouth (June 29). A full-time teacher, for building trade subjects, at the Cheltenham Technical School—The Principal, Technical School, Lansdown Road, Cheltenham (June 30). Four assistant conservators in the Indian Forest Service—The Secretary, Services and General Department, India Office, S.W.1 (July 1). An assistant in geography at the London School of Economics and Political Science—The Secretary, London School of Economics, Houghton Street, W.C.2 (July 1). A mining engineer under the Safety in Mines Research Board—The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, Millbank, S.W.1 (July 2). An assistant or junior lecturer in the department of zoology of the University of Edinburgh, with special knowledge of invertebrates—The Secretary, the University, Edinburgh (July 5). A professor of physiology at the Medical College, Vizagapatam, Madras — The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (July 6). A senior lecturer in biochemistry in the University of Stellenbosch, South Africa—The Registrar, University of Stellenbosch, Stellenbosch, South Africa (July 31). A lecturer in mathematics at the Gordon College, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1. A resident tutor (woman) to take geography and some education at the Edgehill Training College, Liverpool—The Principal, Edgehill Training College, Liverpool. A lecturer in electrical equipment of the motor-car at the Wimbledon Technical Institute—The Principal, Technical Institute, Gladstone Road, S.W.19. A teacher of building subjects at the Croydon Polytechnic—The Principal, Croydon Polytechnic, Scarbrook Road, Croydon. A lecturer in building at the Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield. A male junior assistant at the Chemical Warfare Research Department of the War Office—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1. An assistant lecturer in physics at the University College of Hull—The Secretary, University College, Hull. An assistant in the mechanical engineering Laboratory of University College, London—The Secretary, University College, Gower Street, W.C.1. Two male laboratory assistants in the Research Department, Woolwich, with laboratory experience in physics—The Chief Superintendent, Research Department, Woolwich, S.E.18. A head of the experimental branch under the directorate of ballistics of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

FIREBALL OF MAY 30.—A brilliant fireball was observed from several stations in Cornwall on May 30 at about 11.0 P.M. G.M.T. Observations have, however, come in from only Lostwithiel and Bugle, and these are of somewhat rough character. The meteor gave a very brilliant flash and lit up the surroundings to such a degree that the observers found it difficult to note exact features of the path. It passed along the southern sky from west to north and was evidently from a radiant in the eastern region of the heavens. Its motion was moderately slow, for it occupied 4 or 5 seconds in its flight. One of the observers, who was walking in the direction away from the object, says that he observed a great light behind him as though a brilliantly illuminated motor-car was overtaking him. It appeared like a dazzling ball of fire, but when a good view was obtained of it the nucleus appeared relatively small, though surrounded by a strong glare which apparently lit up the country. Further observations are required of this interesting object, which came on the night of the general election, and on this account may have attracted notice from a greater number of observers than it would otherwise have done.

VENUS A MORNING STAR.—Venus is now a 'morning star' and will continue to precede the sun during the remainder of the present year. The planet will attain its greatest elongation on June 29, when its position will be 46° west of the sun. Its brilliancy is now declining, but not to any great extent. Atmospheric conditions introduce more variations than are sometimes brought about by real differences. Thus Venus will appear brighter when its computed lustre is less and when the air is very clear, than at a time when atmospheric vapours dim its light.

Venus is now approaching Jupiter, and the two planets will arrive at conjunction on July 14 at 10 A.M., when Venus will be placed about 3° S. of Jupiter. Before sunrise this pair of attractive objects may be viewed in the E.N.E. sky before sunrise, Venus rising ten minutes after midnight, and Jupiter fifty-seven minutes after midnight. If the morning sky is clear the two planets may be easily identified and their relative brightness compared.

SATURN.—The planet Saturn will reach opposition to the sun on the night following June 21. The apparent magnitude will be +0·2, and the planet will appear brighter than at an ordinary opposition because of the more favourable conditions prevailing. The rings will be widely open and the planet will be situated almost midway between aphelion and perihelion. At an unfavourable opposition, Saturn may shine as a star of +0·8 mag. only, but with attendant conditions favourable it may appear as a +0·2 mag. star. It is true the aspect is by no means starlike, for the planet shines with a steady, dullish light, much in contrast with the sparkling diamond-like brilliancy of the fixed stars. At the time of Saturn's best display this year, its position will be placed on the extreme west border of Sagittarius, and as the planet is moving westwards it will shortly after enter the south region of the constellation Ophiuchus, and be visible to the north-east of the star 44 Ophiuchi. For critical observation the planet cannot be considered in a good position, its declination being 22° south, and its altitude, when passing the meridian, not greater than 16° or 17° to observers in the south of England.

Research Items.

INHERITANCE FEES.—In *Man* for May, Mr. J. P. Driberg directs attention to an element in primitive marriage which appears to have escaped general observation, namely, the inheritance fees or dues paid by an inheritor of a widow to the responsible members of her family. Such a fee has been found to be compulsory among three unrelated peoples,—the Lango of Uganda, and the Dedinga and Bari of the Sudan. Among the Lango a widow is normally inherited by a brother of the deceased or by his sister's son, in either case a bull being payable to the woman's family. She is differentiated from the wives by being called an inherited wife. Among the Dedinga the deceased's brother pays the fee and calls the children his own, but if a sister's son or mother's sister's son inherits the widow the son pays the fee and claims any children of the new marriage. Among the Bari, when a sister's son inherits, the fee is paid from the estate and the children belong to the estate. This seems an anomalous custom, as the bride's family had already received the full price from the original husband. It arises from an intention of making clear the economic and social status of the children of the new marriage. Marriage is not regarded as completed until the birth of the first child. The bride may not be called a wife till then. Sometimes she only lives in the bachelor's hut until the child is born. In the case of a divorce the bride price is returned and the children go with the mother ; but the father, even after years, may recover the children on payment of the " heifer of upkeep " to the family of the girl or her new husband. Among the Bari, if a marriage takes place without payment of the bride price, the wife's family take all the bride price paid at the marriage of the first daughter of the union. If there is no daughter the family keeps a son until he is ransomed.

THE SHISHAK MIGRATIONS.—Sir Flinders Petrie in *Ancient Egypt*, Pt. 4, 1928, states that the excavations at Gerar (Palestine) have produced repeated evidence of a movement from Central Asia to the west at about 950 B.C. Pottery models of square waggons with divisions from front to back and with two types of pottery wheels, one smooth, the other knobbed, are found. Similar waggons come from Anau, and knobbed wheels occur in the treasure of the Oxus, from 300 miles farther east. The latter wheel is designed to prevent sinking in sand and belongs to desert dwellers. Two types of bronze arrowhead come from Central Asia, one with a tang similar to a type found at Tomsk ; the other is the triangular bladed arrowhead of Minussinsk, Altai, Perm, Siberia, and south-west Caspian. The broad-bladed iron dagger belongs to Anau, the Caspian, and Caucasus. Lastly, all the pottery figures of oxen are humped, a central Caspian type not found west of Mesopotamia. This movement, dated at 970 B.C., links with Sheshenq, the ' Man of Susa ' entering Egypt. Shushinak is the national deity of Elam, worshipped at Susa, and was also a great deity among the Persians. The attribution of Libyan descent to Sheshenq is due to a misreading of the genealogy of Horpasen. His name labels his origin plainly. Further, owing to the practice of hepatoscopy, a Babylonian connexion has been suggested for the Etruscans. Now the horned head-dress of divination, the vases of offerings in Etruscan tombs in the shape of a cone with two globes over it, and other evidence point to a middle Asian origin for the Etruscans, and, it is suggested, link them up with the westward movement of Turkomans, of which evidence is found at Gerar, and of which the coming of Sheshanq to Egypt formed part.

