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Scientific Workers in Government Employment.

THE Report of the Committee appointed by the Treasury in May 1929 "to examine the functions and organisation" of certain specified scientific establishments in the Government Service, and "to report on the method of recruitment and conditions of service of the civilian scientific and technical officers employed therein", has now been published (H.M. Stationery Office, 9*d*. net). The specified departments were :

(*a*) The research and experimental establishments under the Admiralty, War Office, Air Ministry, and Department of Scientific and Industrial Research ; (*b*) the Department of the Government Chemist and the establishments under the Admiralty and War Office concerned with chemical analyses ; and (*c*) the Meteorological Office.

The Report contains a number of important recommendations, and although it introduces differentiations which will inevitably give rise to dissatisfaction among certain sections of the staffs affected, its proposals, if put fully into effect, represent on the whole a great step forward in the direction of both higher status and fuller economic recognition for the scientific worker in Government employment.

The Committee, over which Sir Harold Carpenter presided, was a strong one and included, in addition to an administrative element drawn from the Treasury and War Office, Sir Robert Robertson, the Government Chemist ; Dr. F. E. Smith, Secretary of the Department of Scientific and Industrial Research ; Mr. H. T. Tizard, his predecessor in office and now Rector of the Imperial College ; and Mr. H. E. Wimperis, Director of Scientific Research at the Air Ministry. Evidence was received from the heads of all the larger scientific establishments, while the views of the staffs concerned were represented to the Committee by the Institution of Professional Civil Servants.

The examination of radical proposals for a complete change in the relationships of the scientific departments would appear to have fallen well within the terms of reference. The Committee, however, showed the better part of valour by the ingenious gloss that, as the respective functions of the establishments under consideration had 'recently' (actually in 1928) been set out in considerable detail in the Report of the Research Co-ordination Sub-Committee of the Committee of Civil Research, they had "assumed the first part of our terms of reference to be an instruction, not to

criticise and report on those functions, but to take note of them as the basis of our investigation into the conditions of service of the staffs employed ". Accordingly, " we have considered it unnecessary for us to report, for example, on a proposal (admittedly not unanimous) made to us by the Institution of Professional Civil Servants, for a unified State Scientific Service in the form of a Ministry of Science ".

Although the idea of closer unity of which a Ministry of Science is but the extreme form of organisation did not command the unanimous support of both wings of the Institution's membership, it will be a disappointment to all concerned that such an authoritative Committee should not have given a definite lead, or at least some guidance for the direction of the future development of the scientific services. The Committee has, however, made a series of proposals, following in principle very closely those submitted to the Committee by the Institution and endorsed by the Association of Scientific Workers, which will achieve a greater measure of uniformity in the conditions of service of the staffs concerned, and so pave the way to a more harmonious and progressive development of the scientific services than is at present practicable with the existing departmental structure.

As regards the contention that the present salaries and financial prospects of the scientific staffs in Government service are shown to be generally inadequate by the difficulty of recruiting and retaining officers of the requisite standard, the Report states that " it is open to question whether the State Services are at present attracting a fair proportion of the best recruits. In any case, we think that the present supply is neither so large nor so good as it might be if the conditions of employment were made more attractive." The Report goes on to remark that " the fact remains that the State has to compete with private industry as well as with the universities for the services of research workers, and we are clear that some steps must be taken to make that competition more effective ".

The Committee's proposals for an improved and unified system of salary scales are subject, however, to certain important reservations. It insists—and here it had the full support of the staff organisations—not only that the standard of recruitment must be high, but also that duties must be strictly graded so as to ensure that scientific officers " are always employed either on investigations which definitely require originality of outlook and execution, or on work which, though not demanding exceptional originality, does require wide knowledge and special experience ". Work of an " ancillary character " must, it is urged, be devolved upon a class of ' technical assistants ' corresponding in principle with such existing classes as those of ' observer ' and ' technical assistant ' in the Department of Scientific and Industrial Research and ' test assistant ' at the Royal Aircraft Establishment, for whom improved salary scales and prospects are also recommended.

The new grades and salary scales do not go beyond the existing rank of Principal Scientific Officer at the National Physical Laboratory or its equivalent. Of this senior grade it is stated that the qualifications will normally include both scientific attainment and power to organise and direct research; but the latter is not regarded as essential, and the important recommendation is made that it should be possible for a research officer to reach this grade solely on his merits as an individual investigator. The Committee states that it looks forward to " the Government research establishments being ultimately so organised and recruited that every research officer will be able to reach this grade before retirement, provided only that his proved capacity on appointment is followed by normal development during service ". This departure from civil service practice is an innovation which will be warmly approved by those who feel that the principles and methods of promotion normally applied in the civil service among the non-technical staffs are somewhat too rigid in their application to those engaged in creative scientific work.

While the Committee's grading proposals are based on the conception of uniformity, they retain the present distinctions between ' research ' staffs on one hand and ' technical development ' and chemical staffs on the other hand, as regards provision for superannuation. For the former, the continuance of the Federated Universities Superannuation Scheme is proposed, and for the latter the normal superannuation provision for established civil servants made by the Superannuation Acts. Taking this line of cleavage, the Committee differentiates markedly between the careers to be offered on the respective sides, notably in the earlier stages of service. In the case of staffs under the ' F.U.S.S.', the new entrant, who will normally be a university graduate with first or second class honours, will be appointed as a ' junior scientific officer ' on a scale of £200-15-260 (basic). When he reaches his maximum of £260, steps are to be taken " to assess his capacity for

research work". His record will be reviewed by a selection board, which will keep in mind that the next grade of 'scientific officer' "should include on the one hand officers who must be specially qualified to undertake research work, and on the other hand those who will be engaged on work which although of a responsible nature and best undertaken by officers recruited after graduation at a university, requires scientific experience rather than special aptitude for research". If he is found to be qualified for the duties of a 'scientific officer', he will be promoted to that grade, the basic scale for which will be £300-550; while if he is recommended as exceptionally qualified to undertake research, he may enter the scale at £350 (basic). It is further recommended that a junior scientific officer "who after being two years at his maximum, has not been recommended as suitable for appointment as scientific officer, should be required to leave his department, unless he can be appointed to a vacancy in one of the assistant grades". This process of selection for retention in the service as a scientific officer and the power of allowing the research worker of exceptional promise to jump to £350 (basic) are extremely important suggestions and will do much to render more attractive the research side of the scientific services.

Unfortunately, however, the counterparts of these proposals for the junior grades in the 'technical' and chemical establishments are not identical, with the result that although some existing anomalies are removed among the F.U.S.S. staffs, new differentiations will be introduced in the Air Ministry and Admiralty as between the 'scientific' and 'technical' pools, the members of which are at present uniformly graded. The differentiations will, however, on balance involve a wide measure of unification; for the existing welter of grades and salaries will be replaced by two simple hierarchies, which will be identical in the case of senior officers.

The claims made on behalf of the staffs within the Committee's terms of reference involved complete unification and a commencing basic salary of £250 after a suitable period of probation; and the suggestion that only "limited" prospects should be offered to the technical and chemical staffs of going beyond £450 (basic) will not only give rise to serious dissatisfaction, but also go far to nullify the Committee's efforts to make the State scientific services more attractive. So far as the technical and chemical departments are concerned, it will still be the case that a more lucrative career will be open to the secondary school boy of scientific leanings if he enters the civil service in a non-technical capacity, through, say, the Executive Class examination at the age of eighteen years, for success in that examination will ensure him a clear run through to a salary of £400 (basic) without special efficiency bars and without expensive training, and on first promotion he will be assured of a jump to a scale rising from £400 to £500 basic.

While the Committee makes no specific recommendations with regard to the posts graded higher than principal scientific officer which carry administrative as well as scientific responsibilities, it is pointed out that it is obvious that if the other recommendations are accepted, the position of senior officers will call for review, and that the salaries attaching to many of these posts will have to be increased. As some members of the Committee were in the category in question, it is suggested that a small *ad hoc* committee should be appointed to consider the higher posts. In this connexion it is pointed out that those members of the Committee who have had direct responsibility for recruitment to scientific research staffs have found the inadequacy of the prospects offered by the higher posts a serious obstacle.

On a superficial examination, the Report would appear to be primarily concerned with economic questions affecting the conditions of employment of the State scientific worker, but when the Report is read in conjunction with a knowledge of the diversity of minutely differentiated salary scales and general conditions of employment that obtains in the scientific departments, it will be seen that it represents a very important stage in the development of those services. The recognition of the fact that the scientific workers in State employment are as a class performing a distinctive service will be more readily achieved now that, like other distinctive classes of civil servants, their conditions of employment have been closely assimilated. Moreover, by its insistence upon the need for a departure from normal service practice in the case of the socially valuable but often unrecognised gifted individual research worker without administrative talents, the Committee has made a break with precedent which must have important results. While scientific workers in Government employment as a whole will deprecate the discrimination against technical and chemical staffs, they will, we are sure, be grateful for the care which has obviously been devoted to examining their conditions of employment, and it is to be hoped that the Government will refrain from devising the familiar official excuses for pigeon-holing the Report.

The Human Blood Groups.

Blood Grouping in Relation to Clinical and Legal Medicine. By Prof. Laurence H. Snyder. Pp. xi + 153 + 5 plates. (London: Baillière, Tindall and Cox, 1929.) 22*s.* 6*d.* net.

A PECULIAR value is lent to this book by the fact that its author is not a medical man and that his horizon is therefore not overclouded by the medical applications of his subject. It cannot be said that it has not a certain medical tinge, for Prof. Snyder states with modest pride that he has been concerned in a number of operations for the transfusion of blood; moreover, he has not been able to avoid an excursus into the history of blood transfusion which is interesting but not really germane to his subject. None the less, Prof. Snyder is primarily a biologist and thoroughly competent to deal with the relation of the blood groups to human biology, and this is where their main interest lies.

The best chapters in Prof. Snyder's book are those on Mendelian inheritance, the heredity of the blood groups, the blood groups in animals, and their racial distribution. It is a great pity that the two latter were not considerably extended; very little of the knowledge on these subjects has as yet been collected in book form. The chapter on the technique of blood transfusion cannot be recommended to those about to embark upon the procedure for the first time; it contains descriptions of the divers more or less elaborate pieces of apparatus which have been invented for this purpose by those having a passion for making the simple thing difficult, but fails to lay stress on the fact that all that is actually required in the way of special apparatus is a funnel, tubing and cannula, and an enamelled pint pot, such as is to be found in every nursery and most kitchens. It is, moreover, difficult to understand why Prof. Snyder does not regard direct matching of blood, without grouping, as a satisfactory means of selecting a donor.

The demonstration of the fact that the bloods of all human beings is not identical, but that they fall into four well-defined groups, is one of the most striking of the more recent advances in human biology; the facts of the case are not yet widely known, though much of the knowledge has been available for the past twenty years, and Mr. Snyder has performed a good service in crystallising the present state of knowledge in book form. The credit for the discovery of the groups must rest with Landsteiner; before his time various observers had reported the agglutination of the red cells of one individual by the serum or plasma of another, but up to then such occurrences had been regarded as pathological. Landsteiner in 1900 showed that the serum or plasma of certain normal individuals would agglutinate the red cells of other normal persons, and that this phenomenon was no indication of disturbed health; in 1909 he showed that on the basis of this reaction it was possible to distinguish at least four types of blood. The same thing was shown more or less independently and almost synchronously by Moss in America and by Janssky in Europe; these authors applied numbers to the four groups, but unfortunately they used different numbers for the same things, and thus laid the foundations of a confusion which exists to the present day. When an author speaks of Groups I. or IV. it is even now impossible to know to what he refers unless he appends the name of one of these observers. Landsteiner in his earlier work forecast the importance of the groups both in regard to the transfusion of blood and to legal medicine, but in spite of this, for many years his work was scarcely regarded.

In 1910 von Dungern and Hirzfeld made an intensive study of the inheritance of the groups in a series of families and showed that the observed facts were explicable on the postulation of two dominants presenting the agglutinable substance, which were resident in the red corpuscles, and were referred to as *A* and *B*, and two recessives represented by the corresponding agglutinins and resident in the plasma. Though this hypothesis has lately been the subject of important modification at the hands of Bernstein, the agglutinable factors, or, as it is now the abhorrent but ineradicable custom to describe them, the agglutinogens *A* and *B* still hold the field, and although Prof. Snyder is rather timorous about committing himself on this point, there is every reason that the numerical nomenclature of the groups should now be dispensed with and that they should hereafter be known by their agglutinogen content as *AB*, *A*, *B*, and 0.

It is true that various workers have from time to time produced evidence purporting to demonstrate the existence of agglutinogens other than *A* and *B*. The most portentously long and detailed papers are those of Guthrie and Huck. Prof. Snyder adopts a cautious, not to say timid, attitude in regard to the possible existence of agglutinogens other than *A* and *B*, but it is now fairly evident that the whole structure of the groups is explicable on the postulation of these two only, and that observations reported as demonstrating the exist-

ence of others have depended upon errors of one sort and another, and more particularly failure to recognise that there are differences both in the titre and adsorptive power of agglutinogens and also in the titre of agglutinins in different bloods.

The history of the subject so far as it has gone offers an excellent demonstration of the weakness inherent in the experimental method. The original discovery of the groups and the elucidation of their structure were brought about by sound induction from observed facts. Further experimental work in the hands of many observers revealed what appeared to be exceptions to the general law laid down as a result of the work of Landsteiner, von Dungern and Hirzfeld, and others, and, modern science being firmly bound to the chariot of the experimental method, such observations were accepted at their face value. But the experimental method has its weaknesses. Next to the original discovery of the groups and of their structure, the greatest triumph in this field has been the enunciation by Bernstein of his hypothesis as to their inheritance. It does not appear that this worker performed a single experiment; he did, however, survey with care the data as to the distribution of the groups in various human races, and by the application of mathematical methods was able to show that this distribution could indeed be accounted for by the postulation of the agglutinogens *A* and *B*, but that they must be inherited, not as von Dungern and Hirzfeld had supposed, but as two of three allelomorphs, the third being their absence or 0. Further work has provided no significant exceptions to what may now be described as Bernstein's law.

In the face of the conformity of the known facts to Bernstein's law, it is difficult to believe in the existence of agglutinogens other than *A* and *B*, and in this respect and in spite of a great deal of experimental work and the expenditure of much paper and ink, the situation remains where it was twenty years ago. The whole episode serves to point the remarks of the prelate who at a recent meeting of the British Association pleaded for a seven years' truce of God to experimental work and a consideration of the data already accumulated.

The establishment and general acceptance of Bernstein's law is of considerable practical importance. On the original assumption of von Dungern and Hirzfeld, it is obvious that the appearance of the agglutinogens *A* or *B* in the blood of a child when absent from that of the alleged parents is conclusive proof that the parentage is not as supposed; Bernstein's law limits the possibilities even further; it follows from it that matings involving one *AB* parent cannot result in 0 offspring. It is true that *AB* is a rare group, but this narrowing of the field of possible inheritance is of the greatest importance in legal medicine. In Germany, Russia, and several other European countries, evidence based upon the blood groups is freely admitted in forensic proceedings both civil and criminal, but in the courts of Great Britain natural laws have yet to establish their validity. When it comes, the spectacle of the British legal mind wrestling with the laws of Nature will be full of interest and instruction.

In full-blooded American Indians, Prof. Snyder found more than 90 per cent Group 0 individuals, and his observations go far to support the view that this is the original constitution of the blood of the human race; the agglutinogens *A* and *B* seem to have appeared as mutations, the *A* factor somewhere in western Europe, the *B* somewhere in central Asia. The author wisely points out that the anthropological information to be gained from a study of group distribution is limited, and that up to the moment it fails to throw any light on the question of the single, double, or multiple origin of the human race. S. C. DYKE.

Problems of Asiatic Geology.

The Structure of Asia. Edited by Prof. J. W. Gregory. (Methuen's Geological Series.) Pp. xi + 227 + 23 plates. (London: Methuen and Co., Ltd., 1929.) 15*s.* net.

THIS book contains a series of contributions to an international discussion, held at the British Association meeting in Glasgow in 1928, on problems of Asiatic geology.

Since the publication of the third volume of "Das Antlitz der Erde", more than a quarter of a century ago, wherein Eduard Suess gave his classic account of the geological structure of Asia, increasing evidence has been accumulating that many of his views on the origin and classification of the Asiatic mountain ranges are in need of modification. Thus, his representation of the structure of the eastern coast as bounded by a series of folded mountain arcs continuous with the Himalayan ranges has for many years been abandoned in view of von Richthofen's description of the great fault-blocks which constitute the dominant tectonic feature of that area.

There must, indeed, be many geologists who have found it hard to form an unbiased opinion of, for example, the relationship of the Altaid and Himalayan mountain systems when confronted with the

fundamentally different ideas expressed by Suess and Argand; and for the solution of this and other problems they will welcome the opportunity of obtaining the views of recognised authorities on the subject which is afforded by the publication of the volume now before us.

The introductory chapter by the editor, Prof. J. W. Gregory, which is replete with first-hand information obtained during his own travels in Asia, not only gives a clear and concise summary of much that is contained in the subsequent chapters, but also affords a valuable guide to the discussion of the more controversial questions.

Prof. F. E. Suess contributes an interesting account of modern views regarding the region of the Variscan horsts of Europe, in which he stresses the importance of studying 'intrusion tectonics' rather than mere trend-lines in determining the age of mountain chains and their structural connexions. From a consideration of the crystalline schists of the European Altaids, which, in opposition to the generally accepted view, he regards as having been formed by late Palæozoic granitic intrusions, he abandons his father's theories as to the pre-Palæozoic age of the crystalline schists of the nucleus of Asia.

A wealth of new information, now published for the first time, is contained in the chapter on the tectonics of the Iranian ranges by Dr. H. de Bockh and his colleagues on the staff of the Anglo-Persian Oil Co., Ltd. Their discovery and description of the great Iranian geosyncline appears to be in direct opposition to the view expressed by Argand that the movement of Africa north-eastwards against Asia continued as late as Miocene times, and their account of the strong Pliocene folding of south-west Persia is entirely inconsistent with the conception of the opening of the Mediterranean rift at that time.

It may be suggested that the cost of publication could have been materially lessened without in any way impairing the value of the work if this contribution had been reduced by the omission of much of the detailed evidence on which the conclusions are based. It is, moreover, difficult to see how the profile sections across the Andes of Colombia and Venezuela are germane to the present discussion.

Prof. D. I. Mushketov, in an interesting account of the tectonic features of eastern Turkestan, shows that north of the Pamir there was a northward direction of folding in the Kainozoic era as opposed to the general southward movement of the Himalayan ranges.

The structural evolution of the eastern part of the Asiatic continent is described by Prof. G. S. Barbour with the aid of a series of palæographical maps redrawn from those of Dr. A. W. Grabau, and an account of the structural features of the 'Old-rock floor' of the Gobi region, the result of personal observations made during the Central Asiatic expeditions of the American Museum of Natural History, is contributed by Prof. Berkey of Columbia University. Five periods of orogenic movement are described, each of which was accompanied by volcanism. Copious references throughout the volume furnish a valuable bibliography of the geology of Asia.

Bushman Art in South-West Africa.

Bushman Art: Rock Paintings of South-West Africa, based on the Photographic Material collected by Reinhard Maack. By Hugo Obermaier and Herbert Kühn. Pp. xii + 70 + 39 plates. (London: Oxford University Press, 1930.) 84s. net.

TO the student of cultures and culture contacts a people's art is of particular importance. When objects made for purely utilitarian purposes, such as tools and weapons, are alone available for comparison, the sceptic can often argue that similar implements made by two peoples in widely separated areas are merely the results of similar needs engendered by somewhat similar conditions of life, and that therefore no cultural relationship between the peoples concerned need be postulated. When, however, the artistic productions of two such widely separated peoples manifest striking similarities of style and technique, it becomes difficult to deny some definite cultural connexion. The study of primitive art groups, both modern and prehistoric, in different regions of the world, is thus of vital importance in the elucidation of human history.

The volume under review presents the anthropologist with an account of a number of paintings found on the walls of rock-shelters and on boulders in what was formerly German South-West Africa. The original investigations were carried out some time ago by a German resident, Mr. Reinhard Maack, who has since handed over his photographs and copies of the paintings to Dr. Obermaier of Madrid; and it must be said at once that he could not have confided his valuable material into more competent and distinguished hands. The resulting monograph which Dr. Obermaier has written in collaboration with Dr. Kühn of Cologne, the editor of the *Jahrbuch für prähistorische und ethnographische Kunst*, is of very great scientific importance—as, indeed, we should expect it to be,

considering the European reputations of its authors. The second and larger half of the book is occupied by thirty-nine plates, of which thirty-two are in colour, the earlier part being devoted to a description of the sites and a general account of the problems connected with Bushman art.

In the opening chapter some notes on the Bushmen themselves and their art are given, together with a brief summary of the succession of stone age cultures in South Africa. Chap. ii. is devoted to an account of the pictorial material collected by Reinhard Maack. Chap. iii. is entitled "The Spirit of Bushman Art", and therein is attempted a study of the minds of the artists as seen through their work. Chaps. iv., v., and vi. are concerned with the occurrence of more or less similar art groups in South Africa, eastern Spain, and elsewhere. The last chapter discusses the meaning and significance of Bushman art. A selected bibliography is appended at the end of most of the chapters. Chaps. i., ii., iv., and v. are from the pen of Dr. Obermaier, while Chaps. iii., vi., and vii. are contributed by Dr. Kühn.

The investigations in the field seem to have been confined almost solely to the paintings themselves; no proper excavation seems to have been attempted in the floors of the painted sites, and although stone industries are sometimes mentioned as being present, no description of the finds is given. This, perhaps, is to be regretted, as in Southern Rhodesia and the Union of South Africa various phases of the Bushman art are often associated with stone industries belonging to different cultures. Stone implements occur in the district (as, for example, near Swakopmund), and it would have been illuminating to know what sort of industries were made by these South-west African artists. Again, though superpositions of paintings are alluded to, reproductions or descriptions of them—which would, perhaps, have afforded us sequences of styles or techniques—do not seem to have been given by Mr. Maack.

None the less, this book constitutes the first careful study of Bushman art in this part of Africa. On examining the excellent reproductions in colour, the obvious similarity of some of these paintings to early Southern Rhodesian examples on one hand, and to more recent examples in the Union of South Africa on the other, is at once apparent. That all 'Bushman art' in South Africa was made at approximately the same time is out of the question. Many a century, probably indeed many a millennium, elapsed between the making of the first and last paintings. Nor is it at all certain that men of quite the same race were the authors of the early as well as the later examples. It would seem more probable that the whole corpus of Bushman art should be considered as part and parcel of the general artistic activity of Neanthropic man, the work of various migrations of Neanthropic peoples into South Africa—the last of these migrations having ushered in the Bushmen themselves. In the same way, the rock-shelter art of eastern Spain, which is so similar to the earlier series of Southern Rhodesian paintings while differing somewhat from the more typical Bushman art found nearer the Cape, is equally to be connected with this general artistic activity of Neanthropic man and therefore perforce related to the African art groups. With these theories Dr. Kühn seems to be in general agreement. Dr. Obermaier remains rather more conservative and would like to see them confirmed by the finding of skeletal remains demonstrating the racial similarity of the Spanish and African artists. Such finds will probably be made some day. In the meanwhile the conservative attitude is, of course, a sound one and Dr. Obermaier presents the whole case to the reader in a clear and unbiased manner.

Altogether the book makes a notable contribution to knowledge, is well translated from the German, excellently produced, and priced at a distressingly high figure. But one such monograph, containing as it does information of permanent value, is worth many volumes which merely set forth the theories temporarily held by their writers.

M. C. BURKITT.

Physical and Chemical Properties of Interfaces.

(1) *An Introduction to Surface Chemistry.* By Dr. E. K. Rideal. Second edition, revised and enlarged. Pp. ix + 459. (Cambridge: At the University Press, 1930.) 21*s.* net.

(2) *The Physics and Chemistry of Surfaces.* By Dr. N. K. Adam. Pp. x + 332. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 17*s.* 6*d.* net.

