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Lord Nuffield's New Gifts to Oxford

AN Oxford that had made up its mind not to be surprised by Lord Nuffield's almost daily giving to hospitals and other institutions was agreeably staggered last week to learn that the University had been offered by him approximately £1,300,000 for three important purposes. The first of these is the erection and endowment of wards in connexion with the Radcliffe Infirmary and the other hospitals associated with the School of Medicine, particularly the wards for the special use of the new Nuffield professors. The sum promised for this is £200,000, so that Lord Nuffield's endowment of the medical school within the past twelve months amounts to the munificent sum of £2,200,000. The second is the erection of the new laboratory of physical chemistry on a site between the Organic Chemistry Laboratory and the Department of Pathology in South Parks Road. For this a sum up to £100,000 is promised. The third and, to the general public, the most interesting, is the founding and endowment of a new college for post-graduate work in social studies, to be erected near Worcester College on the canal wharf that lies below St. Peter's Hall. For this, Lord Nuffield has given the valuable site itself, and a sum of about £900,000, about £250,000 of which will be required for the buildings.

The Oxford appeal launched last February aimed at £500,000 for definite and immediate needs, and a further £500,000 for the endowment of new developments in any subject that looks promising. It has now reached the sum of £423,000. As the physical chemistry laboratory is one of the immediate needs, this sum now becomes £523,000, and so as regards these needs the appeal has been successful. The first major step in the ordered development of the science area in the Parks has accordingly been taken—to proceed with the erection of the new physics laboratory for Prof. F. A. Lindemann at a cost of about £80,000; and soon will follow the second, for which already provisional plans have been prepared—the erection and equipment of the University's first laboratory for physical chemistry with the sum given by Lord Nuffield, and the sums earmarked for it in the appeal fund.

The great majority of senior members of the University welcome these gifts as, of course, they deserve to be welcomed. A few complain that they will alter the character of the University considerably and, probably, for the worse; a few wish the offer had been entirely unconditional or, alternatively, that their own department or subject had been in the position of medicine, physical chemistry or social studies. As regards the last, it is realized that the success or failure of the new college will depend much on the start it gets and, in particular, on the first warden and fellows. A long and carefully drafted letter from Lord Nuffield to the Vice-Chancellor gives some ideas of the intended college and its fellows, and others have been got from some of the principal Oxford men who are concerned. The new college is to be mainly a post-graduate one, like All Souls', with accommodation for, say, fifty residents, and principally for research and investigation. It need not be entirely devoted to social studies; other subjects may be considered. It is not intended that it be a teaching institution in the ordinary sense or that it should train undergraduates for business careers, still less that it should be a place where the newly graduated may start to research according to their fancy. It is hoped that the fellows will be mature workers,

brought back after they have been out in the world for some years, to do large-scale team work on those social subjects on which research is urgently needed. The new college, it is hoped, will not merely be a centre for these activities in economics, politics, anthropology, sociology and the like, but also a place where men of business and affairs, by residing there, will have an opportunity of contributing their experience to the common fund. This co-operation of academic and non-academic persons in attacking problems in the social sciences is regarded as valuable by those who, with Lord Nuffield and the Vice-Chancellor, have been thinking of the welfare of the new college. It remains to be seen how Oxford makes use of these gifts, which bring, of course, their difficulties and responsibilities with them. That it will rise to the occasion no one who knows the temper of young Oxford at the present time will question.

African Agricultural Problems

(1) Moisture and Farming in South Africa
By W. R. Thompson. (South African Agricultural Series, Vol. 14.) Pp. 260. (Johannesburg : Central News Agency, Ltd ; London : Gordon and Gotch, Ltd., 1936.) 21*s*.

(2) The Earth Goddess :
a Study of Native Farming on the West African Coast. By G. Howard Jones. (Royal Empire Society Imperial Studies, No. 12.) (Published for the Royal Empire Society.) Pp. xii + 206 + 8 plates. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1936.) 12*s*. 6*d*. net.

THE great diversity of African agricultural problems is well illustrated by these two volumes. In South Africa moisture dominates the situation, and, on the west coast, anthropology.

(1) Mr. Thompson has assiduously collected a mass of information on the alleged drying up of South Africa and has critically examined the numerous explanations that have been advanced. They include the drying up of the inland Kalahari lakes, by head-stream erosion of rivers discharging into the ocean ; the substitution of indigenous vegetation by exotic types such as wattle and eucalyptus with higher transpiration coefficients ; the destruction of natural vegetal cover by veld burning, and the increase in cultivated crops, both of which are alleged to lead to increased evaporation from the soil and to erosion ; and finally, the gradual rising of the earth's crust in South Africa, which in effect lowers the water-table and accelerates the run-off as the rivers cut deeper and deeper.

With the obvious exception of the last, all these theories predict a suitable remedy. The most widely known is Schwarz's scheme for greatly increasing the area of the inland lakes by dams across rivers that now drain the area. Although Mr. Thompson patiently and fairly discusses this and rival proposals, he points out that discussion is somewhat academic unless the country is really drying up. He has examined this crucial question in great detail and can find no convincing evidence for the allegation. It is, in fact, the old story : the abnormal is noted and the account preserved just because it is unusual ; and, in course of time, a series of such records presents a superficial appearance of normality to the uncritical mind. It seems clear that the popular idea that South Africa is drying up is not based on any evidence of change during historic times, but is an erroneous deduction from the peculiar meteorological conditions of the country. These may be summarized as follows : only 35 per cent of the surface receives more than 24 inches of rain annually ; the total rainfall is variable, its distribution is unreliable, and it is markedly seasonal ; the intensity is high and evaporation losses are heavy especially in summer-rainfall areas ; the run-off is also high.

Evidently, rainfall imposes limitations on South African agriculture ; droughts are common and losses severe. The cultivated land is also liable to extensive erosion, and Mr. Thompson discusses its increased incidence following more intensive farming practices, and urges the paramount importance of control measures, lest South Africa should follow the same unhappy path as other countries. No visitor to the country can fail to understand the concern that is felt about erosion dangers, for, whether he travels north from the Cape to Rhodesia, or east to Natal, the signs of drastic erosion are written large in those unique and beautiful panoramas that make a visit so memorable. The main strokes of this giant chisel cannot be stayed or altered ; but the surfaces it leaves can be smoothed by the prevention of sheet erosion and gulleying on cultivated and

grazing land, and by the control of veld burning. Veld burning is a very old practice, and although at first sight indefensible is considered by responsible authorities to possess advantages that justify its judicious use as a part of veld management. It is often the only economical way of removing old fibrous vegetation of low feeding value ; moreover, unburned veld often deteriorates after an extended rest.

Mr. Thompson supports the conclusions from his survey by data from his own experiments on transpiration, evaporation and erosion. These experiments would well repay further examination and separate development by soil physicists. Although the author stresses the tentative character of his conclusions, they carry conviction in all essentials. Farmers are now more numerous and farms are smaller ; the present-day farmers are anchored to their land ; they can no longer move their stock elsewhere during droughts as was possible only fifty years ago ; the farming system must be adapted to the climatic conditions of the area instead of gambling on occasional good seasons ; and finally, as efficient a vegetal cover as the climatic conditions allow must be maintained. The last point is most important, and one on which much more research is imperatively needed.

The book can be confidently recommended not only to agricultural scientists but also to the public, for it deals with matters that have a wide appeal. A more flexible style, an astute publisher to provide the right 'blurb', and it might easily have ranked with certain dissertations on relativity and the more speculative portions of astronomy as a best-seller.

(2) Mr. Thompson fluked his shot close to the bull ; Mr. Howard Jones seems to have taken deliberate aim, but his score looks suspiciously like an outer. There are signs that the hope for popular success was at the back of his mind. The chapters have been forced into a musical analogy : the themes of the fugue ; a digression on scale ; the full-score fugue ; a recital. The device is rather pointless and mildly irritating in its inevitable suggestion of pretentiousness. Two or three of the illustrations would be better omitted, and the absence of any photographs of native agriculture requires comment. The long account of rural organization in Denmark is unnecessary : as strong drink is to the dipsomaniac, so is the admittedly great achievement of the Danes to most amateur—and not a few professional—economists. The book would have been far better for a more objective treatment. The facts are interesting enough to speak for themselves, and wherever the author lets them do so, he holds the reader's attention.

Mr. Jones is a mycologist but, wisely, does not wish to work only in the narrow rut of a specialist. His book is a record of five years' experience of the agriculture of the west coast of Africa. There is an interesting if somewhat discursive opening chapter on Ala, the earth goddess, and the pervading influence of religious beliefs on the agricultural practices of the natives.

The author shows that much of what European observers would rightly classify as careless or worse, is explicable on historical and social grounds. The oil palm provides an excellent example. It has always been a standby of the native, providing oil, wine, kernels, thatch, string and ornaments, and in addition, now provides the main export revenue. So long as the West Coast had a monopoly of palm oil and kernels, the wasteful native methods of extraction did not matter. But a new standard has been set up by modern extraction factories elsewhere and, so far, the West Coast has not responded to this dangerous competition, mainly because of an overriding social problem. The present practice is that the men extract the oil from the fruit, and the women have the nuts, which they crack as a spare time job, selling the kernels for pin money ; but the factory requires the complete fruit, so the men would receive all the money and the women nothing. That, as Mr. Jones says, would mean the destruction of a simple automatic system of domestic economy. When difficulties like these have to be met, the gospel of economic efficiency that is based on the standards of European industrial civilization loses most of its force and all its attraction.

Mr. Jones is at his best in discussing the immediate future of West Coast agriculture. He believes the planter system, and métayage, in which landlord and tenant each take an agreed share of the crop, to be less suitable than peasant farming. Although the nucleus of peasant farming already exists, the author recognizes and discusses the obstacles that must be removed to put it on an effective basis. Co-operation, the provision of credit facilities, education for the children, and the great difficulty of finding men who can combine the power of leadership with an understanding of the native outlook, are only a few of the problems. But the author believes that the choice of method in tackling the problems is as important as the problems themselves. He would impose a minimum of the direct methods which European administrators and technicians naturally adopt. The direct method is easier and will produce more material advance in a given time ; the indirect course is slower, more difficult, and has only one virtue : it will take the people along their own natural road to the goal. B. A. KEEN.

Conditioned Reflexes and Psychology

Pavlov and his School: the Theory of Conditioned Reflexes

By Prof. Y. P. Frolov. Translated from the Russian by C. P. Dutt. Pp. xix + 291 + 16 plates. (London: Kegan Paul and Co., Ltd., 1937.) 12*s*. 6*d*. net.

FEW physiologists can read Russian, and most of them have to depend for their knowledge of Pavlov's work on reviews and summaries published in other languages. Two comprehensive books in English on conditioned reflexes were published in 1927 and 1928, and since then most of us have had to depend on scattered sources of information. The new book by Prof. Frolov is welcome because it gives a general review of the subject up to the time of Pavlov's death. We are indebted to C. P. Dutt for the English translation.

Compared with previous works it is short, and it is attractively produced, containing 26 illustrations and an account of Pavlov's life and methods of work. The author first met Pavlov in 1911, became a disciple, and himself made discoveries about conditioned reflexes. The book is written in a spirit of reverence for the master, whose methods are always right because they are always "physiological". These methods led to conclusions which did not always agree with the conclusions reached by those whose methods were not physiological, and it is evident that in the last ten years Pavlov devoted much thought to the relationship between his own conclusions and those of Freud, Kretschmer, Köhler and others. Pavlov recognized that many of Freud's results were similar to his own, and sometimes found Freud's conclusions helpful in the interpretation of his own results. He created a complex in a dog's brain, which was made to concentrate for two years on problems connected with a metronome and a trumpet. This complex interfered with the dog's subsequent reaction to a sound produced by a telephone receiver, which appears to have become symbolic of the trumpet. The complex was eventually cured, as Freud would have cured it, by a return to the trumpet. On the other hand, "the Ego and the Id . . . encountered the most energetic resistance and rejection on the part of Pavlov".

"Kretschmer's classification of nervous types, which has obtained almost universal recognition, especially among psychiatrists, must be regarded as mistaken or inadequate." Pavlov's classification, which is based on an experience of many thousands of dogs, is more complicated, but is probably a closer approximation to the truth. Dogs are either strong or weak according to the ease with which they develop reflexes; they are either excitable, balanced, or inhibitable according to the relative strengths of excitation and internal inhibition; and both excitation and inhibition may be either labile or inert according to the ease with which they can be modified. This gives twenty-four possible types. This classification corresponds in some ways with that of Hippocrates. The choleric temperament is excitable, the melancholic inhibitable. The sanguine temperament is strong, balanced and labile, the phlegmatic strong, balanced and inert. The strong excitable type and the weak type were found to be particularly liable to pathological disturbances. These two types are thought to correspond to Kretschmer's manic-depressive and schizophrenic types.

Köhler's experiments with anthropoid apes have been repeated, and largely confirmed, in Russia, but his conclusions are "far from the order of thought of Pavlov". Tantalizingly, Frolov gives no details of Pavlov's interpretation of these results, but contents himself with the statement that it is essentially different from, and at the same time simpler than, Köhler's interpretation. Further discussion of this point would presumably have thrown light on what seems to many to be the chief obstacle to those who seek to explain all behaviour in terms of reflexes—the question of intelligent behaviour. This question is briefly discussed in another part of the book. A dog which had been fed whenever its paw was held in a slightly flexed position not only developed a salivary response to the proprioceptive sensation of having a flexed paw, but also deliberately flexed its paw when it saw the experimenter. This response is attributed to the establishment of a well-beaten track from the proprioceptive area of the cortex to the food centre along which impulses eventually pass in the reverse direction so that excitation of the food centre causes movement. When flexure of the paw was followed by the pouring of acid into the dog's mouth, the sight of the experimenter caused extension of the paw. Frolov gives no clear explanation of these facts, and his statement that as a result of these experiments "the mechanism of voluntary movement, at any rate in animals, was for the first time clearly revealed", is unconvincing.

It is possible that the reinforcement of the action which has been followed by food is comparable with the development of reaction in a

circuit containing a thermo-electric valve. In the electric model the amplified electric changes are reintroduced to the valve, and so travel round a circuit, being amplified again and again. In the same way one might suppose that the excitation of the food centre by the presence of the experimenter causes a sub-threshold excitation which spreads over the whole cortex. When this excitation reaches the area corresponding to the movement which has been followed by food, the conditioned reflex increases the excitation of the food centre, and this excitation then reinforces the excitation of the centre corresponding to the appropriate movement because that centre is already excited. The impulses thus travel round a circuit until the excitation rises above its threshold value in the motor centre, and the appropriate movement is made. In order to explain the response to acid, one might suppose that the presence of an experimenter who was accustomed to place acid in the dog's mouth excited a defence centre which, besides causing salivation and other defence actions, caused sub-threshold inhibition to spread over the cortex, and to be reinforced in the same way as the excitation spreading from the food centre. Such a mechanism would account for a great variety of intelligent actions.

J. H. GADDUM.

The Science of Astrology

Dekane und Dekansternbilder:
ein Beitrag zur Geschichte der Sternbilder der Kulturvölker. Von Wilhelm Gundel. Mit einer Untersuchung über die Ägyptischen Sternbilder und Gottheiten der Dekane, von S. Schott. (Studien der Bibliothek Warburg, herausgegeben von Fritz Saxl, Band 19.) Pp. x + 452 + 33 plates. (Glückstadt und Hamburg: J. J. Augustin, 1936.)

IN the Warburg Library, still all too little known, London has an important centre of curious learning. Great erudition backed by ample means went to the making of it. Dr. Warburg's hobby was to study the countless survivals of ancient religion in modern faith and symbolism, and his great library grew up around this fine farrago of learning. The library is organized and arranged with exceptional skill, its doors stand open to every scholar, and its books are only waiting to be read. It publishes studies of its own under the general editorship of the learned librarian, Dr. F. Saxl, and one of these, a volume of more than four hundred pages, lies before us. It is by a well-known student of ancient astronomy, Dr. Wilhelm Gundel of Giessen, and it deals with the 'decans' and their stars, a subject dear to the heart of the founder of the Library.