THE EXTERMINATION OF THE HEATH HEN.—The heath hen of America (*Tympanuchus cupido*), a near relative of the prairie hen which abounds on the prairies of the Mississippi valley, provides one of those problems of casual extermination which man seems powerless to stay. Fifty years ago the heath hen was a common bird on the island of Martha's Vineyard, to which it was confined. But about fifteen years since its numbers were reduced with remarkable suddenness. Attention was directed to the danger and thousands of dollars were spent in an effort to protect the birds. We now learn from a *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., that even so late as 1916 there still survived about 1000 heath hens on the island reservation, and fears of their extinction were allayed. Then, just at the time when the hens were sitting on their eggs, a disastrous forest fire swept over the area, causing the loss of the year's brood as well as of many of the females. It is said that the inbreeding of the few surviving birds weakened the stock, which became subject to some of the common poultry diseases. Two years ago ornithologists were able to find only 30 specimens on the island ; in a year the number was reduced to nine, a little later to three, and then to two. Now only a single specimen is known to exist—the heath hen of Martha's Vineyard is virtually extinct.

AN ALLEGED ANTHROPOID APE EXISTING IN AMERICA.—A discovery of extraordinary interest is that recorded by Dr. George Montandon in *La Nature* of May 11, where he describes from a photograph, which is reproduced, a supposed anthropoid ape from South America. A pair of the apes was seen by M. François de Loys in the virgin forests on the borders of Colombia and Venezuela, and the female was killed. It measured about 1·6 m. in height, and, as the photograph shows, had a distinctly human appearance. Moreover, the beast had no tail, and its teeth are said to have numbered 32, although, most unfortunately, the skull was afterwards damaged during the expedition and was eventually lost. On the strength of these characters, and particularly of its size and appearance, Montandon regards the creature as a new anthropoid ape related to the gibbons, but bearing a resemblance in its coat and in the proportions of its limbs to the orang-utan. Accordingly he names it *Ameranthropoides loysi*, after its discoverer, and makes use of its presence in America to support his theory of the parallel development of anthropoids in America, Asia, and Africa. On the whole, in view of the scanty evidence, we prefer the caution of Prof. L. Joleaud, who in a subsequent paper in the same number of *La Nature* suggests that the new monkey is probably not a true anthropoid ape, but a specialised relative of the spider monkeys (*Ateles*).

ANATOMY OF A FŒTAL AFRICAN ELEPHANT.—Dr. N. B. Eales (*Trans. Roy. Soc. Edin.*, vol. 56, Pt. I, 1929) completes her study of the African elephant based on the examination of a well-grown fœtus. Previous parts dealt with the anatomy of the head and with the body muscles. The final part deals with the remainder of the organs. The most interesting feature in the anatomy of the elephant is the reduction of the pleural cavities shortly after birth by the ingrowth of trabecular connective tissue from the thickened costal and dorsal pleura. The result of the obliteration of the pleural cavities is to reduce costal movements during breathing to a

minimum and to make respiration in the elephant largely diaphragmal. The elastic tissue helps to control the powerful diaphragmatic movements so that the air is not sucked too violently through the long nasal tubes. The diminution of the collapsing power of the lungs consequent on their adherence to the walls of the chest has rendered intra-pulmonary cartilages unnecessary. In the light of her investigations, Dr. Eales discusses the relationships of the two living species of the Proboscidea, and the affinities of the group as a whole. She agrees with the view of the palæontologists that the African and Indian elephants should be placed in two distinct genera, *Elephas* (Indian) and *Loxodonta* (African). The characters of the two genera are summarised and the view adopted that they belong to different lines of descent. Discussing the affinities of the Proboscidea as a whole, Dr. Eales shows that their characters bear evidence of affinities with the stock from which sprang the rodents, Sirenia, Hyracoidea, and the primates, and that their nearest relatives are the Sirenia and the Hyracoidea. The Ungulates are not near them in descent. She therefore supports the modern view that the Proboscidea should be elevated to the rank of order and removed altogether from the Ungulata.

RECLAMATION OF MOSS LAND.—Although much work on reclamation of moss land has been done, the essential principles of the treatment have never been properly established. Some experiments, described by J. Gillies (*Scottish Journal of Agriculture*, **12**, p. 126), have recently been carried out on a large tract of this type of land in Dumfriesshire, and some fundamental results obtained. Before any reclamation by manurial or other treatment can be attempted, effective drainage is essential. Dung was the best type of manure for the purpose, but it would be difficult to obtain in sufficiently large quantity for work on a large scale. Gradual improvement might, however, be secured by grazing stock introduced at intervals from fertile land. For correcting acidity, various forms of lime are suitable, but they all proved of little value unless phosphate was also supplied: the commercial grades of basic slag, mineral phosphate, and superphosphate are the types of phosphatic fertiliser most likely to prove of economic value. Potash and quick-acting nitrogen, on the other hand, produced no visible improvement. Direct seeding with grass and clovers in July yielded very good results if manures were supplied, particularly where dung could be given. Germination, however, failed completely on untreated moss or where lime only was added. Care was necessary to avoid overshadowing of the introduced species by the natural moss in the early stages of growth, tramping by stock or any other method which tended to consolidate the surface being very beneficial. Red and white clovers, cocksfoot, Italian and perennial rye grass, tall and meadow fescues all germinated freely and were easily established. Rose bay willow herb is a serious trouble in any reclamation work, and if strong measures are not taken to suppress it, the moss land may merely change to an equally valueless tract of willow herb.

HYBRIDISATION OF THE MOLLUSK *CERION*.—Dr. Paul Bartsch, Curator of Mollusks in the U.S. National Museum, has for some years experimented in hybridisation with various species of *Cerion*. In August 1928, whilst visiting the Tortugas Laboratory, he examined his enclosures in which had been placed young individuals of *Cerion viaregis* and *Cerion incanum* and succeeded in finding one adult which he claims to be a perfect hybrid (Year Book No. 27 of the Carnegie Institution of Washington, 1928). Criticism was expressed after the original crossing experiments, because Dr. Bartsch had employed large groups (500 individuals), and it was suggested that the organisms claimed to be crosses were possibly mutations of one of the two species involved. To settle this point, restricted areas (cages or islands) were used, one virgin individual of each of the two species being placed in each isolated area. There was a large mortality, but in one cage the adult hybrid was found. This is identical with those assumed to be hybrids in the mass experiments; a result which was to be expected, as in no colony of *C. viaregis* nor *C. incanum* has any individual appeared comparable in appearance to the hybrids in question. It is to be hoped that more of these interesting forms will be forthcoming.

THE BREAD FRUIT OF TAHITI.—It is unusual in a modern botanical monograph to find a description of thirty-two varieties of a plant species which contains no scientific names. The bread fruit is usually regarded as a cultivated form of *Artocarpus incisa*, but according to Raoul the name 'bread fruit' should not be attached to the wild tree of Malaysia with fertile seeds described by Linnæus with this Latin name, but should be restricted to the cultivated tree of Oceania, for which no other Latin name is at present available. Gerrit Parmile Wilder describes thirty-two varieties of this tree found growing in Tahiti and Moorea, the fruit and foliage of each variety being illustrated by photographs, in *Bulletin* 50, of the Bernice P. Bishop Museum. One of these varieties, 'Huera', produces true seeds, but all are propagated vegetatively, usually by root cuttings. This monograph describes fully the native method of preparing the fruit for the table, and the value assigned by the natives to the edibility of the different varieties. The author makes the interesting comment that he noted no insect, fungus, or other pest upon the bread-fruit tree, which has been in cultivation on these islands long before it was first seen by Europeans in the Marquesas in 1595.

VIRUS DISEASE OF PLANTS.—Recent work in Queensland, Australia, with which Prof. E. J. Goddard has been associated, seems to have demonstrated beyond doubt that the economically important disease of the banana known as 'bunchy top' is a virus disease with an aphis vector. An account of further work upon this disease, with suggestions as to its control, is given in Vol. 2, No. 1, of the *Journal* of the Council for Scientific and Industrial Research of the Commonwealth of Australia. Prof. Goddard has drawn upon his experience in this investigation in his presidential address to the Royal Society of Queensland, published in Vol. 40, No. 1, of the *Proceedings* of the Society. He evidently inclines to the view that the virus will be found in the category of living organisms, ultra-microscopic in size, and therefore presumably forming an intermediate step between the molecular organisms of the inanimate world and the cellular organisms of the visible animals and plants. He does not deal, however, with one puzzle which this point of view presents to the investigator. If such ultra-microscopic forms of life exist, why are they not to be found leading a saprophytic or even an autotrophic existence? Until now, attempts such as have been made by Hugo Miehe (*Biolog. Centr.*, **43**; 1924) to cultivate such ultra-microscopic saprophytic organisms have failed to produce any evidence of their existence.