IN August 1918, after sending to the late Lord Rayleigh some reprints and expressing to him my regrets that he had not continued his extensive pioneering work on surface tension, I received a reply from which the following is quoted:

"As regards what you say as to my not following up my own work on surface tension, etc., I may confess that I was rather disappointed at the little attention I then received. Besides that, I was and am rather badly equipped for speculations on the

chemical side. There is one point which I do not find noticed by you or Devaux relating to what occurs when a very limited amount of oil is deposited on a large clean water surface. I do not think the spreading can stop just when the layer has become monomolecular. At this stage there would be considerable outward motion extending downward a certain distance, which must carry the spreading further. Finally the drop is larger than necessary, and its contraction is not resisted by any force.

I am,

Yours very truly,

RAYLEIGH."

Fortunately to-day there is no lack of interest in surface tension and the varied phenomena occurring at the interfaces between phases. A striking proof of this lies in the nearly simultaneous publication of two excellent books in English dealing with this subject, which is so largely the outgrowth of Rayleigh's observations and speculations. Both books are by men who have themselves for several years made very important contributions to our knowledge of surface properties.

Although both books treat of the physics and chemistry of surfaces, there are considerable differences in the subject matter and the methods of presentation. Rideal's book is a revised and much enlarged (35 per cent increase in size) second edition of his book of 1926. There are six chapters covering surface tensions of liquids and of solutions, insoluble films on liquids, liquid-liquid, liquid-solid, and gas-solid interfaces. Two chapters treat the electric potentials at interfaces, stability of suspensions and emulsions, and the last chapter deals with gels and hydrated colloids. There are good indexes of names and subjects, but a table of contents giving more than the titles of the chapters would be desirable.

An excellent discussion of the various experimental methods for the measurement of surface tension is included in the first chapter.

Adam's book also has nine chapters, arranged in somewhat less logical order. The opening chapter considers the elementary theory of the capillarity of liquids, emphasising the importance of molecular motions and interactions. The methods of measuring surface tensions are considered in the last chapter of the book.

The second chapter, of about 75 pages, is devoted to insoluble monomolecular films on water. This chapter constitutes a particularly valuable summary of the rapidly accumulating knowledge of the properties and structures of these films—knowledge which has resulted so largely from the efforts of Adam and his co-workers. There is a detailed description of the latest form of balance for measuring the surface pressures of films and of the precautions required in its use. Films are classified as gaseous, condensed, liquid expanded, and vapour expanded. The history of the development of these concepts is admirably treated. The evidences that the films are monomolecular and oriented on the surface are emphasised and properly evaluated. Fundamental concepts are often strikingly illustrated. For example, in justifying the use of surface pressure, we note the remarks (p. 30): "How far should we have progressed if, in the study of gases, the pressure exerted by a gas on its confining walls had been regarded as the difference between the strong tension of the clean vacuum outside the vessel and the contaminated vacuum within? The surface pressure is the tangible, physical force; the surface tension merely the mathematical equivalent of the free surface energy."

In a few other cases the reviewer cannot agree so completely with the explanations adopted. For example, he believes that too much stress is laid on the 'angle of tilt' of the molecules in a film. A more useful view is that in liquid films of such substances as the higher fatty acids, the hydrocarbon chains are arranged almost as irregularly as in any liquid phase, subject only to the requirement that one end of the molecule must remain in contact with the water. The reviewer cannot agree (p. 75) "that the heads tend to hold the molecules together, while the chains try to disrupt the film". When there are no heads, the film actually contracts into a single droplet, proving that it is the heads that cause the spreading.

The study of surfaces is interrupted in Chapter iii. in order "to review the information available as to the properties of molecules obtained from other sources", such as X-ray studies of organic crystals and liquids, and then in Chapter iv. thirty pages are devoted to surface films of soluble substances and adsorption. The next chapter deals with results of the measurements of surface tension. The whole consideration of the interesting relations of the surface tensions and the total surface energies of benzene substitution products is brushed aside with the statement (p. 151) that "it seems doubtful if the values of the total surface energy can be made to furnish information as to the orientation of the surface molecules"—a conclusion with which the reviewer wholly disagrees.

The properties of solid surfaces, the spreading of liquids on liquids and solids and lubrication are discussed in the next two chapters. A chapter of sixty pages deals with the structure and the chemical properties of solid surfaces and adsorbed films

on them. A discussion of heterogeneous chemical reactions occupies about ten pages, but the electrical properties of surfaces are not considered.

Although both books cover nominally the same subject matter, the differences in treatment and even in the choice of topics make it desirable for every student in this field to read both books. Rideal's book is more comprehensive and gives the better general survey, but Adam's book is unsurpassed in those fields in which he has specialised.

I. LANGMUIR.

Our Bookshelf.

L'Appareillage électrique : le petit appareillage, le gros appareillage basse tension, l'appareillage haute tension, tableaux de distribution, postes de transformations ruraux ; construction, applications. Par Louis Lagron. (Nouvelle Encyclopédie Électromécanique, No. 3.) Pp. 587. (Paris : Albert Blanchard, 1930.) 36 francs.

THIS is the third volume of a useful electromechanical encyclopædia. The author classifies electric apparatus into four groups. First, there is small apparatus, that is, apparatus for use at low voltages and that does not take a current greater than twenty-five amperes ; next he deals with large low voltage apparatus which takes currents greater than twenty-five amperes. The third class consists of high voltage apparatus, the pressure not exceeding 33,000 volts but the current being of any value. The fourth class consists of very high voltage apparatus, the pressure exceeding 33,000 volts. We learn that the French Minister of Public Works standardised the voltage of supply at 230 in July 1925. The pressure of supply of all work completed after that date is to be 115, 230, or 460 for direct current supply, and 115 or 230 for all systems of supply installed after that date. The frequency also is to be 50. Like England, however, it will take a long time before all the pressures of supply are standardised.

Tables are given of sparking distances, and amongst the constants given for insulating materials are their electric strengths. The formulæ given for fuses and for the heating of cables are only roughly approximate. The laws of the convection of heat from bodies cooling in air are now well known and more accurate formulæ could have been given. English engineers will be interested in the information given for wooden poles, cement poles, and lattice towers.

Cours de mécanique professé à l'École Polytechnique. Par Prof. Paul Painlevé. Tome 1. Pp. vi + 664. (Paris : Gauthier-Villars et Cie, 1930.) 100 francs.

FOR many years now the underlying principles of mechanics have been the subject of critical revision. In an elementary treatment of these principles from the point of view of teaching, however, it is quite impossible to approach the subject except largely from the classical point of view, if not because of the essential difficulties of the relativistic outlook, at least because a knowledge of classical mechanics appears to be essential for a true understanding of relativity.

M. Paul Painlevé seems to have found time from his political activities to produce in this " Cours de mécanique " a complete treatment of the first stages of this subject, as they have been expounded by him in his course at the École Polytechnique between 1905 and 1924. The course bears all the marks of a thorough and careful teacher, and the consistent striving after rigorous presentation is typically French in its precision. The earlier part of the course covers most of the material which is normally dealt with in English colleges under the heading of " motion of a particle and of a system of particles ", with astronomical applications to planets and comets. In the later part the author goes on to discuss Lagrange's equations, D'Alembert's principle and its various extensions, the equilibrium of strings, and the nature of frictional forces.

Although the field has been well traversed in English books, nowhere has it been so carefully developed and so logically knit together as in this classic by a world-famous teacher.

The Conclusions of Modern Science. Plainly told by Walter Grierson (" The Enquiring Layman "). (The Outline Library, No. 10.) Pp. xviii + 198. (London : George Newnes, Ltd., n.d.) 2*s.* 6*d.* net.

IN this little book, " The Enquiring Layman " has marshalled the majority of the most important facts and conceptions of modern science. A layman he might claim to be, yet he cannot be a real visitor to the subject of science. He shows a definitely intelligent attitude towards it and presents his findings in a distinctly palatable style.

Astronomy, natural philosophy, biology, and the other conventional branches of science receive consideration, yet the author—quite unconsciously perhaps—has performed one important feat in showing that this conventional subdivision of science is essentially artificial. Of all the subjects dealt with, the most abstract, man the interpreter, is probably the author's *pièce de résistance.*

It is evident that " The Enquiring Layman " is keenly interested in the subject, and he has presented it in such a manner as will infuse a similar interest into his readers.

Practical Plant Biochemistry. By Muriel Wheldale Onslow. Third edition. Pp. vii + 206. (Cambridge : At the University Press, 1929.) 12*s.* 6*d.* net.

MRS. ONSLOW'S book fills a decided gap in botanical literature. Since its first appearance, it has been considerably extended by a chapter on the plant acids, as well as by shorter sections on the derivatives of these bodies, waxes, essential oils, and also nucleic acid. Serious changes of form are scarcely possible in a text-book of this character, but an additional chapter, in many ways the most interesting in the book, has now been added on the possible interrelationships of the hexose sugars, the pentoses, and the pectic substances. The recent work on the oxidising systems of plants is also summarised in a convenient form.

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.*]

A Relation between the Radial Velocities of Spiral Nebulæ and the Velocity of Dissolution of Matter.

ACCORDING to a fundamental formula of Einstein's cosmological theory of gravitation, the total mass of the universe, M, is connected with the radius of curvature of the universe, R, by the formula

$$(1) \quad M = \frac{c^2\pi}{2f}R.$$

In this equation c denotes the velocity of light and f the constant of gravitation.

If we regard the size of the universe as variable, and if we denote by α the 'disintegration constant' of matter and by v that 'cosmic velocity' which represents the differential coefficient of R with respect to time, we obtain from equation (1):

$$(2) \quad M\alpha = \frac{c^2\pi}{2f}v.$$

As is well known, α is equal to the mass equivalent of 2 ergs per gram-second in the case of the sun. The average value for all fixed stars undoubtedly agrees in order of magnitude with that value. Hence, approximately,

$$(3) \quad v = \frac{4f}{\pi c^4}M = 1{\cdot}1 \times 10^{-49}M.$$

If we insert for M, according to Hubble (*Astrophys. Jour.*, **64**, p. 369; 1926), $1{\cdot}8 \times 10^{57}$ gm., equation (3) yields for v a value of about 2×10^8 cm. or 2000 km. per second. This value agrees well with the magnitude of the velocity with which the farthest spiral nebulæ appear to recede from us.

ARTHUR HAAS.

University of Vienna,
Oct. 11.

Animal Husbandry.

THE term 'animal husbandry' is gradually becoming more employed by both administrators and scientists concerned with the live stock industry. That it is differently employed by different speakers is the apology for what follows.

The aim of the science of animal husbandry is the efficient production of farm live stock: it deals with the application of those basic sciences which affect the production and maturation of our farm live stock. The principal sciences from which it derives are genetics, nutrition, animal health, economics, and physiology, both reproductive and nutritional. These basal sciences seek to discern fundamental principles by the formation of hypotheses, which as evidence accumulates become theories, and eventually on final proof take their place as laws. In their turn these sciences draw on others.

The science of animal husbandry does more than apply the sciences from which it derives: it co-ordinates them. The real function of the scientific animal husbandman consists, not in the direct application of new knowledge or the mere testing upon a large scale of such hypotheses as its basal sciences may bring forth, but in the relation of new facts to existing circumstances. This implies that animal husbandry is not merely an applied science: it can evolve new techniques and can prosecute research.

Just as other sciences have various aspects, so has the science of animal husbandry. In a certain aspect one of its basal sciences may predominate. The science of animal husbandry in relation to a particular science applies that particular science to practice and at the same time takes into consideration the other basal sciences which affect the problem under consideration.

In Great Britain there is no school of scientific animal husbandry as such. Consequently this science has been largely developed by those institutes connected with agriculture which are concerned with research into the basal sciences, particularly genetics, nutrition, and physiology. Each kind of institute has, to a greater or less degree, developed animal husbandry. For example, there is the science of animal husbandry based upon the science of nutrition; the science of nutrition alone can make little contribution to the material welfare of mankind through live stock without taking into consideration the other basal sciences. Thus there are developed animal husbandmen who are primarily nutritionists but who also must have a sufficient understanding of the principles and findings of the other sciences to enable them to co-ordinate the work with which they are mainly identified. In the same way, there are animal husbandmen who are primarily either veterinarians or geneticists.

At the present time it is open to question whether the industry of agriculture can profit more from the new scientific discoveries which one may reasonably anticipate will be made by the research workers in the basal sciences or from an intelligent and co-ordinated application of that knowledge which is already available. Hitherto greater emphasis has been laid on the value of fundamental researches: and rightly so, since these are an absolute prerequisite to the proper functioning of the science of husbandry. It can, however, be fairly debated whether the time is not now ripe for an organised development of the science of husbandry. But whether this should be directed as a separate entity seems doubtful. Since its inspiration is drawn from the research institutes, separation would possibly sterilise it.

It would appear better were the science of animal husbandry to continue to be based on the various research institutes, but that the dissemination of results should be made, not through the existing county organisers (who have such a wide field to cover that they can be expert in no one subject without some sacrifice in another), but through advisory animal husbandmen, each operating in an area. These men would have no adminstrative duties. Their function would be to maintain contact with the various research institutes (they could, in fact, have their headquarters at one of these) and to apply the results of the animal husbandry sections of the various research institutes to the particular problems of their area. Such animal husbandmen would specialise in different aspects, such as pigs, horses, dairy cattle, etc. They would at the same time act as *rapporteurs* to the animal husbandry section of the research institute on which they are based. Undoubtedly there is a weak link in the chain which connects scientific research designed for the assistance of agriculture to the practice of farming. A recognition that animal husbandry exists as a science would do much to strengthen this link.

A precise definition cannot be confined to a few words. Briefly, animal husbandry may be defined as

that branch of science which interprets, co-ordinates, and finally applies the results of science to problems of live stock production.

A. D. BUCHANAN SMITH.

Animal Husbandry Section,
Animal Breeding Research Department,
The University of Edinburgh,
Oct. 16.

Highest Recorded Shade Temperature.

IN the issue of NATURE for Sept. 6, 1930, at the bottom of page 386, appears an item, "Sept. 13, 1922. Highest Recorded Temperature."

The validity of the reading at Azizia has been questioned by so eminent an authority as Dr. G. Hellmann—see *Monthly Weather Review*, May 1930, page 208. Weather Bureau authorities are of opinion that the Azizia record of maximum temperature cannot be classed as having been obtained under standard conditions of exposure. We are not unmindful of the fact that it is a difficult matter to determine the maximum temperature in a shelter situated in a desert region. The chief evidence against the Azizia record is the fact that it is not supported by the readings of other thermometers in the same region, as pointed out by Dr. Hellmann, and was independently developed by the Weather Bureau climatologists.

A. J. HENRY.

U.S. Weather Bureau,
Washington, Sept. 24.

THE observations at Azizia were published by Prof. F. Eredia in 1923 (*Roma, Boll. Inform. econ.*, 1923, No. 5). After describing the site, in a plain surrounded by hills, he tells how a complete meteorological station, including registering instruments, was established in 1913, of a permanent character, *similar to the other stations installed at various places in Tripolitania.* He adds that during the period when he lived at Azizia, he determined the frequency of high temperatures from hourly observations and also from the readings of a thermograph at a temporary station near by. Referring to the figure of 58° C. (136° F.) on Sept. 13, 1922, he notes that it occurred during a period of south-west winds and almost cloudless sky. He evidently accepts the reading as correct.

I was aware of Hellmann's criticism, but in view of the above summary, and the fact that Prof. Eredia is a competent meteorologist, I concluded that the high readings were probably due to the nature of the surroundings rather than to any defect of instruments or screen. An analogous case in England was described by Miss E. H. Geake (*Meteorological Magazine*, 61, p. 78; 1926). The lowest screen minima at Garforth, Yorks, are 15°-25° F. lower than those at surrounding stations, and this is entirely due to the local exposure!

The maximum at Azizia is only 2° F. higher than that at Death Valley, California (see NATURE, vol. 126, p. 81; 1930), which is accepted as correct by the U.S. Weather Bureau. Both stations are in depressions in arid sub-tropical regions, and both maxima are isolated readings, for the 225 stations in California for which data appear in the *Monthly Weather Review* for July 1913 do not show any other maximum exceeding 119° F. To complete the parallel, both are criticised by Hellmann as too high. To my mind, the fact that the two maxima are so nearly identical is a reason for accepting both of them.

THE COMPILER.

Ball Lightning.

A CASE of globular or ball lightning was reported to me at East Hampton last summer, and I had an opportunity of questioning an eye-witness and investigating the premises. This account has value only for comparison with other cases, and I presume someone is making a collection of reports of this nature and studying the conditions under which the phenomenon occurs.

A large modern summer residence was struck twice within fifteen minutes. The owner was standing at a window watching the approaching storm, which came up over the ocean. He states that the flashes struck in the water, coming nearer and nearer, like advancing shell-fire; then a flash to the sand dune between his house and the ocean, another in the intervening field a hundred yards from the house, and a few seconds later he found himself 'coming to' in a dazed and very shaky condition. The chimney had been struck and blown to pieces, and his arm was resting on the mantelpiece over the fireplace. He saw no flash and heard nothing, though he did not fall. Fifteen minutes later, a second bombardment commenced, and a flash struck and melted the telephone wire just outside the house, following the wires into the cellar under the kitchen, and apparently dissipating its energy among a maze of criss-crossing bell wires and furnace pipes below the kitchen floor. The thin asbestos covering of one of the pipes had been burst open in places as if by small charges of an explosive.

The ball discharge appeared in the kitchen in the centre of the room (just over the furnace pipes), about three feet above the floor, and within three or four feet of the cook, who was standing up and facing the point at which it appeared. She told me that it appeared just after the thunder crash, was yellow like a flame, about five inches in diameter, and was spinning like a top. She was very positive about the whirling, and was looking down on the thing at very close range. I asked her whether it faded away or exploded. She said, "I didn't wait to see—I jumped for the cellar door and ran down the stairs"! There was no sound of an explosion. She also stated that the room was full of a smoky haze when she returned, and that there was a strong smell. I asked her whether it was 'like sulphur' (the popular description), and she said, "No, it was acid-like." This suggests an oxide of nitrogen. No marks of the flash could be found in the kitchen, but there had evidently been a heavy electrical disturbance below the floor. The cook was near enough to the ball to touch it, and it is regrettable that she neglected the opportunity of making a valuable contribution to our knowledge of this mysterious electrical phenomenon! I think that I should have reached for it, but am not sure.

R. W. WOOD.

Johns Hopkins University,
Baltimore.

Separation of Antibodies from the Serum Proteins.

ANTIBODIES are as a rule associated with serum proteins. In view of both the high theoretical and clinical importance, a large amount of work has been done in order to obtain protein-free antibodies. The failure of these endeavours has led to the assumption that antibodies are either themselves proteins or that they are in some way closely bound to proteins.

In experiments carried out with diphtheria antitoxin and antityphoid serum, we have succeeded in obtaining active antibodies chemically free from proteins. These results were obtained by the method of adsorption and specific elution developed in their recent

studies on enzymes by Willstätter and his co-workers, who succeeded in preparing protein-free solutions of enzymes after previous autolysis of cell proteins.

Antisera diluted 1:10 were adsorbed by large amounts of kaolin (usually one part kaolin to one part serum). This mixture was allowed to stand about 24 hours at 37° and filtered. Aliquot portions of the adsorbed kaolin-serum residue were then resuspended in a number of solutions of organic substances (glycocol, glycerol, glucose, etc.), which under certain conditions are effective eluents. Glycocol was first used by Fodor and his co-workers to elute peptide-splitting enzymes from adsorbate, thus obtaining solutions of enzymes which without previous autolysis were practically free from proteins.

Our experiments showed that antibodies adsorbed on kaolin could be obtained in solutions of glycocol in 2 per cent sodium chloride. The eluates of antibodies obtained corresponded to the protein-free enzymes in that they were chemically free from proteins. Not only the usual colour and precipitation reactions like that of Millon or Esbach, but also the more susceptible Jones-Spiegler test, which indicates 0·0002 per cent proteins, were negative.

The two known typhoid agglutinins reacted differently towards elution with glycocol - sodium chloride. By elution with a solution containing about 2 per cent glycocol and 2 per cent sodium chloride, only the flagellar agglutinin was recovered. However, on diminishing the quantity of sodium chloride (0·3-0·5 per cent), the amounts of flagellar agglutinin recovered became much smaller and at the same time small quantities of somatic agglutinins appeared. The antitoxin behaved like the flagellar agglutinins.

The antitoxin content of the protein-free eluates was tested by the intracutaneous neutralisation test employed by Roemer, while the agglutinin content was determined by the usual agglutination technique. The recovered antibody in the protein-free solutions was, both in the case of diphtheria antitoxin and flagellar typhoid agglutinin, about 20 per cent of the concentration in the original sera. This does not imply that this is the maximum recoverable percentage. In these experiments we were primarily concerned with the problem whether it is possible to purify antibodies by the method of adsorption and specific elution. The problem of yield and concentration as well as the various chemical and serological questions arising from the possibility of separating antibodies from the serum proteins are under investigation.

MAX FRANKEL.

Department of Biochemistry
and Colloidal Chemistry.

LEO OLITZKI.

Department of Hygiene,
Hebrew University, Jerusalem,
Oct. 5.

Commensal Algæ and Reef Corals.

DR. YONGE has directed my attention to an error in my recent paper on coral reefs (*Bull. Mus. Comp. Zool.*, **71**, 6 ; 1930), the origin of which is of no importance. The statement is that *Millepora* and reef-building *Alcyonaria* do not possess commensal algæ. This is quite contrary to fact—for Prof. Hickson showed me them in *Millepora* upwards of forty years ago—and also to the main argument in my course of lectures delivered at the Lowell Institute at Boston. I had decalcified pieces of more than forty colonies of these various forms from surface reefs in the Indian and Pacific oceans and found that zoochlorellæ were present in all. They included *Millepora* and *Heliopora*, which in certain positions may be as important builders as reef corals, and the soft corals (*Sarcophytum*, *Sclerophytum*, and *Lobophytum*) so widely distributed on lagoon and protected reefs.

Prof. Hickson and I have recently examined between us five colonies of *Tubipora*, in all of which we have found the same commensal algæ. I did not think that they existed in *Millepora* from greater depths, having failed to find them by the teasing method in two of Agassiz's specimens of the same from more than 20 fm. Since my return to England I have found them in sections of both *Millepora* and *Heliopora* at various depths down to 50 fm., and believe them to be of universal occurrence in all these reef-builders, though varying in amount. I may add that I found these algæ in a species of the coral *Gardineria* from more than 222 fm., here presumably a parasite.[1]

The argument in the paper in question was that coral reefs have come into existence owing to the active growth of plants and of the above and other plant-animals, especially true corals, which necessarily are dependent *inter alia* on the depth to which light of sufficient intensity for their chlorophyll can penetrate sea-water. This varies mainly with the amount of plankton and other suspended material, but the maximum depth is about 50 fathoms. Under certain conditions the reef-building corals are covered by a white slime, which lies on and in the surfaces of their polyps, and ultimately kills them. This I suggest to be a precipitation of amorphous carbonate of lime from the supersaturated sea-water, owing to the chemical operations of their chlorophyll in utilising carbon dioxide. It is well seen on true corals in lagoon conditions below 10 fm., and I have found a similar slime on Lithothamnioneæ, but not on any of the other builders mentioned. It this be so, it is obvious that shoals cannot be built up on lagoon floors below 10 fm. except near passages or where there is an active flow of water. My object in writing was to induce biologists to examine this and other suggestions in the field. In particular, I should be grateful for any observations upon whether all these several animals digest their commensal algæ, if their feeding conditions are unfavourable. There are places of suitable temperature and with plenty of food, but none of these reef-builders seem to be able to live below 50-60 fm.

J. STANLEY GARDINER.

Zoological Laboratory, Cambridge,
Oct. 21.

[1] *Terra Nova* Exp., Brit. Mus., **5**, 128; 1929.

Laterites and Lateritic Soils.

DURING the course of the past few months I have been afforded numerous opportunities of making field observations on soils over practically the whole range of Australian climatic conditions.