What is a 'decan'? When the year (of 360 days) had been divided into its twelve months and put under the zodiacal signs, each of the twelve was again divided into three parts, of ten days each; and these thirty-six 'decans' had their thirty-six gods, or rulers, or dynasts, watchers of the hours ('horoscopes'), servants or messengers of the greater gods, or of Horus himself in his holy name spelled with thirty-six letters; each had his own 'face' or πρόσωπον, which might chance to be (in Egypt) the face of a bull or of an ibis, or of an eagle or of a man. These were the angels and archangels, the demons and archi-demons, of Hellenistic writers. Each had his own name; in mummy-cases and papyri, in obscure and fragmentary works like Hermes Trismegistus or the Testimonium Salomonis, in Celsus and Firmicus, in the traditionary learning of men like Kircher, Salmasius or Scaliger, we find the names of Chont-har, Chont-chre, Siket, and the thirty-three others, in all kinds of variants and corruptions. Egyptian they were in the beginning, but the true form and meaning of many are long lost. These names form a large part of astrognostic science, but they are very hard to discover; for the simple reason that the demon had to do the bidding of whomsoever called him by his name, and he took great pains to hide it!

The decans play their part in every aspect of astrology. A man's body, always a microcosm of the heavenly body, had its thirty-six parts each under the governance of its god or demon, and the knowledge of these formed the science of iatro-astrology. The decans had their place in magic and in prophecy; they ruled the weather, and it was in the first decan of the year that Sirius brought about the inundation of the Nile; heaven itself was divided into thirty-six regions, and earth, once again a microcosm, had its corresponding mystical geography. A man's life was ruled by his 'horoscope', for in the instant of his birth he assumed the qualities and came under the rule and guidance of the god or demon of his decan: as Manilius has it, *cujus signi quis parte creatur, Eius habet mores atque illo nascitur astro.*

Nothing can be more unlike what we now call science; but almost all our science is but of

yesterday, and this astrology occupied the minds of men of learning for some four thousand years. Scaliger was an astrologer in his younger days, and was the last of the great scholarly astrologers; for astrology came at last to its death-bed, in the century of Galileo and of Newton. There must be many a thing in antiquity which we should all the better understand with some help from a science so ancient and so universal; and every now and then the study of the decans throws light into strange and unexpected places. There can be little doubt (and I have none) that these rulers of the decans are no other than the genii or daemons in whom Socrates so firmly believed, whom "God, in His love of mankind, placed over us to take care of us and give us peace"—words which recall still more familiar words, "He shall give His angels charge concerning thee".

We know the story well of the man whose child was lunatic and sore vexed, and how the devil threw him down and tore him. "Sometimes he falleth into the fire, and often into the water"; and just so we read in the astrological texts that the demon of the seventeenth decan would lay hold of a man in his bath, or cast him to the ground. It happens that this decan was associated with Thoth, as a moon-god, and we know that the epilepsy from which the child suffered was a 'lunacy', or moon-disease. Jesus rebuked the devil, and he departed out of him. "He was of a kind that goeth not out but by prayer and fasting" —that is to say, by the appropriate formula and the ascetic life of the exorcist.

Dr. Gundel has written an admirable book, beautifully illustrated. It will take its place by Bouché-Leclercq's "Astrologie Grecque", and a few other similar works of exceptional learning.

D. W. T.

The Theory of Metals

The Theory of Metals: based on an Essay awarded the Adams Prize in the University of Cambridge, 1931–1932. By A. H. Wilson. Pp. viii + 272. (Cambridge: At the University Press, 1936.) 18*s*. net.

THIS careful study of the electron theory of metals is intended in the first instance as a critical survey of the general principles of the theory and of the approximations made in working out its applications. No attempt is therefore made to give a full account of the applications of the theory to individual metals, and such applications as are given serve as illustrations for the use of the general methods.

Such a critical investigation is highly desirable in a field in which, owing to mathematical complications, one could until quite recently find different results derived by different authors from the same assumptions. Mr. Wilson's book was awarded the Adams Prize for 1931–32, but it has been brought up to date by taking into account a great deal of literature published since then.

The book starts with a historical introduction, giving an outline of the old Lorentz-Drude theory of metals, together with Sommerfeld's theory, which is based on Fermi statistics and free electrons. This chapter also contains a commendably clear definition of the notion of a 'mean free path', and it is made quite clear that a mean free path in this sense need not in every case exist.

Chapter ii discusses the influence of the periodic field of force on the motion of the electrons, while the following chapter deals with the applications of this general theory to equilibrium properties of metals, such as the electronic specific heat, the distinction between metals, semi-conductors and insulators, cohesion forces, magnetic properties and the like. The optical properties are separately treated in chapter iv, while chapter v treats the electric and thermal conduction on the assumption that a mean free path exists. For simplicity it is further assumed that the mean free path is independent of the energy. While this simplification is unimportant for most of the formulæ obtained, it is of considerable importance in the formulæ for the thermo-electric coefficients, and it is regrettable, therefore, that it was not stated explicitly.

The main question as to the existence of a mean free path and its order of magnitude is taken up in chapter vi. It is made clear why a mean free path exists at temperatures above the Debye temperature Θ of the crystal lattice and that it does not exist for lower temperatures. The usual methods for calculating the mean free path at high temperatures and the electric and thermal conductivities at low temperatures are summarized and their validity is discussed. On this point, Mr. Wilson is (one may hope, unduly) pessimistic. He finds an objection to the usual Bloch calculation of the conductivity at low temperatures and shows that a more rigorous calculation would not lead to reasonable results for the conductivity if one retains the assumption that the electrons in the metal are very nearly free. He thus concludes

that this assumption ought to be abandoned, but he is very reluctant to do so, because this would mean abandoning many calculations which have led to results in good agreement with experiment. One may hope, however, that these calculations depend less on the assumption of free electrons than it would appear; the results that are confirmed by experiments are mostly qualitative, and one may hope that they can be reproduced without making use of that assumption. However, that is a point at present unsettled, and even a reader who does not share Mr. Wilson's pessimism as to the future fate of the theory will find his account of the existing theory of low-temperature conductivity clear and correct.

The last chapter gives an account of supraconductivity, a field in which there is little theory to report upon, except for thermodynamical relations. These are derived, together with a brief description of the experimental facts. An appendix contains two derivations of the fundamental formulæ of Fermi-Dirac statistics and a discussion of surface phenomena such as thermionic and cold emission and contact rectifiers.

The treatment throughout the book approaches more closely to rigour in the mathematical sense than most other physical monographs. It is likely to provide, therefore, a pleasant change for the more mathematically-minded reader, while in general it gives enough of the physical argument to be understandable to the physicist.

A list of symbols and a very complete subject index are very helpful for reference to special points.

R. P.

Gem-Stones

The Story of the Gems:
a Popular Handbook. By Herbert P. Whitlock. Pp. vi + 206 + 34 plates. (London and New York: Putnam and Co., Ltd., 1937.) 15*s.* net.

AS the title and sub-title sufficiently indicate, this new book on gem-stones has not been written for the student or specialist but primarily for the ordinary man and woman. The author has been for many years curator of minerals and gems in the American Museum of Natural History, and his experience in that position has helped him to realize the type of information about gems that is most desired by the intelligent layman. The book thus touches only very lightly on the scientific aspects of the subject, and there are none of the explanatory chapters on crystal form, hardness, refraction, etc., which are usually to be found in even elementary texts.

In the introduction, however, brief instructions are given for the measurement of specific gravity by the hydrostatic and pyknometer (here curiously misspelt 'picrometer') methods, and for the detection of double refraction in faceted stones with no apparatus beyond a white card or a pocket lens. Only American gemmologists seem to mention the sunlight-and-card test for double refraction—possibly because in the United States sunlight is a less fugitive commodity than in north-west Europe. Since, however, not only sunlight but any beam of parallel light can be made to serve, this simple and sensitive test merits wider recognition over here. It would have been well also to include the Mohs scale of hardness, since an acquaintance with this is assumed in the many references to hardness later in the book.

The main part of the book opens with a chapter on the antique use of gems, followed by an interesting and unusually full account of the cutting and fashioning of diamond and other stones, illustrated with line drawings and photographs. This is probably the most valuable part of the book.

The remainder of the volume is mainly occupied with descriptions of the various mineral species used as gems, starting, as usual, with diamond, and ending with chapters on opaque and ornamental stones and on 'unusual' gems. The treatment accorded to some of the more important gem-stones is decidedly meagre—ruby, spinel, and zircon, for example, receive an allotment of barely two pages apiece.

Simple means by which stones of similar appearance may be distinguished from one another are in most cases indicated in the appropriate context.

A list of books on gems (in which Eppler's "Edelsteine und Schmucksteine" and Spencer's "A Key to Precious Stones" should certainly have been included), and descriptive tables giving the composition, chief localities and characteristics (except refractive index) for each species in alphabetical order conclude the book. An index is provided.

The work is copiously illustrated from photographs of gems and carved objects from the Morgan collection and there is a double frontispiece in colour of cut specimens to which frequent reference is made in the text. Though not entirely free from small errors and omissions, it provides a well-written and extremely readable account of the subject, and should help to spread a knowledge and love of gems among the general public.

B. W. A.

Temperatur, Salzgehalt und Dichte an der Oberfläche des atlantischen Ozeans
Lief. 1: Das Beobachtungsmaterial und seine Aufbereitung. Von Günther Böhnecke. Pp. iii+186. 27 gold marks. Atlas. Pp. vii+74 plates. 37 gold marks. (Wissenschaftliche Ergebnisse der Deutschen Atlantischen Expedition auf dem Forschungs- und Vermessungsschiff *Meteor* 1925–1927, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft, von A. Defant, Band 5.) (Berlin und Leipzig: Walter de Gruyter und Co., 1936.)

THE temperatures on which this work is founded were observed for the larger part by merchant ships. A very large proportion were collected and partly worked up by the Royal Netherlands Meteorological Institute; the Danish Meteorological Institute, the German Seewarte and the charts published by the Meteorological Office in London with the reports of various expeditions were the sources of other material. For the area from 50° N. to the Antarctic, about 1,400,000 observations were used. The observations of salinity available were so few that it was necessary to use the earlier ones made with the hydrometer; a table of sources gives the method by which they were reduced to modern standards. This table contains 176 entries, some of which cover many ships, and should be useful for reference. The chief table gives the mean temperature and salinity for each month and one-degree square.

The results are not discussed in any way, but are shown in an atlas of beautifully printed charts. There are four charts in black and white showing the distribution of the observations, then follow thirteen in colour giving the mean temperature for the year and each month. Other charts show anomalies and yearly range. Observations of salinity are too few to allow of charts of mean values being drawn for the whole ocean for periods less than three months, but monthly charts for the North Atlantic Ocean are included. There are also charts showing anomalies and times of maximum and minimum, with a complete set for surface density.

These two volumes make an extremely valuable work of reference, and there are few questions as to the surface temperature and salinity which could not be answered by their aid.

The Chemistry of Natural Products related to Phenanthrene
By Prof. L. F. Fieser. (American Chemical Society Monograph Series, No. 70.) Second edition, with Appendix. Pp. xiv+456. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 35*s*. net.

A REVIEW of the first edition of this important treatise appeared in NATURE last year, and already a second edition has become necessary. The opportunity has been taken to add a 90-page survey of relevant papers of 1936, each referred to its appropriate context. The appendix with the revised index may be obtained separately, so that the first edition is not devaluated. The wisdom of adding so large an appendix is doubtful, since abstracts of the three hundred papers cited are available, but references to certain real advances of 1936 could not well have been omitted. Several simple carcinogenic compounds, notably *o*-aminoazotoluene, have been discovered, and the range of œstrogenic substances has been considerably extended. The animal organism has been found to synthesize polyterpenes; and the first chemical transformation of cholesterol to a natural bile-acid has been realized. Outstanding has been the isolation of natural vitamin D and its identification with the irradiation product of 7-dehydrocholesterol. Certain crystalline substances from the adrenal cortex have been found to possess close structural relationship to the sterols. Moreover, the year has witnessed steady increase in knowledge of the stereochemistry of the sterols and sex hormones, and of the structures of the cardiac glycosides.

(1) Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance
By Arthur W. Judge. (Motor Manuals, Vol. 1.) Third and revised edition. Pp. 301. 5*s*. net.

(2) Car Maintenance and Repair
By Arthur W. Judge. (Motor Manuals, Vol. 4.) Second edition. Pp. xii+283. 4*s*. net.

(3) The Electrical Equipment and Automobiles: a Book on Principles for Motor Mechanics and Motorists. By Prof. Stanley Parker Smith. Third edition, revised and enlarged. Pp. xii+250. 6*s*. net. (London: Chapman and Hall, Ltd., 1936-37.)

(1) MR. JUDGE presents the elementary principles of the petrol engine together with a comprehensive description of the various types used in automobiles. A chapter is devoted to the heavy oil engine, and considerable space is given to the lubrication, cooling and testing of petrol engines of all types. The text of the book is well written and adequately illustrated. and the subject-matter has been made interesting by a judicious and versatile selection of examples from modern British practice.

(2) The text of this book is clearly presented, with some 200 useful diagrams, and forms a good introduction to garage technique for the motor-car owner who desires to carry out much of his own maintenance work. The scope of the book is necessarily limited to one or two types of motor-car, and from some points of view it may be considered that the book is intended to be merely supplementary to the appropriate illustrated handbook usually supplied by the motor-car manufacturer with each model sold.

(3) This is the third edition of a book written primarily for students undergoing a course of instruction in the principles and practice of motor-car engineering. The book has been thoroughly revised and considerably enlarged in order to include the extended application which electricity now plays in the modern motor-car. It is comprehensive and thoroughly reliable, and it should prove valuable to the motorist who takes an intelligent interest in his car, as well as to the class of student for whom it was written.

In the Realm of Mind:
Nine Chapters on the Applications and Implications of Psychology. By Dr. Charles S. Myers. Pp. v+251. (Cambridge: At the University Press, 1937.) 7*s*. 6*d*. net.

THE appearance of a further volume of semi-popular papers on psychological subjects by Dr. C. S. Myers, just before the recent meeting of the British Association, was an inevitable reminder of the part he has played in securing the recognition of psychology as one of the sciences. As far back as 1913, it was so recognized by the British Association to the extent of its being made a sub-section under physiology. Not until 1920 was it accorded the rank of a section, and from 1922 to 1931 Dr. Myers was president of that Section.

It is fortunate for a subject which has been called—even by one of its distinguished representatives—no science but only the hope of a science, that so true a man of science as Dr. Myers has had a large share in guiding its destinies. His great work, not only as an experimental psychologist, but also as our national leader in the practical application of psychology to industrial and other problems, is too well known to call for special remark in this place. Readers of his former volume entitled "A Psychologist's Point of View" will not be likely to miss this new collection of papers. They cover a variety of topics—the choice of a career, the human factor in accidents, medical education, social psychology, internationalism, psychological conceptions in other sciences, and the nature of mind. But all this variety is consistent with a unity which comes of a common point of view. This is just the kind of book and just the kind of treatment calculated to convince any reasonable person that psychology is unquestionably a science.

(1) Biochemistry Applied to Malting and Brewing
By Prof. R. H. Hopkins and B. Krause. Pp. 342. (London: George Allen and Unwin, Ltd., 1937.) 12*s*. 6*d*. net.

(2) Practical Management of Pure Yeast:
the Application and Examination of Brewery, Distillery and Wine Yeasts. By Alfred Jörgensen. Third edition, revised by Albert Hansen. Pp. xii+111. (London: Charles Griffin and Co., Ltd., 1936.) 6*s*.

MANY famous names in the past have established the tradition that chemical research is an essential part of brewing practice. It is desirable, therefore, that a proper training in biochemistry should form the basis of the education of the would-be brewer and that the text-books available for the students be of high standard.