DIFFERENTIATION IN THE SILL OF PIGEON POINT.—A valuable study by F. F. Grout of the association of anorthosite and granite with dolerite in the great 'diabase' sill of Pigeon Point, Minnesota, appears in the *Bull. Geol. Soc. America*, vol. 39, 1928, p. 555. A

chilled doleritic roof-phase intervenes in most places between the acid differentiates and the quartzite roof. Locally this phase contains abundant phenocrysts of labradorite, and these pass here and there into masses of anorthosite. These light masses apparently rose in the magma at an early stage because of their lower specific gravity. Some assimilation of quartzite by the magma is indicated, but it is suggested that the granite was probably formed essentially by differentiation, with assimilation as a merely subsidiary factor. The occurrence of granite at Pigeon Point is ascribed to the unusual thickness of the sill (250-700 ft.) which allowed ample time during cooling for differentiation to occur. The composition of the average dolerite magma is such that granite could be formed from it by crystallisation, or by the separation of partially miscible fractions, in about the proportions actually found at Pigeon Point. Numerical data indicate that probably much less than a quarter of the total granite was due directly or indirectly to assimilation of sediments.

TRANSMISSION OF SOUND WAVES IN THE EARTH.—The solution of the problem of underground communication through earth strata would be of great value to miners. Unfortunately, its solution offers great difficulties. The ideal method should enable miners to communicate no matter the nature of the strata, whether they are water bearing or not, and also whether they are broken up by old workings. The apparatus must be cheap, light, and able to withstand rough usage. A large number of experiments have been undertaken by the United States Bureau of Mines to find out the best way of communicating between miners entombed by a disaster and persons on the surface. As many of the bituminous coal mines in America are comparatively shallow, even a partial solution would be of value to them. In *Technical Paper*, No. 433, of the Bureau of Mines, experiments on communication by L. C. Ilsley, H. B. Freeman, and D. H. Nellers are described. Owing to the great developments taking place in radio, it was hoped that by this means communication could be established. The tests were made at the Bureau's experimental mine in Pennsylvania. Vertical antennæ were found to give the best results, but on the whole radio methods were found to be of little practical value. A promising method discovered was to connect the source of electrical energy (two dry cells) between a point on one side and a point on the other side of the coal seam. Some of the paths of current flow spread out to the surface and could be picked up by a telephone satisfactorily by choosing suitable earths. It was found, however, that this 'roof-to-rail' method was only practicable for the transmission of signals from the surface into the mine and was therefore only a half solution. Tests made with a geophone—an instrument which converts the earth waves made by hammering on the rock into an air wave which is heard in the ear as sound—gave good results. The simplicity of this method and of the requisite apparatus is greatly in its favour.

TEXTILES AS INSULATORS.—The usefulness of industrial research is well shown in an article by A. C. Walker on "Textiles as Insulators", which appears in the *Bell Laboratories Record* for April. Silk has been used for many years for insulating conductors owing to its much higher insulation resistance than cheaper fibrous materials like cotton. The fact that the insulation resistance of textiles is greatly diminished when moisture is absorbed, suggested that a research on the effect of moisture on textiles might discover methods of treating them which would improve their electrical properties. It was found that the continued application of voltage sometimes increased the insulation resistance a hundredfold. This was traced to the partial removal of electrolytic impurities. The most significant evidence of the importance of electrolytic impurities in silk, wool, cotton, and other textiles is the great improvement in their electrical qualities due to thorough washing with water. It was found that cotton washed with water from Lake Michigan had higher insulation resistance than cotton washed with distilled water in the laboratory. A saturated solution of magnesium carbonate was then used with encouraging results. Washing the cotton with a little calcium sulphate in it gave as satisfactory results as using water from the lake. As a result of the research the insulation resistance of cotton can now be improved by simple washing processes to such an extent that its use as a substitute for unwashed silk for telephone cords has been approved. It is estimated that for this purpose alone the annual saving effected in manufacturing costs to the Bell Company is about one hundred thousand pounds.

EFFECT OF DRYING ON THE PROPERTIES OF BENZENE.—The effect of intensive drying on the physical properties of benzene has been re-investigated by Briscoe, Peel, and Robinson, whose results are described in the *Journal of the Chemical Society* for March. Baker's previous conclusion that the density of benzene does not change upon drying has been confirmed, not only for the liquid as a whole but also for the various fractions obtainable by distillation. After drying for sixteen months, there did not appear to be any definite change in the surface tension, and any change that may have taken place would seem to be in the direction of a decrease. Baker, however, found a considerable increase after a year's drying, and attributed it to a change in the degree of association. The reason for this discrepancy is not apparent and the experiments are being continued.

CHEMICAL APPARATUS.—Messrs. Griffin and Tatlock, Ltd., have issued their new catalogue of chemical apparatus, No. 12A, as an attractive and well-illustrated volume of close on a thousand pages. The firm, which combines the former businesses of J. J. Griffin and Sons, Ltd., and Baird and Tatlock, Ltd., is established in London, Glasgow, Manchester, Edinburgh, and Liverpool. The volume is divided into 12 sections, which are further classified for convenience in the list of contents. The usual fittings and furniture of chemistry laboratories are illustrated not only with pictures but also with model plans and sections. A special feature of the Balance Section is the Christian Becker chainomatic balance, the action of which is fully described. In the section for physical chemistry will be found apparatus for measuring osmosis, surface-tension, etc., and also pyrometers and various kinds of electrical appliances. A section on micro-analysis opens with references to standard works where complete descriptions of methods of work will be found. The apparatus is specially designed for the methods of Pregl and Dubský. A large selection of the well-known Reichert microscopes is minutely described in the optical section, which also includes refractometers, spectrometers and polarimeters with various accessories, as well as optical benches, mercury vapour lamps, selenium cells, etc., and the Bausch and Lomb projection apparatus for which the firm acts as sole agent. Meteorological appliances, laboratory machinery, and apparatus designed for the special methods of assaying used in many different industrial processes form a prominent feature of the catalogue. At the end there is a fairly long list of chemical and technical books and of Kahlbaum's pure chemicals.

Systematic Investigation of the Oceans.

AN international oceanographic conference was held in May 1928 in Berlin to commemorate the centenary of the Gesellschaft für Erdkunde, which has published a series of papers dealing with recent and imminent expeditions.[1] Most of these naturally deal with the results obtained by the *Meteor*, but articles also describe the work of the *Carnegie*, of the little Norwegian auxiliary ketch *Armauer Hansen* in the north-east Atlantic, and the aims of the new Dutch Expedition to the East Indies in the *Willebrord Snellius*.

As these articles are for the most part summaries of methods used and results achieved, they cannot be condensed into a short review, but the following notes on various points in this symposium may be of general interest.

Numerous samples of sea-water collected by the *Meteor* in the Atlantic were analysed for gold by the method due to Haber, whereby the gold in the water is adsorbed on a precipitate of lead sulphide which on heating with lead formate and boric acid leaves a minute bead of gold. This is picked out from the crucible and measured under the microscope.

An ingenious method was used to collect the small amount of lead sulphide, about 40 milligrams in each litre of sea-water. The full flask was inverted over a crucible also containing water and the whole spun in a centrifuge, when the lead sulphide collected at the bottom of the crucible. To prevent loss of water in handling, the top of the crucible was covered with a rubber cap.

The plankton rich upper layers were found to be richer in gold than the water below, much of this being adsorbed on, or contained in, the organisms. The quantity varied from about $\frac{1}{100}$th milligram of gold per cubic metre to a third of this amount, or less in the deep water.