A conscious look-out has been kept for evidences of tropical soil weathering processes distinctive from those of temperate regions, and for evidences of laterite formation. Two outstanding results of these observations have been : on one hand, the inability to observe any real distinction between the leached tropical soils and the corresponding temperate series usually carrying eucalyptus savannah forests, both being entirely podsolic in character ; and on the other hand, the observation that every authentic case of laterite, from the geologist's point of view, was fossil in character—that is, the laterite was to be regarded entirely as a parent material from which new soils were being produced in equilibrium with current climatic conditions. In certain cases, notably in Western Australia, such soils are quite abnormal and

cannot be placed into any of the recognised soil groups. It is only when the laterite sequence has been denuded away, exposing the parent rock, that soils are found falling recognisably into one or other of the zonal soil types.

The fossil character of the Western Australian laterites in the goldfields region has already been suggested by Walther,[1] and it would be of considerable importance if geologists and soil workers could reach some mutual agreement with respect to the definition of laterites. At the present time the geologists seem to be unanimous in the recognition of laterite, although not necessarily with regard to its origin; while amongst soil workers the confusion appears to be very considerable. This confusion probably originates in the fact that the original type laterites were first described from India, and have hence been presumed to be exclusively of tropical origin.

If every authentic laterite is indeed, as in Australia, the product of a past climatic cycle, the position will be very much simplified and laterite soils will find their place in Glinka's endodynamomorphic group. In this case the points of greatest interest will be the nature and period of these past climatic conditions: one feature will certainly be greater humidity, and possibly even water-logged conditions. I doubt whether it will be necessary to bring in higher temperatures, as has been suggested in the past.

J. A. PRESCOTT.

University of Adelaide,
Sept. 15.

[1] *Zeits. Deutsch. Geol. Ges.*, **67**, 113; 1915.

Flashing Afterglow in a Discharge Tube.

ALTHOUGH the observation recorded here may not be new, I have not been able to find a reference to it. A discharge tube was used for testing a vacuum pumping set. It was a straight tube of Pyrex glass 2½ cm. diameter with plane nickel electrodes; the gas was air with residual gases from the walls of the apparatus; and the Crookes dark space was about 3 cm. long.

After passing a discharge from an induction coil there was a strong afterglow which persisted for several seconds, dying away apparently continuously. Before it became invisible it passed into a flashing condition, the flashes occurring at longer and longer intervals and ceasing after about ten seconds.

The phenomenon is almost certainly due to the dissipation of charges on the glass walls of the tube, as is indicated by the following experiment. Two strips of tin-foil were wrapped round the tube and connected to a valve amplifier and telephones. The 'continuous' afterglow was then accompanied by a rushing noise, and each flash in the later stage was accompanied by a loud click.

This effect may be important in the interpretation of discharge tube phenomena and in particular in work on the decay of afterglows. It is conceivable that it takes place more readily with a Pyrex tube and that this circumstance has helped it to escape notice.

H. J. J. BRADDICK.

Physical Laboratory,
Trinity College, Dublin.

Meiosis in a Triploid *Œnothera*.

MY recent statement (*Trans. Roy. Soc. Edin.*, **56**, 467-484; 1930) that a triploid plant of *Œnothera pynocarpa* Atk. and Bartl. had a closed ring of twenty-one chromosomes, has, following its questioning by Dr. Darlington (NATURE, May 17, 1930), been the subject of a reinvestigation. A brief statement of the results would seem desirable, since they confirm Darlington's observations and agree with recent work upon triploid Œnotheras, reported by Capinpin in NATURE of Sept. 27, 1930; moreover, it is as well to remove an error, as soon as it is fully comprehended, from the already too complicated field of *Œnothera* cytology.

Different nuclei at diakinesis and at the heterotypic metaphase show various combinations of the following types of chromosome groupings: univalents; ring and rod pairs; chain, Y-shaped, and ring-and-rod trivalents; various types of quadrivalents, quinquevalents, and associations of chromosomes involving higher numbers. The largest group seen was made up of a chain of eight chromosomes associated (at one end by a triple union) to one end of each of two other chromosomes, making ten in all. Analysis of all the configurations found shows that every one conforms to and may be predicted upon the segmental formula that must be assigned to this triploid on the basis of Darlington's hypothesis (*Jour. of Genetics*, **20**, 345-346; 1929).

A full statement of the facts, and of the theoretical deductions from them, is made in a paper appearing shortly in the *Journal of Genetics*.

DAVID G. CATCHESIDE.

Department of Botany,
University of Glasgow, Oct. 4.

Band Spectrum of Antimony Oxide.

I HAVE obtained and measured a large number of bands extending from λ3250 to λ6700 in the spectrum of the flame surrounding the antimony arc in air. Some of the bands were previously obtained by Eder and Valenta with different salts of antimony introduced into an oxy-coal-gas flame. So far, their vibration quantum analysis has not been attempted. Some of these bands have now been classified and there are at least three systems, with origins approximately at 29619 cm.$^{-1}$, 26480 cm.$^{-1}$, and 24203 cm.$^{-1}$. The origins of the remaining systems have not yet been correctly ascertained. The bands show a doublet structure consistent with the fact that their emitter is the neutral antimony oxide molecule.

A detailed account of the investigation will be published elsewhere.

B. C. MUKHERJI.

Applied Physics Laboratory,
University College of Science,
Calcutta, Sept. 24.

Scientific Inexactitude.

IN recent scientific writing there is frequently a tendency to abbreviate to such an extent that a reader not conversant with the subject may be completely fogged. As an example the following quotation from a recent book on sound may be given: "A clamped steel bar electrically maintained is sometimes employed as a rough standard of frequency." This unfortunate sentence is evidently the result of the general use of the contracted but incorrect expression 'an electrically-maintained tuning fork' in scientific publications. The vibrations are maintained, not the tuning fork, and if this idea is to be conveyed in shortened form a word such as 'operated' or 'driven' should be used instead of 'maintained'. This is only one example of a tendency which, if unchecked, will produce a scientific slang.

CHAS. R. DARLING.

34 Eglinton Hill, London, S.E.18,
Oct. 20.

studies on enzymes by Willstätter and his co-workers, who succeeded in preparing protein-free solutions of enzymes after previous autolysis of cell proteins.

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MAX FRANKEL.

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LEO OLITZKI.

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DR. YONGE has directed my attention to an error in my recent paper on coral reefs (*Bull. Mus. Comp. Zool.*, **71**, 6; 1930), the origin of which is of no importance. The statement is that *Millepora* and reef-building *Alcyonaria* do not possess commensal algæ. This is quite contrary to fact—for Prof. Hickson showed me them in *Millepora* upwards of forty years ago—and also to the main argument in my course of lectures delivered at the Lowell Institute at Boston. I had decalcified pieces of more than forty colonies of these various forms from surface reefs in the Indian and Pacific oceans and found that zoochlorellæ were present in all. They included *Millepora* and *Heliopora*, which in certain positions may be as important builders as reef corals, and the soft corals (*Sarcophytum*, *Sclerophytum*, and *Lobophytum*) so widely distributed on lagoon and protected reefs.

Prof. Hickson and I have recently examined between us five colonies of *Tubipora*, in all of which we have found the same commensal algæ. I did not think that they existed in *Millepora* from greater depths, having failed to find them by the teasing method in two of Agassiz's specimens of the same from more than 20 fm. Since my return to England I have found them in sections of both *Millepora* and *Heliopora* at various depths down to 50 fm., and believe them to be of universal occurrence in all these reef-builders, though varying in amount. I may add that I found these algæ in a species of the coral *Gardineria* from more than 222 fm., here presumably a parasite.[1]

The argument in the paper in question was that coral reefs have come into existence owing to the active growth of plants and of the above and other plant-animals, especially true corals, which necessarily are dependent *inter alia* on the depth to which light of sufficient intensity for their chlorophyll can penetrate sea-water. This varies mainly with the amount of plankton and other suspended material, but the maximum depth is about 50 fathoms. Under certain conditions the reef-building corals are covered by a white slime, which lies on and in the surfaces of their polyps, and ultimately kills them. This I suggest to be a precipitation of amorphous carbonate of lime from the supersaturated sea-water, owing to the chemical operations of their chlorophyll in utilising carbon dioxide. It is well seen on true corals in lagoon conditions below 10 fm., and I have found a similar slime on Lithothamnioneæ, but not on any of the other builders mentioned. It this be so, it is obvious that shoals cannot be built up on lagoon floors below 10 fm. except near passages or where there is an active flow of water. My object in writing was to induce biologists to examine this and other suggestions in the field. In particular, I should be grateful for any observations upon whether all these several animals digest their commensal algæ, if their feeding conditions are unfavourable. There are places of suitable temperature and with plenty of food, but none of these reef-builders seem to be able to live below 50-60 fm.

J. STANLEY GARDINER.

Zoological Laboratory, Cambridge,
Oct. 21.

[1] *Terra Nova* Exp., Brit. Mus., **5**, 128; 1929.

Laterites and Lateritic Soils.

DURING the course of the past few months I have been afforded numerous opportunities of making field observations on soils over practically the whole range of Australian climatic conditions.

A conscious look-out has been kept for evidences of tropical soil weathering processes distinctive from those of temperate regions, and for evidences of laterite formation. Two outstanding results of these observations have been: on one hand, the inability to observe any real distinction between the leached tropical soils and the corresponding temperate series usually carrying eucalyptus savannah forests, both being entirely podsolic in character; and on the other hand, the observation that every authentic case of laterite, from the geologist's point of view, was fossil in character—that is, the laterite was to be regarded entirely as a parent material from which new soils were being produced in equilibrium with current climatic conditions. In certain cases, notably in Western Australia, such soils are quite abnormal and

cannot be placed into any of the recognised soil groups. It is only when the laterite sequence has been denuded away, exposing the parent rock, that soils are found falling recognisably into one or other of the zonal soil types.

The fossil character of the Western Australian laterites in the goldfields region has already been suggested by Walther,[1] and it would be of considerable importance if geologists and soil workers could reach some mutual agreement with respect to the definition of laterites. At the present time the geologists seem to be unanimous in the recognition of laterite, although not necessarily with regard to its origin; while amongst soil workers the confusion appears to be very considerable. This confusion probably originates in the fact that the original type laterites were first described from India, and have hence been presumed to be exclusively of tropical origin.

If every authentic laterite is indeed, as in Australia, the product of a past climatic cycle, the position will be very much simplified and laterite soils will find their place in Glinka's endodynamomorphic group. In this case the points of greatest interest will be the nature and period of these past climatic conditions: one feature will certainly be greater humidity, and possibly even water-logged conditions. I doubt whether it will be necessary to bring in higher temperatures, as has been suggested in the past.

J. A. PRESCOTT.

University of Adelaide,
Sept. 15.

[1] *Zeits. Deutsch. Geol. Ges.*, **67**, 113; 1915.

Flashing Afterglow in a Discharge Tube.

ALTHOUGH the observation recorded here may not be new, I have not been able to find a reference to it. A discharge tube was used for testing a vacuum pumping set. It was a straight tube of Pyrex glass 2½ cm. diameter with plane nickel electrodes; the gas was air with residual gases from the walls of the apparatus; and the Crookes dark space was about 3 cm. long.

After passing a discharge from an induction coil there was a strong afterglow which persisted for several seconds, dying away apparently continuously. Before it became invisible it passed into a flashing condition, the flashes occurring at longer and longer intervals and ceasing after about ten seconds.

The phenomenon is almost certainly due to the dissipation of charges on the glass walls of the tube, as is indicated by the following experiment. Two strips of tin-foil were wrapped round the tube and connected to a valve amplifier and telephones. The 'continuous' afterglow was then accompanied by a rushing noise, and each flash in the later stage was accompanied by a loud click.

This effect may be important in the interpretation of discharge tube phenomena and in particular in work on the decay of afterglows. It is conceivable that it takes place more readily with a Pyrex tube and that this circumstance has helped it to escape notice.

H. J. J. BRADDICK.

Physical Laboratory,
Trinity College, Dublin.

Meiosis in a Triploid *Œnothera*.

MY recent statement (*Trans. Roy. Soc. Edin.*, **56**, 467-484; 1930) that a triploid plant of *Œnothera pynocarpa* Atk. and Bartl. had a closed ring of twenty-one chromosomes, has, following its questioning by Dr. Darlington (NATURE, May 17, 1930), been the subject of a reinvestigation. A brief statement of the results would seem desirable, since they confirm Darlington's observations and agree with recent work upon triploid Œnotheras, reported by Capinpin in NATURE of Sept. 27, 1930; moreover, it is as well to remove an error, as soon as it is fully comprehended, from the already too complicated field of *Œnothera* cytology.

Different nuclei at diakinesis and at the heterotypic metaphase show various combinations of the following types of chromosome groupings: univalents; ring and rod pairs; chain, Y-shaped, and ring-and-rod trivalents; various types of quadrivalents, quinquevalents, and associations of chromosomes involving higher numbers. The largest group seen was made up of a chain of eight chromosomes associated (at one end by a triple union) to one end of each of two other chromosomes, making ten in all. Analysis of all the configurations found shows that every one conforms to and may be predicted upon the segmental formula that must be assigned to this triploid on the basis of Darlington's hypothesis (*Jour. of Genetics*, **20**, 345-346; 1929).

A full statement of the facts, and of the theoretical deductions from them, is made in a paper appearing shortly in the *Journal of Genetics*.

DAVID G. CATCHESIDE.

Department of Botany,
University of Glasgow, Oct. 4.

Band Spectrum of Antimony Oxide.

I HAVE obtained and measured a large number of bands extending from λ3250 to λ6700 in the spectrum of the flame surrounding the antimony arc in air. Some of the bands were previously obtained by Eder and Valenta with different salts of antimony introduced into an oxy-coal-gas flame. So far, their vibration quantum analysis has not been attempted. Some of these bands have now been classified and there are at least three systems, with origins approximately at 29619 cm.$^{-1}$, 26480 cm.$^{-1}$, and 24203 cm.$^{-1}$. The origins of the remaining systems have not yet been correctly ascertained. The bands show a doublet structure consistent with the fact that their emitter is the neutral antimony oxide molecule.

A detailed account of the investigation will be published elsewhere.

B. C. MUKHERJI.

Applied Physics Laboratory,
University College of Science,
Calcutta, Sept. 24.

Scientific Inexactitude.

IN recent scientific writing there is frequently a tendency to abbreviate to such an extent that a reader not conversant with the subject may be completely fogged. As an example the following quotation from a recent book on sound may be given: "A clamped steel bar electrically maintained is sometimes employed as a rough standard of frequency." This unfortunate sentence is evidently the result of the general use of the contracted but incorrect expression 'an electrically-maintained tuning fork' in scientific publications. The vibrations are maintained, not the tuning fork, and if this idea is to be conveyed in shortened form a word such as 'operated' or 'driven' should be used instead of 'maintained'. This is only one example of a tendency which, if unchecked, will produce a scientific slang.

CHAS. R. DARLING.

34 Eglinton Hill, London, S.E.18,
Oct. 20.

Evolution in Material Culture.*

By Dr. H. S. HARRISON.

BY the aid of *methods*, often dependent upon extraneous *means*, man employs *materials* for the achievement of *results*, many but by no means all of which persist as artefacts or other *products*.

Substance is the static warp, and method the dynamic woof, of man's material culture, whilst the products may be looked on as the fabrics, though these are not always tangible. Amongst the more obvious of those which are material in their nature are artefacts of all kinds, but it is clear that such products are themselves the means to further ends. These further ends are material in the case of implements, less immediately material in that of houses or canoes, and non-material in the case of shrines or musical instruments, which satisfy demands of social and individual mentality. Here we find our objective point of view overlapping the subjective—our material products require for their explanation some understanding of such aims and ends as lie outside the field of primary material needs. As soon as we get beyond the study of the instinctive quest of food and self-protection, and pass to that of the aims of the human artificer, we realise that aims and ends as well as ways and means are products of evolution. Man did very well before he was a man at all, and no one has given any reason why he ceased to be an ape.

THE DISTORTING MIRROR OF THE PRESENT.

Our attitude towards the problems that arise in the study of origin and development depends very largely upon the extent to which we ascribe to man a power of foresight enabling him to overrun the limits of environmental suggestion. If we assume that his progress has been based upon his opportunist reactions to such suggestion, we secure a vantage point from which to take a retrospective view of human progress. The visibility is not too good, and the details that are fundamental are often but obscurely seen, partly because the field of view is not only restricted by our ignorance but is also overshadowed by our knowledge. We can see too little of the past and too much of the present.

We have to make a big allowance for our own sophistication, when we are trying to explore the origins and growth of discoveries and inventions, and neglect of this precaution is not infrequent. In the case of pottery, for example, it is sometimes maintained that the plasticity of clay is so obtrusive, and its hardening by heat so easily made manifest, as to place the ceramic art amongst those human industries that may have been developed more than once, if not over and over again. The two essential properties of clay are obvious enough, given the conditions for its accidental hardening by fire, and both may have been discovered at various periods. Looking backward it seems evident to us that an early discoverer, looking forward, could have deduced from these two properties of clay the advantages of modelling this plastic stuff into the forms of vessels and baking them to hardness. Some may think that the deduction was an easy one, but the ease is purely retrospective. The potter was not a product of predestination. The conventional theory of the origin of pottery through the plastering of clay on the walls of baskets may or may not be acceptable, but it is in any case a recognition of the need that is felt to bridge the gap between the discoveries of two properties of clay, and the production of an earthenware pot. The discoveries were essential, but it is only in the light of our own knowledge that pottery appears to have been an inevitable result.

To take another example of the hasty reasoning which credits ancient man with anticipatory conceptions that in ourselves are due to knowledge, it is sometimes suggested that there is no improbability in the idea of the multiple origin of the pyramid, since the observation that piles of loose materials readily assumed a conical form must have been frequently made. To this it may be answered that pyramids are not small, are not made of loose materials, and are not conical in form; but this is only a small part of the relevant reply. The affiliation is indeed inconceivable, since the evolution of a pyramid depended not only upon many material factors, but also upon a number of social and religious sequences. Pyramids were not preconceived as being more pleasing to the gods, and more elevating to the human soul, than any other geometrical monstrosity; nor were they built out of mere Euclidean bravado. For such structures, even in their various modifications of material, form, and function, to appear independently in Mesopotamia, Egypt, India, Cambodia, Java, and America, would have called for parallel networks of coincidences rather than parallel chains.

MAN'S COMMON FACULTIES.

The question as to the nature and importance of the common faculties of the human mind—the components of the psychic unity—is one which demands more attention than it has yet received from anthropologists, Bastian notwithstanding. This is especially the case in relation to the subject of independent evolution. For our purposes it would not only be needful to isolate the common faculties, but also to identify those which have a bearing on the progress of discovery and invention. Here we should meet with the primary difficulty of distinguishing between an inborn human faculty and a traditional or inculcated mode of thought—an acquired type of reaction.

Assuming we had progressed so far in the comparative psychology of *Homo sapiens*, we should still be left with the problem of determining which—if any—of the common faculties are directive in their nature. It is not a question of deciding

* From the presidential address to Section H (Anthropology) of the British Association, delivered at Bristol on Sept. 4.

which faculties are permissive, enabling man to react in a similar way to similar external stimuli, but of determining which of them give him the power, whoever and wherever he may be, to override deflecting influences. Two environments may be similar, but only when they are the same are they identical, and our broad generalisations as to the cultural effect of surroundings such as deserts, mountains, forests, river-valleys, have a bearing upon the general mode of life they encourage or permit, and therefore upon a portion of the field which is open to the discoverer and inventor, but they ignore the differences in the details of any two environments of one general character; and it is discrepancies in detail that produce divergencies in end results. The human mind is very prone to skid on trifles. Moreover, even on the assumption that two similar natural environments are so nearly identical as to lead to similar reactions, under the guidance of the common faculties of the human mind, there still remains the most important factor of them all—that of the artificial environment, in gross and in detail, which formed the starting-point of two peoples whose artefacts and general culture are compared.

Taking all these difficulties into account, we see that the common faculties of man, if they are to be powerful enough to keep his independent lines of progress parallel, must be of an initiating and controlling character. If they are of such a character, history should reveal a wealth of examples of their power to keep man steadily progressing on his course, in all grades and aspects of his culture. But history has no such tale to tell, since it is merely a story of one provisional expedient following on another.

That there are mental faculties common to all men is undoubted, and it was in part by the exercise of such faculties that man secured advancement. Of the evolution of the human brain we begin to know a little, but we are not able to draw a line of demarcation between the innate and the acquired powers of its cells and tracts. In both mind and body we inherit potentialities which only unfold under certain conditions. For the development of the body we may define what are normal conditions, and they must not depart too widely from natural conditions; but for that of the mind the conditions may be almost wholly artificial. Heredity provides the aptitudes, but the grist is delivered through the sense-organs, and whilst the brain is a natural growth, the mind is a cultural construction. Human thought is compilation—a rehash of the past in the present—and no satisfactory record has ever been made of the mind of a man whose sole knowledge had been acquired without the tuition of his fellow-men.

The brain of Later Palæolithic man appears to have been like our own in all essentials, and a Cro-Magnon born to-day might become a skilled mechanic or an able bishop. But man had no more need to become a mechanic than he had to practise as a theologian, though he drifted into both professions. If the mental faculties that had survival value in the prevailing of our species were also those that were active in the initiation and pursuit of cultural advance beyond its needs, we are perhaps led to the conclusion that by far the greater part of human culture, material and immaterial alike, is an afterthought of evolution—an embroidering of the fabric. Man was given the means to earn a livelihood, and found himself commanding and inventing luxuries. In producing a new and cunning big-brained animal with hands, Nature overshot her mark, and we are struggling with the consequences.

The essence of my contention—and, of course, not mine alone—is that there are no common faculties of the human mind that are capable of overruling the vagaries of environmental and historical compulsions, and of directing man's progress in discovery and invention, in various times and places, along lines that are parallel. Beginning with the primary discoveries of early man, applied for material purposes, the prevailing outcome of his independent and opportunist reactions to the results of his own interference with natural materials and phenomena has been divergence and not parallelism.

Discovery and Invention.

It is obvious that discovery lies at the root of all man's material activities, since he must know something of the everyday behaviour of material substances before he can apply or adapt natural objects to his purposes. Discovery may result in the development of activities in which method remains the essential and controlling factor, as in agriculture and the domestication of animals, and we may then call the resulting system of techniques a discovery-complex; or it may initiate and further the development of artefacts, which we may provisionally call inventions. Perhaps few would be disposed to call an agricultural system an invention, and the same applies to techniques of metallurgy or weaving. If these arts are called discovery-complexes, what term may be applied to the products, such as bronze and woven cloth? Iron is an element, extracted from its ores, and man has not reached the stage of inventing elements. Bronze is an alloy of two elements, owing its first production to a series of discoveries, and we can scarcely call it an invention. We may perhaps best get out of the difficulty by using the term discovery-product for all artificially extracted, prepared, and compounded materials which have no significant form imposed upon them, but are merely the raw materials for the future production of shaped artefacts.

The application of the term 'invention' to any and every shaped or constructed artefact can only be justified on the grounds of expediency, and it must be understood that the concession is not meant to embody a definition of invention as distinct from discovery, in the relation of these words to the subjective workings of the human mind, or even to the objective results.

The word 'discovery', in its bearing on material culture, relates only to the subjective appreciation of the properties or reactions of material substances

or bodies, and it does not necessarily carry the implication of an objective exploitation of the knowledge gained. Only when the knowledge is applied to a useful purpose, more or less directly, for the initiation or development of a method or an artefact, does the discovery play a practical part. We may say, therefore, that a discovery is a subjective event which may in many cases be utilised in an objective application, and that it is these applied discoveries alone that are factors in human progress. It is therefore necessary to qualify the word discovery, and speak of an applied discovery, before we can obtain an objective as well as a subjective term. If we attempt to treat the word invention in the same way, and speak of applied invention as the objective aspect of invention, we realise at once that we are doing violence to our conception of the meaning of the word. The word invention, in fact, unlike discovery, is mainly objective in its significance.

Applied Discoveries.

It is clear that material progress began with discoveries relating to materials, objects, and phenomena, of natural or chance occurrence, and that the initial value of such discoveries lay in their immediate practical use. It may have been the behaviour of stones he handled that first aroused man's interest in them, but the utility of individual stones as implements was more important to him than the properties which made them useful. His generalising was unconscious, or even instinctive, since animals discover, though man alone invents. The making of discoveries was not the result of a conscious search for means or methods to achieve an end. Upon those which arose out of observation of simple natural phenomena, and of superficial properties of natural materials, were built up knowledge and experience which led man further and further away from his initial steps, until he was making discoveries about materials which owed their character or composition to his development of methods of treatment.