(1) The book under notice is largely a translation from the Danish of a book by Krause to which Prof. Hopkins has given an English aspect. It falls into two sections—one chemical, the other largely practical. The former is on the whole unsatisfactory, though the difficulty of compressing the necessary chemistry into a few pages must be allowed for. Probably it is best to separate the two subjects and teach the student his chemistry on orthodox lines. The more practical portion written by a man who knows his subject is excellent: the work should prove useful.

(2) In the yeast field the name of Jörgensen of Copenhagen stands high: no one has done more for the subject in practice and as a teacher. A third edition of his little practical handbook, revised by A. Hansen, is assured of a welcome.

Military Engineering
Vol. 6: Water Supply. (War Office.) Pp. 421+171 plates. (London: H.M. Stationery Office, 1937.) 10*s*. net.

THE volume on water supply, issued as a manual by the War Office, is a comprehensive survey of the subject in which, naturally, predominance is assigned to those aspects of the matter which affect military operations. At the same time a very useful summary is given of general principles, and the essential facts relating to water supply, whether civil or military, are set out with commendable directness and precision. There are fifteen chapters, covering water supply requirements; reconnaissance of sources and measurements of yield; well-sinking and -boring; reciprocating and centrifugal pumps; water elevators and pumping by compressed air; selection, installation and operation of pumping plant; storage; water analysis; principles of water purification; water purification practice; distributing systems, water points and water transport; field supplies during mobile operations; field supplies during protracted operations; water supply calculations and examples of camp supplies. A number of tables, plates and figures, with seven appendixes and an index, help to make up a very serviceable manual for general use.

In the compilation within reasonable limits of such a variety of information, there is naturally scope for difference of opinion on certain points, such as the statement on p. 42 that "in searching for suitable sites for shallow wells and tube wells, the employment of dowsers, or water diviners, may save time and possibly fruitless labour in well sinking". B. C.

Health and a Day:
Addresses. By Lord Horder. Pp. viii+213. (London: J. M. Dent and Sons, Ltd., 1937.) 7*s*. 6*d*. net.

THIS volume consists of twelve addresses delivered during the last two years before medical and lay audiences in Great Britain and the United States. Six of the addresses were given before medical gatherings, but only two, entitled "The Clinician's Function in Medicine" and "Direct Action in Medicine", were specially intended for the medical profession. Other addresses deal with the strain of modern civilization, the doctor as humanist, the doctor's place in society, the Hunterian tradition, national health, old diseases and new, and euthanasia. Although several of the addresses have been published before, the pleasant conversational style, and the eminently sane opinions expressed by one of the most distinguished London physicians, should secure for the work a wide circle of readers.

Tendencies of World Power Development

By Dr. E. F. Armstrong, F.R.S.

IN the modern world the question of natural power supply becomes more and more important. There is the tendency, not by any means confined to power alone, to exploit national resources and to make these available even if they are uneconomic. Power resources are of two kinds: those which are limited, including coal, oil, natural gas, peat, oil-shale; and those which are perpetually renewed, such as water, wood, wind or even the tides. A recent analysis shows that for 1935 the world power supply consisted of 56·6 per cent coal, 3·7 per cent lignite, 16·5 per cent oil, 3·8 per cent natural gas, 12·8 per cent firewood, 6·6 per cent water.

The proportion derived from coal has been stationary over the last four years, but has gone back materially since 1913; that from oil and water has increased. The consumers of power take little heed that these resources are limited, and the less wasteful use of recent years has been in the main imposed by increasing cost. Modern technique does aim constantly at a reduction of the amount of power used per product or per working unit, a factor which must tend towards a decline in the total consumption of power unless the trend of general industrial development is upward. This growth will determine in the future whether the production and consumption of fuel will rise slowly or rapidly.

In Great Britain during the last twenty-five years the gas industry has increased its yield of gas per ton of coal by more than 27 per cent: it is unlikely, however, that this figure will improve further. In the electrical industry the increase has been more than 130 per cent per unit of weight: substantial technical economies and improvements are being effected. The chief cause of the decrease in home consumption of coal is shown by the statistics to be due to the diminished use in blast furnaces and steelworks owing to more efficient methods of production. The coke consumption per ton of pig iron actually stood still for forty years at 40 cwt. per ton—to-day it is down to 33 cwt. per ton of pig. For steel the corresponding figures are a fall from 37·8 cwt. in 1920 to about 21 cwt. to-day. There is still more to be done in this direction in almost every industry; moreover, the change will be accelerated by the largely increased price of coal.

There are thus strong reasons for a decline in consumption of coal even with accelerated industrial development.

Actually the protection of oil and coal resources will first be attained when these materials cease to be squandered and are used only in the form of 'residual products' after more or less extensive chemical changes.

Coal resources are variously estimated as lasting some hundreds or even thousands of years; the mineral is becoming increasingly costly to mine. Oil resources at the present rate of consumption are given only a very short life. Water resources are in a sense inexhaustible, but it must be remembered that in the more advanced countries the most accessible falls are already developed, and that in consequence every expansion of water-power meets with more unfavourable conditions and therefore involves high costs of development. About 35 per cent of the total electric current generated is hydro-electric.

It is difficult to say in assessing the competition between coal and water-power which of the two is the cheaper: this largely depends on the continuity of the load. It is stated, for example, that the kilowatt hours produced in steam plants or water plants cost the same on an average yearly performance of 3,000 hours, water-power being cheaper above and steam-power being cheaper below this factor. The most satisfactory modern development aims at establishing a combined use of water-power and steam-power: it is preferable to use them to supplement one another rather than in competition. There is still ample water-power available in the world, only 55 million h.p. being so far developed out of 470 million h.p. available. One of the factors with electricity produced by water-power in remote places is its economic transportation with a minimum of loss to the point where it is used. Should industry, however, be thrown back more largely on water-power, it would mean a transference of manufacturing plants to countries or localities where this is available. For this reason, there are many who regard Canada as having great potentialities as a manufacturing country.

Oil competes with coal for motoring and for the aeroplane, both new uses for which there is no alternative source of power, and for shipping—this last turnover constituting a serious loss to coal. Its use for transportation and general purposes is regionally limited. The development of the competition is influenced far more by the price of oil derivatives than by that of crude oil, and it appears likely that the advance in the use of

synthetic oils having special and valuable properties will in the long run involve their production from coal even at a higher cost. The purely economic point of view alone will not be sufficient to prevent this development as it does to-day—military, political and fiscal points of view are likely in the near future to make the advent of oil from coal nearer than is generally believed.

Whereas in the United States coal only makes up half of the power production, in Germany it is necessary for 90 per cent. Hence Germany is forced to make oil from coal, the more so as in times of peril she will have no easy access to world supplies without command of the sea.

The position in Great Britain is an intermediate one; with no natural oil we are staking everything on the command of the sea and the ability to continue supplies of oil on an enormous scale. To-day, as for many years past, our industrial supremacy is based on coal.

In any event, under present-day conditions, crude oil production can scarcely keep step with the rate of increase in demand. The share of the United States has declined, though the production of Venezuela, Rumania, Iran and Iraq has assumed greater importance.

There is always a change in the particular oil product required: thus the proportion of gasoline (petrol) to crude oil has risen from 7 per cent in 1913 to 35 per cent in 1931, since when it has slightly declined as the production of heavier gas oil has increased. The position of oil supplies twenty years hence is obviously one of uncertainty.

In England, where the wood resources are so small, it comes perhaps somewhat as a surprise that 12·8 per cent of the world power supply is produced from wood, the equivalent figure in 1913 being 17·6 per cent. In heavily timbered countries, however, both on the continent of Europe and abroad, wood is still of prime importance. The forests which cover so much of northern Quebec represent to-day what the English Lake District must have looked like before the trees were felled—largely to smelt copper—in the time of Elizabeth: the oft-related destruction of the Sussex woods to smelt iron ore before the discovery of sea-coal is another parallel of what is happening abroad to-day. Scientific attempts are being made to utilize wood and its products in the best manner for a variety of purposes connected with power production and also as a raw material for the paper industry. Actually about half the total wood cut is used as firewood—a quantity estimated at 680 million cubic metres.

At the turn of the nineteenth century, coal seemed to dominate the field and to have pushed all other sources of power into the background. To-day coal, oil and water compete: the situation is determined in the various countries by conditions which have relation to factors not purely economic.

Modern Study of Plants in Relation to Education*

By Prof. E. J. Salisbury, F.R.S.

FROM the cultural point of view, plant life and all that it implies may be regarded as the foundation of a vast extent of human activity and the basis of a large and essential part of every human environment. Because neither we nor the animals could persist without plant life, it follows that much of the present distribution of these organisms over the face of the earth can only be understood in terms of the plant life either of the present or the past. Even man's industrial activities have been largely localized and in part determined by the geographical distribution of vegetation, whether it be that of the forests, of perhaps 280 million years ago, which gave origin to our coal deposits, or the vast extent of grasslands that have determined the location of pastoral communities.

A realization of the widespread demands made upon plant products would probably astonish many of those who, like Mr. Babitt, find in the mechanistic devices of the age their chief delight. Yet it has been recently estimated that a thousand Ford motor-cars utilize in their manufacture the entire plant yield of more than six hundred acres, and this quite apart from the indirect demands for grazing necessary to furnish the materials of animal origin. Despite the vast areas of the earth's surface devoted to the growth of foodstuffs, of textile fibres, of timber, rubber, tea, tobacco and innumerable other plant products, the plant remains perhaps the least known and appreciated of all man's servants by those who lay claim to any cognizance of their environment.

Even the town dweller can scarcely fail to recognize the indirect contacts of his everyday existence with the activities of agriculture, forestry and horticulture, and, if education is to be interpreted as a means of enabling the individual to

*Continued from p. 671.

have an intelligent appreciation of and harmonious relations with his environment, then a knowledge of plant life is manifestly essential to that end. I should almost feel that an apology was necessary for expressing sentiments so trite were I not sure that whatever agreement there may be in theory, our educational curricula bear witness to the neglect of these principles in practice.

The increasing diversity of pursuits in a progressive science is only too liable to be accompanied by an increasing detachment of interests and divergence of expression. Specialization, which should be accompanied by greater co-ordination, is only too frequently the begetter of disintegration rather than synthesis, and the mutual interdependence of one branch on another is lost sight of. One of the main purposes which the British Association should serve is to promote the co-operation between workers in different fields. But we only come together for a short week in each year, and so it is to the universities that we must look mainly for the continuous fostering of a liberal outlook both on science as a whole and within the domains of each particular subject.

In its earlier phases, botany was naturally concerned largely with description, and in such branches as taxonomy, morphology, anatomy, cytology, mycology, palæobotany and plant geography the descriptive aspect must necessarily play an important part, just as in ecology, physiology, bacteriology and genetics the experimental aspects should predominate. But in all, the cultural value can only be maintained if form and function are closely integrated. Each branch has its own contribution to make in this respect not only to the pure science but also to its applied aspects in agriculture, horticulture, pomology, sylviculture and plant pathology. The mere enumeration of these branches, whether pure or applied, envisages the richness of the field we cultivate and the extensive contribution that botany can make towards both the enrichment of the human mind and the well-being of the race. But the accumulation of data in these varied directions of inquiry will only fulfil its full purpose if the many threads are continually woven into the warp and woof of a single fabric.

The retention of plant physiology within the domain of botany has saved us from the worst evils of the study of form unrelated to function. This has also been one of the chief factors which led to that synthetic approach to our subject which concerns the relation of the plant to its surroundings. The supreme value of ecology, however, lies not so much in the attention which it focuses upon the mutual relations of organisms or even upon their relation to the environment, but in the synthesis which ecology achieves, into a single picture, of so many aspects of botany itself and so many branches of human knowledge. Its high educational and cultural potentiality is an outcome of the fact that it is the very antithesis of that common failing of the human mind to think of different subjects as isolated compartments of knowledge and not as different facets of one and the same jewel.

When we attempt to understand any plant community, the necessary study of the physical environment leads us at once into realms of soil structure, into the physical problems connected with water retention and water movement involving colloid properties and surface action. So, too, the chemist and the meteorologist make their contributions to our concept of the habitat, whilst the bacteriologist, the mycologist and the protozoologist all help us to envisage that teeming population of bacteria, fungi and protozoa in the soil which, by their proper balance, maintain a healthy circulation of chemical products and are a necessity for the maintenance of the supply of raw material for the higher plants and animals.

Since the environment of the present is in some considerable degree the consequence of that of the immediate and sometimes of the remote past, the study of external conditions brings us into contact with the contributions of glaciologists and historians, whilst even the student of 'place names' may materially assist in the reconstruction of those past conditions that in part have determined the present state.

When we turn from the study of the habitat to that of the vegetation which it supports, we are at once confronted with the question as to the extent to which one is in equilibrium with the other.

The morphologist and the anatomist furnish the data upon which we base our judgment as to the degree to which the external form and internal structure have contributed to render the organisms suited to the environments that they frequent. In so far as there is adaptation, whether passive or active, in this respect, to that extent the community is in equilibrium with its surroundings and represents a climax, subject, it is true, to secular change but of a relatively stable character.

The contribution of the systematist is to distinguish between the more critical species and races which exhibit a localization that less meticulous examination might readily ignore and which often have an ecological importance far greater than the Linneons of which they are the segregates. The experimental conclusions of the physiologist in the laboratory must be applied by the ecologist to the elucidation of problems in the field, complicated and often profoundly modified

by the continual operation of the competitive factor.

Finally, knowledge of the life-histories of the constituent organisms, the reaction of the various phases of their development to the environment, their modes of reproduction, their establishment and extension, comprise a mass of knowledge to which many astute observers have contributed and amongst whom the amateur holds an honoured place in our esteem. The *clichés* of the politician with regard to policies could be applied with far more than their usual significance to the ecologist, who might with some reason be described as "exploring every avenue" and "leaving no stone unturned" in his attempt to reveal the causal relations underlying the social organization of plant life; but this all too brief résumé of the contents and contacts of a single branch of botany has, I hope, sufficed to emphasize that the wide range of knowledge invoked by the ecological approach, though constituting its chief difficulty, is the very basis of its cultural value, since it weaves together into a comprehensive whole so many threads of knowledge spun by the specialists upon the wheels of research.

The value of such approach is also obvious in relation to everyday affairs. In any well-considered plan of land utilization of catchment areas the ecological aspects are apt to be ignored. The land surface under its various guises may be likened to a sponge which absorbs the divers forms of precipitation and allows the water with more or less rapidity to find its way into the streams and rivers. But the effectiveness of the land surface for holding back the water varies according to whether it is under high forests, scrub, grassland or is arable. Each type of plant cover has its own absorptive factor and its own resistance to erosion. Furthermore, each vegetation type is not static but dynamic, and its role in this respect changes both with the seasons and with the passage of time. If therefore our land utilization is to be properly conceived, due regard must be had to the proportions in which the various communities, whether natural or artificial, are present. If we are to avoid floods and droughts, we must preserve rural England for practical, as well as æsthetic, reasons. To all this ecologists can contribute valuable help, the more so that with the passage of years the surface of our roads has become better and less absorbent, and our ditches are kept cleaner so that drainage to rivers has generally become more effective and rapid. Hence what sufficed to restrain extreme conditions a hundred years ago would not suffice to-day. Afforestation of the catchment area of the Thames and other rivers would, in the long run, be perhaps far more effective and less costly as a guarantee against future floods or droughts than grand-scale engineering works, and whilst the former would produce ancillary assets of great value the latter would not.

Prof. F. W. Oliver pointed out, in reference to the reclamation of foreshores, that the plastic plant can and does meet the constantly changing impact of the forces of Nature in a way which the dead material of the engineer cannot hope to emulate, and at a far lower cost. But such biological control demands not only a comprehensive knowledge of the life-histories of the species utilized, but also an appreciation of the environmental factors, dynamic as well as static, that is summed up in the phrase ecological foresight.