The greater part of the scientific work of the *Meteor* centred around depth and physical measurements, from which to deduce the oceanic circulation from the internal field of force produced by differences in density, from the general distribution of salinity, and from direct-current measurements. For the first time these were successfully made from a ship at anchor in mid-Atlantic where the depth was over 4 kilometres. For this purpose stocked anchors weighing a quarter of a ton and a tapered wire cable $7\frac{1}{2}$ kilometres long were carried. The circumference of the wire cable at the anchor end was 3·6 cm. and at the end made fast to the winch 5 cm.

The temperature measurements at various depths were made with reversing thermometers, every precaution being taken to attain the greatest possible accuracy. In order to avoid error in reading due to parallax—a matter of very real difficulty on board a small ship in rough weather—the thermometer tubes were ground semicircular in section, with the bores close to the flat face upon which the graduations were marked. The readings were carried to the third place of decimals, the graduation being in 0·05°.

Only general conclusions regarding circulation in the Atlantic have yet been published; the mass of data and calculation for the application of Bjerknes' theory is in process of being worked up.

An account of the biological survey by E. Hentschel includes a chart showing the number of plankton organisms present per litre of surface water (Fig. 1).

The effect of water rising from below and bringing nutrient salts to the upper layers, where there is sufficient light for plant growth, is clearly shown along the west coast of Africa. The same effect is also shown in lower latitudes due to convection currents and unrestrained turbulent motion unchecked by a discontinuity layer.

The chemical observations by H. Wattenberg are of particular interest. The distribution of phosphates and nitrates and the relation of these nutrient salts to the density of plankton in the south Atlantic confirm and extend previous investigations in more limited areas. The distribution of dissolved oxygen was found to be regular and to reflect the circulation in the deep water, saturated cold water falling in high alti-

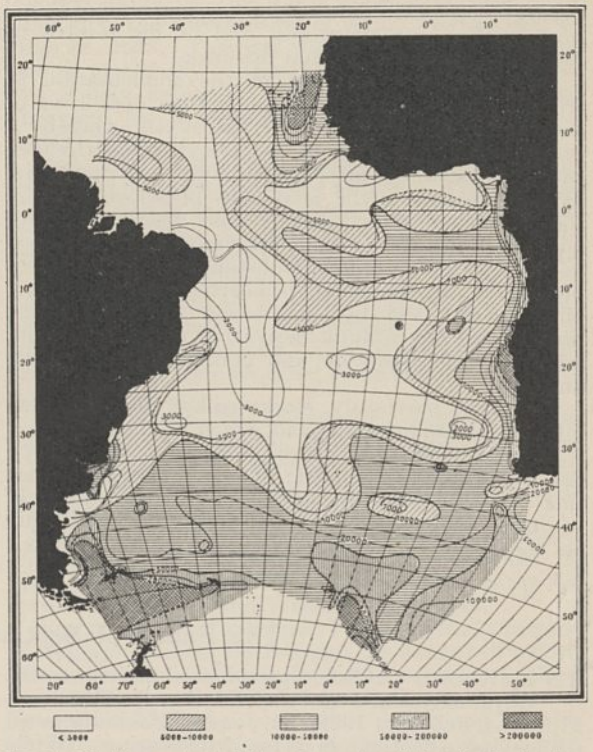

FIG. 1.—Plankton content of the surface-water of the Atlantic, showing number of organisms per litre of water. From "Verhandlung der ozeanographischen Konferenz."

tudes and filling the depths of the oceans, overlaid by water layers of less oxygen content in lower latitudes. The minimum occurs at about 200 metres in the tropics, where a relatively thin warm and light layer lies like oil on the heavier water below; mixing by convection is hindered, and the supply of oxygen is cut off from above. This minimum layer appears to be the graveyard of plankton organisms where oxygen is used up during their decay. The presence of 5 to 6 c.c. of oxygen per litre in the deep water of the oceans indicates its origin in those latitudes where the surface water is at a temperature where more oxygen is needed for saturation, and where in winter convection currents can extend deep into the sea.

The distribution of dissolved calcium carbonate in the sea is peculiar. In the upper water layers of the tropics values indicating 50 per cent over-saturation are indicated; below this the main mass of water is under-saturated; less so near the bottom, where calcium carbonate is apparently dissolving out from the calcareous skeletons of dead organisms. The actual quantity of calcium in solution, however, is considerably less in the upper layers, where it is utilised to build up the skeletons of such organisms.

[1] "Verhandlungen der ozeanographischen Konferenz veranstaltet von der Gesellschaft für Erdkunde zu Berlin anlässlich ihrer Hundertjahrfeier." Berlin, 1928.

Closed Carbon Chains in Organic Chemistry.

PROF. W. H. PERKIN chose "The Early History of the Synthesis of Closed Carbon Chains" as the subject of the first Pedler lecture, which he delivered before the Chemical Society on May 30. It was, he said, very difficult to appreciate the fact that not more than fifty years ago the idea was firmly fixed in the minds of chemists that organic compounds must be sharply divided into the group having open carbon chains and the group having six-membered rings. The lecturer gave an interesting account of his discussions, as a young student, with Victor Meyer and Baeyer regarding the possibility of preparing compounds containing rings composed of three, four, or five carbon atoms, and of his resolve to prosecute researches in that direction.

The first step consisted in the condensation of trimethylene bromide with the sodium derivative of acetoacetic ester, followed by hydrolysis, whereby a product then believed to be acetyltetramethylenecarboxylic acid, but afterwards shown to be methyldehydrohexonecarboxylic acid, was obtained. Before the erroneous interpretation had been corrected, however, the new method was vigorously developed in various directions, a substance which, indeed, proved to be tetramethylenecarboxylic acid being obtained in 1883 by the action of trimethylene bromide on the sodium derivative of malonic acid, followed by hydrolysis and elimination of carbon dioxide.

Two years previously, Markownikoff and Krestownikoff had obtained an acid which the lecturer and E. Haworth afterwards proved to be *trans*-tetramethylene-1:3-dicarboxylic acid; it was remarkable that this earlier observation attracted little attention at the time, and remained undeveloped. Experiments on the action of ethylene bromide in place of trimethylene bromide on the sodium derivatives of acetoacetic ester and malonic ester brought the lecturer into conflict with Fittig, who with his pupils was at that time investigating the conditions of formation and the properties of lactones. Prof. Perkin gave a brief account of the evidence which led to the recognition of the formation of acids derived from trimethylene.

The next step was to devise a method for the preparation of a derivative of the five-carbon ring. Tetramethylene bromide was then unknown, but ten years later it was obtained accidentally during the preparation of pentamethylene bromide; on condensation with the sodium derivative of malonic ester it readily yielded pentamethylenedicarboxylic ester, this on hydrolysis and elimination of carbon dioxide affording the long-sought pentamethylenecarboxylic acid. Similarly, hexamethylenecarboxylic acid was synthesised from pentamethylene bromide, and was shown to be identical with hexahydrobenzoic acid resulting from the reduction of benzoic acid. In the meantime, an alternative method for the synthesis of the five-carbon ring had been devised in 1885; the disodium derivative of pentanetetracarboxylic ester was treated with bromine, the resulting pentamethylenetetracarboxylic ester then affording pentamethylene-1:2-dicarboxylic acid. The demonstration of the stability of the five-carbon ring confirmed the views which Baeyer had, but a few months previously, developed in his "Spannungstheorie".

Finally, the lecturer referred to the syntheses of hydrindene and tetrahydronaphthalene, published conjointly with Baeyer in 1884. Interaction between *o*-xylylene bromide (which proved troublesome on account of its severe effect on the eyes) and malonic ester proceeded exactly as Baeyer predicted.

The Fauna of Scotland during the Ice Age.

IN his recently published presidential address to the Royal Physical Society of Edinburgh (*Proc.*, vol. 21, Part 4, February 1929), Dr. James Ritchie discussed the Ice Age in Scotland in its faunistic bearings. While Scotland must have shared in some degree the fluctuations of climate which have left traces so marked on the neighbouring shores of continental Europe, the earlier fluctuations either left no material remains or these have been removed by subsequent glaciation, for there is no faunistic evidence of the long series of changes which represents the early ice age or *altdiluvium* of continental geologists. The Scottish Ice Age exhibits but a relatively short section of the Pleistocene glacial epoch.