The general conclusion to which we are forced is that there are no absolute criteria by means of which we can decide what part may have been played by independent discoveries in the production of similarities in human culture. We are safe in assuming that simple primary discoveries, such as that of the plasticity of clay, or the malleability of copper and gold, may or must have been made more than once, but we are equally safe in assuming that, with every step beyond the first, an independent repetition of the same sequence becomes more and more unlikely, and also that the more difficult a single discovery and the more difficult its application, the less likely is its fruitful repetition.

Inventions.

The general recognition of the gradual character of the evolution of human artefacts—so obvious even under modern conditions—makes it unnecessary to dwell upon it. There are, however, no accepted definitions of the kinds of developmental changes or modifications, viewed either objectively or subjectively. If the initial steps in the evolution of simple artefacts are due to discovery alone, as already suggested, we have to decide in what way such steps differ from those which can be called inventive, if difference there is; and also to inquire into the nature of any other factors that may play a part in evolution. Moreover, if we call all artefacts inventions, there is no term left for single inventive steps. If, for example, the outrigger-canoe or the Chinese repeating crossbow is an invention, what distinctive term can we apply to the steps by which it has evolved, assuming these can be identified as due to individual discoveries, or to true inventions, whatever these may be? There is also the possibility—or the certainty—that changes may occur which are due to neither discovery nor invention, but to some slower and more gradual process.

If we begin with implements which were amongst the first to achieve an individuality of their own, those made of stone are for many reasons the most convenient for our purpose. We can scarcely doubt that accident, perhaps often repeated, led to the intentional breaking of stones for the production of edged or pointed implements, which gradually evolved into standardised forms. To summarise a sequence of events that arose out of more than one discovery, we may say that the first artificially shaped stone implement was due to the application of a discovery, and since the artificial shaping was a definite and decisive step, it may be called a *mutation*. Since also it was the first intentional conversion of a particular kind of natural object or material into a kind of artefact, it was a primary mutation. From such a mutation, perhaps occurring more than once, developed the many forms of stone implements with which we are familiar. A mutation of this or any other type is an abrupt and discontinuous step, contrasting with changes which are trivial in character and produce their effect by a process of summation. For these the name of *variations* is appropriate.

In the shaping of the early types everyone agrees that forms such as hand-axes and 'ovates' were not preconceived as models to be aimed at; they must have been the end results of a gradual process of change, in which the shapes emerged through an opportunist selection and imitation of those which were most convenient and effective. This was in effect a process of variation, casual at first but later becoming more selective and adaptive.

Simple stone implements are thus to be traced to a primary mutation, a sudden jump, followed by variation, a gradual process. They were evolved, not invented to serve specific purposes. Similarly, beginning with a primary mutation in each case, the fighting-stick became the club, with its immense variety of form; the digging-stick became the spade, and perhaps the spear, with its derivative the arrow; the pick became the hoe and finally the plough; the hollow reed became the blow-tube. Even before the more evolved implements of these classes had got beyond their one-piece character, however, other factors than variation

sometimes intervened. That is to say, whilst the field of variation is that of form, it is not in exclusive possession of this field.

If a primary mutation was due to one or more discoveries made in relation to the behaviour of natural objects or materials, it is not unreasonable to suppose that similar discoveries concerning artefacts may have led to other mutations. As a hypothetical case, let us consider the origin of the bamboo spear-thrower of New Guinea, which has a socket for the spear, in place of the peg that is present on almost all other spear-throwers. We may suppose that this implement was derived from the ordinary type made of wood, such as is in common use in Australia, and that the first change was that of translation into bamboo. The carved or attached peg for the spear was at first retained, but during the manufacture or use of the appliance it would be easy for the discovery to be made that the bamboo rod readily supplied a natural socket, which would serve in place of the peg for effecting the discharge of the spear. Then followed the intentional construction of spear-throwers with socket instead of peg, and we may call the step —which may or may not be regarded as a progressive step—a free-mutation. If it happened as the result of a discovery, as suggested, it was free from any influences from other implements or mechanisms. It is impossible to be sure that no such outside influence was at work, but the step being decisive and discontinuous, it was at any rate a mutational step and not variational.

We may assume with some degree of probability that free-mutation initiated the provision of the foot-rest on the digging-stick, a grip or handle on the stone knife, the detaching head of the spear to produce the harpoon, the sling-hafting of the flail, and that it was concerned in the origin of other types of hafting. Primary mutation, followed by variations which led to change in form, stimulated by discoveries in relation to method, and often influenced by substitution, led to other discoveries which could be applied for the improvement of the form or construction of artefacts, and these applied discoveries may be called free-mutations. In this way there were produced many implements of a simple character, some having form alone, others showing construction and often mechanism.

So far we have identified no inventive foresight of a kind that would lead directly to the subjective preconception of a new or improved type of implement, differing in any important respect from what had gone before. We know, however, that in our own times the inventor designs his products in advance. This is not to say that at some stage in the evolution of material culture there was a sudden change in the mentality of man. Discovery and imitation lay at the root of all his methods, initiated all his artefacts, and led to the appearance of free-mutations, but when he had established a variety of artefacts that had construction as well as form, he began that process of transfer and adaptation of structural and mechanical characters for which I have suggested the term cross-mutation. These, like the other mutations already defined, were abrupt and discontinuous changes which could not have arisen gradually by variation, but, unlike other mutations, they owed their origin to a combination of features, or an application of 'principles', which had evolved in independence.

The process corresponds to what Mr. Henry Balfour has laid stress upon as hybridisation. It is a process involving foresight, in predicting the possibility of combination, and ingenuity in effecting it. A cross-mutation is a true invention, a product of the inventive faculty, unaffected by discovery in its first conception, though the inventor nowadays may need to make discoveries in relation to materials and methods before he can test the viability of his inventive forecast. Through it all runs the opportunist thread that may be plainly seen in the historical retrospect. Combinations for inventive purposes can only occur to the mind in an artificial environment in which the two (or more) elements of the combination are at hand, and these may have been evolved in entirely different artefacts or contexts.

Accepting these arguments as valid, an invention proper—as distinct from our loose application of the term to shaped and constructed artefacts in general—may be defined as a single mutational step which owes its origin not to discovery, but to a combining of structures or devices already in existence. The result is objectively a structural combination, which is preceded subjectively by the action of the mind in recognising the advantages and the possibilities of the hybridisation, and in thinking out the method of effecting it.

In a further treatment of the subject of inventions it would have been desirable to discuss such factors as change of function, change in method of use, substitution, and numerical mutation, but sufficient has been said to indicate the analytical method of approach.

If we take into account all the factors involved in the development of artefacts, even in simple cases, independent evolution involves coincidences, few or many. It is also clear that the further the artefact from the primary mutation which began it, that is to say, the longer the series of variational and mutational changes that has been undergone, the bigger the draft on coincidence. Nevertheless, we are still unable to point to definite mutational criteria, and to say that it is impossible that some particular mutation—and especially a primary mutation—should have occurred more than once. But a primary mutation is only a first step. As in the case of discovery-complexes and discovery-products, it is necessary to consider each case on its merits, and endeavour to identify all the links in the evolutionary chain.

The general case against identity or similarity by independent evolution is, however, overwhelming, as is very widely admitted at the present day, but to a large extent it is based on cumulative circumstantial evidence, since there are grave difficulties in finding proofs that leave no loophole for the defence.

Periodicity in Australian Weather.

METEOROLOGISTS generally recognise that as the sun's radiation heats the earth's surface, provides the energy of winds, and evaporates the water which falls as rain, so most of the variations from year to year in temperature, wind, and rainfall must be in some way caused by variations of solar radiation. The literature of the subject is immense, but is mostly directed towards discovering direct and simple relationships between solar radiation, especially as represented by Wolf's sunspot numbers, on one hand and terrestrial weather on the other hand. With a few isolated exceptions, however, these efforts have met with little success, probably because a simple direct connexion rarely exists, the solar changes working rather through complex changes in the atmospheric circulation. In a recent paper,* Dr. E. Kidson approaches the problem, as it affects Australia, by studying the variations in the tracks and intensities of the moving anticyclones which traverse the country from west to east. The data employed were extracted from the Australian daily weather charts (usually including New Zealand) for the years from 1887 onwards; they are expressed in various ways, including the average latitude of the centres in different longitudes, the annual range in the latitude of the centres, the intensity, and the rate of travel, all of which give fairly concordant results.

The most obvious periodicity in these data is not the sunspot cycle of eleven years, but a shorter one of only eighteen months. The effect is not large—the range between the most northerly and the most southerly positions of the average tracks is only one or two degrees of latitude—and the data require smoothing to bring out the periodicity, but from an inspection of the unsmoothed figures it is probably real. The author believes it to be of terrestrial origin, and he writes: "An eighteen-months period in terrestrial phenomena may at first sight appear unnatural, but it is a period between a season in one hemisphere and the next but one of the same kind in the opposite hemisphere. This suggests an oscillation between the hemispheres which would be of quite a natural type."

Now one of the most striking features of Australian meteorology is a three-year cycle in the pressure of Darwin, which is the basis of long-range forecasts of rainfall in Java. A similar periodicity is widely distributed in other parts of the world, and the author suggests that this is really the same eighteen-month periodicity of the circulation which, having opposite effects according as its maximum falls in summer or winter, actually appears as a three-year cycle. This would account for the frequency with which the latter is interrupted by a secondary maximum. Moreover, this apparent three-year cycle at Darwin is not constant, but breaks down from time to time. These breaks are all near sunspot maxima, and this suggests that the cycle is controlled by solar variations and so kept in step with the eleven-year sunspot cycle. So we arrive at a mechanism in which seasonal changes, a natural oscillation of the earth's atmosphere, and solar control all combine to produce complex variations of weather.

The second half of the paper is devoted to the effect of the sunspot cycle in the rainfall of Australia. The rainfall data are grouped into districts, and the annual totals for each district are then combined to obtain the average variation during an eleven-year cycle. The curves produced in this way are mostly very irregular, and are smoothed over three years. This is legitimate as a graphical process, but the high correlation coefficients which the author obtains between these much smoothed rainfall data and the sunspot figures similarly smoothed can have little significance, and the arguments which he bases on them correspondingly little weight. The deduction of the eighteen-months cycle rests on surer ground, though the question whether this or the well-established three-year cycle is the real primary oscillation seems to need further consideration. C. E. P. B.

* Melbourne, Commonwealth of Australia Bureau of Meteorology. Paper 1. Some Periods in Australian Weather. By Edward Kidson.

Obituary.

Dr. H. R. H. Hall.

BY the premature and sudden death, on Oct. 13, of Dr. H. R. H. Hall, the British Museum loses one of its most active and distinguished Keepers, and a large circle of colleagues and friends a genial, generous, and wholesome personality. Hall was born on Sept. 30, 1873, educated at Merchant Taylors' School and St. John's College, Oxford, and appointed to the Department of Egyptian and Assyrian Antiquities in 1896, during the long keepership of Sir E. Wallis Budge. He was promoted Assistant Keeper in 1919, and succeeded his old chief as Keeper in 1924.

Hall's father was an artist, and the dedication of Hall's first book, "The Oldest Civilisation of Greece" (1901), acknowledged and exemplified a very real debt, in its keen appreciation of the beauties as well as the scientific interest of that Ægean culture which he was one of the first to popularise in Great Britain, even before the Cretan material was available. To this culture, though it lay only on the outskirts of his professional studies, he recurred often and lovingly, in his "Ægean Archæology" (1915) and his Rhind Lectures of 1923, published in 1928 as "The Civilisation of Greece in the Bronze Age" with a wealth of illustration which testified to his mature artistic judgment. For, as he wrote, characteristically, "the plan of each lecture as delivered was to explain the pictures". At need, he would come back to Oxford, after his Museum-day, to 'explain pictures' on this favourite theme. Yet this was only one of

many personal interests, ranging from Dutch pictures to army buttons, wherein Hall's exuberant boyish vitality found expression. For him, as for Stevenson's happy child, "the world was so full of a number of things".

Meanwhile, in the Museum, Hall rapidly mastered the difficult technique of both sides of his department, Egyptian and Assyrian. He published hieroglyphic texts, Coptic and Greek documents almost as difficult, scarabs combining linguistic and historical with artistic problems, early metal-castings from Al-'Ubaid, and the monumental architecture of Dair-el-Bahari. A great museum's exhibition galleries rightly reflect the personality and outlook of its keepers, in liaison between the advance of learning and the broadening interests of its popular visitors. Certainly, with his keen eye for colour and modelling, and his strong historical sense of perspective, Hall left appreciably brighter as well as more intelligible those halls along which, swinging his keys, you met him striding as if over downland.

It was Hall's good fortune—as well as due to his quality—that he was one of the first assistants in the British Museum to be allowed, and later sent, to take part in excavation abroad; a practice now well established, and amply justified by its effects, as the recent Royal Commission has testified. Hall's first campaigns were with the Egypt Exploration Fund at Dair-el-Bahari (1903–7) and at Abydos (1910), under the veteran Edouard Naville, and with Prof. T. E. Peet in the party. At Abydos he excavated again in 1925. The War brought him in time, like other archæologists, to the countries he most needed to visit, as a captain in political service in Mesopotamia; and as soon as circumstances permitted he organised the great series of excavations which the Museum has conducted jointly with the University of Pennsylvania, at Ur and in its neighbourhood, and himself discovered and brought home the wonderful early statues and relief work in copper from Tell-al-'Ubaid, published in the first instalment of "Ur Excavations" (1929). As responsible Keeper, after 1924, he was no longer able to conduct this field work; but the successes of Mr. C. L. Woolley and his colleagues owe much to his vigorous, methodical, and tactful conduct of the home-front.

Probably Hall's best-known book was an "Ancient History of the Near East", first published in 1912. It was the first handbook of the kind in English, since the days of Rawlinson, and is in its seventh edition; the soundness of its conception and workmanship is attested by the very small amount of remodelling which it has needed, in a period of rapid, multifarious discovery. Without attempt at fine writing, Hall tells his story as of a living world, with a historian's training, the museum-man's gift of easy reference to required fact, and the broad humanity and common sense characteristic of all he said and did. That indeed is what his Trustees, other learned institutions, and the Government valued in him increasingly; and his untimely death followed over-exertion as their representative at a series of important conferences abroad.

J. L. M.

WE regret to announce the following deaths:

Prof. Adolf Engler, formerly Director of the Botanic Garden and Museum at Berlin-Dahlem and joint author with Prantl of "Die Natürlichen Pflanzenfamilien", on Oct. 10, aged eighty-six years.

Col. J. W. Gifford, a pioneer in the use in Great Britain of X-ray photography, who also contributed to the improvement of telescopic lenses, on Oct. 27, aged seventy-four years.

Mr. J. E. Purvis, of Corpus Christi College, Cambridge, who had been University lecturer in chemistry and physics as applied to preventive medicine since 1909, on Nov. 1.

Mr. B. B. Woodward, an original member and past-president of the Malacological Society of London, formerly librarian of the British Museum (Natural History), on Oct, 27, aged seventy-seven years.

News and Views.

THE Rede lecture delivered by Sir James Jeans at Cambridge on Tuesday last, on "The Mysterious Universe", was marked by the clarity and suggestiveness to which we have grown accustomed in his welcome utterances. Starting with the conception of mankind as the product of an accident in a universe the main course of which was quite other than towards the production of human life, he reviewed the successive ideas which these chance creatures have held of the universe outside themselves. He enumerated three stages, represented by an anthropomorphic, a mechanical, and a mathematical view of the nature of the reality behind phenomena. The last of these has lately been introduced by the advance of physics, and Sir James regards it as a far closer approximation than its predecessors to the 'ultimate reality', with which, however, we are not yet in contact. He made no attempt to evade issues which are the subjects of acute differences of opinion. "We discover", he said, "that the universe shows evidence of a designing or controlling power that has something in common with our own individual minds—not, so far as we have discovered, emotion, morality, or æsthetic appreciation, but the tendency to think in the way which, for want of a better word, we describe as mathematical." "This concept of the universe as a world of pure thought", he went on, "implies, of course, that the final truth about a phenomenon resides in the mathematical description of it; so long as there is no imperfection in this, our knowledge of the phenomenon is complete."

To Sir James Jeans, as—rather less tentatively—to Sir Arthur Eddington, the recent developments of physics seem to rule out determinism from the course of Nature. "The old science had confidently proclaimed that Nature could follow only one road, the road which was mapped out from the beginning of time to its end by the continuous chain of cause and effect; state A was inevitably succeeded by state B. . . . The new science . . . can . . . specify the relative probabilities of states B, C, and D. But,

just because it has to speak in terms of probabilities, it cannot predict with certainty which state will follow which." Sir James Jeans's views will not meet with general acceptance, and indeed it was one of the merits of the lecture that it was provocative of far more thought than it expressed. While it may be true that physics has led to a mathematical conception of Nature, it may well be asked whether it could possibly do anything else. The mechanical view which has been displaced was itself fundamentally mathematical, and the 'displacement' is in reality less a substitution than a purification. We may well ask whether we are justified in concluding that a mathematical description of a phenomenon is a complete one when our means of investigation could scarcely yield anything more. How could an æsthetic description, for example, supposing it to be possible, be given by the methods of physics ?

SIR JAMES JEANS dealt briefly with this point, but his remarks will probably not give universal satisfaction. Incidentally, we may note also that the view he advances is not altogether a modern one : it was not, in fact, unknown to the ancient Greeks, to whom the universe was a problem in geometry. "The Creator", says Plato—of whose ideas in another connexion Sir James Jeans made a striking application—"practises geometry eternally." The bearing of the new physics on the problem of determinism, too, is perhaps not so simple as it appears. It is not sufficiently emphasised nowadays that the departure from strict causality exists, if at all, only in a purely conceptual world, which, by its own innate requirements, can never possibly be observed. The determinism of Nature is not removed but merely re-interpreted, and the whole question is given an illusory bearing on the problems of philosophy and religion by the employment of the word 'probability' in a different sense from that in which it is generally understood. Sir James's lecture will serve a more than useful purpose if it becomes the means of dragging these questions out of the confusion in which they are now deeply immersed into the air of clear thought.

WHATEVER his political creed, no one familiar with the scientific work done by the dyestuffs industry in Great Britain could fail to be moved to uneasiness by the impending lapse of the Dyestuffs (Import Regulation) Act. The safeguarding of this new and virile national industry is not a matter merely of economic importance, although from this point of view and in relation to the volume of employment it is serious enough. The question, however, of the continuance of the protection is one which ought not to be regarded as necessarily being subject to the same mode of approach, or debated on the same political principles, as may fairly be applied to the general case of tariffs versus free trade. It has to be remembered that there are bound up with the fortunes of this branch of our chemical industry wide and serious problems of national scientific development in directions which lead far from the immediate interests of the colour industry.

THE Institute of Chemistry of Great Britain and Ireland has recently published a statement referring to the influence of the Dyestuffs Act during the past ten years on the education of British chemists and on the progress of research in industry. During this period of assistance, the laboratories maintained by the dyestuffs industry in Great Britain have followed the example of those established long ago in Germany, by serving as the focus of research and development not only in the extending range of coal-tar products but also generally in the domain of applied organic chemistry. This most desirable movement has called into being an adequate corpus of skilled chemists and technologists, and the protection afforded to the industry has encouraged the provision of substantial facilities for instruction and research. In short, good progress has been made along sound lines towards the re-establishment, on an independent footing, of our coal-tar colour industry ; the future both of the industry and of organic chemistry in Great Britain would, however, be jeopardised if the Act were allowed to expire forthwith.

IT is announced that the Nobel Prize for Medicine for 1930 has been awarded to Dr. Karl Landsteiner, of the Rockefeller Institute for Medical Research, New York. Dr. Landsteiner was born in Vienna in 1868, and was educated at the University of Vienna, where he became professor of pathological anatomy in 1909, holding this chair until 1919, and becoming attached to the Rockefeller Institute in 1922. His published work includes studies on the virus of fowl plague and on infantile paralysis. In immunology, he has devoted much attention to the characters and individual differences of human blood as regards blood groups, corpuscular agglutinins and agglutinogens, and their inheritance, and to the serological properties of the blood of the anthropoid apes. He has also published investigations on the formation of bacteriolytic immune bodies, cell antigens and specificity, and serological specificity and chemical constitution.

OF the many pioneers of the steamboat, to Henry Bell—the centenary of whose death falls on Nov. 14—belongs the distinction of inaugurating steam navigation in the Old World, just as to Robert Fulton belongs the honour of inaugurating steam navigation in the New World. Fitch, Rumsey, Miller, Stevens, and Symington had all achieved a certain amount of success with their experimental boats, but it is with the passages of Fulton's *Clermont* on the Hudson in 1807 and of Bell's *Comet* on the Clyde in 1812 that the history of the steamboat as a regular means of transport begins. Neither Fulton nor Bell were the originators of steam propulsion ; neither of them constructed either the hulls or the machinery of their boats ; neither of them introduced any improvement in steam engines or boilers ; but it was to their imagination, confidence, and courage rather than to their mechanical ingenuity that they owed their achievements. Of the two, Fulton undoubtedly possessed in a greater degree the qualities requisite to a great pioneer, but our debt to Bell is not lessened thereby.

BELL was born in the Old Torphichen Parish Mill, Linlithgow, on April 4, 1767, and died at Helensburgh on Nov. 14, 1830. Brought up as a mechanic, he had worked under Rennie in London and had been the partner of a builder in Glasgow before settling in 1808 in Helensburgh. At this place he was proprietor of the Baths' Inn, and it was for conveying customers between Helensburgh and Glasgow that the *Comet* was built. Laid down in October 1811, at Port-Glasgow, the vessel was launched on July 24, 1812, and began running during the following month. Seven months later she found herself with a rival, and in 1813 no fewer than five steamboats were afloat on the Clyde. These proved superior to the *Comet*, which Bell tried for a time on the Forth and then on the west coast of Scotland, until on the afternoon of Dec. 15, 1820, she was caught by the tide and cast ashore off Crinan, and broke in halves. The forward part holding together, the engine was salved and to-day stands in the Science Museum, South Kensington. In spite of his efforts, Bell's fortunes never rose high, and during the latter part of his life he was given a grant by the Government and an annuity by the Trustees of the River Clyde. At his death he was buried in the parish churchyard at Rhu, near Helensburgh, and many years later the famous shipbuilder, Robert Napier, erected his statue there. A granite obelisk to Bell's memory was also set up on the front at Helensburgh, while another memorial at Bowling recalls his services to those who have occasion to pass up and down the most important shipbuilding river in the world.

A STRONG earthquake occurred on the morning of Oct. 30 along the sea-coast of the province of the Marches in Italy. The epicentre was probably submarine and close to the small town of Senigallia (near Ancona), where one-third of the buildings were destroyed, another third seriously injured, and ten persons lost their lives. Slight shocks were felt at Trieste (142 miles from Senigallia), Padua (145 miles), and Naples (195 miles), so that the area disturbed may have contained so much as 120,000 square miles, a rather unusual size for an Italian earthquake. Sea-waves are said to have swept the adjoining shores and damaged some of the quays, indicating, if the report is correct, that there was some displacement at the epicentre. The Kew seismographs recorded an earthquake of moderate intensity at 7 h. 16 m. 7 s., G.M.T. All along the coast of the province of the Marches, there are, according to Dr. M. Baratta, a number of minor seismic zones. Senigallia lay within the meizoseismal areas of the destructive earthquakes of Rimini in 1672 and Ancona in 1690, but the earthquake that bears the closest relation to the recent shock is the Senigallia earthquake of Sept. 21, 1897, by which nearly all the buildings in the town were more or less damaged. The epicentre was probably a few miles off the coast at Senigallia, and the disturbed area about 175,000 square miles.