Another matter is the much-discussed question of the preservation of natural areas. Owing to the widespread ignorance of biological knowledge, the dynamic character of vegetation is by no means widely realized. There are indeed many educated people to-day who think that to preserve an area all you need to do is to leave it alone. The fact that our open downland, presented to the National Trust, may, if left unhindered, ultimately cease to be downland and become woodland, with the loss perhaps of the very features for which the area was preserved, is for most a novel concept. But an enlightened policy of such control of national reserves and all that this implies will only be possible if the rising generation has been inculcated into a biological mode of thought.

It is probably true to say that no branch of botany could be cited that has not its important practical applications. Botany needs no defence in respect to the practical utility of its pursuit, although it is probably true to say that the majority of those who reap the benefits of its achievements are unmindful of their source. But it is, I feel, the contribution that botanical knowledge can make towards general culture and spiritual contentment that is its chief claim to rank high in our educational scheme.

A sympathetic understanding of botanical thought and progress is essential to a community which is to deal adequately with such national problems as agricultural policy, land utilization, afforestation, drainage and water supply, the preservation of rural areas or the provision of national parks. Only on the foundation of a knowledge of plant life and its requirements can an educated public opinion be built up that will receive and give effect to well-considered legislative action. Moreover, it is perhaps truer of these pressing questions than of most that a sympathetic and informed public opinion is essential to the continued effective operation of any policy however well conceived and enlightened.

Congrès du Palais de la Découverte

International Meeting in Paris

WHEN the President of the French Republic entered the main hall of the Sorbonne to take part in the opening of the 'Congrès du Palais de la Découverte', many were struck by the civic simplicity of his appearance, contrasting strangely with that usually associated with assemblies in which the political heads of States take part. Even the accompanying sounds of the Marseillaise seemed merely to give an objective commentary on the political situation: 'Contre nous de la tyrannie l'étandard sanglant est levé. . . .' The opening speeches of the Minister of Education, and of Jean Perrin, who acted as president of the Congress, echoed this anxiety. Both speakers affirmed their belief that the independent search for truth embodied in science is the best safeguard of civilization against threatening destruction. Jean Perrin went to the length of acclaiming science as the new supreme religion destined to reign over the happy future.

At the first moment these utterances appeared strange and exaggerated, yet as the meeting went on, bringing out one symptom after another of the world-wide struggle of international science with various local tyrannies, they gained a very simple significance.

The political situation of science unfolded itself as the various delegates rose to greet the Congress. When, after the English and the Americans, the Germans got up they were listened to with the consideration due to the hardy survivors from a great flood. Later in the evening, in conversation with one of the German delegates, he spoke to me about a better understanding between the German and French peoples; and three delegates used what seemed to me to be the same official phrase. The Italian delegates did not mention politics. The U.S.S.R. was not represented by a single member. Great applause went up when the delegate of 'the Spanish Government' was called. He said little, but the words 'in the name of the Academy of Madrid' made all the subdued terror of the situation flare up in a momentary blaze. The Portuguese who followed him, the Jew who spoke later for the University of Jerusalem, evoked in turn their particular fringe of political associations, and so did the fact that no Japanese delegate appeared. By the time the list had finished the political scene of the world was fully illuminated, and on it the new situation of science was well visible.

Science, and generally the independent search of truth, is destroyed when political liberty falls. The totalitarian States which claim to be supreme spiritual beings can admit no independent thought, be it religious, political or scientific. By its very nature such thought must claim superiority to temporal power and is therefore incompatible with totalitarianism. Thus it is quite logical that in such States the position assigned to science by the official philosophies of dialectic materialism and racialism respectively should be merely to serve the higher aims of the State.

In view of this common fate shared by independent science and political liberty, the opening speeches of the Congress appeared in a clearer light. Their appeal to science from the depth of political anxiety was guided by the recognition that the link between science and liberty is completely reciprocal: while the profession of truth needs for its protection the free institution of democracy, these institutions themselves must decay and fall if people abandon their belief in reason. The idea of liberty derives its strength from many roots but among these there is one most vital: the belief that men can reach a better understanding by free discussion, that in fact society can be continuously improved if public life is steadily guided by reasoned controversy. It was a controversy on the question of a single fact from which about half a century ago the present political system of France emerged. A handful of men had faced the violence of the Government and the fury of the populace to establish the innocence of Dreyfus. They won, and modern political France was built on their victory. To-day the rise of a new threat to liberty causes the French Government to appeal with anxious hope to the men whose profession embodies the right to reasoned controversy and whose political duty is to defend this right. M. POLANYI.

PHYSICS

THIS international congress of physicists, chemists and biologists was conceived and organized within ninety days, chiefly through the initiative of M. Frederic Joliot-Curie, who was the chairman of the executive committee. It was attended by eleven hundred men of science

and four hundred other members. Its aims included the intellectual celebration of the success of the Palais de la Découverte, the unique quality of which was described in NATURE of August 21, p. 328, and which was visited by two million persons between May 25 and October 7.

The chief motive of the congress, which gave it exceptional vitality, was the concern of many of the leading men of science in France to struggle for the preservation and extension of the conditions upon which culture, science and democracy are equally dependent. M. Jean Perrin, M. Paul Langevin, M. F. Joliot-Curie and their colleagues are determined to act in support of these principles, which they regard as sacred. M. F. Joliot-Curie told me that good scientific workers would not willingly spare time from the fascinations of research, but to-day it was their duty to appeal to the people.

The scientific meetings were arranged in thirty-seven sections. It was characteristic of the anti-nationalistic spirit that no opening paper was given by a Frenchman. All the first speakers were non-Frenchmen of international standing. Prof. P. Scherrer (Zurich) gave a review of the results published on the nuclear reaction $D+D=$ ^3He+n. Various experimenters find that the number of deutons needed to produce one neutron varies by a factor of 1,000, according to the compound of deuterium bombarded. Scherrer has bombarded heavy orthophosphoric acid with a beam of deutons of 80 microamperes and 130 kv. The number of neutrons and their energy were measured from recoil atoms of helium with an oscillograph in an ionization chamber. For a pure D target and 100 kv. it is calculated that $8{\cdot}9 \times 10^6$ deutons produce one neutron. The energy of the nuclear reaction is $2{\cdot}92 \pm 0{\cdot}3$ Mev., corresponding to a mass for the neutron of 1·0090.

Dr. J. D. Cockcroft described the new high-tension equipment at the Cavendish Laboratory. This is housed in a hall of dimensions 25 m. × 13 m. × 14 m. A 1·2 Mv. generator of the multiplied voltage type has been installed, and another of the same type giving a continuous 2 Mv. is being installed. A 12 Mv. cyclotron is also being constructed. He discussed the transmutation of boron with fast protons. The experiments show that it breaks into three alpha particles in two steps. The first involves the formation of a nucleus excited to the very high level of 3 Mv. He discussed the physical significance of the separate existence of such an excited nucleus.

Prof. Niels Bohr (Copenhagen) described the essential differences between the dynamics of the nucleus and that of whole atoms. In the latter the movements of the constituent particles can be treated to a high degree of accuracy as those of free particles in isolation. This leads to a great simplification, and a complete explanation of the details of the periodic table of the elements. In the nucleus the conditions are different. Here the constituent particles are very closely packed, and therefore under the mutual influence of forces which act only at very small distances. They act, therefore, as a collective system, and the energy of the nucleus is to be conceived as shared among the constituent particles. Disintegration occurs when sufficient energy becomes concentrated through mutual interactions on one particle. The final result of the nuclear reaction is determined by a concurrence between the various possibilities of disintegration and of the radiation of the collective system. From this point of view, the capture and expulsion of swift particles has analogies with the phenomenon of evaporation of a molecule from a liquid surface. One arrives at a notion of the 'temperature' of the collective system, which determines the speed of the ejected particles. In the case where the ejected particles are charged, the influence of the electrostatic forces is predominant, but with neutrons these forces do not exist. The collisions of slow neutrons exhibit resonance phenomena analogous with optical dispersion. Considerable progress has been made with the help of the theory of the collective system towards the understanding of the new data revealed by nuclear transmutations. Bohr remarked that very surprising analogies between the structure of nuclei and of organic molecules might be discovered.

Prof. P. M. S. Blackett (London) gave a thorough analysis of present knowledge of cosmic ray particles. The absorption of the soft component of energy up to 250 Mv. obeys the quantum theory, and the theory of Bhabha and Heitler explains the formation of cascade showers in thick plates. The evidence that the soft rays are Dirac electrons is satisfactory. But what are the hard rays? They penetrate a mile of water and produce their own type of showers. Examination of 5,000 tracks shows that only 20 exhibited abnormal ionization. All the heavy particles appear to be protonic, and Anderson's suggestion of the existence of a heavy electron seems to be rather too simple to explain the experimental evidence. Blackett suggests that, if the hard cosmic rays consist of heavy electrons, then it follows that they must have a variable rest-mass which is a function of their energy, and must change into ordinary electrons below energies of 250 Mv. But other explanations are possible.

Dr. J. Clay (Amsterdam) discussed the penetration of matter by cosmic rays and gave evidence for the existence of artificial radioactivity produced by cosmic rays. He finds that if a chamber

is suddenly covered with lead, the intensity of the cosmic rays passing through the chamber does not fall to a new steady value suddenly. There is a period of gradual decline which suggests the presence of artificially radioactive atoms with half-lives of eight minutes. He has observed similar effects when the lead is removed.

Prof. G. Lemaître (Louvain) gave an account of his analysis of the deflection of cosmic rays by the earth's magnetic field according to Størmer's theory. The equations were developed in a form of Fourier series, and solved with the Bush machine at the Massachusetts Institute of Technology. The principal cone has been exactly determined up to latitude 30°, and the Johnson latitude effect has been satisfactorily explained.

Dr. W. Bothe (Heidelberg) discussed the different methods of the experimental determination of nuclear levels, depending on the spectra of gamma rays and ejected particles. He gave some new data concerning isomeric nuclei, and results of proton and neutron capture which may be interpreted by Bohr's new theory.

Dr. P. Debye (Berlin) gave a lucid exposition of the adiabatic demagnetization method of reaching very low temperatures. He remarked that the method is an excellent demonstration of Boltzmann's principle, because the application of a magnetic field has the effect of increasing the amount of atomic order, which is conserved during demagnetization, so the effect is equivalent to a cooling. Simon's recent experiments show that heat anomalies occur in two regions under the adiabatic process. In the second, at very low temperatures, ferromagnetic properties appear. He explained that the atomic theory of paramagnetism accounts for the experimental data, and also the considerable effect of relatively weak magnetic fields on calorific properties. He extended the notion into the domain of nuclear magnetism, and said that the calculations of Heitler and Teller on the time necessary to produce thermal equilibrium deserve very close attention.

Prof. E. Wiersma (Delft) discussed the recent progress in low temperature research, and Prof. F. Simon (Oxford) reviewed the recent experimental work. He referred to the impossibility of reaching absolute zero, and described the progress in the technique of liquefying helium. He said that Talmud in Leningrad has successfully used the 'bellows' method of liquefying helium which he had proposed ten years ago. Prof. M. Polanyi (Manchester) summarized the Griffith, Taylor, and other theories on the deformation of solid bodies. J. D. Bernal contributed to the discussion with an account of Stepanov's thermal theory of deformation.

Sir C. V. Raman spoke on the optics of colloids, and on ultrasonics in liquids. He described the importance of the optical study of colloids for the determination of the size, form and distribution of the particles, and the analogy between the Tyndall effect and the diffusion of light by molecules. His general lecture on ultra-sonics was illustrated by striking metaphors. He described the experiment of Debye and Sears, and Biquard and Lucas, in which fringes are produced by light passing through a liquid transmitting ultra-sonic waves, as making sound visible, and as introducing the accuracy of optical technique into experiments on sound.

Dr. B. Van der Pol (Eindhoven) gave a lecture with experimental demonstrations of non-linear vibrations, and explained their importance in mechanics, electrical engineering and biology.

Prof. W. L. Bragg (Teddington) spoke on the structure and classification of silicates ; Dr. U. R. Evans (Cambridge) on the state of the surface of bodies during corrosion; and Dr. F. London (Paris) on supraconductivity in aromatic compounds.

J. G. CROWTHER.

BIOLOGY

THE Palais de la Découverte, which represents a great effort of popularization on the part of French science, is an attempt, and a very successful attempt, to parallel the South Kensington Science Museum and the Deutsches Museum. In the biological section, for example, there are exhibits of evolution phenomena, embryology, tissue-culture, etc., and continuous demonstrations of such experiments as the Berger rhythm. All the most modern devices such as neon lighting and automatic switching are used to give life to the exhibits and diagrams.

On Friday, October 1, there was no specifically biological meeting, but many biologists took advantage of an elegant description of the polyterpene compounds by Prof. Ruzicka (Basel), who did not fail to point out the biological importance of the sterols and lipochromes while tracing the chemical similarities between them, and their transformations. The following day was entirely devoted to embryology. Prof. Holtfreter (Munich) gave a lucid address in which he went over the fundamental discoveries on which our knowledge of the material interactions of the parts of the embryo during its development is based. He described recent results obtained by his method of explantation of parts of amphibian embryos ; thus a piece of the dorsal surface is taken from the neurula and cultivated in isolation : if from the spinal region, a neural ball is formed, surrounded by ectoderm ; if from the eye-region, an eye-cup covered with ectoderm is formed, to which a naked piece of brain is attached. Such experiments are

of great value in analysing the process of induction, a question which C. H. Waddington (Cambridge) dealt with in the succeeding paper. Waddington also described the progress made with synthetic substances in Cambridge; thus œstrin itself, styryl blue, the acenaphthene derivatives, and to a lesser extent, squalene, can act as efficient evocators, inducing the appearance of neural tubes from ventral ectoderm.

In the afternoon Dr. J. Needham (Cambridge) spoke on carbohydrate metabolism and the morphogenetic process. The association, he said, between carbohydrate catabolism and the earliest stages of development, in which determinative processes are going on, has been observed by many independent investigators for many animal groups. The glycolysis of embryonic tissues appears to differ from that of adults, in particular the machinery of the phosphorylation cycles is not fully laid down at early stages, and non-phosphorylated glucolysis takes place. Organizer phenomena and carbohydrate metabolism are probably connected, since there are strong reasons for thinking that the evocator exists in its masked form in combination with polysaccharide and protein.

Monday, October 4, opened with a paper by Prof. D. Keilin (Cambridge), who dealt with the enzymes peroxidase and catalase which have protohæmatin compounds as their prosthetic groups. The reaction of these with their substrates changes the absorption spectrum and this allows the analysis of the mechanism of the reaction. Prof. R. Kuhn (Heidelberg), on the other hand, in dealing with vitamins, emphasized how in several cases they, or compounds very similar to them, may be united in combination with proteins, giving compounds of quite different properties. Thus the lipochrome retinene, almost identical with vitamin A, forms with protein the visual purple of the retina. Lactoflavin, vitamin B_2, forms with protein the dehydrogenating enzyme, flavoprotein, of Warburg; while vitamin B_1, a thioazol derivative, is one of the components of co-carboxylase. Phosphorylation may be as important as combination with protein.

In the afternoon Prof. J. H. Northrop (Princeton) described the present state of the work on the constitution of the crystalline enzymes, trypsin and pepsin. In none of these can any prosthetic group be detected, and practically any modification of the molecule leads to a loss of its enzyme properties. No fragments are active. Work on the bacteriophage was described and an analogy sustained between its power of increase and the autocatalytic action of trypsin on trypsinogen. He was followed by Prof. Warburg (Berlin), who in a brilliant address proposed a new classification of active proteins (alloxazino-proteins, pyridino-proteins, ferro-proteins, etc.) according to the reactive groups.