The remains of early glacial animals in Scotland are extraordinarily scanty, but they belong to the most important of all the animals as indicators of the period of their sojourn—the mammoth, the woolly rhinoceros, and the reindeer. The association of these three animals indicates a period corresponding to the Third Terrace of the Thames Valley. The mammoth and reindeer remains of Kilmaurs were overlaid by an extensive deposit of boulder clay, indicating conditions of ice-covered land in which even such sub-arctic animals could not have survived. Their appearance in Scotland therefore must date to a preceding warmer period which was followed by a major glaciation.

The known distribution of the mammoth in Scotland extends from Berwickshire through Midlothian to Lanarkshire and Ayrshire. Northward migration of the mammoth may have been prevented by a water barrier formed by the junction of the estuaries of the Forth and Clyde. Such a condition in the midland valley would be accounted for by a relatively slight subsidence of the land. Representative animals of the later glacial faunas have been found in Scotland only in isolated spots, with the exception of the fairly extensive faunas first discovered by Drs. Peach and Horne in limestone caves near Inchnadamph, now being further explored by Dr. Ritchie, Mr. J. E. Cree, and Mr. J. G. Callander.

The oldest fauna so far discovered appeared after the cave-riddled hill, more than 1000 feet above sea-level, had been set free from an ice-cap which left enormous deposits of silt in the inner cave, and is an arctic fauna containing scarce remains of reindeer, many arctic rodents, the arctic wolf, lynx, and a very large bear. A considerable period must have elapsed before the second fauna made its appearance, when the animal remains became involved in streams flowing off the valley glacier: this fauna was predominatingly a reindeer fauna, remains of more than 400 individual reindeer having been discovered in a single cave of relatively small size. There is no trace here of modern Scottish animals. These appear in a higher layer which contains for the first time remains of red deer and, on account of the skeletal character and mode of burial of human remains in it, may be regarded as belonging to the period of Azilian culture, between the Palæolithic and Neolithic Ages.

University and Educational Intelligence.

BIRMINGHAM.—The Mason chair of botany, made vacant by the death of Prof. R. H. Yapp, has been filled by the appointment of Prof. Walter Stiles, professor of botany in the University of Reading. Prof. Stiles is well known for his work in plant physiology and on the cold storage of food. He has made numerous contributions to knowledge of cell permeability and photosynthesis.

CAMBRIDGE. — J. C. Burkill, Peterhouse, and P. A. M. Dirac, St. John's, have been appointed university lecturers in mathematics.

G. Anrep has been reappointed university lecturer in physiology, and H. Banister lecturer in experimental psychology.

R. A. Webb has been reappointed demonstrator in pathology and H. E. Tunnicliffe demonstrator in physiology.

The Council of the Senate recommends the adoption of the following regulations for the A. W. Scott fund:

I. The money received from the bequest of Prof. A. W. Scott for the furtherance of physical science shall be separately invested and shall constitute a fund called the A. W. Scott fund.

II. The income of the fund shall be applied as follows:

1. A short course of annual lectures shall be instituted in the physics department, and a sum of £100 shall be paid to the lecturer.

2. The head of the department may make grants, not exceeding a total of £150 in any financial year, to necessitous research students working in the Cavendish Laboratory.

3. A sum of £50 shall be retained in the fund each year, and money so accumulated may at any time be used by the head of the department in defraying the expenses of occasional small scientific conferences to be held in the laboratory.

4. The remaining income of the fund shall be paid into the departmental fund of the Cavendish Laboratory for general purposes.

The Rouse Ball studentship at Trinity College, founded for the purpose of enabling a student to study mathematics or the application of mathematics in a foreign university or school, has been awarded to W. R. Andrews.

On June 4 honorary degrees were conferred upon Sir Kynaston Studd (Lord Mayor of London), Prof. Langevin, Sir Frank Dyson (the Astronomer Royal), and Prof. Beazley.

The Appointments Committee of the Faculty of Agriculture and Forestry will shortly proceed to appoint (1) a university lecturer in agriculture to give instruction in crop husbandry, and (2) a university lecturer (Gurney lecturer) in forestry to give instruction in forest botany. Particulars may be obtained from Prof. T. B. Wood, Department of Agriculture, University of Cambridge.

LEEDS.—The Senate has awarded the degree of doctor of science to Mr. J. H. Birkinshaw and Mr. A. J. V. Underwood. Mr. Birkinshaw's thesis was entitled "Studies in the bio-chemistry of micro-organisms"; Mr. Underwood submitted a series of papers under the general title of "The application of mathematical methods to some engineering problems".

LONDON.—The degree of D.Litt. has been conferred on Dr. F. A. P. Aveling, University reader in psychology, for a Thesis entitled "The Psychological Approach to Reality".

Prof. John Coatman has been appointed as from Aug. 1, 1929, to the University Chair of Imperial Economic Relations tenable at the London School of Economics.

Calendar of Patent Records.

June 17, 1783.—John Fischer, mechanic, of London, is the first patentee of a pedometer, his patent, sealed on June 17, 1783, being for "a geometrical and pedometrical watch which not only answers the purposes of a common watch, but is also distinguished by showing on the dial every step the walker makes and by measuring the distance". A combined pedometer and watch of this type made a few years later, but not by Fischer, is in the South Kensington Museum.

June 18, 1823.—Great economy and improvement in the bleaching industry resulted from the patent granted to William Southworth for a machine to hang out wet fabric in the tenter-house and take it up when dry, the specification of which was enrolled on June 18, 1823. This was the first successful application of machinery to this purpose, and the invention was widely adopted. The life of the patent was prolonged for five years from 1837 in the name of E. Haworth.

June 18, 1849.—The Bourdon pressure gauge derives its name from Eugene Bourdon, who obtained a French patent for the instrument for fifteen years on June 18, 1849. An instrument acting on the same principle was invented about the same time by R. E. Schinz, a railway engineer of Cologne, as a gauge for locomotives, and was patented in Germany by C. J. Rahskopf, a watchmaker of Coblenz, in March of the same year. The rights in Bourdon's English patent were acquired by Messrs. Dewrance, of London.

June 20, 1801.—The lithographic printing process was patented on June 20, 1801, by Alois Senefelder, a native of Prague living in Germany. Senefelder brought the art to great perfection, and in 1818 published instructions for using it.

June 20, 1840.—Samuel Morse patented his electric telegraph system in the United States on June 20, 1840, and the first commercial telegraph was opened between Baltimore and Washington in 1844.

June 21, 1889.—To William Friese Greene, a London photographer, must be awarded the honour of having first introduced a practical camera capable of taking an unlimited number of photographs in rapid sequence upon a band of sensitised celluloid film and suitable for subsequent reproduction in the form of a moving picture. His patent was taken out in conjunction with Mortimer Evans and is dated June 21, 1889. The first moving picture taken by Friese Greene was that of the traffic at Hyde Park corner, and it was shown on the screen at a meeting of the Royal Photographic Society in 1890.

June 22, 1839.—On June 22, 1839, Abel Morrall, a needle-maker of Studeley, was granted a patent for burnishing the eyes of needles by threading them upon a roughened steel wire stretched in a frame and caused to revolve or to move backwards and forwards. The needles are thus made to vibrate upon the wire, and the eyes are very effectively smoothed. Up to that time there was no method of making the elongated eyes smooth, and the patent, which was acquired by Messrs. Bartlett of Redditch, became a very valuable one.

June 22, 1906.—Low-temperature carbonisation of coal and the production thereby of a smokeless fuel dates from the work of Thomas Parker, engineer, of Wolverhampton, who patented his process on June 22, 1906, and introduced the new fuel to the public under the name of "Coalite". Plants were erected at Plymouth gas works and later at Barking, but commercial success was not at that time achieved, and it has required many years of research to make coalite a marketable product.

Societies and Academies.

LONDON.