FOR some years past, there has been a wish on the part of some of the inhabitants of Bournemouth to establish there a natural history museum. In 1912, Sir Ray Lankester addressed a public meeting upon this matter, and recently, Mr. J. B. Calkin, of Bournemouth, has been instrumental in again urging the need for such an institution. A letter signed by a number of influential citizens has been forwarded to the mayor, but it was felt that this should receive support of a more public nature, and an invitation was sent to Mr. Reid Moir, president of the Ipswich Museum, to address the Bournemouth Rotary Club upon the question. The meeting was held on Oct. 28, and was fully representative of the scientific and municipal life of Bournemouth. Mr. Reid Moir, after outlining the great richness of the area from the geological, archæological, and other points of view, remarked that a vast mass of important material has already left the district, and that this regrettable process will continue until a properly equipped museum is in existence to receive it. He urged the necessity of such provision, and suggested that, in its initial stages, the museum should be of a more or less local character. Mr. Reid Moir also stressed the ever-growing importance of museums in national education, and outlined the nature and value of a modern museum of natural history. He emphasised the need for erecting the building on a site where expansion can take place, and the expectation that large numbers of visitors to Bournemouth would be attracted to the museum. Judging from the support given to the proposal at the meeting, it is hoped that, before long, this progressive town will possess an adequate and up-to-date exhibition of objects of natural history.

MOST towns of considerable size have their occasional exhibitions to illustrate and commend the use of gas, the use of electricity, developments in domestic utensils, and so on, but few contemplate an exhibition to illustrate the wonders of science, as Hastings has done in recent years (NATURE, Oct. 25, p. 658). Of course, the practical exhibitions are backed by the hope of ultimate financial gain, while the wonders of science are fortunate to escape without financial loss; but nevertheless it is a little disturbing to think that the men of commerce are more determined to proselytise the people for a material end, than the men of science generally are for a spiritual. The attempt at Hastings to interest the people in science and add to their knowledge by means of a temporary Science Exhibition, accompanied by demonstrations, science talks, and formal lectures, is therefore to be encouraged. Such an exhibition can be planned in detail and carried out only by scientific men, but the organisation and the financial arrangements must be in the hands of a municipal or other authority, capable of looking beyond the monetary balance-sheet to the educational benefits which follow. Co-operation between municipalities, museums, and teaching institutions to this end should be readily obtained, and we trust that other towns may follow the lead which Hastings has given in introducing to the public some of the wonders of science.

AN exhibition illustrating the utilisation of photography in astronomy, arranged by the Royal Photographic Society of Great Britain, is being held at

the Society's rooms, 35 Russell Square, W.C.1, on Nov. 4–29. The exhibition is the second of a series planned by the Society to illustrate the uses of photography in the service of man. The Society is to be congratulated on having secured a comprehensive series of photographs representing the work of observatories and of individual astronomers not only in Great Britain but also in Canada, Egypt, France, Germany, India, South Africa, and the United States. The increasing application of photography to astronomical observations during the last fifty years has been rich in results to an extent almost unimagined, and there is ample evidence of this in the four hundred items of the exhibition. The number of exhibits requiring technical discernment for their full appreciation, such as solar and stellar spectra, is in reasonable proportion, and in many cases where the subject under illustration is not obvious, simple descriptions have been appended. The exhibition is worth careful inspection for more than one reason. In several instances exhibits have been arranged to present some elementary fact of astronomical observation—the sun's rotation, the rapid changes of solar prominences, the changing appearance of the surface of Jupiter with the shadow of a satellite —whilst the latest discovery pertaining to the solar system is shown by a photograph of the planet Pluto.

A FEW photographs of historical interest have been included in the Exhibition of Astronomical Photography to show the march of progress; one views with respect the results achieved by those early workers who used a wet plate or a recently invented dry plate with what would now be considered limited telescopic equipment. Concerning the wealth of recent work represented—it would be invidious here to particularise—astronomers have sent of their best results, and one cannot fail to be impressed with their spectacular record of many of the grandest aspects of the heavens known to man. In connexion with the exhibition, Prof. H. Dingle will deliver a lecture on "Spectrum Photography", on Nov. 17, and Mr. J. H. Reynolds will give "A Talk on the Slides and Films in the Exhibition", on Nov. 24. The Exhibition is open free to visitors between 10 A.M. and 5 P.M. on each day, except on Sundays. No tickets are required for the above lectures at 7 P.M.

ON Friday, Oct. 31, a public lecture on "High-Pressure Reactions" was delivered before the Institution of Chemical Engineers by Prof. W. A. Bone. Prof. Bone dealt briefly with the historical events leading up to an understanding of the rôle played by pressure in gas reactions. Within a period of less than fifty years has been included the first recorded synthesis of ammonia from its elements by the agency of a catalyst, the statement of the principle of mobile equilibrium, and the classical work of Haber and his collaborators upon equilibrium in an ammonia-nitrogen-hydrogen system. A more recent development has been the synthesis of various organic compounds from water-gas by the employment of suitable catalysts and high pressure, which has opened up a wide field for future exploration. The variety and complexity of these new processes, however, require much systematic and fundamental research before a clear understanding of their mechanism is obtained. One of the difficulties encountered in high-pressure gas reactions is the lack of reliable fundamental data on the physical properties of gases. No more useful link could be undertaken at present than a comprehensive determination or re-determination of such data as the compressibility of gases and of mixtures of gases and the effect of pressure on viscosity, dielectric strength, solubility, and thermal conductivity. Although such work falls within the scope of a high-pressure gas research laboratory rather than of a works routine laboratory, the cost of equipping and maintaining such a laboratory has hitherto proved an insuperable barrier. Some three years ago, however, a complete high-pressure gas research laboratory was established in the Department of Chemical Technology at the Imperial College of Science, and work has been commenced on a number of physical problems directly connected with high-pressure reactions. Prof. Bone's lecture will appear in full in the *Transactions* of the Institution of Chemical Engineers, vol. 8.

THE British School of Archæology in Egypt has found recently in the Wadi Gaza, and its tributary valleys in Southern Palestine, a very important series of flint implements of Lower Palæolithic types. These specimens, which were described by Mr. Reid Moir at a meeting of the Royal Anthropological Institute on Oct. 28, can be divided into two sharply defined groups, the oldest comprising coarsely flaked rostrocarinate implements, rostroid hand-axes, choppers, and points. There is no doubt that these specimens, in their method of evolution, forms, and technique, are comparable with others found in East Anglia and elsewhere, and known to be of Early Pleistocene date. The latter implements exhibit usually striation and abrasion by ice-action, while the Palestinian examples, which have not yet been discovered *in situ* in any ancient deposit, show manifold signs of collisions with other stones in rapid movement. It is supposed that the ice-sheets present farther north were represented in Palestine by extensive snowfields, which, on melting, gave rise to widespread floods, and the abrasion of any implements exposed to such conditions.

THE second group of Palestinian specimens described by Mr. Reid Moir differs very markedly from the first—as they are quite unabraded, and comprise beautifully made hand-axes of Late Acheulean types. Some of these implements have been found *in situ* beneath a considerable depth of sand at Sherah. It is evident that both the archaic and the later groups of specimens from Palestine were made each by a differing technique and upon a highly specialised plan. Further, it can be demonstrated that a precisely similar method of implement-making was in vogue in England, Africa, and India in remote times. It seems necessary to suppose that centres of dispersal of cultures existed in prehistoric times, as it is not a reasonable supposition that a race of people living, for example, in Palestine would, by coincidence, proceed to make their flint implements on the same

complex plan as that adopted by another race in England or India. The existence of these world-wide cultures in the Lower Palæolithic epoch appears to imply that the human race was even then more highly organised than has been hitherto supposed, and that very extended periods of time were involved in the spread of certain "fashions" in implement-making over such wide areas of the globe.

IN *Engineering* for Oct. 31 is an illustrated account of the closing of the arch span of the great Sydney Harbour Bridge in August and September. The span, which is 1650 ft. between the main supports, has been erected as two cantilevers from either side, each cantilever being supported by 128 steel wire cables connected to the top chord at the end of each end post, and carried down to the solid rock through a tunnel 120 ft. deep. The steel-work has been put into position by creeper cranes, each 605 tons in weight, travelling on the tops of the half-arches. There are fourteen panels in each half-span, and when thirteen and a half of these had been completed the total pull on the cables was 27,440 tons. When sufficiently far advanced for joining both upper and lower chords, the load was lessened on the cables one by one by means of hydraulic jacks. Included in the article are photographs of the forged steel saddles, with their alignment pins, for the bottom chords, and the jacking arrangements by which the correct compression was obtained in the upper chords. The forcing apart of these chords was done by means of four hydraulic jacks of nickel steel, each of 950 tons capacity.

AT the invitation of the Ministry of Agriculture and Fisheries, three committees of the International Council for the Exploration of the Sea met at the Fisheries Laboratory, Lowestoft, during the first week in November. Several foreign delegates and experts were present, and the president of the Council, Mr. H. G. Maurice, presided over the meeting of the Executive Committee, or Bureau. The other two committees dealt respectively with the plaice and the herring. It has long been known, as the result of marking experiments, that small plaice transported from the overcrowded grounds on the Continental coast to the Dogger Bank will grow very much faster on this famous fishing ground, and the Council decided at the last meeting that the possibility of carrying out such transplantation on a large scale should be very carefully examined. A committee has therefore been constituted to study the financial aspects of the question and to decide, if possible, whether the transplantation of, say, one million plaice can reasonably be expected to yield a commercial profit. The committee on the herring includes in its membership the principal experts from all countries bordering on the North Sea. It is engaged principally on technical questions, its main task being to secure uniformity and standardisation of methods of research and closer co-operation in the study of the herring. A scheme was presented by the English fishery workers for a more detailed study of the herring in the southern North Sea, with the view of rendering more exact the predictions of the great East Anglian herring fishery, which have already been made with some success.

A SCIENTIFIC Advisory Committee on Medical Administration and Investigation has been appointed by the Secretary of State for Scotland "to assist the Department of Health for Scotland in applying the results of scientific research to the details of public health administration and in promoting such medical investigations as come within the sphere of the Department or of the local authorities in Scotland". The members of the Committee are: Dr. Alexander Bowman, Scientific Superintendent, Marine Laboratory of the Fishery Board for Scotland; Prof. C. H. Browning, professor of bacteriology, University of Glasgow; Prof. E. P. Cathcart, professor of physiology, University of Glasgow; Prof. F. A. E. Crew, professor of animal genetics, University of Edinburgh, and Director of Animal Breeding Research Department; Sir Walter M. Fletcher, Secretary to the Medical Research Council; Sir Robert Greig, Secretary, Department of Agriculture for Scotland; Mr. John Jeffrey, Secretary, Department of Health for Scotland; Dr. J. Parlane Kinloch, Chief Medical Officer, Department of Health for Scotland; Dr. A. S. M. Macgregor, Medical Officer of Health, Glasgow; Prof. T. J. Mackie, professor of bacteriology, University of Edinburgh; Prof. J. J. R. Macleod, professor of physiology, University of Aberdeen; Prof. Robert Muir, professor of pathology, University of Glasgow; Dr. J. B. Orr, Director of the Rowett Institute for Research in Animal Nutrition, Aberdeen; and Prof. W. J. Tulloch, professor of bacteriology, University of St. Andrews. Dr. Parlane Kinloch is chairman, and Mr. George Wallace, of the Department of Health for Scotland, is secretary of the committee.

IT is announced in the *Museums Journal* for October that the Carnegie Trustees are now prepared to receive applications for grants from small museums administered by public authorities, under the following conditions, which will be strictly observed: (1) The grants will not exceed £250 to any one museum. (2) The museum authorities must show that they are prepared to adopt some definite policy and are reorganising their institution on the lines recommended by Sir Henry Miers in his 1928 Report to the Trustees. They must also show that they are prepared to provide an adequate annual revenue for the upkeep of the institute under the new policy. (3) The grants are to be confined to towns with between 10,000 and 70,000 inhabitants. They will be given in respect of capital expenditure only on the £ for £ basis. They will not be available for the erection or structural alteration of buildings, or for ordinary current expenditure. They are to be expended on special outlays (for example, purchase of cases, employment of temporary staff) in connexion with the reorganisation schemes in respect of which they are sanctioned. (4) Each museum applying must have, or be prepared to appoint, a competent curator. Applications should be addressed in the first instance to the Secretary, Carnegie United Kingdom Trust, Comely Park House, Dunfermline, Fife, Scotland.

THE *Australian Museum Magazine*, a quarterly edited by Dr. Charles Anderson, an Orcadian by birth, manages well to strike the balance between pure

science and popular reading. But the July-September number especially interests us, apart from its articles, by the evidences it contains of the activity of the Australian Museum. Notices on the covers direct attention to new series of postcards illustrating in four-colour process typical beasts and birds of Australia; other notices are attractive invitations to special exhibits in the Museum and to a series of popular scientific lectures in which "the subjects dealt with will be presented in a clear, lucid, non-technical manner, making known many unfamiliar facts concerning Nature and her ways". Finally, the telephone extension number of each specialist on the staff is given, and visitors are invited to apply for information, when they "will receive every attention from Museum officials". These are excellent methods of making the public feel that the Australian Museum exists for their service, and so of obtaining the widest public assistance and support. Museum officials in Great Britain perform the same services, but it is well that the public should be reminded so frankly of the willingness of the museums to help in the spread of scientific knowledge.

THE Leicester Literary and Philosophical Society, with a membership of more than three hundred, performs useful service to science in arranging a series of lectures on scientific (as well as literary) subjects, delivered by experts. In addition to these general lectures, more specialised meetings bring together members interested in particular branches of scientific work. The *Transactions* for 1929–30 (vol. 31) contain reports of these sections and an interesting address by the president, Mr. T. Kingdom, on "The Minor Legacies of Greece", in which he reviews briefly the contributions to knowledge made by some outstanding men of science among the ancient Greeks. Unfortunately, the statement of accounts shows a deficit of £15 on the year's working, but since there appears to be no entry for interest on War Stock and deposit account, there may be a hidden reserve to meet part of the loss. The Society deserves more local support, and the projected meeting of the British Association in Leicester in 1933 should give a fillip to its aims and to its membership.

MANY highly qualified translators have now been enrolled on the Aslib Panel of Expert Translators (see NATURE, June 28, p. 984). More than thirty languages are represented, from Arabic to Urdi, but the great value of the service offered by this scheme is that the members of the Panel possess that expert knowledge of special subjects without which trustworthy translations cannot be made. The range of subjects covered by the Panel is wide. Especially strong in pure and applied science, medicine, chemistry, engineering, etc., it includes also men and women experienced in law, industry, commerce, and many other branches of knowledge. Particulars of the scheme may be obtained from the Association of Special Libraries and Information Bureaux, 26 Bedford Square, London, W.C.1.

IN the article entitled "African Ethnology and Archæology" in NATURE of Nov. 1, p. 707, paragraph 2, it is stated that associated with the pottery of stone age cultures in Kenya were "tools of a Mousterian type". This phrase should read "tools of Upper Kenya Aurignacian type". Mr. L. S. B. Leakey informs us that the Upper Kenya Mousterian is contemporary with the Upper Kenya Aurignacian but is not associated with even crude pottery.

THE Year Book of the Commonwealth of Australia, of which the issue for 1929 has now appeared (Commonwealth Bureau of Census and Statistics, 5*s*.), is more than a statistical record of the country. There are many descriptive articles of considerable value, such as those on various aspects of agriculture and mineral wealth, and that on the structure and scenery of the federal capital territory. In several sections parallel figures for other countries add to the value of the statistics. The volume now runs to more than a thousand pages.

PART II. (Civil Tables) of "The Registrar-General's Statistical Review", 1929, has just been published at the reduced price of 2*s*. (London: H.M. Stationery Office). The estimated population (in thousands) of Great Britain and Ireland was 48,684. Compared with 1928, England and Wales show an increase of 0·32 per cent, Scotland and the Irish Free State decreases of 0·18 and 0·20 per cent respectively, while Northern Ireland remains stationary. Statistical data concerning marriages and divorces, passenger movements, births, and electors are included in the volume.

MESSRS. W. and G. Foyle, Ltd., 119 Charing Cross Road, W.C.2, have recently issued a catalogue of nearly 700 second-hand works relating to scientific subjects which should be of interest to many readers of NATURE.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in engineering at the Cape Technical College—Chalmers and Guthrie (Merchants), Ltd., 9 Idol Lane, E.C.3 (Nov. 17). An assistant bacteriologist in the Public Health Laboratory of the County Council of the West Riding of Yorkshire—The Clerk of the County Council, County Hall, Wakefield (Nov. 17). A junior research assistant in the High Pressure Research Laboratories of the Imperial College of Science and Technology—The Registrar, Imperial College of Science, South Kensington, S.W.7 (Nov. 21). An agricultural chemist at the Agricultural Institute and Experimental Station, Kirton—The Principal, Agricultural Institute, Kirton, near Boston, Lincs (Nov. 22). An assistant in the Department of Pathology of the Hospital for Consumption and Diseases of the Chest—The Secretary, Hospital for Consumption and Diseases of the Chest, Brompton, S.W.3 (Nov. 22). An assistant pathologist at the Royal Surrey County Hospital, Guildford—The General Superintendent, Royal Surrey County Hospital, Guildford. A test assistant under the directorate of technical development of the Air Ministry, to assist in experimental metallurgical work—The Chief Superintendent, R.A.E., South Farnborough, Hants (quoting A.459).

Research Items.

Wastage in Imported Fruit.—Two special Reports of the Food Investigation Board, No. 38, by Dr. J. Barker, and No. 39, also by Dr. J. Barker and dealing with New Zealand apples (London: H.M. Stationery Office, 1*s.* 6*d.* and 6*d.* respectively), together with *Bulletin* No. 23 from the New Zealand Department of Scientific and Industrial Research, in which Mr. L. W. Tillar deals with the relation of storage temperature to the overseas carriage of apples, show that investigation is now actively proceeding into the many important scientific problems associated with the marketing of overseas fruit. Since 1926, with the co-operation of the Food Investigation Board, a small laboratory has been maintained near Covent Garden Market, and most of the data utilised by Dr. Barker in his more general report have been obtained through the opportunities thus provided for studying wastage, through the cordial co-operation of the Covent Garden salesmen. The problems are now seen to be many and various, but in many cases there seems to be clear indication as to the lines to follow for practical success. Thus, the condition of the fruit when gathered is seen to be of prime importance; 'bitterpit' in apples, for example—on which subject a valuable paper by W. H. Carne, H. A. Pittman, and H. G. Elliot was presented at the Imperial Horticultural Conference—can be practically avoided if the apple is picked at the rightly mature stage. New Zealand shipping experience shows the importance of prompt reduction of the temperature in the ship's hold; whilst South African experience has shown how wastage can be reduced by care and inspection during picking, the use of refrigerated trucks for long-distance rail transport, and improvement of the refrigeration systems on board ship. We are still ignorant often of the best temperature at which to maintain the fruit during transit and before sale. Also, in many cases, simple precautions such as tight packing, to avoid bruising in transit, are essential preliminaries to refinements as to temperature, ventilation, and humidity controls. The reports referred to, however, are ample evidence of the progress that has been made and of the necessity for further experimental investigation in a co-operation which extends from the orchard overseas to the retail counter at home.

Food of the Terns of the Dry Tortugas.—Mr. W. H. Longley (Year Book No. 28, Carnegie Institution of Washington, p. 288) gives some interesting observations on the food of the terns, especially the Noddy and the Sooty tern of the Bird Key Rookery, the material studied being the more or less digested fishes and squids dropped and lost by the parents when feeding their young. It is clear from these investigations that the pelagic fishes of the several hundred square miles of deep water over which the birds feed outside the Tortugas atoll provide the greater part of their food—the shallow water inshore relatively little. The chief food consists of the flying fishes *Parexocoetus mesogaster* and *Cypselurus fuscatus*, Carangids, especially *Caranx ruber* and *C. crysos*, and a variety of species belonging to various groups. Many rare forms occur in the list, some of which are new to the Tortugas. One adult *Amia* occurred and the deep water fishes *Bollmania* and *Lonchopisthus*. The little cephalopod *Spirula* is also eaten. *Coryphœna*, the 'dolphin' of these waters, also preys to a large extent on the flying fishes, but those up to six inches in length are themselves eaten by the terns, forming an important part of their food.

Mitogenetic Radiation.—Dr. Nine Choucroun (*Jour. Mar. Biol. Ass.*, vol. 17, No. 1, pp. 65-74, 1930) gives an account of experiments designed to test the validity of the hypothesis of mitogenetic radiation, formulated to account for the influence, at a distance, of dividing cells on other living tissues. Gurwitsch first observed the mitogenetic influence of embryonic tissues on the root of the onion and on yeast cells. According to him, this action, exerted only through quartz and not through glass, was due to an ultra-violet radiation, of wave-length of 2000 A., produced by the active embryonic tissues and capable of regular reflection. Dr. Choucroun exposed the developing eggs of *Echinus miliaris* to the influence of *Bacterium tumefaciens*, using as controls eggs not so exposed. He found that the observed mitogenetic influence undoubtedly exists, but, as a result of carefully designed precautions, he found that the influence could not reach Echinoderm eggs contained in flasks the stoppers of which were surrounded by a water seal. He concludes that the action of the bacterial culture on the Echinoderm eggs could not be ascribed to a radiation or to any influence acting through the walls of the receptacles containing the eggs. He believes that the observed action is the result of something material, given off by the bacterial culture and reaching the medium in which the eggs are developing, possibly as a monomolecular film which travels round the walls of the receptacles, penetrating any ordinary stopper or seal, but effectively stopped by a water seal such as he used in his experiments. He finds further evidence in support of his belief that the influence is the result of something material, in the fact that sea-water exposed first to the influence of a bacterial culture and afterwards used for Echinoderm eggs causes abnormal development of the eggs. The author, therefore, rejects the hypothesis of a mitogenetic radiation acting through the walls, whether of glass or quartz, of the receptacles in which the eggs were developing.

Northern Rotifers.—A recent part of "Die Tierwelt der Nord- und Ostsee" (Lief. 16, Teil 7.*e*: Rotatoria, von A. Remane. Pp. 156. Leipzig: Akademische Verlagsgesellschaft, m.b.H. 1929) contains a very complete and up-to-date account of the Rotifers of the North Sea and Baltic. This is a specially useful section and enables one to identify the species with ease besides learning much about the group as a whole. These tiny animals, scarcely reaching more than 2 mm. in length and usually much smaller, have always been favourites of the microscopist and one is not surprised at the large number of brackish water and marine forms recorded from these districts. They are predominantly freshwater organisms but may occur largely in water of various salinities, many being found in the sea. It is interesting to note that the order Seisonidea, containing the genus *Seison* living on *Nebalia*, possesses the most primitive characters and is purely marine, showing no trace of a freshwater ancestry. The remaining orders and sub-orders may occur in fresh, brackish, or sea water and it seems probable that they have mostly migrated seawards from fresh water. Here only one genus (*Zelinkiella*) is purely marine. There is a good general account of the group embracing the anatomy, reproduction, biology, and ecology, occupying about half the memoir, the remainder being devoted to the systematic part. Good keys are given, the illustrations are excellent, and the whole is recommended thoroughly to all workers in the group.

Fishes of Porto Rico and the Virgin Islands.—Mr. J. T. Nichols ("Scientific Survey of Porto Rico and the Virgin Islands." Vol. 10, parts 2 and 3. New

York Academy of Sciences, 1929) has provided a survey of the fishes of Porto Rico and the Virgin Islands, Part 2, the families Branchiostomidæ to Sciaenidæ, Part 3, Pomacentridæ to Ogeocephalidæ. This is a very useful work with a description of each species and in nearly every case a small and simple figure. Shore fishes are much the best known of the Porto Rico fauna, consisting of pelagic off-shore fishes which are for the most part cosmopolitan, and of West Indian species of the coasts, islands, and reefs from the Capes of the Carolinas to Brazil. The tropical pelagic species are usually wide-ranging surface fishes which approach tropical island shores rather freely and evidently had their origin from tropical shore forms. Of these, certain Scombriformes including *Coryphæna*, *Gymnosarda pelamys*, and various flying fishes (Exocœtidæ) are the most important. The fish fauna of these regions is very rich and all species should be easily identifiable from the present work, which not only describes and figures the species but also adds notes on distribution and in many cases on colour, feeding, and habits.