On Wednesday, October 6, Dr. N. W. Pirie and J. D. Bernal (Cambridge) gave an account of their work on the plant virus of tobacco mosaic disease, from which this appears to be a nucleoprotein of special character, spontaneously forming liquid crystals of gigantic cell-size when isolated, but probably existing as spheres or short rodlike particles in the actual plant sap. This gave rise to a long discussion. Later Prof. Rideal (Cambridge) described the work of his collaborators and himself on monomolecular films of proteins and other substances of biological importance. Of particular interest was his demonstration that a sterol-protein complex, requiring long treatment with ether for separation, dissociates and reforms again under the pressures applied to it in monolayers.

Thursday, October 7, was devoted entirely to genetics. Prof. Muller (Moscow) gave a fine paper on the effects of radiations on the genotype, and this was remarkably extended by the lecture of Dr. Timofeev-Ressovsky (Berlin) in the same afternoon, who has succeeded in analysing the physico-chemical mechanism of X-ray-induced mutations much further than possible hitherto. Spontaneous mutations may now be regarded as mono-molecular reactions produced by thermal agitation when this oversteps the energy threshold of the chemical bonds. Mutations should therefore conform to the rules of chemical kinetics, and it has indeed long been known that, other things being equal, the mutation-rate is proportional to the external temperature. Prof. Haldane (London) gave an interesting discussion of the genetics of populations, introducing the term "cryptopolymorph" for populations such as man, many individuals in which carry recessive genes giving (sometimes deleterious) abnormalities. Finally, Dr. Wrinch (Oxford) developed her theory of protein structure, which she applied particularly to the structure of genes and chromosomes.

To one participant, at any rate, it seemed that the main idea which, in a quite unrehearsed way, ran through all the papers, was the great importance of compounds combined with proteins, either as loose complexes or as prosthetic groups. There were the lipochrome-protein compounds (Ruzicka, Kuhn), the sterol-protein compounds (Needham, Rideal), the vitamin-protein compounds (Kuhn, Warburg), the hæmatin-protein compounds (Keilin), and last but not least the nuclein-protein compounds (Pirie, Bernal and all the geneticists). It is the intention of the organizers of the congress to publish three volumes containing the contributions (Hermann et Cie., Paris), so that these will happily be available in permanent form. J. N.

Biological Chemistry

THE rapid increase, during recent years, of our knowledge of the chemistry of the biological catalysts and of the chemical changes involved during intracellular respiration was the most striking feature of the Section of Biological Chemistry.

On the basis of this knowledge Prof. O. H. Warburg (Berlin-Dahlem) proposed a classification of these catalysts according to chemical structure. These ferments, or active proteins, he classifies into four groups.

	Protein	Prosthetic Group	Active Group
1.	Alloxazino protein	Alloxazine nucleotide	Alloxazine
2.	Pyridino protein	Pyridine nucleotide	Pyridine
3.	Cupro protein	Unknown	Copper
4.	Ferro protein	Ferroporphyrin	Iron

As examples were quoted (1) the yellow enzyme, (2) the enzymes of alcoholic fermentation and hexose phosphate oxidation, (3) the catechol-oxidase of potato recently investigated by F. Kubowitz, (4) the well-known catalysts of the hæmoglobin type. Such a classification will naturally meet with criticism in Group 2, where the conception of enzyme plus coenzyme forming as rigid a compound as, for example, hæmoglobin will not be generally accepted. The action of these ferments was described in the case of hexose phosphate oxidation involving the stoichiometric transfer of hydrogen to atmospheric oxygen via the alloxazine and pyridine nuclei.

Prof. R. Kuhn (Heidelberg) dealt with ferments of the first two classes in a paper illustrating the close relationship between vitamins and ferments. Thus, aneurine (B_1) when phosphorylated is the prosthetic group of carboxylase, lactoflavine (B_2) plays a similar part in the yellow enzyme, while ascorbic acid (C) without phosphorylation is the active grouping of esterase. Prof. D. Keilin (Cambridge) confined his address to ferments of the fourth class. The three compounds methæmoglobin, peroxidase and catalase were taken as well-established examples, and the remarkable similarities in the chemical and spectroscopic properties were emphasized. In particular, an account was given of the spectroscopic study of the reaction with hydrogen peroxide, by which it was established that the iron of catalase, but not of the other two, is reduced in reacting with hydrogen peroxide. Manometric evidence for this reduction was also brought forward.

The discussion which followed these two papers centred mainly round the role of the yellow enzyme. It was generally accepted that oxidation *in vivo* of the reduced yellow enzyme, which cannot take place at the oxygen tension in the tissue, must be brought about through the intermediate action of the cytochrome system according to the scheme previously proposed by H. Theorell.

In dealing with the chemical nature of pepsin, trypsin and bacteriophage, Prof. J. H. Northrop (Princeton) stressed the difficulties of obtaining reliable evidence as to the purity of so-called pure crystalline preparations. Apparently the most reliable criterion is the solubility test based on phase rule considerations. Thus only with a pure substance will the concentration of dissolved solids remain constant as further solid is added to a saturated solution. This method has established that many preparations formerly believed pure are mixtures. An active crystalline nucleoprotein has also been obtained from bacteriophage. These substances contain no prosthetic group, and the properties must be ascribed to characteristic molecular structure. Their formation from inactive precursors involves but a very slight chemical change, which is autocatalytic.

A general discussion, entitled "Enzymes, Chromosomes, Virus," was opened by Dr. N. W. Pirie (Cambridge), but was mainly restricted to the subject of virus. The chief problem here is the exact relationship between the crystalline preparations and the virus as it exists in the plant. Ultrafiltration of tobacco mosaic virus shows that particle size increases during purification and gives rise to anisotropy of flow. J. D. Bernal, reviewing his work on the optical properties of purified preparations and on X-ray diffraction measurements, produced evidence of a linear aggregation of virus particles during purification, and was able to deduce the dimensions and spacial configurations of these aggregates. The identical 'unit cell' dimensions of three tobacco viruses find a parallel in the serological tests of Prof. Garcia, whereby the tobacco and potato viruses fall into two groups of closely related individuals.

An address by Prof. E. K. Rideal on chemical reactions in monolayers indicated a new line of approach to the study of changes within the cell, where surface reactions predominate. The change of chemical activity with molecular orientation in a monolayer is well illustrated by the action of permanganate on a film of oleic acid. By compression of the film the molecules assume a perpendicular position, the double bonds are removed from the interface and the oxidation practically ceases. Similarly, the photochemical decomposition of stearyl anilide can be stopped by compressing a film so that the benzene nuclei, revolving until parallel with the incident light, no longer absorb in the ultra-violet region. Similar technique makes possible the study of the orientation of protein molecules, with results in agreement with Astbury's X-ray diffraction method, and the degradation of proteins with loss of chromophoric groups (tyrosine residues) and formation of melanine.

E. F. HARTREE.

Obituary Notices

Mr. Richard Inwards

SOMETIME near the beginning of the present century a distinguished Continental meteorologist remarked that in England meteorologists were long-lived. It was perhaps the example of the Meteorological Council of that time that was in the mind of the speaker. If the remark had been printed in time it might have been included in the well-known book on "Weather Lore" by Richard Inwards, who died on September 30, at the age of ninety-seven, after seventy-six years of fellowship of the Royal Astronomical Society and seventy-five of the Royal Meteorological Society, including therein a considerable period of 'occlusion' at his residence in Croftdown Road, Highgate, accentuated by failing eyesight.

Mr. Inwards was born at Houghton Regis, not far from Dunstable, on April 22, 1840, the son of Mr. Jabez Inwards, and was educated at Soulbury, about ten miles away. In some way not apparent in the available records his education led to mining as a professional career. His interest in science is obvious from the first. He joined the Royal Astronomical Society at the age of twenty-one and the Royal Meteorological Society at twenty-two, when the latter Society was closely associated with the Institution of Civil Engineers and held its meetings in their room. According to "Who's Who", he managed mines in Bolivia and in Spain, and he reported upon mining enterprises in Norway, Austria, South America, Mexico, Spain, Portugal and England. His recreations were mechanical and microscopical.

When Mr. Inwards joined the Royal Meteorological Society, founded in 1850, it was engaged in organizing and collecting weather observations from volunteer observers in England, represented from 1881 onwards by an annual volume of the "Meteorological Record", while the Scottish Society, with Sir Arthur Mitchell, T. Stevenson (of the Screen) and A. Buchan, were discharging similar duty for Scotland. G. J. Symons was developing the British Rainfall Organization, Kew Observatory was held by the British Association, and the Meteorological Department of the Board of Trade under FitzRoy was organizing, collecting and co-ordinating observations from the sea.

In 1900 the Society had ninety-three stations of the second or third order, and among the names of observers we find E. Mawley at Berkhamsted, Sir J. W. Moore at Dublin, E. Kitto at Falmouth, H. Mellish at Hodsock, Sir Lothian Bell at Rounton, J. Baxendell at Southport, R. Bentley at Slough, F. Campbell Bayard at Wallington. Inwards's name does not appear, though he had already "passed the chair" of the Society in 1894 and 1895, with addresses on "Weather Fallacies" and "Meteorological Observations". He had been on the Council since 1884 and was treasurer in 1900, when Theodore Williams had passed up to be president on the death of G. J. Symons. He was joint editor of the *Quarterly Journal* for about twenty years and contributed three papers ("The Metric System in Meteorology", "On Some Phenomena of the Upper Air", and "Turner's Representations of Lightning"). He also wrote "On an Instrument for Drawing Parabolic Curves" (*Phil. Mag.*, 1892) and "The Temple of the Andes", 1884. In 1911 he edited the "Life and Work of W. F. Stanley", the instrument maker.

Inwards is specially remembered for his book on "Weather Lore" published first in 1869, with a third edition in 1898. So it would appear that while helping his colleagues to collect and arrange observations from British localities he was himself engaged in collecting notes about the weather and its ways from the literature of the ancients and the moderns, ranging from Hesiod and Theophrastus to *Notes and Queries*. It is a wonderful collection of the weather wisdom of more than two thousand years of common experience, 206 pages displaying perhaps three thousand spontaneous inferences.

In respect of its arrangement this book is perhaps typical of the meteorological practice of the time and has something to do with the final sentence of Mr. Inwards's introduction to "Weather Lore" that "meteorology itself especially as regards English weather is very far from having reached the phase of an exact science". In the "Meteorological Record," as elsewhere, we find separate columns for the several items observed, and the page is so brimful of observations that one is reminded of a supersaturated solution which will develop into beautiful crystals if only an efficient nucleus can be suggested. So in "Weather Lore" we find remarks about weather collected and arranged in groups related to times and seasons, sun, moon and stars, wind, clouds, mists, and so on, while those who were dealing with observations of instruments were formulating their theory round the idea of the cyclonic depression, as they do now on the idea of fronts. In "Weather Lore" the grouping under the chosen headings is rigorous, regardless of latitude or chronology (outside the limits of the solar year) and generally regardless of orographic features. The reader may be pardoned for wondering whether some day a meteorological Kepler may co-ordinate the facts which are disclosed and formulate the insight into Nature which they carry.

Prof. de Burgh Birch, C.B.

WE regret to record the death, which occurred on September 18 at the age of eighty-five years, of Prof. de Burgh Birch, emeritus professor of physiology in the University of Leeds. Prof. Birch, who was born on May 18, 1852, received his medical training at Bristol and graduated at Edinburgh.

After three years as assistant to the professor of the Institutes of Medicine at Edinburgh, Birch went in 1883 to Leeds as the first full-time professor in

the School of Medicine, which had just been amalgamated with the Yorkshire College of Science in order to become a constituent of the Victoria University and had received a nucleus of an endowment of a chair in memory of Lord Frederick Cavendish. There was practically no equipment and as little money, so for ten years, while sharing in the work of a scheme for building a new school, he set about the task of equipping the department with the practical assistance of a young mechanical engineer—Kershaw—who later made a name in the invention and manufacture of instruments for the film industry. When the new school was opened in 1893 it was extremely well equipped for practical courses, especially experimental physiology.

The necessities of the time seem to have diverted Birch's mind from inquiry into physiological problems, for which he had shown excellent promise in his work with Rutherford in Edinburgh. His attention was given to perfecting apparatus: unless perfect an instrument was no use; when perfect it ceased to have interest. His bent for organization and making the fullest use of slender funds was well shown in his military hobby. He raised a medical staff corps with such success that little improvement was required to make it a full unit in the Haldane scheme. He retired with the distinction of C.B. after serving as A.D.M.S. of the unit of his own creation. In 1915, although more than sixty years of age, he was invited to resume the rank, and he accompanied the division to France.

The same bent was marked in the organization and discipline of Birch's department and in his conduct of the affairs of the Faculty in the dean's chair, which he occupied in the first seven years of the century and again from 1913 until his retirement in 1917. In these periods he laid certain lines along which the post-War development of the school were facilitated. In these days of grants of a liberality entirely unknown in the Victorian period, this generation can scarcely understand the amount of labour and ingenuity exercised by men like Birch in laying the foundations of a department in the condition of *magna inopia omnium rerum*. Though unquoted in text-books, he is one of the corner stones of the Leeds Medical School.

Dr. W. N. Bond

IT is with much regret that we record the death of Dr. W. N. Bond, lecturer in physics in the University of Reading, which occurred on August 25, following an operation, while on holiday at Minehead.

Wilfrid Noël Bond was born on December 27, 1897, and educated first at St. Albans School and afterwards at East London College and the Royal College of Science, whence he graduated with first-class honours in the University of London. After nearly two years' experience in industrial research in the engineering works of Messrs. Kent in Luton, he returned to academic research work, first under Prof. A. W. Porter at University College, London, and later at the Cavendish Laboratory, under Sir J. J. Thomson, where he took his Cambridge B.A. by research. He was appointed lecturer in physics in the University of Reading in January 1921, a position which he continued to occupy with distinction until his death.

A kind, patient and conscientious teacher, Bond was also keenly interested in research and published numerous original papers. Readers of NATURE may recall his recent investigations into the most probable values of the universal constants, made in connexion with the theories of Sir Arthur Eddington. Bond's experimental work was mainly (though by no means exclusively) concerned with the flow of fluids, and the allied subjects of viscosity and surface tension. An experimenter of exceptional skill and ingenuity, his methods were distinguished by their elegance and simplicity. His research work showed a steady development in power and maturity, and his most recent publications on "The Viscosity of Air" and on the "Measurement of Surface Tension by the Moving Sheet Method" (a continuation of which was passing through the press at the time of his death) reveal his work at its best. In addition to his original papers, Bond published three books, "Numerical Examples in Physics", "An Introduction to Fluid Motion", and "Probability and Random Errors", all of which received very favourable notices.

Modest, friendly and sincere, Bond will be greatly missed, not only by his students and colleagues to whom at all times he gave unsparingly and unselfishly of his best, but also by a much wider circle of acquaintances and friends. He is survived by his father, and leaves a widow and three children.

WE regret to announce the following deaths:

Sir John Dewrance, G.B.E., president of the Institution of Mechanical Engineers in 1923, on October 7, aged seventy-nine years.

Dr. Paul Emerson, senior soil scientist of the Soil Conservation Service of the U.S. Department of Agriculture, an authority on soil bacteria, on September 20, aged fifty years.

Mr. W. B. Ferguson, K.C., known for his researches in photography, on October 7, aged eighty-five years.

Mr. W. S. Gosset, head of the scientific staff of Arthur Guinness, Son and Co., Dublin, known for his contributions to statistics and economics over the pseudonym "Student", on October 16, aged sixty-one years.

Prof. L. M. Hoskins, emeritus professor of applied mathematics in Stanford University, on September 8, aged seventy-seven years.

Sir Ashley Mackintosh, emeritus professor of medicine in the University of Aberdeen, an authority on nervous diseases, on October 14, aged sixty-nine years.

Sir John Moore, president of the Royal Academy of Medicine in Ireland in 1918–21 and president of the Royal College of Physicians of Ireland in 1898–1900, author of "Meteorology: Practical and Applied", on October 13, aged ninety-one years.