Geological Society, May 8.—**F. M. Trotter**: The glaciation of eastern Edenside, the Alston Block, and the Carlisle Plain. Three glaciations separated by intervals have been recognised. The ice of the first or Scottish glaciation deployed from the Southern Uplands, swept across the Carlisle Plain, one stream continuing eastwards, the other advancing up Edenside, where it was joined by a stream from the Lake District. Exposures of the ground-moraine of this glaciation are rare, and in eastern Edenside the moraine is in places overlaid by a series of contorted laminated clays, etc. These clays are in turn overlaid by the drifts of the second or main glaciation, when eastern Edenside was occupied by Lake-District ice and Cross-Fell ice. Because of the presence of Scottish ice on the north and ice from Howgill and Wild Boar Fells on the south, Edenside became congested with ice. The surface-level of the ice rose to 2200 feet at least, and probably higher. The retreat of the ice-front after the maximum of the main glaciation can be traced stage by stage. The last glaciation was the renewed advance of the Scottish ice across the Carlisle plain, up to an altitude of 400 or 500 feet O.D. At its maximum extension, and during its retreat, this glacier dammed up glacier-lakes which drained south-westwards.—**J. A. Douglas**: A marine Triassic fauna from eastern Persia. An account of the discovery by Mr. R. C. Jennings and Mr. K. Washington Gray, geologists of the Anglo-Persian Oil Co., of a marine Triassic fauna in the district of Naiband. Comparison with other Triassic outcrops suggests an extension of the Triassic Tethys into Persia in Carnic times, and again at a later stage, in the Rhætic period. During the intervening Noric epoch, however, communication with the Mediterranean province was severed, while species characteristic of the Trias of the East Indies make their appearance in great numbers. There is little evidence for migration having taken place between the two areas along the 'Himalayan route', and it is suggested that the continental barrier of Gondwanaland was breaking up into an archipelago of islands.

Royal Meteorological Society, May 15.—**J. Edmund Clark, I. D. Margary, R. Marshall, and C. J. P. Cave**: Report on the phenological observations in the British Isles, December 1927 to November 1928. The year 1928, considered as a whole, differed but slightly from the average for 35 years. We think of the year as sunny, but the dull spring balanced brilliancy in January, July, and September; so, too, the bitter December and chilly June were offset by the wonderful warmth from January to April, with only occasional slices of cold. December checked the hazel, despite January, making it flower at the average date; coltsfoot came early. The horse-chestnut flowered two days instead of six earlier than the hawthorn. Migrants, despite some remarkable premature records of swallow, chiffchaff, and cuckoo, averaged only a couple of days early. But this fully suffices to make the lines of equal appearance dates (isophenes) shift markedly northwards compared with 1927.—**D. Brunt**: The index of refraction of damp air, and the optical determination of lapse-rate. The correction to the index of refraction to allow for the presence of water vapour is given. Variations of humidity give results which cannot be distinguished optically from variations of temperature.—**J. Reginald Ashworth**: The influence of smoke and hot gases from factory chimneys on rainfall. In a manufacturing town such as Rochdale, the combustion of large quantities of coal must produce an upward current of hot air which is probably sufficient to influence the rainfall. The variation of the rate at which rain falls agrees very closely with the fluctuation of smoke emission as tested by the average number of soot particles deposited from the air each day of the week.

DUBLIN.

Royal Dublin Society, May 28.—**J. Joly**: Bi-radiant needles for use in the radioactive treatment of tumours. These needles, like those developed by the author in collaboration with Dr. Walter Stevenson in 1914, are hollow, so as to contain radium or its emanation. They are, however, divided vertically into half-needles differing in density or thickness so that rays issuing from opposite sides of the needle are unequally screened. It is therefore possible to control the intensity of radiation in different directions. Thus the natural selective effect which is believed to be responsible for the success of radio-therapy, may be enhanced by the orientation of the needles; the surrounding healthy tissues receiving definitely weaker radiation than the body of the tumour. Details respecting security against rotational movements of the needle when *in situ*, their various forms, and mode of construction are given.—**W. R. G. Atkins** and **H. H. Poole**: (1) Photo-electric measurements of illumination in relation to plant distribution. Pt. 2: Using portable galvanometers and blue-sensitive vacuum sodium photo-electric cells of the Burt type measurements were made of the daylight factor (δ) at various points in a garden; δ may be as low as 1·3 per cent under laurel bushes and holly, where only ivy straggles. *Scolopendrium vulgare* may thrive with $\delta = 2{\cdot}2$ per cent. (2) The photo-electric standardisation of an uranyl oxalate method of daylight photometry. By exposing 10 c.c. of solution in six-inch quartz tubes it was found that from 0·183 to 0·236 c.c. of N/10 oxalate was destroyed per thousand metre-candles per hour. The illumination was measured by a Burt cell. In noon July sunlight 85 mg. oxalic acid may be destroyed per hour, and the daily variation in this rate was studied. (3) The photo-chemical and photo-electric measurement of the radiation from a mercury vapour lamp. The uranyl oxalate method, the fading of methylene blue, the production of nitrite, and the Burt sodium cell were used, in conjunction with erythema tests, to measure the radiation from a quartz lamp. By means of various screens it was shown that what the cell measures may be taken as an index of the therapeutic value of the radiation. The intensity reaches a minimum one minute after the arc has struck and reaches a roughly constant value, fifteen times as great, five minutes later.

PARIS.

Academy of Sciences, May 6.—The president announced the death of Dr. Trabut, *correspondant* for the Section of Rural Economy.—**L. Cayeux**: The conditions of the Silurian sea with Graptolites in Normandy. A study of the upper Silurian as revealed by a deep boring made at Danneville, Calvados, in a search for iron ore. The Graptolite Gothlandian of Normandy offers strong evidence in favour of a phenomenon of lagunar evaporation, leading to the formation of a bed of gypsum.—**Charles Richet** and **Mme. L. Braumann**: The accelerating action of minute amounts of lanthanum salts on fermentation. The amount of acid produced by the lactic ferment is increased by amounts of lanthanum sulphate of the order of 10^{-8} grams per litre.—**Gabriel Bertrand** and **Mlle. C. Voronca-Spirt**: Titanium in phanerogam plants. Titanium is met with in all phanerogams, the

green parts, especially the leaves, containing the highest proportion of the metal. Titanium has been found in plants by other workers, but its presence has been ascribed to the accidental presence of dust. Precautions against such contamination have been taken.—**J. B. Charcot**: The South American Antarctic. A statement of the results of French explorations, especially those of Dumont-d'Urville.—**Léon Guillet** and **Michel Samsoen**: Studies of traction at high temperatures. A description, with illustrations, of the arrangement of test-pieces and furnace, the latter automatically controlled within 3° of 450° C. Figures are given for the elastic limits of four steels.—**E. Mathias**: Contribution to the study of fulminating matter: its explosion by shock. Historical summary of cases of globular lightning.—**Charles Nicolle, Charles Anderson**, and **Pierre Hornus**: A new spirochæte from a case of recurrent Moroccan fever. A discussion of the relations between the spirochætes of Spain, Mansouria, and the new organism, based on the agglutination effects and partial immunities.—**Constant Lurquin**: The forms of extension of the Bienaymé-Tchebycheff criterion.—**J. Favard**: What is the smallest circle in the interior of which can be put all the plane convex curves of length L and surface S?—**Bertrand Gambier**: Groups of transformation and geometrical theorems.—**Georges Giraud**: The generalised problem of Dirichlet; complements relating to the linear case and to the non-linear case.—**A. Angelesco**: Certain polynomials of Tchebycheff.—**Rolf Nevanlinna**: A problem of interpolation.—**R. Chambaud**: The bending of rectilinear pieces submitted to an eccentric force of compression.—**D. Wolkowitsch**: A new type of spring.—**P. Biquard**: The phenomena produced by the interposition of a metallic plate in a bundle of ultra-sound waves.—**Henri Chaumat**: A comparison between electro-static machines and direct current dynamo machines.—**Henri Gutton**: The dielectric constant of ionised gases.—**L. Bouchet**: The electrolytic potentials of some metals. Results of measurements of the electrolytic potential, referred to the normal calomel electrode taken as zero, are given for magnesium, zinc, hydrogen, copper, and silver.—**Mlle. A. Serres**: The magnetic properties of ferric oxide and of some ferrites above their Curie point; conservation of constant paramagnetism in these combinations.—**Robert Forrer**: The two Curie points, ferromagnetic and paramagnetic. To obtain spontaneous magnetisation, the existence of a magnetic moment and a spontaneous orientation is not sufficient; there must be hysteresis in addition. Ferromagnetism only exists below the two Curie points.—**A. Couder**: Description of the diffraction figure at the mean focus of an astigmatic bundle.—**E. Sevin**: The theories of the continuous X-spectrum and of Compton's phenomenon. Remarks on a recent communication of Décombe on the same subject.—**Jean Jacques Trillat**: The phenomena of orientation and of pseudo-crystallisation resulting from the effect of traction in colloidal gels. Results obtained by the application of X-ray photography to nitrocellulose or cellulose acetate films under varying amounts of stretching.—**C. Pawlowski**: The production of the H-disintegration rays under the α-radiation of polonium. The α-rays of polonium are, as Schmidt has shown, capable of producing the disintegration of aluminium. The H_∞-rays can be produced not only by α-rays of a path of 3·9 cm. but also by those of a path of 2·4 cm.—**E. Cornec, H. Krombach**, and **A. Spack**: The equilibria between water and the nitrates and sulphates of sodium and potassium.—**P. Lebeau** and **A. Damiens**: A new method of preparing fluoride of oxygen.—**Ch. Bedel**: The solubility of silicon in hydrofluoric acid. The variations in the solubility of silicon in hydrofluoric acid have been attributed to the state of division of the former; the experiments detailed in the present paper do not confirm this, the most important factor in the attack being the concentration of the acid.—**Mlle. M. Cabanac**: The hydrogenation of the acetals of the fatty acids. The reaction is