Transplant Experiments of the British Ecological Society.—A detailed account of preliminary results arising out of transplant work carried out at Potterne, Wilts, is given by Marsden-Jones and Turrill in *Journal of Ecology*, vol. 18, No. 2; August 1930. From stock plants of known homozygosity, large numbers of individuals have been obtained by cloning and selfing, and the resulting plants have been grown under carefully standardised conditions, in beds of sand, calcareous sand, clay, and chalky clay. Modifications resulting from growth under different soil conditions have been periodically recorded for *Centaurea nemoralis*, *Silene vulgaris*, *Silene maritima*, *Anthyllis vulneraria* and *Plantago major*. Of these, the first is least plastic and capable of surviving under a wide range of edaphic conditions, whilst *Anthyllis* is also non-plastic but is limited in its edaphic requirements. *Silene maritima* is more plastic than *Silene vulgaris*, which changes slowly under certain edaphic conditions. *Plantago major* is exceedingly plastic and varies between wide limits for the characters examined, namely, number of infructescences, maximum and minimum length of spike and of spike plus peduncle, on the different soils. The changes in this species, moreover, become apparent within the space of five months.

Swedish Cretaceous Mollusca and Brachiopoda.—The mollusca and Brachiopoda from the Cretaceous formation at Eriksdal, Sweden, have been investigated by R. Hägg (Sver. Geol. Undersök., *Årsbok* 23, No. 8); 130 species, including forms to which names have not as yet been given, are described and many figured. Of these, 16 gastropods, 18 pelecypods, and 1 cephalopod are new to Sweden. The geological and palæontological aspects of the containing beds are discussed, and it would appear that the Eriksdal fossils are referable to the Danian and Senonian horizons.

Neogene Shells from Japan.—Prof. Matajiro Yokoyama, to whose researches into the Tertiary molluscan fauna of Japan we have previously had occasion to refer (Cf. *inter alia*, NATURE, Aug. 24, 1929, p. 319), has now published further papers in this connexion (*Jour. Fac. Sci.*, Imp. Univ. Tokyo, sect. 2, vol. 2). From around Okuyamada, Tsuzuki county, Yamashiro province—not far from Kioto—he chronicles 37 species of Neogene mollusca, including a new species of *Umbonium*. Occasion is then taken to correct an error of determination and transfer his *Cochlioconus* from the Conidæ to the Fusidæ, as they used to be called, and place the shell in the genus *Thatcheria*. A further collection of Neogene mollusca from the southern half of the island of Karafto, or Sakhalin (Cf. NATURE, Mar. 8, 1930, p. 392), has yielded 45 species, including 5 new and some as yet indeterminate; descriptions and figures of the more important of these are given.

Length of the English Mile.—In a paper in the *Geographical Journal* for October, Sir Charles Close records some conclusions he has reached regarding the length of the old English mile as ascertained by measurements on old maps. The Bodleian map of about 1300 A.D. is the earliest detailed map of Great Britain. By comparing distances on that map, where distances between towns are marked in miles, and modern measurements, it would appear that the mile then in use was about ten furlongs. This, as Sir Flinders Petrie pointed out from a study of the same map some years ago, was about equal to the old French mile. In Lily's map of 1546 the mile was 7·4 furlongs, which was apparently the Italian mile. Mercator's map of 1564 had a mile of 9·47 furlongs. In Saxton's county maps of 1574–79 the length varied from 10·4 to 10·75 furlongs. In Speed's county maps of 1608–12 it was 10·3-10·4 furlongs on the average. In short, Sir Charles Close found out that from 1574 to 1695 the customary mile was about 10 furlongs, in spite of the statute of 1593 defining it as eight furlongs or 1760 yards.

Distribution of Earthquakes in Northern Europe.—Mr. K. E. Sahlström has recently published a valuable earthquake-map of Sweden, Norway, Finland, and Denmark (Sveriges Geologiska Undersökning, *Årsbök*, 1930). He uses a method previously applied by H. Renqvist to the earthquakes of Finland. On the map of the country, a network of points 30 km. apart is plotted. The disturbed areas of all known earthquakes from 1600 to 1925 are drawn on special maps and it is noted how many times each of these points falls within a disturbed area. Curves are then drawn through points of equal earthquake-frequency. The method thus depends on the mapping of disturbed areas rather than on the plotting of epicentres. The map shows that in northern Europe there are four principal areas of marked frequency—the fringe bordering the Gulf of Bothnia, the country round Oslo in southern Norway eastwards to Lake Vänern, the extreme west of Norway, and the west coast of Norway between the parallels of 64° and 68°. The regions free, or almost free, from earthquakes are southern Finland, Finnish Lapland, the interior of Sweden, and nearly all Denmark.

Pliocene Deposits in California.—The youngest Tertiary rocks on the south slope of the Santa Susana mountains, north of Simi Valley, California, are several hundred feet thick and consist of sandstones and conglomerates that lie unconformably on beds ranging in age from Upper Miocene to Eocene. They were examined during the course of work carried on by the 1929 summer field camp of the California Institute of Technology and the fossils collected determined and enumerated by W. P. Woodring (*Proc. Calif. Acad. Sci.*, Fourth Series, vol. 19). These fossils represent a warm-water Pliocene fauna which has been found at localities from Lower California northward to the Ventura basin and is best known as the fauna of the San Diego formation.

***Aa* and *Pahoehoe* Lavas.**—In *The Volcano Letter* for Aug. 14, 1930, a review of the *aa-pahoehoe* problem is given by G. L. Chang, with special reference to the basaltic flows of Kilauea and Mauna Loa. The rough, blocky *aa* lava is due to partial crystallisation while the flow is moving rapidly. When the crust has crystallised so that it ceases to flow easily, the under-

lying current may be sufficient to break it up into a tumbled mass of blocks. The smooth, ropy *pahoehoe* lava has a chilled skin of glass. The lava below flows more slowly and the forces are insufficient to break up the smooth crust. The 1823 flow of Kilauea changed from *pahoehoe* to *aa* just as the lava reached the edge of a gentle slope and started down a much steeper incline. This sequence is usual. No flow which begins as *aa* has ever been found changing to *pahoehoe*. It commonly happens, however, that the earlier discharges of an eruption are dominantly of the *aa* type, whereas it is in the declining phases that most of the *pahoehoe* is formed. Chemically there is no significant difference between the two types, except that more iron is in the ferric state in the *aa* form. Gas is more readily released from the latter and the vesicles in consequence are very irregular in size and shape. In *pahoehoe* lava the gases are confined by the skin and the total volume of the vesicles thus tends to be greater than in *aa* lava. In the depths of both types the degree of crystallinity is alike.

Geology of Auckland, New Zealand.—A valuable study of the region south-east of Auckland City has been made by C. W. Firth (*Auckland University College Bull.* 10, Geol. Series No. 3, 1930). The Hokonui (Trias-Jura) strata were deposited in a geosyncline which then covered much of New Zealand. In early Cretaceous times the thick sediments were thrown into sharp folds and before the late Cretaceous submergence they were deeply eroded. Further erosion followed a later orogenesis, and Miocene beds are in consequence found lying on the Hokonui greywackes. Small andesitic volcanoes broke through the floor of the Miocene sea. This period of deposition was closed by the Kaikoura orogeny of the early Pliocene, and great fractures in two sets, north-west–south-east, and north-east–south-west, broke up the district into blocks which were uplifted and tilted to the north-west. Great erosion and successive movements of uplift have since taken place, followed by a comparatively recent subsidence which caused the flooding of the deep, youthful valleys cut during the preceding uplift. Commencing just before this latest submergence, and continuing almost up to the present, basaltic lavas broke out and tuff and scoria cones were built up. A slight uplift of a few feet (relative to sea-level) has since occurred, but its effects on the embayed coastline of the vicinity of Auckland are almost inappreciable.

Solar Radiation at Sea.—The April–May issue of the *Bulletin* of the Polish Academy of Letters and Sciences (Mathematical Series) contains a summary of the results obtained by Dr. W. Gorczynski for the solar radiation at sea-level over the oceans he has traversed during the years 1923–28. Most of his observations were made with thermopiles and millivoltmeters, which were compared with other standard instruments from time to time. Of the 0·032 calorie per second which should be received on a square centimetre of the earth's surface if the sun were vertically over it and there were no atmospheric absorption, the atmosphere if dry absorbs and scatters 9·6 per cent, and if moist, with a humidity which is found to vary little from 80 per cent, 17·5 per cent in the North Atlantic in the latitude of the Azores and 23·7 per cent in the Indian Ocean. Absorption and scattering by dust account for a further reduction of less than 1 per cent in the North Atlantic in the latitude of the Canaries, in the Gulf of Mexico, and in the Eastern Indian Ocean, and of more than 3 per cent in the Mediterranean and Red Seas. As a result, the Red Sea and the Indian Ocean get about 65 per cent, and the Gulf of Mexico, the Atlantic, and Mediterranean about 69 per cent of the possible solar radiation. On land at sea-level—for example, Bangkok—about 60 per cent is received.

The Ratio *e/m* for an Electron.—A determination of *e/m* for free electrons is described by C. T. Perry and E. L. Chaffee (in the first September number of the *Physical Review*) which, unlike other accurate measurements on free electrons, gives a value ($1{\cdot}761 \pm 0{\cdot}001 \times 10^7$ abs. e.m. units) in agreement with the value obtained spectroscopically. The method used was a development of the classical one of Wiechert, in which the time of passage of an electron between two points is compared with the period of a high-frequency oscillator, the electrons being driven by potentials of 10,000-20,000 volts and timed over a distance of 75 cm. in these experiments. If this result is accurate —and the measurements appear to have been made with great care—the question arises as to why earlier investigations of free electrons have led to a substantially higher value for *e/m*. The suggestion made by the authors, that this has been due to the effect of residual gas in the apparatus, can presumably be readily checked, and if it proves correct, will provide a welcome solution of an outstanding discrepancy.

Field-free Enclosures.—In an important class of experiments on the properties of gases at low pressures, they are subjected to bombardment by a beam of electrons introduced with known energy into an almost closed metal vessel, and the assumption is made that the whole of the interior of the vessel is at the potential of its walls. A direct test of the validity of this assumption, described by Dr. F. L. Arnot in the October number of the *Proceedings of the Royal Society*, shows that it is not accurately true. Two methods were employed. In the first, the velocities of the positive ions, which diffused out at right angles from the path of the main electron beam, were measured by a retarding field, and it was found that with the particular apparatus used, potential differences of rather more than two volts could occur in the enclosure. In the second method, the condition of the gas was analysed by a small auxiliary electrode and the results deduced from the speeds of the positive ions confirmed, and the electrons outside the main beam shown to have a random distribution of velocities equivalent to more than 20,000° abs. The potential gradient is set up by the unequal rates of diffusion of positive ions and electrons from the main beam (much as in an electrolytic concentration cell), and the method indicated for reducing it to a minimum is to work with as small a current of electrons in the main beam as is compatible with the other requirements of the experiment.

Available Phosphoric Acid in Soils.—An improved method for the determination of available phosphoric acid in soils by means of an extraction with one per cent potassium carbonate instead of the generally employed citric acid solution, has been shown by S. Das to be particularly useful in the case of calcareous soils. This new method has now been tested out on a large number of Indian soils, including acid, laterite, humus, alkali, calcareous, and non-calcareous types, all of known cropping and manurial history, and the results compared with similar estimations based on the citric acid extraction (*Soil Science*, **30**, p. 33). The potassium carbonate method is shown to be equally applicable to all varieties of soil, whereas the citric acid method proved untrustworthy on alkali or calcareous types. Further, since potassium carbonate is able to extract phosphorus in organic combination in humus, which citric acid fails to do, the new method gives a truer measure of the probable fertility of the soil with respect to available phosphoric acid, and is recommended as a substitute for the citric acid methods now generally in use.

Aspects of Carbohydrate Metabolism.

II.

INVESTIGATION of the utilisation by the body of various compounds related to the sugars may be expected to throw light upon the intermediary metabolism of the carbohydrates and is, at any rate, of scientific interest. In this connexion, dihydroxyacetone, methylglyoxal, and glyceric aldehyde may be cited. Although the former antidotes insulin hypoglycæmia in both man and animals, yet, administered by mouth to human beings on a fasting stomach, it itself produces a definite hypoglycæmia (E. P. Cathcart and J. Markowitz: *Biochem. Jour.*, vol. 21, p. 1419; 1927). The fall may be compared with the secondary decrease in the blood-sugar after the ingestion of glucose, and may be due to stimulation of secretion of insulin from the pancreas. At the same time, the increased tension of carbohydrate in the liver may arrest the processes of glyconeogenesis and glycogenolysis.

In the rabbit, on the other hand, dihydroxyacetone raises the blood sugar (M. W. Goldblatt: *ibid.*, vol. 22, p. 464; 1928). In comparison with glucose this author found that dihydroxyacetone raised the respiratory quotient and increased the oxygen consumption to a greater extent but was not so effective in inhibiting the ketosis produced experimentally in man by starvation. Starvation reduces the sugar tolerance and the respiratory quotient is not raised so much as normally following the ingestion of carbohydrate. The antiketogenic influence of glucose is exerted simultaneously with the maximum increase in oxygen intake, that of dihydroxyacetone later. It appears that the latter forms glycogen less readily than glucose and cannot be considered as an intermediate stage in the breakdown of the glucose molecule. In muscle, on the other hand, W. O. Kermack, C. G. Lambie, and R. H. Slater failed to demonstrate any significant difference in the power of glucose or dihydroxyacetone to cause deposition of glycogen (*ibid.*, vol. 23, p. 416; 1929). The experiments were carried out on decerebrate, depancreated cats, in which the liver remained in circulation.

Glyceric aldehyde is another compound which may play a part in the intermediary metabolism of carbohydrate. H. G. Reeves, however, found that it was toxic to the isolated heart of the rabbit, although it could augment and accelerate the beat of the frog's or toad's heart (*Quart. Jour. Exp. Physiol.*, vol. 18, p. 277; 1927). It is possible that the difference between the mammalian and amphibian hearts is due to the difference in the temperatures at which the perfusions are necessarily carried out. It appears, therefore, that, at any rate in mammals, glyceric aldehyde is not an intermediate in the utilisation of glucose by cardiac muscle.

Goldblatt has found that carbohydrate metabolism is seriously interfered with in man by the administration of alkali, with the consequent production of a state of alkalosis (*Biochem. Jour.*, vol. 21, p. 991; 1927). Glucose by mouth now increases the blood-sugar to a greater extent than normally and some is excreted in the urine; at the same time the rise in the respiratory quotient is less marked. These results indicate that both the storage and oxidation of carbohydrate are depressed. Similarly, alkali decreases the response of the rabbit to an injection of insulin, as well as the deposition of glycogen in the liver and muscles of the rat.

A considerable amount of work has been carried out on the carbohydrate metabolism of isolated tissues. G. S. Eadie has examined the conditions of action of rat's liver amylase (*Biochem. Jour.*, vol. 21, p. 314; 1927). The enzyme was obtained by drying the organ with acetone and extracting the powder with 50 per cent glycerol, afterwards filtering and dialysing the extract. It was found that the liver enzyme was contaminated with blood amylase unless the organ was first perfused with Ringer's solution. The optimum *p*H of liver amylase is at 6, whilst that of blood amylase is at 6·8–6·9. The optimum salt concentration is 0·1 per cent; addition of adrenaline has no effect upon its activity. The enzyme and its substrate glycogen coexist in the same cell. E. F. Lesser (*ibid.*, p. 1128) considers that the amylase is to a large extent adsorbed upon surfaces within the cell and so unable to act upon the glycogen.

J. T. Irving has investigated the glucose metabolism of kidney tissue *in vitro* (*Biochem. Jour.*, vol. 22, p. 964; 1928). In the presence of oxygen, but not in its absence, chopped cortex incubated in phosphate or carbonate buffer converts glucose to lactic acid together with a small amount of hexose diphosphate; at the same time glycogen is utilised. The mechanism is therefore different from that found in muscle.

E. G. Holmes has continued his researches upon the metabolism of nervous tissue (*Biochem. Jour.*, vol. 23, p. 1182; 1929; with C. A. Ashford, *ibid.*, p. 748; with R. W. Gerard, *ibid.*, p. 738; and with M. Sherif, *ibid.*, vol. 24, p. 400; 1930). In the case of brain it was found that free phosphate was liberated on both anaerobic and aerobic incubation, in the presence or in the absence of glucose; no evidence of the synthesis of hexose phosphate in the process of formation of lactic acid was obtained, although the tissue can perform this operation to a small extent. Sodium fluoride inhibits this liberation of phosphate, when present in high concentration; even low concentrations markedly inhibit the formation of lactic acid, so that the two processes appear to be independent; in fact, it was found that lactic acid is freely formed from glucose in the absence of phosphate and its addition does not increase the velocity of formation of the acid. Brain tissue forms less lactic acid from glycogen than from glucose; sodium fluoride inhibits both phosphate and acid production, and removal of phosphate stops the formation of acid. It appears, therefore, that there are two lactic acid mechanisms in brain: one, quantitatively the more important, involves glucose and is independent of phosphate; the other involves glycogen and depends on the availability of phosphate. The source of the phosphate in the former case is obscure.

On anaerobic incubation, mammalian nerve produces lactic acid, two-thirds of which come from the free carbohydrate of the tissue and one-third from glycogen; in oxygen, no lactic acid is formed, but there is a definite fall in the free carbohydrate. Preformed lactic acid is not removed in oxygen (as is the case with brain and muscle). The oxygen consumption of nerve is much less than that of brain; about 60 per cent of the resting metabolism can be accounted for by the observed oxidation of carbohydrate. These carbohydrate changes apparently play no part in the extra metabolism of stimulation, since the nerve will still give a response after disappearance of all the carbohydrate. As the carbohydrate is consumed the oxygen consumption of resting nerve decreases; in the presence of small amounts of glucose or galactose, however, the consumption remains linear for several hours; brain, on the other hand, does not apparently use galactose.

The chemical composition and metabolism of non-

medullated nerve are different from those of medullated; for these experiments Holmes used the nerves of crabs. The free carbohydrate, and especially the glycogen content, is very much higher; the latter may form 20 per cent of the total solids. Under anaerobic conditions at rest, the glycogen decreases, with a coincident increase in the free carbohydrate and lactic acid; in oxygen the fall in glycogen and the rise in free sugar are considerably less, and there is no increase in lactic acid, although preformed lactic acid is not removed. In the nerve-ganglia the presence of a polysaccharide was detected.

J. Pryde and R. W. Humphreys (*Biochem. Jour.*, vol. 20, p. 825; 1926) have shown that the oxidic bridge of the galactose in the cerebrosides of ox brain is of the stable amylene type.

The carbohydrate metabolism of cancer cells differs from that of most normal tissues in that aerobic glycolysis is a prominent feature, whilst the oxidative removal of lactic acid is a relatively slow process. B. E. Holmes (*Biochem. Jour.*, vol. 20, p. 812; 1926) has shown that certain tumour tissues contain very little reduced glutathione and have only a slight activity in reducing the oxidised form when added. H. G. Crabtree (*ibid.*, vol. 22, p. 1289; 1928) has found that certain pathological overgrowths, aroused by different viruses, behave like malignant tissue in their carbohydrate metabolism; this change from the normal was not seen when the virus failed to produce hyperplasia.

F. Dickens and F. Šimer (*Lancet*, vol. 2, p. 10; 1930) have recently shown that the respiratory quotient of normal tissues runs parallel with their power of anaerobic glycolysis; tumours have a low respiratory quotient, indicating a poor ability to oxidise carbohydrate, although actively glycolytic. The inability to oxidise lactic acid is peculiar, since tumours, like normal tissues, oxidise pyruvic acid.

S. T. Harrison and E. Mellanby (*Biochem. Jour.*, vol. 24, p. 141; 1930) have investigated the inhibitory action of pancreatic and other extracts upon the formation of lactic acid in cancer and muscle. It has been known for some time that pancreatic extracts inhibit acid production by muscle hash. D. R. McCullagh (*ibid.*, vol. 22, p. 402; 1928) confirmed this for muscle extract; he also showed that the former prevented the disappearance of carbohydrate, but caused an increase in the free phosphate content instead of a decrease. In the presence of sodium fluoride, pancreatic extract prevented the formation of hexose phosphate, and the author considers that this is the cause of the failure to produce lactic acid. In a later paper, working with E. M. Case, it was found that the inhibition was probably due to the amylase present in the pancreatic extract (*ibid.*, p. 1060).

The properties of the unknown factor and the enzyme are very similar: inhibition is observed when malt or taka diastase replaces the pancreatic extract, or when glycogen is used as substrate instead of starch; and the formation of lactic acid from activated glucose by muscle extract is not inhibited. Harrison and Mellanby confirmed the inhibition when starch is used as the source of the lactic acid, and the failure of inhibition with glucose; they also found, however, that inhibition occurs with hexose diphosphate but not with hexose monophosphate. They therefore consider that the pancreatic extract does not act by inhibiting the esterification of hexose but by forming maltose, which is only slightly acted upon by the muscle system with the production of lactic acid. They agree that the inhibition is due to amylase; the inhibition of lactic acid formation from hexose diphosphate, however, cannot yet be explained. The same authors have also shown that various preparations of amylase inhibit the glycolysis, anaerobic and aerobic, of tumour tissue; the latter cannot form lactic acid from hexose di- or mono-phosphate or from starch to any appreciable extent, so that in this case also the inhibition cannot be due to inhibition of ester formation.

Pancreatic extracts have also been reported to contain an antiglyoxalase. Phenylglyoxal is converted to mandelic acid by liver extract; pancreatic extract inhibits the reaction. J. O. Giršavičius (*Biochem. Jour.*, vol. 24, p. 446; 1930) has found that pancreatic extract itself produces acid from phenylglyoxal; a reaction appears to occur between the phenylglyoxal and diamino-acids and polypeptides in the extract with production of an orange substance. It does not appear that this reaction can be responsible for the antiglyoxalase activity of pancreatic extracts, since the substances involved are thermostable and dialysable.

Mosses as Epiphytes.*

WISNIEWSKI has surveyed parts of the virgin forest of Białowieza, with special reference to the epiphytic Bryophyta. His results and the discussion of their significance bring out several points of interest bearing on the nature of epiphytism in this group. He recognises four associations of mosses on the trees, the first two of which appear to be true epiphytes, whilst the other two are more closely related to the vegetation of the ground flora.

The two epiphytic associations are:

(1) On broad-leaved trees (except *Betula* spp.): *Leucodon sciuroides* (chiefly on *Carpinus betulus*) and *Anomodon viticulosus* (chiefly on *Acer platanoides* and *Fraxinus excelsior*).

(2) On coniferous trees and *Betula* spp.: *Drepanium* (*Hypnum*) *cupressiforme*, var. *filiforme* and *Orthodicranum montanum*.

The other two associations under consideration are: (3) In damper situations on any type of tree: *Eurhynchium striatum*.

(4) In drier situations on any type of tree: *Pleurozium Schreberi*.

Considering possible factors influencing the ability of mosses to grow in different situations, it is clear that neither light nor temperature is a limiting factor. The light intensity lies well within the limits at which at least some of the species under consideration have been found to flourish, according to the work of Zmuda and Malta, and the same applies to the temperature range. The question of water supply is, however, a vital one for mosses as their method of water absorption is entirely different from that of root-bearing plants. It is clear from the work of Schimper and others that the rhizoids of a moss are ineffective in the uptake of water, for even if the lower parts of a moss plant are actually in water, the upper parts may be seen to wilt. The chief method of water absorption seems to be imbibition by the walls over the whole surface of the plant, whether dead or living, as is illustrated by the rapid recovery of form on moistening dry specimens. Wisniewski found an interesting difference in this respect between the epiphytic mosses and those of the ground flora, for whilst the dry plants of the former group

* Wisniewski, T. "Les associations des Muscinées (Bryophyta) épiphytes de la Pologne, en particulier celles de la forêt vierge de Białowieza." (*Bull. Internat. de l'Acad. Polonaise des Sci. et des Lettres*, pp. 293-342; 1929.)

recovered either instantaneously or at most after a few seconds on moistening, those of the latter took 40-50 sec., or often longer.