Prof. F. Morley, emeritus professor of mathematics, in Johns Hopkins University, on October 17, aged seventy-seven years.

News and Views

Lord Rutherford, O.M., F.R.S.

IT is with profound regret that we record the death at Cambridge, on Tuesday, October 19, at sixty-six years of age, following a serious abdominal operation, of Lord Rutherford, whose experimental researches and scientific genius form the main part of the impressive structure of modern physics. By his friendly nature, as well as his alert and brilliant mind, he won the affection and esteem of all with whom he came in contact, whether as students, research workers, or members of the numerous scientific councils, committees and other bodies on which he served. The outstanding characteristics of his life, work, and influence were described by Maurice, Duc de Broglie, in NATURE of May 7, 1932, when Lord Rutherford was added to our series of Scientific Worthies; and there would be little to add to that article if it were now published as an obituary notice. We prefer, however, to arrange for personal tributes after a great scientific investigator like Lord Rutherford has passed into silence but leaving his friends a memory which will be cherished by them all throughout life, and a record in the history of science which will never be forgotten.

Dr. C. C. Paterson, O.B.E.

DR. C. C. PATERSON is delivering the Guthrie Lecture of the Physical Society for this year at the Imperial College of Science and Technology, South Kensington, at 5.15 p.m. on October 22. The title of the lecture is "The Appraisement of Lighting". Dr. Paterson is the director of the Research Laboratories of the General Electric Company, Ltd., Wembley. He was for sixteen years a member of the staff of the National Physical Laboratory, Teddington, where he established and administered the Electrotechnics and Photometry Divisions of the Laboratory until 1918. He then accepted the task under Lord Hirst of initiating the G.E.C. Laboratories at Wembley. These have now grown so much in size and influence that they have a personnel of 500 and cover a floor area of about 170,000 sq. ft. Dr. Paterson's activities have not been confined to the Wembley Laboratories. He was president of the Institution of Electrical Engineers in the year of the Faraday celebrations (1931). He has been president of the International Illumination Commission, the Illuminating Engineering Society, and this year of the Institute of Physics; he is also a vice-president of the Royal Institution and of the Royal Society of Arts. He has been Faraday Lecturer of the Institution of Electrical Engineers and Huxley Lecturer of the University of Birmingham. Whilst Dr. Paterson's activities in engineering and science have covered a wide range, his chief personal contributions and scientific papers have been in the fields of light and lighting. He has recently had the honorary degree of doctor of science conferred on him by the University of Birmingham "in recognition of his many contributions and services to electrical science".

Prof. J. H. Gaddum

PROF. J. H. GADDUM, professor of pharmacology at University College, London, has been appointed to the University chair of pharmacology tenable at the College of the Pharmaceutical Society of Great Britain and has also been appointed director of the Society's Pharmacological Laboratories. Prof. Gaddum was educated at Rugby and at Trinity College, Cambridge, and afterwards he studied medicine at University College Hospital in 1922–24. From that time onwards he has been in the forefront as an investigator of problems of biological standardization. In 1924 he was appointed to the Wellcome Physiological Research Laboratories and in 1927 became assistant to Sir Henry Dale at the National Institute for Medical Research. From January 1934 he was professor of pharmacology in Cairo, and in the summer of 1935 was appointed to the professorship of pharmacology at University College which he has just relinquished. Prof. Gaddum was a member of the sub-committees on the biological standards for digitalis, strophanthus and ergot for the British Pharmacopœia, 1932: he also served on the sub-committee dealing with the accuracy of biological assays for the 1936 Addendum to the Pharmacopœia. His published work includes contributions on the estimation of strophanthus, thyroid preparations and on the determination of the toxicity of neoarsphenamine. His other work has been connected with the detection and isolation of substances occurring naturally in the body, such as the estimation of histamine in blood. He is secretary of the Physiological Society.

Moriz Kaposi (1837–1902)

PROF. MORIZ KAPOSI, one of the leading dermatologists of the nineteenth century, was born at Kaspovár, Hungary, on October 27, 1837. He studied medicine at Vienna, where he qualified in 1861, and then became assistant to the celebrated Prof. Hebra, whom he succeeded later in the chair of dermatology in the medical faculty of the University of Vienna. He was the first to describe several new skin diseases, such as multiple pigmented sarcoma of the skin (1872), xeroderma pigmentosum (1876), to which he has given his name, and lichen ruber moniliformis (1886). In addition to collaborating with Hebra in his work on diseases of the skin, which was translated into English in the New Sydenham's Society's publications (1866–80), he brought out an independent work on skin diseases which was translated into English and French, and a handbook on syphilis, as well as numerous articles in the *Archiv für Dermatologie und Syphilis* and the *Wiener medizinische*

Wochenschrift. His lectures, which attracted numerous specialists from both his own and foreign countries, were remarkable for their clearness and precision, and many of his pupils afterwards occupied chairs of dermatology in different countries. Throughout his life he upheld Hebra's teaching, including the erroneous doctrine of the identity of chicken-pox and small-pox, and of measles and German measles. He died on March 16, 1902, a few days after the celebration of the twenty-fifth anniversary of his appointment as professor.

Compton Manor Estate: Veterinary Field Station

THE recent announcement that the Agricultural Research Council has purchased from Mr. Alfred Barclay the Compton Manor Estate on the Berkshire Downs will be welcomed by farmers and others having an interest in the well-being of agriculture and particularly the livestock side of the industry. In addition to the purchase of the land, the Council has arranged to buy the well-known pedigree herds of Ayrshire, Friesian and Guernsey cattle and also the herd of Large White pigs. A field station is to be established at Compton Manor primarily for investigation of problems of animal health and disease. Farmers, veterinarians and all workers in any branch of animal husbandry or nutrition will agree that a development of this nature is long overdue. Material advance has been made in recent years in our knowledge of the breeding and feeding of farm livestock, and while admitting that important advances in the diagnosis, prevention and treatment of many diseases have been made, it is unfortunately only too true that there are still diseases, of wide incidence and causing enormous loss, of which very little is known in the way of treatment. Until these diseases can be controlled or cured, the potential gain which could be derived from the existing knowledge of nutrition and breeding is very seriously curtailed. The Council's announcement mentions two such diseases on which it is proposed work should commence immediately, namely, contagious abortion in cattle and fowl paralysis in poultry stocks. A bad attack of either may seriously interfere with progress which has been made over years of constructive breeding and successful feeding and management.

IN the investigation of diseases, the initial work must be carried out in research laboratories and then on small animals, but a stage comes when the results must be tried out on farm animals and under normal farm conditions. Facilities for this field work, while not non-existent, have been extremely limited in the past, and the creation of a field station for this specific purpose will help to bridge this gap. The field station will allow methods of treatment or control apparently successful in the laboratory to be tried out under practical conditions before being passed on to the farmer or practising veterinary surgeon. Another object in the establishment of the station is that it will be able to supply to other research institutes, for experimental purposes, farm animals of known history and free from disease. This service will bridge another gap; and in addition to increasing the opportunities for work at existing research institutes, it will help to maintain the desirable collaboration between those institutions and the new station. The Council states it does not wish to set up a self-contained research institute, and hopes that, in addition to other methods of collaboration, existing institutes will second members of their staff to work at Compton on some problem when it would appear that the station is the most suitable place for joint work. All agriculturists, whether farmers or research workers, will watch with great interest the development of this new station, and wish it success in the important work which it is undertaking.

German and British Lantern Slides

A CORRESPONDENT writes: "Those who, during recent years, have attended lectures on scientific subjects in Germany will have been favourably impressed by the well-made, dignified lantern slides which are used there. In many cases, the slides are made with different colours to indicate the various curves or other significant portions of diagrams. Sometimes they have coloured arrows pointing to special details. The lantern slides are generally produced to a standardized system, so that time and mental energy are saved in knowing where to look for the title, date of preparation and other significant features. This year it was noticed that some of these lantern slides were made by the Technisch-Wissenschaftliches Lehrmittelzentrale, Berlin N.W.7, Dorotheenstr.32. There would appear to be no organization in England corresponding to this technical science teaching equipment centre and it is probably true to say that lecturers in this country generally use lantern slides less satisfactory than those seen in Germany. It is suggested, therefore, that it would be to the benefit of technical education in England if encouragement could be given to the production of high-class lantern slides in this country, through the Board of Education, organizations of technical teachers and similar bodies. In this manner they would assist technical education both from the point of view of the lecturer and of the student."

Lectures and Demonstrations at the Zeiss Works

NINE hundred scientific workers, including no fewer than 160 non-Germans, attended the second Zeiss-Kurs in Jena last month. As apparently only three Englishmen were present, it would appear to be worth recording that many German firms sent several representatives to this three-day course of twelve lectures, at which more than two hundred instruments were set out, to be demonstrated by between fifty and sixty experts. On one evening during the course, a performance was given in the Zeiss Planetarium. The first day was devoted to microscopy and metallography, the lecturers being Prof. Hanemann (speed of alloy transformations); Prof. Pomp (causes of failure in the working of iron and steel); Dr. Scheil (theory of hardening steel) and Dr. Hansen (light metals and their uses). The second day's lectures dealt with spectro-analysis and photometry, the lecturers being Prof. Gerlach (progress in spectro-analytical methods); Dr. Ginsberg

(new photometrical methods in light metal analysis); Dr. Ramb (various spectro-analysis investigations for industrial laboratories) and Dr. Kaiser (contributions to the spectro-analysis of light metal alloys). The third day's work was on fine measuring, the lecturers being Prof. Kienzle (means of obtaining reliable dimensional data regarding machine components); Dipl.-Ing. Claassen (supervision of gear wheel manufacture); Dr. Berndt (testing of gear teeth) and Herr Nichterlein (modern developments in projection as a means of measuring).

Engineering and Transport

IN his presidential address to the Institute of Transport on October 11, Sir Alexander Gibb suggested that we are on the threshold of another great advance in methods of transport. He did not speak of the experiments that the great physicists of the world are carrying out in their laboratories; he confined himself to consideration of the most that engineers can offer, to improve transport with the knowledge and means they have at present. In constructing bridges, the record for length (4,200 feet) is held by the Golden Gate Bridge at San Francisco. He said that American engineers are confidently looking forward to building, within the next ten years, spans up to 10,000 feet long. With present materials and the development of wire cable construction, it is quite possible to expand this length to 18,000 feet; but before this limit is reached, the ratio of dead load to live load would be too great to make spans of this length economically justifiable. In air transport the speeds at which aeroplanes will regularly operate will before many years equal or exceed the highest speed records at the present time, and the distances over which they will operate will be greatly extended. Sir Alexander doubts, therefore, whether floating seadrome bases or mother seaplane ships will ever be necessary for great ocean crossings.

AT the moment, road design is the most urgent of the problems of transport engineering. It is purely a matter of policy and economics whether Great Britain should endeavour to develop road systems like those in Germany. In Great Britain there are 41,000 miles of road subject to the 30 m.p.h. restriction; and more than half the Great North Road is only suitable for two-line traffic, although we have the greatest density of motor traffic on the roads of any country in the world. Germany recently in one year spent 25 million pounds on entirely new road construction, and in 1935 the United States spent about 120 million pounds. In Great Britain the building of a new road is a rare event. A complete programme of new trunk motor roads in Great Britain, connecting all the principal towns, might cost up to a thousand million pounds. A further attempt to solve the traffic problems of London in the way that New York is dealing with its difficulties, on the lines of the regional plan of 1929, with its forty years programme, involving about 1,700 miles of parkways, boulevards, etc., would cost more. It might even not be possible. Sir Alexander pointed out that these are not exclusively engineering problems. They must be examined from the economic point of view before a decision can be reached.

The Hanseatic Scholarships

IT is announced in *The Times* that a Hamburg merchant, who desires to remain anonymous, has created out of his private means a fund to provide in the first instance not fewer than four scholarships annually, each of the value of 3,000 Rm., for young British graduates who desire to study in Germany. These scholarships are to be known as the Hanseatic Scholarships. They will be tenable for one year, may be held in any subject, and will be open to all students of the universities of the British Empire, with a preference for students from Great Britain. The founder hopes that the Hanseatic Scholarships may help "to further closer relations and understanding between the German and British peoples and to promote a consciousness of European solidarity". The trust, of which the first patron is the German Ambassador at the Court of St. James's, will be assisted in the selection and guidance of the scholars by a German and a British committee. The British committee, as so far constituted, will consist of: Lord Lothian (chairman), Dr. W. G. S. Adams, Prof. E. D. Adrian, Dr. George Gordon, Sir Henry Tizard, and Prof. H. G. Fiedler (secretary), professor of German language and literature, University of Oxford, from whom further particulars may be obtained.

Association of British Chemical Manufacturers

TWENTY-ONE years of activity were reviewed by the chairman, Mr. Eben Wallace, at the annual general meeting, held on October 14, of the Association of British Chemical Manufacturers, which was formally incorporated on December 28, 1916. The initial membership was 110 firms, representing a capital of £39,000,000, whereas now, although the actual membership has not shown any great increase, the capital represented is more than £200,000,000. The Association's directory, "British Chemicals and their Manufacturers", was first published in 1919, and a new edition has since been issued every second year. 1920 saw the formation of the British Chemical Plant Manufacturers' Association, whilst in 1927 the Association's Works Technical Committee commenced its work on safety in the chemical industries. Other activities have been concerned with fiscal matters, with the setting up of standards, with the organization of exhibitions, with the incidence of legislation, and, generally, with the promotion of co-operation within and around the industry. The annual report refers to the Association's activities, during the year ended May 31 last, in relation to the new Factories Act and other legislation, to the work of the Import Duties Advisory Committee, to commercial treaties, to safety measures, to the fund which the chemical industry has established in support of chemical publications and library facilities, to transport, and to various other relevant matters. Dr. F. H. Carr was elected president of the Association, and Mr. E. V. Evans and Mr. R. Duncalfe respectively chairman and vice-chairman of the council.

Plant Hormone Investigations

A STUDY meeting on the subject of "Phytohormones" was held at the International Institute of Intellectual Co-operation on October 1 and 2. This meeting, which was organized by the International Institute of Intellectual Co-operation and the International Union of Biological Sciences, was the first of a series that will be held in the course of the coming months and which will discuss a variety of questions such as "The New Vitamins", "Nomenclature of Genetics", "The Double Electric Layer", etc., included in the plan of work of the International Council of Scientific Unions, which acts as a committee of scientific advisers to the Intellectual Co-operation Organization. The meeting was held under the chairmanship of Prof. P. Boysen Jensen and reports were discussed on various aspects of the study of phytohormones, prepared by the following: Prof. F. Kögl, Utrecht; Prof. Niels Nielsen; Prof. N. J. Koningsberger, Utrecht; Prof. G. S. Avery, Connecticut; Prof. R. Bouillenne, Liége; Prof. C. Zollikofer, Zurich; Prof. K. Dostal, Brno; and nomenclature of phytohormones, by Dr. Janot, Paris. The question of the nomenclature of phytohormones gave rise to an exhaustive discussion and positive results have been reached. The reports and the discussions to which they gave rise will be published under the auspices of the International Institute of Intellectual Co-operation and the International Union of Biological Sciences. This publication will be revised by Prof. Boysen Jensen before being issued. The second meeting of this character will be held at Copenhagen at the end of September 1939. Profs. Boysen Jensen, Laibach and Koningsberger have been invited to organize this meeting from the technical point of view, in collaboration with the International Union of Biological Sciences.

Archæological Investigations in Ireland

ARCHÆOLOGICAL excavations continue to be carried on with vigour in Ireland through the scheme for the relief of unemployment under the direction of the Office of Public Works and the National Museum. Among the more important of recent discoveries are the antiquities brought to light in the excavation of the large ring fort at Garranes, near Templetown, Co. Cork, which throw a valuable light on the industries and culture of the little-known period of the sixth century of our era. The excavations are being conducted by Prof. Sean P. O'Riordain, professor of archæology in University College, Cork. The site is identified with Rath Raithleann. The fort has triple ramparts, with an external diameter of about three hundred feet. The entrance proved on excavation, according to a report in *The Times* of October 18, to be of a complex character, with several gates, of which the fourth and last in the approach to the interior was formed by rows of posts, small tree trunks of six inches in diameter, set in two palisade trenches terminating the middle bank at each side of the opening.