$$CH_3.CH(OR)_2 + H_2 = C_2H_5.O.R + ROH,$$

and appears to be general. It constitutes a method of preparing either symmetrical or mixed ethers.—**D. Ivanoff**: The thermal decomposition of the organomagnesium alcoholates.—**Y. Milon**: The existence of a marine Eocene formation in the depression of Toulven (Finistère).—**Bruet**: A particular facies of the upper Pleocene of the valley of the Aujon (Haute-Marne).—**G. Delamare** and **C. Gatti**: *Indiella americana*, a hyphomycete capable of cultivation.—**Jules Amar**: The pulmonary *tirage*. This term is applied to the expression $\pi h/p$, where π is the perimeter taken round the level of the breasts, h the height of the bust, and p the weight of the body. This has an average value of 124 for men and 108 for women.—**Emile F. Terroine** and **Mlle. Thérèse Reichert**: The influence of the salt ration on the magnitude of the nitrogen retention in the course of growth. It has been shown in an earlier communication that the presence of a complex mineral ration (common salt, potassium chloride, potassium phosphate) considerably increased nitrogen retention during growth. It is now shown that the constituents of the saline mixture, taken singly, exert no favourable action.—**E. Voisenet**: Divinylglycol considered as the cause of the bitter taste in the disease of bitter wine. From a sample of Burgundy attacked by the disease a liquid has been isolated with a very bitter taste. It has been identified as divinylglycol, $CH_2=CH—CH(OH)—CH(OH)—CH=CH_2$.—**Georges Blanc** and **J. Caminopetros**: The duration of conservation of the virus of dengue in the Stegomyas. The influence of the cold season in the infecting power. It has been shown that dengue is transmitted in Greece by the mosquito *Stegomya fasciata*. The infected mosquitoes can live under favourable conditions at least 200 days. They lose their infecting power when the mean temperature falls below 18° C., but the virus is not destroyed, since the Stegomyas again become infectious when the temperature rises above 18° C. This mosquito can thus carry the infection from one year to the next.

Official Publications Received.

BRITISH.

The Scientific Proceedings of the Royal Dublin Society. Vol. 91 (N.S.), No. 21: The Effect of Strong Magnetic and Electric Fields on the Rectilinear Propagation of γ Rays. By Dr. J. H. J. Poole and A. G. Clarke. Pp. 265-271+plate 16. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 2 (New Series), No. 4, April. Abstracts Nos. 590-824. Pp. v+133-171. (London: H.M. Stationery Office.) 9d. net.

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 20, Technological Series No. 15: The Effect of using either One Head or Two Heads of Drawing instead of Three Heads of Drawing in the Spinning Preparation for Spinning Tests. By A. James Turner. Pp. ii+18. (Bombay.) 1 rupee.

FOREIGN.

Smithsonian Miscellaneous Collections. Vol. 81, No. 9: A Second Collection of Mammals from Caves near St. Michel, Haiti. By Gerrit S. Miller, Jr. (Publication 3012.) Pp. 30+10 plates. (Washington, D.C.: Smithsonian Institution.)

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1928. (Publication 3011.) Pp. vi+198. (Washington, D.C.: Smithsonian Institution.)

Bulletin of the National Research Council. No. 67: The Minimum Protein Requirements of Cattle; Report of Committee on Animal Nutrition. Pp. 84. No. 68: Transactions of the American Geophysical Union, Ninth Annual Meeting, April 26 and 27, 1928, Washington, D.C. Pp. 103. (Washington, D.C.: National Academy of Sciences.)

Diary of Societies.

FRIDAY, JUNE 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—T. P. Bhaskaran: The Number of Stars of Different Magnitude in the Hyderabad Astrographic Catalogue. Fifth Paper: Zone −21°.—Prof. E. W. Brown: The Planetary Theory with the True Longitude as Independent Variable.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 5.—E. Maddox: Demonstration of the Cheiroscope.—Miss M. Dobson: Velanoskiascopy, a Control in the Correction of Astigmatic Defects.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—W. E. Pretty: Pressure Shifts in Line Spectra of Gases.—A. S. M. Symons and J. Daley: The Zeeman Effect for the Arc Spectrum of Gold.—Dr. W. Jevons: The Band Spectrum of Lanthanum Monoxide.—Demonstrations by G. D. Preston: (*a*) The Crystal Structure of the Allotropes of Manganese; (*b*) The Change of Physical Properties during the Age-hardening of Aluminium Alloys.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 6.—C. H. Faris: Repairs to Diesel Engine Parts by Electro-deposition.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

SATURDAY, JUNE 15.

BIOCHEMICAL SOCIETY (at John Innes Horticultural Institution, Merton), at 11.45 A.M.—H. W. Kinnersley and R. A. Peters: Observations on Carbohydrate Metabolism in Avitaminous Birds.—E. Boyland: The Lag between Phosphate Esterification and Carbon Dioxide Evolution in Alcoholic Fermentation.—H. B. Stent, V. Subramanian, and T. K. Walker: The Degradation of Succinic Acid by *Aspergillus niger*.—R. Scott-Moncrieff: The Isolation and Identification of Some New Anthocyanins.—E. Phillis: The Sugars of Tulip Bulbs.—H. J. Channon and G. A. Collinson: Absorption of Liquid Paraffin from the Alimentary Tract of the Rat and Pig.—T. Moore: The Association of Vitamin A Activity with Carotene in the Carrot Root.—D. L. Collison, E. M. Hume, I. Smedley-MacLean, and H. H. Smith: The Nature of the Vitamin A Constituent of Green Leaves.—H. W. Dudley: The Isolation of Acetyl Choline from Natural Sources.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—R. G. Carruthers: Burnt Outcrops of the High Main Coal at Newcastle-on-Tyne.—*Papers open for discussion*:—Roof Control on Longwall Faces, J. F. C. Friend; Diamond Boring Applied to Tapping Drowned Areas Underground, F. E. Smyth; Land Drainage, H. C. Pawson; The Laws of Motion of Particles in a Fluid, R. G. Lunnon; Boring against Workings likely to contain an Accumulation of Water or other Liquid Matter, and a Method of Negotiating a Fault, C. H. Leeds; The X-Ray Analysis of Coal: the Radiographic Variables and their Control, C. N. Kemp.

TUESDAY, JUNE 18.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Spa Hotel, Bath), at 10 A.M.—Dr. Margaret Fishenden and A. F. Dufton: Heating Research at Watford, 1928–1929.—At 2.30.—Demonstration of Treatment at the Grand Pump Room.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—A. Capleton: W. H. Hudson the Naturalist.