Müller points out that mosses cease to condense atmospheric moisture when the tension of water vapour is lower in the air than in the cells, so that this method is of significance to the moss only at times when the atmosphere approaches saturation. In the forest, the saturation deficit of the atmosphere increases with the distance from the ground level, and the rate of this increase depends chiefly upon the permeability of the soil and the type of forest (that is, broad-leaved or coniferous). Partly as a result of this, the moss life of the *Leucodon* and *Anomodon* type in the broad-leaved forest extends up the trees to a height of 20 m., whilst the *Drepanium* and *Orthodicranum* type in the coniferous forest only extends 3-4 m. The heights to which the mosses can extend is evidently controlled to some extent also by properties of the mosses themselves, since only certain species—the epiphytic species—can extend up the tree more than about 30-50 cm.; below this level one finds some of the species characteristic of the ground flora, for example, *Eurhynchium striatum*, *Pleurozium Schreberi*, along with certain Phanerogams, such as *Oxalis acetosella* and *Geranium Robertianum*.

The general occurrence of certain epiphytes on broad-leaved and others on coniferous trees might be explained to some extent by the humidity of the type of forest formed by such trees, a factor which is seen to influence the flora of the undergrowth and tree bases. There is, however, something more than this obvious relationship between the true epiphytic mosses and their hosts, for one finds that trees of a particular kind, for example, *Pinus sylvestris*, have their characteristic epiphytic mosses whether growing in a typical pine association or occurring as an isolated example in an association consisting typically of broad-leaved trees, and vice versa. Further, one finds that within an association, a particular moss may show a preference for a particular kind of tree, for example, *Leucodon* for *Carpinus betulus* and *Anomodon* for *Acer platanoides* and *Fraxinus excelsior*—a curious fact which future investigation may show to be associated with the type of bark (fissured or scale) and the consequent difference in the rate at which water flows away.

An unexpected feature that is without any explanation is that, as regards epiphytic moss vegetation, *Betula* spp. are classed with the conifers—a fact which is further supported by the distribution of epiphytic lichens by Räsenen in Finland.

The connexion between an epiphytic moss and its host cannot be regarded as strict, by any means. Wisniewski points out that, although the types he regards as epiphytic are rarely found in other habitats, there are very few of them which have not been recorded as growing on rock or stone as well. The marked preference for the epiphytic habit is further emphasised by the fact that very few of them are recorded from altitudes or latitudes beyond the tree zone. A study of the literature on moss distribution brings out the fact that the majority of the epiphytic forms—48 per cent—of the Białowieza forest are holoarctic in distribution, extending across Europe to North Asia and China on one side, and to North America on the other. It is curious to find that of the twelve species of trees serving as the commonest hosts for epiphytic mosses in the Białowieza forest, none occurs in North America, so that evidently the same species of mosses in the latter continent must have transferred to other hosts.

World Geometry in its Time Relations.

PROF. R. C. TOLMAN, of the Norman Bridge Laboratory of Physics, Pasadena, has published, in recent issues of the *Proceedings* of the U.S. National Academy of Sciences, a series of papers on world geometry in its time relations. The subject is the same as that of recent papers by Lemaître, de Sitter, and Eddington, namely, the existence of non-static solutions of Einstein's gravitational equations. Prof. Tolman's papers are admirably concrete and free from paradox, and will appeal to those who are attracted by a certain definiteness of point of view.

After discussing the recognised weaknesses of the Einstein line-element (full, static universe) and the de Sitter line-element (empty universe), Prof. Tolman proceeds to determine a line-element on the basis of five assumptions: (1) spatial spherical symmetry; (2) symmetry with respect to past and future time; (3) a criterion of stability; (4) and (5) conditions of isotropy with respect to the volume defined by a system of nebulæ and with respect to the average density of matter. These conditions are shown to determine the form of the line element uniquely save for a certain function of time only, which occurs as a multiplier in the space part of the line element. As a first approximation, Prof. Tolman takes this to be a linear function of the time, and reduces its determination to the ascertaining of the numerical value of a single parameter, which must be a physical constant. This constant can be interpreted in terms of the time-interval between the sending out of two light-impulses by a nebula and the time-interval between their receptions. If these are not equal, the nebula will appear to be in motion in the line of sight, and the lines in its spectrum will be displaced with red or violet. The discrepancy between the two intervals will increase with the distance of the nebula, and Prof. Tolman deduces a proportionality between distance and line-displacement. This is in agreement with the empirically found relation between red-shift and distance for nebulæ, and, using the observed numerical values, the author infers the values of the constant in his formula for the line-element.

Prof. Tolman then shows that owing to the presence of this time-factor in the line-element, the mass enclosed within a given volume must be changing, and he identifies this change with the transformation of matter into radiation—that is, he identifies the reduction in measured mass with the mass disappearing from the volume in the form of radiation. The value of the time-constant deduced from the observed recession of nebulæ should thus be connected with the rate of evolution of energy per gram by the stars. From the nebular recession, Tolman finds $k = 5{\cdot}1 \times 10^{-10}$ (years)$^{-1}$, whilst the values of k deduced from the observed masses and luminosities of the stars as tabulated by him vary from $1{\cdot}7 \times 10^{-10}$ down to $2{\cdot}3 \times 10^{-16}$.

In a later paper of the series Prof. Tolman shows that the addition of higher terms to his linear approximation for his undetermined function of time may seriously modify the values of k deduced from the observed rate of annihilation of matter, and concludes that the discrepancy is not fatal. One is naturally tempted to make the criticism that the rate of annihilation of matter must be governed by the physics of the energy-generating process in stars, and so is surely a different physical phenomenon from the recession of the nebulæ, implied by such considerations as those of stability and symmetry in the universe. This, however, is not incompatible with the view that the transformation of matter is the

primary process, and that this by conditioning the mass-change of the universe is the 'cause' of the world-geometry which predicts the nebular recession.

The same confusion between perhaps diverse physical phenomena is seen in another paper of the series, where Prof. Tolman gives an actual formula for the luminosity of a nebula in terms of its distance and red-shift. This appears to assume some common property in the nebulæ, but it is obvious that nebulæ (like stars) could have intrinsically different luminosities for the same distance. The whole discussion is, however, most stimulating, and will certainly help to provoke more accurate and extensive observations of the most distant nebulæ.

Thinning Operations in Forestry.

FOR a century or two it has probably been the desire and aim of the scientific forester to endeavour to bring the work of thinning a wood, at various ages in its development, within the circumscribed limits of a definition. There are many experienced foresters, and probably some of the most expert in this part of the forester's work, who maintain that any definition of the work involved or the laying down of any hard-and-fast rules is impracticable—if for no other reason than that in any wood the soil and other factors vary from place to place, with a consequent variability in growth. It follows from this state of affairs that the thinning operations must, if properly carried out, be based upon the condition of the individual trees and their crowns at any spot; and this condition will be a variable quantity. Greater regularity may be found in well-managed coniferous woods, and even in young well-grown broad-leaved crops; but so far as the forests of the British Empire are concerned, such conditions are only exceptionally present.

Some of these points are recognised in the brochure entitled "Classifications of Thinnings" (*Indian For. Records*, vol. 15, pt. 1, 1930. Govt. of India, Calcutta Press). One of the reasons for the persistent effort to evolve some method of classifying thinnings has been the desire to have some rules or rule-of-thumb methods of dealing with certain types of crops which would be simple enough in practice to enable their carrying out by the subordinate staff. In view of the enormous and increasing amount of this type of work which faces the numerically small staffs of the Empire Forestry Departments, it will prove almost a necessity to place a portion of the thinning work in the hands of the non-gazetted grades. But it has long been accepted that the best amongst thinning experts are born with the gift; that such are to be found in the lower ranks as well as in the upper. In either case the young forester requires to be trained by the senior who is an expert in practice, and not by any rule of thumb such as the brochure here under review attempts to prescribe.

This is not to say that the attempted classification is not of use to those who have a first-hand practical acquaintance with thinning work, either in one type of crop (mixed or pure), or in varying crops managed under different sylvicultural systems. But a very considerable amount of experience would be required before this attempt at classifying thinnings could be translated into practice: even then a wide and varying meaning can be given by different performers to the definitions given under the subdivisions on "Intensity of Thinnings". These subdivisions speak for themselves (for the definitions the pamphlet must be consulted). I. Ordinary Thinning: (1) Light thinning (A grade); (2) moderate thinning (B grade); heavy thinning (C grade); very heavy thinning (D grade). II. Crown Thinnings: (1) Light crown thinning (L.C. grade); heavy crown thinning (H.C. grade). To make use of this brochure with intelligence, and without danger to the crops being treated, the forester requires to possess a clear knowledge of the relative significance of the words and phrases used in the definitions, combined with a very considerable previous practice in the carrying out of one of the most important and interesting of his duties.

Curious Markings on Stones in Scotland.

THE *Glasgow Herald* of Sept. 17 contains an article by Mr. L. MacLellan Mann describing the markings on some stones at Langside and Cleuch, near Glasgow. The markings on the two stones are nearly alike, consisting of series of rings, arcs, and cup-like depressions. Mr. Mann claims that these have astronomical significance; some of the groups of cups are shown to resemble the Sickle in Leo and (more doubtfully) a star-group in Scorpio. He further claims that he can identify records of ancient eclipses; it would, however, need a fuller explanation of his method to induce astronomers to accept his claims in full. He states that he identified the date of a recorded eclipse as B.C. 2983 Mar. 28* Gregorian reckoning from the stone itself, and afterwards found by consulting astronomers in Berlin that there was a total eclipse on that date, the track of totality passing over or near Glasgow. The writer of the present note has verified this latter fact independently, making use of the new-moon tables by the late C. Schoch that are contained in "The Venus Tablets of Ammizaduga" (Langdon and Fotheringham, 1928). These tables make use of the latest values of the solar and lunar accelerations; but there is of necessity a considerable margin of uncertainty in computing the tracks of very early eclipses.

This eclipse affords a good illustration of the use of M. Oppert's long eclipse cycle of 1805 years; the name 'megalosaros' has been suggested for it; it is about a hundred times as long as the 'saros', and shares with it the useful property that the parallaxes of sun and moon nearly repeat themselves. The following table gives the tracks of the three successors of this eclipse; they are from Oppolzer's "Canon" and Schrader's sequel to it:

Date.	Sunrise Point.	Noon Point.	Sunset Point.
	° °	° °	° °
−2982 April 21·6		47 W.	
−1177 April 16·43	41 W. 1 N.	20 E. 40 N.	99 E. 58 N.
628 April 10·03	99 E. 9 N.	161 E. 51 N.	104 W. 63 N.
2433 April 20·46	50 W. 6 N.	13 E. 48 N.	106 E. 56 N.

The first three dates are by the Julian calendar, the fourth by the Gregorian one.

It will be seen that the cycle enables us to make a close approximation to the latitude of the eclipse track; the longitude offers greater difficulty owing to the large effect of the secular acceleration in such a long period. Oppolzer's older eclipses themselves require a considerable shift in longitude to reduce to Schoch's values of the accelerations.

Mr. Mann claims to have found similar records of still older eclipses; thus he refers to one in New Mexico of the date B.C. 3457 Sept. 5. It would, however, be well for him to make the full case for the 2983 eclipse accessible to astronomers before asking them to consider these more remote ones.

* Mr. Mann gives Mar. 27, but 28 appears to be correct.

University and Educational Intelligence.

CAMBRIDGE.—The title of Girdlers lecturer in economics has been conferred on Mr. G. F. Shove, of King's College. Mr. H. H. Nicholson, of Selwyn College, has been appointed University lecturer in agricultural chemistry.

The following elections have been announced:—To an Isaac Newton studentship, founded for the encouragement of study and research in astronomy and physical optics, value £250 a year for three years: R. van der Riet Woolley, of Gonville and Caius College, formerly of the University of Cape Town, who was a wrangler with mark of distinction in the Mathematical Tripos of 1928; to additional Isaac Newton studentships, tenable in each case for one year: V. V. Narliker, Non-Coll., and L. C. Young, Trinity.

At the annual general meeting of the Cambridge Philosophical Society held on Oct. 27, Prof. F. J. M. Stratton was elected president, and the following new members of the council were elected: Mr. J. W. Landon, Dr. E. D. Adrian, Mr. F. Debenham, and Mr. W. R. Dean.

NOTICE is given by the Chemical Society that applications for grants from the research fund of the Society must reach the assistant secretary, on prescribed forms, by at latest Dec. 1. Applicants are reminded that the income arising from the donation of the Goldsmiths' Company is to be more or less especially devoted to the encouragement of research in inorganic and metallurgical chemistry, and that the income from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the coal tar and allied industries.

THE Association of University Teachers has as one of its objects the promotion of exchanges of opinion not only between the universities of Britain but also between them and the universities of other nations. To further this aim, a short visit to French universities was recently organised with the cordial and very efficient help of M. Desclos, of the Office National des Universités et Écoles françaises. Fifteen members of the Association took part in the visit, which embraced the three universities of Paris, Lille, and Dijon. A report of facts elicited in the course of their investigations, with an account of some of their impressions and inferences, is published under the title "The French University System" in the October number of *The Universities Review*, issued by the Association, price 2*s*. This gives, in thirty pages, an informative and interesting conspectus of the university in relation to the State; the relation of the university to the general system of education; the university in relation to the cultural and economic life of France and other countries; the constitution and establishment of the university; university finance; staffing; student life and work; and courses and examinations. The report brings out some instructive comparisons and contrasts. At the head of each of the seventeen regional units, known as 'académies', in which the administration of public instruction in France is organised, stands the 'Recteur de l'Université'. Of this functionary the report observes that his duties comprise those of vice-chancellor, principal, president, and treasurer of the university, and in addition those of local director of education, member of the university grants committee, and official of the board of education. "Formidable and even autocratic as the authority of the Recteur may appear to be, we found that university dependence on the State entailed far less sacrifice of educational freedom than we were inclined to expect."

Historic Natural Events.

Nov. 9, 1883. Brilliant Sunset in England.—About ten minutes before sunset, the sky being very clear and a deep blue except for a few fleeces of cirro-cumulus nearly overhead, the sun turned unusually white and descended in a slight haze, with curious greenish white and yellowish white opalescence in the upper part. About 15 minutes after sunset the sky turned a brilliant but delicate pink, beneath which a shining green and white opalescence hung like a luminous mist. The effect grew with increasing darkness, and lit up the landscape, although the moon was shining brightly. The horizon, remained deep red until nearly 6 P.M. These remarkable sunsets, and similar effects at sunrise, were visible throughout the winter, and were due to the dust thrown into the air by the explosive volcanic eruption of Krakatoa, on Aug. 26–28, 1883.

Nov. 11, 1099. Storm in the North Sea.—A violent storm at high tide flooded the coasts of Holland and England as far as Kent, including the Thames Estuary. It is said that 100,000 persons lost their lives.

Nov. 11, 1572. Nova Cassiopeiæ.—On this date, Tycho Brahe at his observatory at Uraniborg saw that a new star, surpassing the other stars in brilliancy, had appeared in the constellation Cassiopeia. At first the nova was as bright as Venus at its maximum brightness and could be seen by keen-sighted people near midday. It then slowly declined, but in February and March 1573 it was still as bright as the first magnitude stars; by February 1574 it had reached the sixth magnitude, and by the end of March it ceased to be visible to naked-eye vision. There were accompanying changes in the colour of the nova—from white to yellow, then to a reddish hue, and lastly it became "like lead, somewhat like Saturn". Measurements of its position convinced Tycho Brahe that "this star is not some kind of comet or a fiery meteor . . . but that it is a star shining in the firmament itself—one that has never previously been seen before our time, in any age since the beginning of the world". Pliny records that Hipparchus is said to have observed a new star; since that of 1572, there have been thirteen bright novæ discovered, the most notable being those of 1604, 1901, and 1918.

Nov. 12, 1236. Inundations in East of England.—The sea burst out with such high tides and tempests of wind that the marsh countries were drowned and overflowed, and great herds and flocks perished, besides many persons. The sea rose continuously for two days and one night without ebbing, owing to the great violence of the wind. At Wisbech and neighbouring villages many people were drowned, one hundred in one village.

Nov. 14–15, 1574. Aurora.—Stow records in his "Annals" that there "were seen in the Air strange Impressions of Fire and Smoak to proceed forth of a black Cloud in the North towards the South . . . the next Night following, the Heavens from all parts did seem to burn marvellous ragingly, and over our Heads the Flames from the Horizon round about rising did meet, and there double and roll one in another, as if it had been in a clear Furnace".

Nov. 14, 1854. "Balaclava" Storm.—The British and French fleets and transports lying outside Balaclava Harbour, in the Black Sea, were wrecked and scattered by a violent gale, accompanied by rain which afterwards turned to snow. The loss of stores caused intense suffering among the allied troops in the severe winter which followed. The course of this storm across Europe was afterwards studied by the

French astronomer Leverrier, as a result of which he organised the international exchange of telegraphic weather reports and the first storm-warning service in Europe.

Nov. 14, 1866. **Meteor Shower.**—The occurrence of notable meteor showers in November 1799 and in November 1833 led to the prediction of a recurrence on a similar scale in 1866 on Nov. 14. Expectations were realised and a shower began about 11 P.M. on Nov. 13, culminated in a wonderful display between 1 and 2 A.M. on Nov. 14, and died away about 4 A.M. As the shower progressed, the radiant point in Leo was ascending above the eastern horizon. In brightness great numbers of the meteors equalled first magnitude stars, many were as bright as Jupiter, and some exceeded Venus at its brightest. It was estimated from systematic counts made by observers that at the height of the display about 6000 meteors were seen in one hour.

Nov. 14, 1923. **Floods in Northern England.**—On Nov. 12 and 13 a deep barometric depression passed north of Ireland and across Scotland along the line of the Caledonian Canal. The south-westerly gales in Lancashire were associated with heavy rains on the Pennines. On Nov. 14 the Mersey overflowed its banks, the floods at Sale being the most severe on record. At Sale Priory the water was 11 ft. deep, at Clitheroe 300 houses were flooded, and at Bury fire engines had to be called to pump the water out of houses.

Nov. 15, 1905. **Aurora Borealis.**—A remarkable display of aurora borealis was seen in all parts of the British Isles between 6 and 9.30 P.M. At Epsom, according to Mr. Spencer Russell, it first became visible in the north at 7.30 P.M., a narrow arc of pale yellow spanning the horizon. "Frequent displays of rays and streamers were noticed rising and falling rapidly from the arc, their colour varying from pale pink to a blood-red crimson. By 8.55 P.M. the aurora had extended considerably and was of an irregular form, a most noticeable feature being the variability in colour, fading at times to a pale subdued pink, brightening up with a peculiar twitching movement to a deep crimson." The display was very brilliant in the west of Europe—so much so that at Ghent and Turnhout in Belgium alarms of fire were raised. It is noteworthy that in Scotland the aurora appeared to the south of the zenith, in southern England to the north.

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 29.—**E. L. Bouvier**: A new type of ceratocampian Saturnioid.—**Mlle. Marie Charpentier**: The Peano points of a differential equation of the first order.—**Paul Montel**: Some consequences of Rolle's theorem.—**A. Rosenblatt**: Linear equations with total differentials.—**Miron Nicolesco**: The extension of the theorem of Gauss to harmonic functions of p order.—**Podtiaguine**: The upper limit of the canonical product of infinite order.—**L. Escande** and **M. Teissié-Solier**: The chronophotographic study of the flow [of a fluid] round a plate normal to the current. The velocity measured on the surface of discontinuity is constant and equal to the velocity at infinity, agreeing with that indicated by theory. The velocities found experimentally at various points give a law of retardation in good agreement with the theoretical law.—**L. Goldstein**: The principle of exclusion and intramolecular statistics.—**Pierre Chevenard** and **Albert Portevin**: The secondary tempering of hyper-tempered steels and the stability of austenite.—**Jean Lugeon**: Simultaneous investigation by atmospherics at Zurich and in the Sahara. On the basis of three years' records, the following conclusion can be drawn: out of every 100 atmospherics recorded in a year, 20 per cent are of distant origin, some thousands of kilometres; 70 per cent have a range of between 100 and 1000 kilometres; 10 per cent are local, with a range of less then 100 kilometres. The Kennelly-Heaviside layer is always higher at El-Golea (Sahara) than at Zurich.—**Jean Piveteau**: Contribution to the study of the fossil Ganoid fishes: the family of the Catopterideæ.—**Louis Baudin**: The variation of the respiratory exchanges of fishes as a function of the barometric pressure. By experiments at Lausanne and at Concarneau it has been established that fish are very sensitive to changes in the barometric pressure, and this sensibility is measured by large differences in the gaseous exchanges and in the respiratory coefficient.

Oct. 6.—The president announced the death of Paul Wagner, *correspondant* for the Section of Rural Economy.—**J. Costantin**: The phytopathological guarantees of non-degenerescence of the potato in North America. Since 1922 the author has recommended the use of seed potatoes collected in cold countries or in the mountains. Further support of this view has been obtained from results in America and Canada. The climate probably acts in limiting the extension of disease, in facilitating the selection of healthy individuals, and perhaps in suppressing disease.—**Paul Helbronner**: The polar aurora of Sept. 3, and on its action on radio-telegraphic transmissions. A list of wireless communications interrupted by this aurora is given.—**Léon Guillet, Jean Galibourg,** and **Marcel Ballay**: Thermal treatment hardening grey cast irons.—**E. Bataillon** and **Tchou Su**: The reaction peculiar to the egg in *Hyla*. Perivitelline and infertility of the hydrated virgin material.—**A. Buhl**: Wave geometry. Propagated waves and integral invariants.—**P. Rachevsky**: Sub-projective spaces.—**B. Kagan**: Sub-projective spaces.—**H. Chapiro**: Sub-projective spaces.—**V. Romanovsky**: A class of linear integral equations.—**Mezin**: The kinematics of the elements of lines and surfaces applied to meteorology.—**E. Coupleux** and **Givelet**: An electric organ. An outline of an entirely new type of instrument, based on the triode valve.—**A. Bogros**: The saturated vapour pressure of lithium.—**Charles Platrier**: The broadcasting in France of the landing of the aviators Costes and Bellonte in the United States.—**Nicolas G. Perrakis**: The influence of the developer on the properties of a photographic plate. A quantitative study of the action of two different developers, other variables being maintained as constant as possible.—**A. Kastler**: The Raman effect in liquids possessing rotatory power. The molecular asymmetry shown in the transmission of light (rotatory power) and in its absorption (circular dichroism) does not appear in the Raman diffusion spectra.—**A. P. Rollet** and **L. Andrès**: The alkaline pentaborates.—**J. Fromaget** and **J. H. Hoffet**: The extension of the littoral facies of the upper Devonian and the palæogeography of northern Indo-China.—**E. Saurin**: The existence of post-Lias granites in Cochin China and South Annam.—**A. Loubière**: The intranucellar vascularisation of the Trigonospermales.—**Ad. Davy de Virville**: The existence of an unnoticed zone of vegetation on the coast of the Armorican massif: the *Caloplaca marina* zone.—**H. Lagatu** and **L. Maume**: The explicit reply of leaf diagnosis when other means of observation fail.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 7, 1930).—G. Krutkov: A problem of the theory of perturbations.—S. Sobolev: The wave equation in the case of a heterogeneous isotropic medium.—A. Mordvilko: Aphids of the tribe *Hormaphidina*. General considerations on the relationships and life histories.—A. Tolmačev: A new species of *Draba* from northern Siberia. Description of *D. prozorovskii* sp. n., from the river Khatanga.—E. Kozlova: Bionomics of *Pratinocola insignis* Blyth. This species nests in the subalpine zone of the Khangai mountains, northern Mongolia; nest and eggs are described, and notes on the colour of nesting birds are given.

Comptes rendus, No. 8, 1930.—F. Loewinson-Lessing: The delimitation of liparites from dacites. The percentage of silica is a less reliable character than the acidity coefficient.—R. Kuzmin: The Diophantine approximations of algebraic irrational quantities.—A. Andronov and A. Witt: Inconstant periodic movements and the theory of multivibrators of Abraham and Bloch.—V. Česnokov and E. Bazyrina: The factors limiting photosynthesis. The intensity of light and the carbon dioxide concentration are not direct factors limiting the photosynthesis; the actual limiting factor is the velocity of the penetration of carbon dioxide through the protoplasm, and this velocity increases with the intensity of light and with the concentration of the carbon dioxide.—D. Gerasimov: Distinctive characters of the pollen of *Larix* and *Pinus cembra* in turf. The main difference is the structure of the air-sacs.—P. Schmidt: The Pacific halibut, *Hippoglossus hippoglossus* L., of the Atlantic, does not occur in the Pacific, and is replaced there by *Hipoglossus stenolepis* Schmidt.