IN the inner bank of the fort under masses of stone, which had been used to strengthen it, was a deposit showing that here had been the workshop of the metal-workers, who had been under the patronage of the ruler. Clay crucibles were found here in greater number than had previously been found in the whole of Ireland. Some still contained the bronze they had been used to melt, while others, of a type previously known from Scotland, but not hitherto found in Ireland, had been used to melt enamel. A discovery of extreme interest consisted of pieces of *millefiori* glass, made by fusing different coloured pieces of glass together, which leave no room for doubt that the *millefiori* glass of Irish ornament was a native product. Another important discovery was a quantity of pottery fragments, of which some are Roman, while others are copies. Such pottery has hitherto been lacking from Irish fifth and sixth century sites.

The Battersea Power Station

THE annual report of the Electricity Commissioners (London: H.M. Stationery Office) giving the returns of fuel consumption and electric units generated in Great Britain shows that the total quantity of electricity generated during 1936 was 14 per cent more than during the preceding year. The annual fuel consumption was 1·57 lb. per electric unit distributed. The steam station with the highest thermal efficiency, 27·63 per cent, is Battersea (London Power Company) and the station with the highest load, 208,000 kilowatts, is Barking A (County of London). The London Power Co. is extending its station at a cost of £1,500,000. The work constitutes the beginning of the second half of the station and includes the extension of the building to double its present size and the installation of 100,000 kw. of generating plant. This is the first instalment of the plant to be provided in the new building. It is expected that this, together with the 243,000 kw. plant already working, will meet the probable demands for electricity up to the winter 1939–40. Eventually the generating capacity is to be raised to 500,000 kw. The new plant comprises a high-pressure set, a low-pressure set and a house set. The high-pressure set generates 16,000 kw., the low-pressure set 78,000 kw. and the house set 6,000 kw. The new plant also includes one boiler of 550,000 lb. evaporative capacity. Londoners will watch the development of this huge power station with interest. Practice has justified the policy of fostering the efficient stations in Great Britain. The returns show that whilst there were 458 generating stations in 1935, there were only 442 in 1936.

Loris: a Journal of Ceylon Wild Life

IN many respects the fauna of Ceylon is of unusual interest, and like many another island fauna it runs the risk of gradual encroachments at the hands of 'civilized' man. In order to further the preservation of the native animals and to stimulate a greater interest in them and their habits, the Ceylon Game and Fauna Protection Society has undertaken the

publication of a new natural history magazine, *Loris*, to be issued twice a year (Colombo and London: *Times of Ceylon* Co., Ltd. 2*s*. 6*d*.). That there is need for such propaganda is shown by the history of faunal protection in Ceylon, which A. B. Lushington contributes to the first number. The slaughter of sambhur and deer for the sake of the export of their hides and horns had reached gigantic proportions and entailed great cruelty, before the Government in 1891 passed ordinances to check the trade and to "prevent the wanton destruction of elephants, buffaloes and other game". Even so the trade continued, and several subsequent enactments have been required to bring about the protection which was desired. The first number of *Loris* is by no means confined to direct propaganda, for the editors are aware that the stimulation of interest in animal life is a better means to their end than mere denunciation. Accordingly they include sporting articles of a naturalist flavour, accounts of trips in the jungle, and an instructive article on natural history photography and the apparatus it demands, illustrated by excellent photographs of birds and nests.

Fisheries of Wales

A TEMPORARY exhibition illustrating the activities of the Welsh fishing industry has been on view during the past five months at the National Museum of Wales. A small hand-book supplements the information given on the labels of the exhibits ("The Fisheries of Wales". By Colin Matheson. National Museum of Wales and the Press Board of the University of Wales. 2*d*.). The fishes landed in the largest quantities in Wales are demonstrated by models and spirit specimens, and the handbook sets forth the habitats and means of capture of the different species, with some comments on their biology. The hake, on which the deep-sea fisheries of South Wales are based, is given due prominence. A separate section is given to the deep-water trawler and its methods of work, with exhibits of echo-sounding devices and wireless direction-finders. The beam trawl and various appliances of the inshore fisherman are explained; and there are notes upon the primitive Welsh coracle and the salmon nets and spears used in fresh water. The general ignorance about the modern fishing industry is so great that a welcome must be extended to such an exhibition as this, for it will show that each species of fish must be sought by methods adapted to its habitat and habits; and that every fishing boat more than 20 feet long is not necessarily a trawler. Mr. Matheson is to be congratulated upon the arrangement of such a demonstration.

British Association Seismological Committee

THE recent report of the Committee of Seismological Investigations records much useful work done by its members. During the preceding year, three slight earthquakes occurred in the British Isles: in East Kent on December 29, 1936, in North Staffordshire on April 7, 1937, and near Inverness on June 26, 1937. Brief references are made to the study of the recent earthquakes in Montserrat, to Mr. Brennan's work on the greater frequency of earthquakes in Jamaica during the dry months of the year, to the deep-focus earthquakes of 1932, and to the new globe, 18 in. in diameter, recently installed at Oxford, which has already proved most useful in the determination of epicentres. Notes are also contributed by Dr. H. Jeffreys on seismic transmission times, and by Dr. R. Stoneley on his study of the records of the Mongolian earthquake of August 10, 1931.

Parliamentary Science Committee

THE Right Hon. J. Ramsay MacDonald has recently accepted an invitation to join the executive of the Parliamentary Science Committee. It has always been the aim of the Committee to preserve an even balance between men of science and Parliamentarians on the executive, and on the Parliamentary side to secure representatives from all political parties. Mr. MacDonald's advent brings the Parliamentarians up to eleven—three peers, and eight members of the House of Commons. The three peers are the Earl of Dudley (president), Lord Melchett and Lord Rothschild. The members of the lower house are Sir Arnold Wilson (chairman), Mr. Alan Chorlton (deputy-chairman), Mr. Ramsay MacDonald, Prof. J. Graham Kerr, Sir Philip Dawson, Sir Murdoch MacDonald, Mr. Andrew MacLaren, and Mr. S. F. Markham.

Komodo 'Dragons' at Edinburgh Zoological Park

BY permission of the Netherlands Government, two Komodo monitors (*Varanus komodoensis*) have been added to the collections at the Scottish National Zoological Park in Edinburgh. This gigantic lizard, which may reach a length of 10 feet, was first shown in Great Britain at the London Zoo in 1927, a year after the habits of the creature had been studied by an American expedition in its native island of Komodo to the south-east of Java. It is swift and active out of keeping with its heavy build, and is said to be fierce as well as voracious, the larger individuals feeding when opportunity offers upon deer and wild pigs.

The Joint Committee on Materials and Their Testing

THE Joint Committee, whic consists of representatives of twenty-four co-operating technical institutions and societies under the chairmanship of Dr. H. J. Gough, has arranged its first technical discussion to take place in the College of Technology, Manchester, on October 29, commencing at 2.30 p.m., when a series of three important papers on different aspects of "Notched Bar Impact Testing" will be presented. Application forms for papers and reprints, and for tickets to attend, should be made to the Secretary, the Manchester Association of Engineers, St. John Street Chambers, Deansgate, Manchester, 3. Particulars regarding the objects, aims and work of the Joint Committee may be obtained from the Secretary, Joint Committee on Materials and their Testing, at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1.

Aeronautical Research in Australia

MR. H. E. WIMPERIS, who retired last March from the position of director of scientific research to the Air Ministry, is at present visiting Australia at the invitation of the Commonwealth Government. The determination to establish an aircraft industry in Melbourne has focused attention on the need for greatly improved facilities for scientific investigation, and Mr. Wimperis will advise the Government early next year on the steps which he considers necessary for the initiation and steady development of aeronautical research. A careful survey is being made of existing laboratories, particularly in the universities, to determine to what extent they may serve specific purposes in association with a central establishment.

Institution of Civil Engineers: Awards for Papers

THE following awards have recently been made for papers read and discussed at ordinary meetings of the Institution of Civil Engineers: Telford Gold Medal to D. M. Watson. James Watt Gold Medal to Sir Noel Ashbridge. Coopers Hill War Memorial Prize to J. Guthrie Brown. Telford Premiums to A. H. Naylor; Dr. S. F. Dorey; F. W. A. Handman; C. L. Howard Humphreys; G. E. Howorth; B. W. Huntsman; Dr. L. R. Wentholt; Prof. S. M. Dixon, Gerald FitzGibbon and Dr. M. A. Hogan; Prof. A. J. Sutton Pippard, Eric Tranter and Letitia Chitty; and A. J. Dean. Indian Premium to Dr. H. J. Nichols. Trevithick Premium to D. A. Stewart. For papers published in the *Journal* with written discussion the following awards have been made: Webb Prize to Dr. P. L. Henderson. Manby Premium to Prof. H. W. Swift. Crampton Prize to B. D. Richards. Telford Premiums to Dr. W. H. Glanville and F. G. Thomas; J. C. Richards; and Robert Ferguson. Trevithick Premiums to E. N. Webb and Prof. B. L. Goodlet. For students' papers read in London or at meetings of local associations the following awards have been made: James Forrest Medal and a Miller Prize to D. F. Orchard. Miller Prizes to S. K. Jordan; N. C. C. de Jong; D. M. Hamilton; R. C. Whitehead; Henry Grace; and F. C. Squire. The Baker Gold Medal for the triennial period 1934–37 has been awarded to B. M. Hellstrom and the Howard Quinquennial Prize for the quinquennial period 1932–37 has been awarded to Prof. J. F. Baker.

Announcements

SIR ROBERT ROBERTSON, treasurer of the Royal Institution, and lately Government chemist, has been appointed director of the Salters' Institute of Industrial Chemistry in succession to Prof. Arthur Smithells, who has resigned through ill-health.

THE Baly Medal of the Royal College of Physicians of London was presented on October 18 to Prof. E. L. Kennaway, professor of experimental pathology in the University of London and director of the Research Institute of the Royal Cancer Hospital, for his biochemical investigations which have led to the identification of a group of substances provoking malignant growth of tissues.

THE Planck Medal of the German Physical Society has been awarded to Dr. Erwin Schrödinger, professor of theoretical physics at Graz.

THE following awards have been made by the Institution of Naval Architects: Parsons scholarship in marine engineering (1937) to S. F. Rice of Messrs. G. and J. Weir, Cathcart, Glasgow; the scholarship is of the value of £150 per annum, and will be held at the Royal Technical College, Glasgow, for four years; Denny scholarships in naval architecture and marine engineering (1937): the naval architecture scholarship to A. Silberblatt, of Kilburn Grammar School, and the marine engineering scholarship to P. Martin, of Eltham College; both scholarships are of the value of £75 per annum and will be held at the University of Glasgow for four years.

THE Hillel pharmaceutical concern in Haifa, Palestine, has recently announced the foundation of a Hillel prize of 2,500 dollars for medical work in Palestine. Prof. Gottlieb of Vienna, the founder of the concern, has stated that funds had been provided by the company for raising the standards of hygiene in Jewish agricultural settlements in Palestine.

UNDER the auspices of the Food Education Society, Dr. M. Bircher-Brenner of Zurich will give three addresses on "The Principles of Therapy according to the Laws of Life" at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, on October 25, 27 and 29 at 8 p.m. Admission is free.

THE ninth International Ornithological Congress will be held at Rouen on May 9–13, 1938, under the presidency of Prof. A. Ghigi. Visits will be paid to Paris on May 14–15, and on May 16–19 there will be a long excursion to the Carmargue. Further information can be obtained from the Secretary, M. Jean Delacour, Chateau de Clères, Clères, Seine Inférieure, France.

WE have received a copy of an attractive publication entitled "The World from a Window Garden" compiled by Grace E. Pulling (Society for the Propagation of the Gospel in Foreign Parts, 15 Tufton Street, London, S.W.1. Pp. 88. 1*s*. 6*d*.). It takes the form of a diary for gardening or engagements, and contains notes on some plants suitable for cultivation in window-boxes, hanging baskets, etc. Apart from general descriptive notes and hints for culture, not the least interesting are brief references to the history and geographical distribution of each plant. The work is illustrated by forty photographs, twenty neat black-and-white drawings by Frank J. Stanley, and eight beautifully executed water-colour drawings by various artists.

ERRATUM. In the second part of the table included in the letter "Solubility of Silica Dusts" by Dr. E. J. King in NATURE of August 21, p. 320, for "acetic fluid" read "ascitic fluid".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 730.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Recent Improvements in Diffraction Gratings and Replicas

THE advent of the aluminized glass mirror has done away with many of the difficulties of making diffraction gratings of large size and unique properties. Some years ago, after some preliminary experiments in diamond grinding and adjusting, we ruled a six-inch three-metre concave grating with 15,000 lines to the inch which threw about 80 per cent of the light into one first-order spectrum. This estimate was made with a photo-electric cell and the light of a high-intensity mercury arc passed through a green filter.

Feeling that we had the problem solved, we sent this grating to Prof. Herzberg of the University of Darmstadt, but we have not been able to duplicate its properties, until we abandoned speculum for aluminium. The first large grating ruled on this metal was a plane one with a ruled area measuring about 4 in. × 5·5 in., 15,000 lines to the inch, throwing perhaps 75 per cent into the first order for red light, and giving a very strong spectrum in the second order for the ultra-violet. This grating has been in continuous use on the spectrograph of the 100-inch telescope of the Mt. Wilson Observatory, and was responsible for the discovery of ionized titanium vapour in interstellar space. More recently, we have sent a still better grating to the Observatory ruled on an 8-inch disk of aluminized Pyrex glass which Dr. Adams reports as 30 per cent brighter than the first one. In a letter he tells me that, with the first grating which we sent, he believes that they have made the finest stellar spectrograms ever produced and that in his opinion the day of the glass prism for star spectrographs is over.

This high concentration of light in a single order cannot, however, be accomplished with a ruling of 30,000 lines to the inch, since the diffracting elements are now too narrow to act as oblique mirrors giving preferential direction to the diffracted energy. It is also difficult to produce such rulings on concave surfaces, especially those of short focus, owing to what I have called the target pattern, which shows up as concentric circular zones of different colours, especially at fairly large angles of incidence. These are due to the change of form of the groove, as the diamond drops down into the bowl, for as the diamond descends, the ruling edge turns through a small angle, coming up more on to its point. My assistant, Mr. Wilbur Perry, has developed a very ingenious method of compensating for this difficulty, and we have already obtained promising results with it on some small gratings of 50 cm. radius.

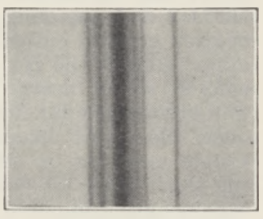

Fig. 1.

Fig. 1 is from an enlargement of the green mercury line in the third order of the last 30,000 line grating ruled. This was a 6 in., 21-ft. grating ruled on aluminium, and the photograph was made with the slit and plate close together. The print shows clearly the several components of the line and the freedom from ghosts; there is also a lack of appreciable background, indicating that nearly all the reflexion is specular and not scattered. The exposure was only ten minutes.

I have been making a lot of replicas from the 4½ in. × 6⅜ in. aluminium plane grating, which I estimate contain 80 per cent (concentration) for λ 4300 and 50 per cent for the extreme red. Combined with a flint prism of 25° it gives direct vision (normal) for the blue-green boundary, and the dispersions are added. I have just mounted one on the 6 in. 25° objective prism of the Lick Observatory. To obtain the same dispersion with prisms, several would be necessary, and the spectrum would be very far from normal.