WEDNESDAY, JUNE 19.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. F. J. W. Whipple: Potential Gradient and Atmospheric Pollution: the Influence of 'Summer Time'.—A. J. Bamford: Vertical Air Currents as Measured by Pilot Balloons.—Dr. G. Slater: Studies on the Rhone Glacier, 1927. The Relationship Between the Average Air Temperature and the Rate of Melting of the Surface of the Glacier.

THURSDAY, JUNE 20.

ROYAL SOCIETY, at 4.30.—Sir Charles Sherrington: Some Functional Problems attaching to Convergence (David Ferrier Lecture).

CHEMICAL SOCIETY, at 8.—Prof. H. B. Baker: Manipulation in Intensive Drying.—Prof. W. A. Bone: Notes on Intensive Drying of Gaseous Media.—H. J. Emeléus: The Light Emission from the Phosphorescent Flames of Ether, Acetaldehyde, Propionaldehyde, and *n*-hexane.—A. J. H. Houssa, J. Kenyon, and H. Phillips: The Relative Configuration of *d*-β-octanol and its Dextrorotatory Halides. The Interconversion of the Optically Active β-octanols by a New Method.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—MRS. C. B. HODSON: Birth Control Clinics in the United States.

FRIDAY, JUNE 21.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge), at 2.—L. Yates: The Evolution of the Sense of Hearing.—J. S. Tucker: Localisation of Sound.—S. Hett, Dr. A. G. Wells, and Dr. Murray Levick: Ionisation as a Treatment for Middle-ear Suppuration.—At 4.30.—Dr. A. A. Gray: The Application of the Principles of Maximum Stimulation to Clinical Otology.—G. Wilkinson: Demonstration of a Model Resonator, Designed to Illustrate the Mechanism of the Cochlea.

ROYAL SANITARY INSTITUTE (at North-East Coast Exhibition, Newcastle-upon-Tyne), at 2.30.—Dr. H. G. Davison and others: Discussion on The Problem of Feeding the Premature Infant.—Dr. E. F. Murray and others: Discussion on The Need for a Maternity Service.—Dr. H. H. Evers and others: Discussion on The Importance of Ante-Natal Supervision.—At 4.30.—D. Boyd and others: Discussion on Eliminating the Tuberculous Cow: Administrative Results at Berwick-upon-Tweed.—D. W. Henderson and others: Discussion on Hygienic Milk Supplies.—C. H. Westwater and others: Discussion on Clean Milk in the Northern Counties.—At 8.—Prof. L. E. Hill: Smoke Pollution (Public Lecture).

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual General Meeting) (at 11 Chandos Street, W.), at 8.15.—Induction of New President, Dr. G. Carmichael Low.—Dr. J. F. C. Haslam: Some Health Problems of British Guiana.—Presentation of the Manson Medal to Sir Ronald Ross, and the Chalmers Medal to Major A. C. Sinton.

ASSOCIATION OF ECONOMIC BIOLOGISTS (Annual Field Meeting) (at Cambridge) (continued on June 22).

SATURDAY, JUNE 22.

ROYAL SOCIETY OF MEDICINE (Otology Section) (at Cambridge), at 9.30 A.M.—M. Vlasto: The Chorda Tympani Nerve in Otology.—C. S. Hallpike: Some Observations on Bone Conduction.—A. R. Tweedie: Demonstration of Apparatus for Control of Conversation Test.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Nottingham).

PHYSIOLOGICAL SOCIETY (at Plymouth).

PUBLIC LECTURE.

WEDNESDAY, JUNE 19.

UNIVERSITY OF BIRMINGHAM, at 4.30.—Dr. C. Singer: The Modern Spirit in Medicine (I.).

CONFERENCES.

JUNE 14 AND 15.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at John Innes Horticultural Institution, Mostyn Road, Merton Park, S.W.).

Friday, June 14, at 10 A.M.—D. Ward Cutler: Soil Protozoa and Bacteria Relationships.

V. B. Wigglesworth: (*a*) The Part Played by the Tracheal System of the Tse-tse Fly during the Digestion of Blood; (*b*) The Functions of the Proventriculus in the Tse-tse Fly.

Dr. R. A. Fisher: The Experimental Examination of the Theory of the Evolution of Dominance.

C. Diver: Reverse Mutations in *Limnæa peregra*.

At 2.15.—Prof. A. E. Boycott and Dr. J. Henderson Smith: The Nature of Filterable Viruses.

Dr. R. J. Ludford: Vital Staining with Acid and Basic Dyes.

At 4.30.—Dr. M. C. Rayner: The Practical Importance of *Mycorrhiza* to Forest Trees.

A. L. Bennett: The Changes in the Testis of the Stickleback Preceding the Breeding Season, and their Relation to the Development of Nuptial Coloration.

E. A. Spaul: The Distribution of Biological Activity in the Anterior Pituitary.

Saturday, June 15, at 10 A.M.—J. B. S. Haldane: The Bearing of Genetics on the Species Problem.

F. W. Sansome: Experiments on the Physiology of Pollen.

E. J. Collins: Some Hybrid Calceolarias.

At 11 A.M.—Demonstrations:—

Dr. E. J. Collins: Some Hybrid Calceolarias.

Dr. C. L. Huskins: Cytology of Cereals and Tomatoes.

M. B. Crane: (*a*) Sterility and Incompatibility in Fruit Trees; (*b*) Graft Hybrids.

T. Philp: Flower Colour in *Papaver*.

Miss D. M. Cayley: 'Breaking' in Tulips.

Miss de Winton and Miss Pellew: (*a*) Linkage in *Pisum sativum*; (*b*) Genetics in *Pisum sativum*.

Miss Pellew: (*a*) Genetics of *Primula Kewensis*; (*b*) Chimeras. A New Segregation in W. Bateson's Pelargonium, var. Mrs. Mappin.

Miss M. A. Tazelaar: The Effect of Rapid Limb Growth on Neighbouring Limbs in *Palæmon carcinus*.

JUNE 14.

INTERNATIONAL CONFERENCE ON LARGE HIGH-TENSION SUPPLY SYSTEMS (at 9 Avenue Hoche, Paris).

In Morning.—C. I. Budeanu: Power Factor Improvement.—F. Rutgers: Simplified Graphical Representation of Active and Reactive Power in Vectorial Diagrams.—L. Gratzmuller: The Conservation of Reactive Power in Electric Systems.—A. Iliovici: Measurement of Electrical Energy and Power at Very High Voltages.—G. Renesson: Notes on the Measurement of Electrical Energy at High Voltages.—A. Barbagelata: Metering and Tariffs in Three-phase Supply.

In Afternoon.—L. C. Grant: Lightning and Surges on High-tension Transmission Lines.—R. O. Kapp: The Selective Protection of Transmission Lines.—P. Traverse: Investigation and Statistics on Surges in Transmission Systems.—F. W. Peek: Developments in the Control of Lightning.—Barbillion and Teszner: The Rôle of Condensers and Similar Devices in the Protection of Networks Against Surges: Theoretical and Experimental Study.—K. Gotoh and Matsunaga: Lightning and 154,000-volt Transmission Lines.—A. Iliovici: Selective Protection of Networks, Based on Unbalanced Currents, Voltages, and Power.—A. Tchernycheff: A New Method of Protection for Heavy-current Equipment.—M. Walty: Long-distance Communication in Electric Systems.—A. Tchernycheff: Special Apparatus for the Protection of Long-distance Communication Lines.—German Telephone Administration: Measurement of the Coefficient of Mutual Induction between Two Lines with an Earth Return.—T. N. Schulz: Standardisation of International Statistics in Regard to the Generation and Distribution of Electric Power.—P. Rieunier: Interconnexion of Systems Operating at Different Frequencies.—J. Kopeliowitch: The Use of an Ohmmeter as a Selective Relay.—L. Gratzmuller: Increasing the Number of Phases for a Supply to Mercury Converters, with a View to Reducing the Effect of Harmonics in a Distribution System.