MELBOURNE.

Royal Society of Victoria, Sept. 11.—John Clark: A new species of Lymexylonidæ (Coleoptera). Under the name of *Atractocerus crassicornis*, a new species is described and figured, together with the remarkable elongated, slender larvæ. A résumé was given of the habits of the beetle and larvæ. The latter are usually regarded as pin-hole borers and cause extensive damage in growing trees, particularly Eucalypts, in Australia.

ROME.

Royal National Academy of the Lincei, May 18.—G. Scorza-Dragoni: A problem on the partial maxima and minima of a function.—D. Montesano: The normal descendencies of geometric Cremonian groups (1).—G. Nicoladzé: A general method of investigating the invariant properties of geometric figures.—E. Čech: A demonstration of Cauchy's theorem and of Gauss's formula.—M. Maggini: The spectral type of the components of a double star, determined by means of the interferometer. Determination of the colour indices and hence of the spectral type of the components of a double star by measuring the visibility of the fringes, is described.—G. Viola: Circular orbit of U Cephei.—G. L. Andrissi: The system 61 Cygni. The existence of an orbital motion of the two components of 61 Cygni, first proved by Schlesinger, and hence that of a physical connexion between these components, are confirmed.—A. Baroni: Action of magnesium ethyl bromide and of oxidising agents on diethyl polysulphides. The action of magnesium ethyl bromide on diethyl polysulphides leads to the complete demolition of these polysulphides, with formation of diethyl sulphide and mercaptan. Diethyl trisulphoxide is obtained by the action of nitric acid on diethyl trisulphide, and diethyl disulphone and trisulphone by the action of nitric acid on diethyl disulphide. The bearing of these results on the various formulæ proposed for the alkyl polysulphides is discussed.—C. Jucci: Distribution of the pigment in the strata of the coccoon of the reciprocal crosses (F_1) between two races of silkworms, the Chinese gold and the native yellow.

VIENNA.

Academy of Sciences, July 10.—F. Friza and H. Przibram: Johnston's sense organs in the tentacles (*Aristopeden*) of *Sphodromantis* and *Drosophila*. Concerning the nature of the regeneration after the amputation of the first or second joint of a limb.—H. Przibram: Influence of infundin and of adrenalin doses on the colour of the frogs *Rana esculenta*, *R. fusca*, and *H. arborea* (Causes of animal coloration, 12). Doses were kept below the fatal limit. The change of colour is not merely a death signal. There is a brightening of colour with weak doses of infundin.—H. Przibram: Rôle of visual perception for colour changes in the frogs *R. esculenta*, *R. fusca*, and *H. arborea* (Causes of animal coloration, 13). To eliminate the effects of rough or smooth surfaces the frogs were placed in glass dishes, these being surrounded by coloured papers. The darker colour of the frog when on a darker background appears to be a visual effect.—R. Zieske: Influence of the extirpation of hypophysis or eyes on the colour changes of the frog *H. arborea*. A hormone of the hypophysis provokes an expansion of the melanophores and hence a darkening of the skin.—J. Pollak and K. Deutscher: The preparation of an *o*-aminothio-phenol-sulphonic acid.—E. Katscher: Xylenol-sulpho-chloride and -sulphonylide.—A. Müller and P. Bleier: Two syntheses of hepta-methylene-imine.—A. Kailan and A. Irresberger: The esterification of 3, 5 diamino- and of iodo-benzoic acid by ethylalcoholic hydrochloric acid.—A. Kailan and A. Irresberger: The influence of neutral salts on the velocity of reaction in alcoholic solutions. The varying results are explained as partly due to the combination of water with the salt.—L. Waldmann: Geology of the Rosalia hills.—L. Waldmann: Geological studies in the mica schist zone of southern Bohemia.—H. V. Graber: Report on the geological and petrographical investigations in the Upper Austrian and south Bohemian primitive rocks.—J. Regen: The formation of stridulation sounds in some of the saltatory Orthoptera.—A. Dadieu and K. W. F. Kohlrausch: Studies on the Raman effect (10). The Raman spectrum of organic substances. Sixteen amino-bodies have now been studied.—A. Brukl and G. Ortner: The sulphides of gallium. Three sulphides are reported, Ga_3S_2, GaS, and Ga_2S.—F. Urbach: The interpretation of Stokes's law.—Radium Institute Communications (No. 264), F. Urbach and G. Schwarz: Luminescence of the alkali halides. Measurements of thermo-luminescence on the hypothesis of 'loosened regions' (*Lockerstellen*).—(No. 265), F. G. Wick: Experiments on radio-thermo-luminescence. Fluorites show a series of sharp bands possibly due to rare earths.—B. Karlik: Experiments on the luminescence of zinc sulphide and diamond under the influence of radioactive radiation. The α-radiation from polonium destroyed the blue and green bands of zinc sulphide. The capacity for luminescence in the diamond was also destroyed by α-radiation.—F. Hölzl: The mobility of some ions containing iron.—O. Dischendorfer: On *o*-chlorbenzal-dinaphthol.—O. Dischendorfer and H. Suvan: Researches in the field of phyto-chemistry (6). Allobetulin.—R. Reinicke: The evaluation of the Raman spectrum of

CH_2Cl_2 by K. W. F. Kohlrausch. A discussion with the help of the tetrahedral carbon model of the exact angular positions of the chlorine atoms.—E. Bondy-Horowitz: Contributions to the anthropology of north-east New Guinea, published in book form.

Official Publications Received.

BRITISH.

Southern Rhodesia. Geological Survey Bulletin No. 16: The Geology of the Chromite and Asbestos Deposits of the Umvukwe Range, Lomagundi and Mazoe Districts. By Dr. F. E. Keep. Pp. 105+12 plates. (Salisbury, S.R.)

H.M. Treasury. Report of the Committee on the Staffs of Government Scientific Establishments. Pp. 45. (London: H.M. Stationery Office.) 9d. net.

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 4th November 1930. Pp. 40. (Newcastle-upon-Tyne.)

Proceedings of the Royal Irish Academy. Vol. 39, Section B, Nos. 20, 21, 22: The Ecology of the Mountains of Mourne with Special Reference to Slieve Donard, by J. I. Armstrong, J. Calvert and C. T. Ingold; Re-Colonisation after Peat-Cutting, by J. M. White; The Ecology of the Moss Lane Region, Lough Neagh, by Mary Duff. Pp. 440-496+plates 5-14. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s.

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 5: January, February, March, 1930. By Ernest A. Hodgson. Pp. 67-86. 25 cents. No. 6: April, May, June, 1930. By Ernest A. Hodgson. Pp. 87-100. 25 cents. (Ottawa: F. A. Acland.)

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1929-30. Pp. 43. (London.)

FOREIGN.

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 7, No. 2, September. Pp. 101-198. (Tokyo: National Research Council of Japan.)

R. Osservatorio Astrofiso di Catania. Catalogo Astrofotografico Internazionale 1900-0. Zona di Catania fra le declinazioni +46° e +55°. Vol. 8, Parti 7ª e 8ª: Declinaz. da +53° a +55°, ascens. retta da 18h a 24h. (Fascicoli N. 63 e 64.) Pp. xi+151. (Catania).

The University of Colorado Studies. Vol. 18, No. 1, August. Pp. 42. (Boulder, Colo.) 1 dollar.

United States Department of the Interior: Office of Education. Bulletin, 1930, No. 12: National Ministries of Education. By James F. Abel. Pp. ix+158. (Washington, D.C.: Government Printing Office.) 25 cents.

City Noise: the Report of the Commission appointed by Dr. Shirley W. Wynne, Commissioner of Health, to study Noise in New York City and to develop Means of abating It. Edited by Edward F. Brown, E. B. Dennis, Jr., Jean Henry, G. Edward Pendray. Pp. xii+308. (New York City: Noise Abatement Commission.)

Clouds. By Prof. Alexander McAdie. Pp. iii+22+52 plates. (Readville, Mass.: Blue Hill Observatory.)

Sailplaning. Pp. 43. (Clarendon, Va.: Soaring Flight Co.)

Memoirs of the College of Science, Kyoto Imperial University. Series B, Vol. 5, No. 3, July, Article 12: Contributiones ad Caricologiam Asiae Orientalis, Pars Prima. By Jisaburo Ohwi. Pp. 247-292. (Tokyo and Kyoto: Maruzen Co., Ltd.)

CATALOGUES.

New Design Vacuum Grating Spectrograph. Pp. 4. (London: Adam Hilger, Ltd.)

Watson's Microscope Record. No. 21, September. Pp. 32. (London: W. Watson and Sons, Ltd.)

Vegetable Parchment: its History, Manufacture and Uses. Pp. 12+2 plates+samples. (Northfleet, Kent: British Vegetable Parchment Mills, Ltd.)

Dr. Müller's Improved X-ray Goniometer Spectrograph. Pp. 24. (London: Adam Hilger, Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 7.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—A. R. Tweedie: Presidential Address.—Dr. D. McKenzie: The Pathogenesis of Cholesteatoma.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir Vijaya Raghava Acharya: The Work of the Imperial Council of Agricultural Research.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion. In Chair, Sir Gerald Lenox-Conyngham.—Sir Gilbert Walker: Microseisms due to Meteorological Causes, followed by Dr. F. J. Whipple and A. W. Lee.—Dr. H. Jeffreys: (*a*) The Damping of Seismic Waves, and (*b*) The Revision of the Seismological Tables.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Dr. Chevalier Jackson and others: Discussion on Precancerous Conditions of the Larynx.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Prof. S. Chapman: The Absorption and Dissociative or Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth.—Dr. W. N. Bond: Turbulent Flow through Tubes.—J. S. Badami: The Spectrum of Trebly Ionised Cerium (Ce IV).—J. S. Rogers: The Photographic Effects of Gamma-Rays.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens of Surgical Interest recently added to the Museum of the Royal College of Surgeons.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. J. W. Gregory: The Machinery of the Earth (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—R. W. Allen: Feed-Water Systems for Steam Installations.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Adelphi Hotel, Liverpool), at 6.30.—W. V. Wood: The Economic Position of Railways.

INSTITUTE OF TRANSPORT (Leeds and District Section) (at Town Hall, Leeds), at 7.—J. W. Mitchell: Some Aspects of Indian Transport.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—E. Fawssett: Chairman's Inaugural Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) (Informal Meeting), at 7.—Discussion on Prints contributed to the P.G. Portfolios.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Literary and Philosophical Society and Manchester Sections of British Association of Chemists, Institute of Chemistry, Institution of Electrical Engineers, Institute of Fuel, Institution of the Rubber Industry, and Oil and Colour Chemists' Association) (at the College of Technology, Manchester), at 7.—Sir William B. Hardy: Problems of the Boundary State (including Friction and Lubrication) (Lecture).

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry, South Wales Section) (at University College, Swansea), at 7.30.—A. Stuart: The Study of Crystals with Special Reference to Chemistry.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—H. Marryat: Luminous Electric Tubes (Neon, Helium).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. H. W. Featherstone: A Visit to some of the Hospitals in Canada and the Mayo Clinic (Presidential Address).

SATURDAY, NOVEMBER 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Hamilton Smith: Some Recent Archæological Work in Italy (1).

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute (Extraordinary General Meeting), at 3.30.

MONDAY, NOVEMBER 10.

ROYAL SOCIETY OF MEDICINE (United Services Section), at 5.—Group Capt. Martin Flack: Air-sickness and Sea-sickness.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens illustrating the Pathological Conditions of the Scalp and Cranium.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Institute of Transport and Commercial Users' Association) (at Institution of Electrical Engineers), at 7.—G. J. Shave: Passenger-carrying Vehicles.—C. le M. Gosselin: Goods-carrying Vehicles.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. F. Stevenson and others: Discussion on V.I.R. Cables; their Failures, their Future, and their Rivals.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—D. B. Hoseason: The Cooling of Electrical Machines.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—N. C. Marples: The Applications of High-Nickel, Nickel-Copper Alloys and Pure Nickel in Industry.

SOCIETY OF MOTION PICTURE ENGINEERS (London Section) (at Royal Photographic Society), at 7.45.—C. W. Glover: Sound Proofing a Studio.

SURVEYORS' INSTITUTION, at 8.—E. H. Leeder: Presidential Address.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 8.30.—Symposium on The Nature of Stammering to be opened by Dr. Millais Culpin and Dr. E. J. Boome.

MEDICAL SOCIETY OF LONDON.—Prof. Chevalier Jackson: The Diagnosis and Treatment of Malignant Disease of the Chest.

TUESDAY, NOVEMBER 11.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. D. Ellis: New Aspects of Radioactivity (2).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Prof. A. W. Nash, H. M. Stanley, and Dr. A. R. Bowen: Synthetic Lubricating Oils.

INSTITUTE OF MARINE ENGINEERS, at 6.—Eng. Lt.-Comdr. S. F. Dorey: Tubes for High Pressure Water-Tube Boilers.

INSTITUTE OF METALS (Swansea Local Section) (at Y.M.C.A., Swansea), at 6.15.—Dr. H. W. Brownsdon: Alloys—Some Reasons for their Composition.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (Manchester and District Branch) (at Milton Hall, Manchester), at 7.—A. Hindley: Some Unusual Jobs.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—L. W. Oliver: Progress in Colour Photography.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch—Burnley Section) (at Municipal College, Burnley), at 7.15.—R. W. Stubbs: Some of the Aims and Objects of the Institute of British Foundrymen.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—G. J. Shave: Passenger-carrying Vehicles.—C. le M. Gosselin: Goods-carrying Vehicles.

SOCIETY OF GLASS TECHNOLOGY (jointly with Ceramic Society) (at North Stafford Hotel, Stoke-on-Trent), at 8.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at College of Technology, Manchester) (jointly with North-Western Centre of Institution of Mechanical Engineers).—D. B. Hoseason: The Cooling of Electrical Machines.

WEDNESDAY, NOVEMBER 12.

SOCIETY OF GLASS TECHNOLOGY (jointly with Ceramic Society) (at North Staffordshire Technical College, Stoke-on-Trent), at 2.30.—J. T. Randall, H. P. Rooksby, and B. S. Cooper: The Structure of Glasses: The Evidence of X-Ray Diffraction.—E. J. C. Bowmaker: A Method for Determining the Plasticity of Clays and Clay Mixtures suitable for Glass House Refractories—W. J. Rees: Specifications for Tank Blocks.—W. Emery: Notes on the Casting of Refractories.

ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street, W.1), at 5.30.—A. M. Hocart: Spirit Worshippers of the South Seas.

ROYAL SOCIETY OF MEDICINE (Surgery Section—Sub-Section of Proctology), at 5.30.—L. E. C. Norbury: Multiple Primary Malignant Growths, with Special Reference to the Colon and Rectum (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at Municipal College, Portsmouth), at 7.30.—R. E. Horley: Oil-filled Cables.

ROYAL SOCIETY OF ARTS, at 8.—Prof. A. E. Richardson: The Royal Society of Arts Competition of Industrial Designs.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Leicester Museum), at 8.—F. Dranstield: Fuels (Presidential Address).

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute) (Annual Meeting), at 8.15.—Dr. R. S. Hutton: Presidential Address.

TELEVISION SOCIETY.

THURSDAY, NOVEMBER 13.

ROYAL SOCIETY, at 4.30.—G. Endres, B. H. C. Matthews, H. Taylor, and A. Dale: Observations on certain Physiological Processes of the Marmot, I.-V.—Dr. J. Gray: The Mechanism of Ciliary Movement.—W. S. Duke-Elder and P. M. Duke-Elder: The Contraction of the Extrinsic Muscles of the Eye by Choline and Nicotine.—*Papers to be read in title only*:—Dr. C. D. Darlington: A Cytological Demonstration of 'Genetic' Crossing-Over.—W. Moppett: The Differential Action of X-Rays on Tissue Growth and Vitality, II., III., IV.—Prof. J. Mellanby: Prothrombase—Its Preparation and Properties.—Dr. D. Keilin and R. Hill: The Porphyrin of Component *c* of Cytochrome and its Relationship to other Porphyrins.—A. Geiger: The Isolation by Cataphoresis of Two Different Oxy-hæmoglobins from the Blood of some Animals.—R. Deanesly: The Development and Vascularisation of the Corpus Luteum in the Mouse and Rabbit.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—A. Bloch and G. Polya: On the Roots of Certain Algebraic Equations.—R. D. Carmichael: Expansions of Arithmetical Functions in Infinite Series.—W. L. Edge: On the Quartic Developable.—R. M. Gabriel: The Rearrangement of Positive Fourier Coefficients.—J. Hodgkinson: Note on one of Ramanujan's Theorems.—L. S. Bosanquet and E. H. Linfoot: On the Zero Order Summability of Fourier Series.—Prof. L. J. Mordell: A New Waring's Problem with Squares of Linear Forms.—A. Myller et O. Mayer: Géométrie différentielle centro-affine. Courbes Planes.—L. Roth: On Plane Forms in Four Dimensions.—Prof. G. N. Watson: Theorems Stated by Ramanujan (XIV.). A Singular Modulus.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. L. S. T. Burrell: Indications for Treatment in Pulmonary Tuberculosis (Mitchell Banks Lecture).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—J. H. Fisher: Ocular Muscles, Movements, and Judgments (Bradshaw Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: The Physiology of Water (2).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—A. E. Norris: The Methods of a Modern Reformatory.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. L. Stevens: Testing the Control of Aeroplanes.

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.—E. R. Hall: Waste Heat Recovery.

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—Dr. W. H. Hatfield and others: Discussion on Metals and Alloys of the Future.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7.—A. Coleman: Demonstration of the Finlay Colour Process.

SOCIETY OF DYERS AND COLOURISTS (Midland Section) (at University College, Nottingham), at 7.30.—R. Burgess: Factors affecting the Development of Mildew on Wool.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—Demonstrations of Photo-electric Cell Applications, illustrating some Important Properties which are made use of in Optical Work, Research Staff of the General Electric Co. Ltd.; The Use of the Spectrograph in Metallurgical Analysis, D. M. Smith: A New Spectrophotometer, H. Buckley and F. J. C. Brookes.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—D. B. McKenzie: Automatic Railway Control.

INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.—A. E. Shorter: Metal Surface Hardening.

ROYAL SOCIETY OF MEDICINE (Neurology and Ophthalmology Sections), at 8.30.—Dr. A. Lindau, T. Collins, Sir Percy Sargent, and others: Discussion on Vascular Tumours of the Brain and Spinal Cord.

FRIDAY, NOVEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—L. H. Thomas: The Slow Contraction or Expansion of a Fluid Sphere.—M. Bronstein: Note on the Temperature Distribution in the Deep Layers of Stellar Atmospheres.—V. C. A. Ferraro: (*a*) Note on the Possible Emission of Electric Currents from the Sun; (*b*) On Recombination in Ionised Streams of Corpuscles from the Sun.—Dr. H. Jeffreys: (*a*) The Resonance Theory of the Origin of the Moon (second paper); (*b*) Convection in Stars.—W. H. McCrea and G. C. McVittie: On the Contraction of the Universe.—R. H. Fowler: The Solutions of Emden's and Similar Differential Equations.—B. M. Peek: Photometric Observations of Nova Persei 1901.—S. Plakidis: Observations of Comet Forbes (1930 *e*) made with the Doridis Reflector of the National Observatory of Athens.—K. Nakamura: On the Observation of Faint Meteors, as experienced in the case of those from the Orbit of Comet Schwassmann-Wachmann, 1930 *d*.—A. Pannekoek: The Theoretical Contours of Absorption Lines.—Prof. E. A. Milne: The Analysis of Stellar Structure.

BIOCHEMICAL SOCIETY (at St. Thomas's Hospital Medical School), at 5.—R. D. Lawrence and R. A. McCance: The Effect of Phloridzin, Thyroid and Adrenaline on the Glycogen Distribution of the Rat.—E. C. Barton-Wright and J. G. Boswell: An Electric Furnace for the Micro-Combustion Method of ter Meulen.—B. C. P. Jansen, H. W. Kinnersley, R. A. Peters, and V. Reader: Curative Activity of Rice Antiberiberi Vitamin.—W. J. N. Burch: Esters of Phosphoric Acid.—R. K. Callow: The Purification of Yeast Ergosterol and the Separation from it of α-Dihydroergosterol.—F. Challenger, L. Klein, and T. K. Walker: A Note on the Mycological Production of Kojic Acid.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: An Account of Col. McCarrison's Experiments in the Production of Urinary Calculi, with an Exhibition of his Specimens.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—E. F. Spanner: Disembarkation of Passengers in Emergency at Sea.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—T. I. Illingworth: The Economic Application of Electricity to Space Heating.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 6.30.—J. A. Macintyre: The Lighting of Offices and Public Buildings.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (jointly with Chemical Engineering Group) (at Armstrong College, Newcastle-upon-Tyne), at 6.30.—W. S. Coates: Caustic Embrittlement.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry, South Wales Section) (at Technical College, Cardiff), at 7.30.—Prof. S. Knox: The Chemist and the Coal Industry.

INSTITUTE OF METALS (Sheffield Local Section) (in Applied Science Department, Sheffield University), at 7.30.—Dr. H. Hyman: Unsoundness in Metals.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.

SATURDAY, NOVEMBER 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Hamilton Smith: Some Recent Archæological Work in Italy (2).

PUBLIC LECTURES.

SATURDAY, NOVEMBER 8.

MATHEMATICAL ASSOCIATION (at Bedford College for Women), at 3.—A. H. Russell: Some Methods of Lightning Calculation.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Animal Childhood.

MONDAY, NOVEMBER 10.

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. L. E. Bayliss: The Respiratory Functions of the Blood. (Succeeding Lectures on Nov. 17, 24, and Dec. 1.)

UNIVERSITY OF LEEDS, at 5.15.—Prof. J. W. Gregory: The Structure of Eastern Asia.

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (jointly with London Safety First Council—Industrial Section) (at Institution of Mechanical Engineers), at 6.—Dr. G. H. Miles: The Psychology of Industrial Accidents.

TUESDAY, NOVEMBER 11.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: Russian Farming and Agriculture.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir Leonard Hill: Atmospheric Pollution.

GRESHAM COLLEGE (Basinghall Street), at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on Nov. 12, 13, and 14.)

MEMORIAL HALL (Farringdon Street).—Sir George Newman: Modern Collective Humanism at Work.

WEDNESDAY, NOVEMBER 12.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. R. S. Williams: The Importance of a Complete Study of the Nutritional Value of Milk.

UNIVERSITY COLLEGE, LONDON, at 5.30.—L. A. Burgess: Public Libraries in Wales.

BELFAST MUSEUM AND ART GALLERY, at 8.—Rev. W. F. A. Ellison: Suns and Stars.

THURSDAY, NOVEMBER 13.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. Marie C. Stopes: Present Day Technique and Clinical Results in Contraception.

BRITISH SCIENCE GUILD (in Goldsmiths' Hall, E.C.), at 4.30.—Sir William Pope: Science and Modern Industry (Norman Lockyer Lecture).

KING'S COLLEGE, LONDON, at 5.—Dr. W. Robson: The Metabolism of Proteins. (Succeeding Lectures on Nov. 20, 27, and Dec. 4.)

MEMORIAL HALL (Farringdon Street).—Sir George Newman: Gains and Losses in National Health.

FRIDAY, NOVEMBER 14.

BOROUGH POLYTECHNIC INSTITUTE, at 6.30.—Prof. J. T. MacGregor-Morris: Iron, Nickel, and Highly Permeable Alloys (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Nov. 21 and 28.)

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.15.—J. H. Coste: The Object and Methods of Sewage Treatment, particularly in relation to Inland Towns and Isolated Institutions (Chadwick Lecture).

SATURDAY, NOVEMBER 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. St. George Gray: The Lake Villages of Somerset.