By employing aluminium deposits of several times the thickness of those in common use, it is now possible to construct very superior echelette gratings for the infra-red. Gone are the old difficulties of producing optical flats of copper, free from embedded grains of abrasive which wore away the razor edge of the ground diamond. Replicas made from such echelettes by flowing them with a nitro-cellulose solution, stripping the film and mounting in optical contact with selected plate glass, or better still plane parallel glass, may give by transmission as much as 90 per cent of the light in the first-order spectrum, as I showed some years ago with replicas taken from a 15,000 ruling on commercial half-tone copper plate. Such replicas can be made with a ruled area measuring 4½ in. × 6⅜ in. and with a 5-inch telescope show the *D* lines with a separation fully equal to eight times the width of the lines. One of these has been in use at the Harvard Observatory every clear night by Dr. Whipple during the past year as an objective grating for obtaining the distribution of the different gases in nebulæ.

The introduction of the modern plastics, such as Lucite, makes it seem probable that fair gratings of small size, both plane and concave, may be made by a moulding process. The casting of a concave grating from a ruling made on a convex spherical surface has been in the minds of all interested in the cheap duplication of gratings for many years, but the few experiments which I made some years ago with Bakelite did not look promising as the casts warped. More recently I have obtained better results with Lucite, the castings being made with polymerized material, softened by a moderate temperature and

under high pressure. Whether the technique can be developed to such a point that a large casting can be separated from the metal surface without losing its figure remains to be seen. If this can be accomplished and the ruled surface is found to keep its structure intact during the ordeal of the bombardment by aluminium vapour, excellent concave gratings should be within the means of the smallest institution. This can doubtless be accomplished, as a nitro-cellulose replica from an echelette grating has been successfully coated with aluminium.

R. W. WOOD.

Lake Louise,
Alberta, B.C.
July 15.

Coronal Emission Lines observed at the Total Solar Eclipse of June 19, 1936

AT the total solar eclipse of June 19, 1936, a joint party composed of observers of the Tokyo Astronomical Observatory and the Central Meteorological Observatory of Japan, headed by me, was engaged in various sorts of observations of astrophysical as well as geophysical interest at Nissin ($\lambda = 9^h\ 37{\cdot}1^m$, $\varphi = 43°\ 51'$) in Hokkaido.

An exposure of 50 seconds made by myself and Mr. Koiwai with a slit spectograph with two 55° prisms of very heavy flint and a Tessar type camera lens of 55 mm. aperture having the focal ratio $F/45$ gave fourteen bright lines that cannot be attributed to chromospheric emission. Their wave-length calculated by referring to a number of well-situated Fraunhofer lines of the photospheric spectrum taken a few minutes before second contact are tabulated below. The accuracy for the lines near the red end and for those near the blue end is not satisfactory, for the instrument was focused for the green part and the curvature of the focal surface was not negligibly small.

No.	Wave-length	Intensity	No.	Wave-length	Intensity
1	4312	1*	8	5738·0	1
2	4725·3	1	9	5930·3	2
3	4815·9	1	10	6266·9	1
4	5116·4	2*	11	6373·9	6*
5	5302·8	>4*	12	6534	2
6	5624·4	1	13	6703	2*
7	5718	1	14	6777	1*

The lines marked with an asterisk are of recognized coronal origin. Beside the above lines there appeared chromospheric lines such as $H\alpha$, $H\beta$, $H\gamma$, D_3, 4472 He, etc. But out of another 20 chromospheric lines within our region of intensity exceeding 20 (Mitchell's values[1]), we could detect with confidence only five on our plate, and none out of 140 chromospheric lines of intensity between 8 and 20. This fact must be borne in mind in considering the significance of the lines in the above table. There are no chromospheric lines near them the intensity of which exceeds 7 on Mitchell's scale.

Some of the outstanding features of the spectrogram are mentioned below :

(1) Predominance of the green line λ5303.

(2) So far as the region near the eastern limb is concerned, the coronal emission in lower latitudes, especially over the spot zones, appeared to be more intense and to have extended to a higher level than in the polar region.

(3) The fact observed by me that the line λ6374, though inferior in intensity, extended farther outward than λ5303 seems to give support to the view of Prof. Mitchell[2] that they can be classed in separate groups.

(4) The fact that the line 4725·3, which has been rejected by Prof. Stratton[3] and others from the list of coronal lines, appeared on our plate, points to the necessity of reconsidering the possibility of its being a genuine member of the coronal emission spectrum. In this connexion, it may be cited here that Prof. Tanaka of the Tokyo Imperial University has also pointed out its reality on his spectrogram taken at the same eclipse by means of a three-prism apparatus, giving the wave-length 4725·4 by comparison with the iron arc lines[4]. Special attention must be paid to the fair coincidence of the wave-length of this line with that of the nebular line λ4725·7[5]. The lines 4815·9 and 5738·0 also respectively come close to the nebular lines λ4814·78 and λ5737 observed in the spectrum of η Carinæ by Moore and Sanford and also by Lunt[6].

On each of three plates taken by means of another spectrograph with four prisms (60°, 60°, 45° and Rutherfurd's compound system), which was used without slit, a few monochromatic rings of coronal emission could be detected. We can easily perceive on one of these the difference in the general mode of intensity distribution of the lines λλ5303, 6374 and 6704 ; thus those lines seem to originate from different kinds of atoms or at least from atoms in different states of excitation. On the same plate there is a short emission arc detected near $H\alpha$. It is rather weak but distinct. Its reality cannot be doubted as judged by its general appearance and by the fact that the curvature is quite consistent with that of $H\alpha$. Moreover, it shows a rather sharp boundary on the concave side, namely, towards $H\alpha$, fading gradually toward the convex side, even manifesting some sort of structure. This arc is limited to the range of position angle a little less than 30° in middle latitude along the north-eastern quadrant of the sun's limb. It may be remarked that this is the region which corresponded to the most active zone of the solar surface at that time, as shown by independent photographs and spectroheliograms. Such a peculiar distribution of emission intensity is quite contrary to that of the other three emission lines, which were observed to extend over other quadrants with remarkable intensity, and lends support to the view that this line belongs to a separate group of atoms.

It is a remarkable fact that the wave-length of the above line calculated by referring to $H\alpha$, λ6703·5, λ6374·2 and assuming the effective lower boundary of each coronal emission layer to be located at the upper limit of the $H\alpha$ chromosphere, came out to be 6583·8, which nearly coincides with λ6583·6, the well-known nebular line[7] as given by Wright. Moreover, there was detected another faint arc, barely visible near $H\alpha$ on its violet side and over nearly the same range of position angle as λ6583·6. The wave-length computed in the same manner as 6584 is 6548·7. This result is also noteworthy since it comes very near the nebular line λ6548·1, though the real existence of this arc cannot be regarded as so conclusive as λ6584. This, with the former line, was observed[8] in the spectrum of the Wolf-Rayet star $D.M. + 30°$ 3639.

Finally, it is to be remarked that our detection of such weak lines by a prismatic camera owes its success to their chancing to be placed in a part of the spectrum where the photographic density due to

the continuous spectrum was extremely feeble, so as to bring out sufficient contrast of the line against the background; and also to the excellent focusing of the apparatus, which had been attained by using a long and slender neon discharge tube of circular shape with a considerable diameter set at a distance of about 200 metres for focus adjustment and also for rehearsing.

A full account of the work will be given in a paper which is now in preparation to be published shortly.

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Aug. 23.

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THE unusual brightness of the corona at the 1936 total eclipse—it was easily seen several seconds before totality began—has given Prof. Sekiguti and his colleagues the chance of obtaining some new lines in the emission spectrum of the corona. Confirming Prof. Tanaka, he restores the line at 4725 A., previously rejected as being insufficiently supported, to the list, and points out that this line and several other lines are close to, if not identical with, certain lines in the spectra of nebulæ and novæ. His new spectral lines strengthen the link between the coronal and nova spectra based previously solely on the presence of the stronger coronal lines in the spectrum of *RS* Ophiuchi a few weeks after its outburst in 1933.

If Prof. Sekiguti's identification of the two weak arcs in the objective prism spectrograms is accepted, then we have evidence for the first time of a known element in the corona, namely, nitrogen, for the lines 6548, 6584, which Prof. Sekiguti classes together, are forbidden lines in the spectrum of N II. New emission lines in the spectrum of the corona have been reported as secured by Dr. Dunham at the eclipse of last June. Their wave-lengths will be awaited with interest. Before long the last important celestial spectrum of unknown origin may have been identified.

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Phosphorus Exchange in Yeast

THE individual phosphorus atoms present in the leaves of plants have been found[1] for the most part to exchange with great ease within a short time. We extended our experiments to the behaviour of phosphorus atoms present in yeast.

Yeast was grown in a culture solution which, after the lapse of some days, was replaced by a similar solution containing 8·7 mgm. of labelled phosphorus per 100 c.c., besides the usual amount of salts and in some cases ten per cent sugar, in others none. The radioactivity of the labelled sodium phosphate was such that 1 mgm. P corresponded to 1000 activity units. After the yeast had grown for twenty-four hours in the solution containing labelled phosphorus, it was removed, washed carefully and digested by treatment with sulphuric acid and nitric acid. The phosphorus content of the solution of the yeast was determined both by radioactive measurements and by the usual chemical (colorimetric) analysis.

The results of both determinations for the last set of a long series of experiments are given in the accompanying table. As seen from the later the same figure for the uptake of phosphorus was obtained by the chemical and by the radioactive analysis. We can conclude from this coincidence that no exchange of phosphorus atoms takes place between the yeast and the culture solution. Had such an exchange taken place we would have higher values by the radioactive than by the chemical analysis.

The lack of exchangeability of the phosphorus atoms present in yeast could be interpreted on the assumption that yeast contains little or no readily exchangeable phosphate ions but only phosphorus compounds like hexosephosphates, adenylphosphoric acid and so on in which the phosphorus atoms are not or are only slowly exchangeable with the inorganic phosphate ions.

An alternative explanation would be that yeast cells are impermeable to phosphate ions except when growing.

Yeast grown	Dry weight of yeast (mgm.)	Total P found by chemical analysis (mgm.)	Total P per mgm. dry weight of yeast	Mgm. P taken up	
				chem. analysis	radio-active analysis
Initial weight and P content of yeast samples used	108·6 108·0 108·4	1·375 1·384 1·361	0·0127 0·0128 0·0126		
In labelled P with sugar at 25°	249·8 260·2 252·3	3·414 3·407 3·390	0·0137 0·0131 0·0134	2·046 2·034 2·017	1·966 1·987 2·095
In labelled P with sugar at 0°	101·4 103·1 101·5	1·295 1·309 1·320	0·0128 0·0127 0·0130		0·004 0·012 0·012
In labelled P without sugar at 20°	89·2 88·1	1·369 1·345	0·0153 0·0153		0·044 0·054

The radium-beryllium mixture was most kindly put to our disposal by Prof. Niels Bohr; we should also like to express our thanks to Mr. V. Hartelius, Mr. H. Lanz and Miss Hilde Levi for their assistance in this work.

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Glycerophosphoric Dehydrogenase

THE question whether the dehydrogenation of α-glycerophosphoric acid by animal tissues depends upon the catalytic action of coenzyme I (diphosphopyridine-nucleotide) has recently been the subject of controversy[1-4]. The extraction of a very powerful α-glycerophosphoric dehydrogenase preparation from horse brain by a modification of Green's method[1] has offered an opportunity of contributing a few observations.

The enzyme is prepared in the following way: minced horse brain is incubated with two volumes of *M*/20 bicarbonate at 37·5° for 20 minutes. The extract is centrifuged off, care being taken that only the red supernatant layer is decanted, and the

residue washed twice with two volumes of water. The combined extract and washings are brought to *p*H 4·6 by addition of dilute acetic acid, centrifuged, the precipitate washed twice with distilled water and resuspended in two volumes of *M*/15 veronal buffer, *p*H 8·2.

Pyocyanine was found to be more active as 'carrier' with this enzyme than either methylene blue or brilliant cresyl blue (Table 1).

TABLE 1.

2 ml. enzyme, 0·3 ml. *M*/2 dl-Na-α-glycerophosphate. Values corrected for blanks.

	0·5 ml. *M*/50 methylene blue	0·5 ml. *M*/50 brilliant cresyl blue	0·5 ml. *M*/50 pyocyanine
Oxygen uptake in 10 min. (μl)	132	134	216

Although the enzyme preparation contained no coenzyme I, its addition did not influence the oxygen uptake at all. This result corroborates the observations of Green[1] and of Dewan and Green[3]. To explain the divergent results of the Stockholm workers who

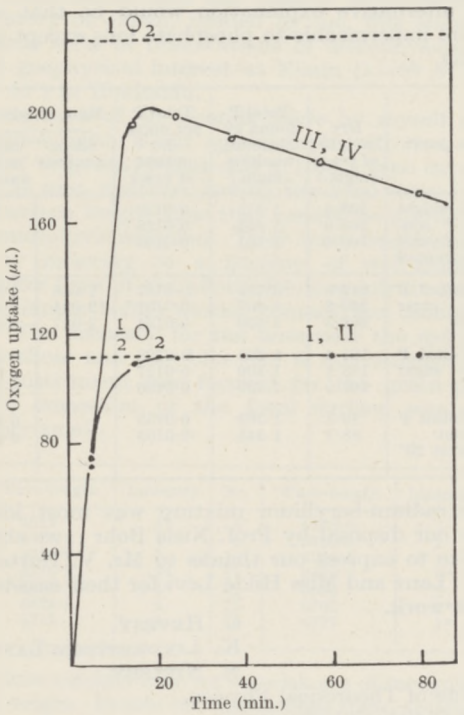

Fig 1.

(I). 2 ML. ENZYME, 0·5 ML. *M*/50 PYOCYANINE, 0·2 ML. *M*/10 dl-SODIUM-α-GLYCEROPHOSPHATE.

(II). 2 ML. ENZYME, 0·5 ML. *M*/50 PYOCYANINE, 0·5 ML. 0·3 PER CENT COENZYME I, 0·2 ML. *M*/10 dl-SODIUM-α-GLYCEROPHOSPHATE.

(III). SAME AS I + 0·2 ML. *M*/2 CYANIDE.

(IV). SAME AS II + 0·2 ML. *M*/2 CYANIDE.

reported an acceleration of the reaction by coenzyme I[4], the assumption was made that the preparations of α-glycerophosphoric dehydrogenase contained another enzyme oxidizing the triosephosphate further to phosphoglyceric acid and depending on coenzyme I. Such an enzyme has been found in yeast[5]. In that case half a molecule of oxygen per molecule of α-glycerophosphoric acid should be taken up in absence of coenzyme I and one molecule in its presence. It is possible that in such a case, with an excess of α-glycerophosphoric acid, no acceleration of the initial velocity of the reaction by coenzyme I would be produced. This hypothesis, however, could not be verified. Only half a molecule of oxygen is taken up per molecule of α-glycerophosphoric acid with and without coenzyme I (Fig. 1).

Supplementary to Green's work, the interesting observation may be added that with our enzyme preparation the final value of the oxygen uptake was almost doubled in presence of cyanide. This is no doubt due to an inhibition of catalase and formation of hydrogen peroxide, which can be demonstrated by the titanium sulphate reaction. The three carriers give the same result. A slow and steady evolution of gas is observed after the reaction is completed owing to the slow decomposition of this peroxide (Fig. 1). This explains the 'stimulating' effect of cyanide on the rate of reaction observed by Green.

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The Effect of Enol-Esters of Testosterone

ENOL-ESTERS from the series of male sex hormones were first prepared by L. Ruzicka and W. H. Fischer[1]. Experiments carried out in our laboratories showed that testosterone diacetate was less active on the capon's comb than the testosterone monoacetate, but that in single injection (2 mgm.) it was more active than testosterone monoacetate on rats[2]. Deanesly and Parkes[3] recently compared the effect of testosterone monacetate and testosterone diacetate, and the results of their experiments indicated that these two substances are similar as regards activity. In the meantime, our experiments were extended to the previously described dipropionate and also to two newly prepared enol-esters of testosterone. The technique corresponds to that earlier described by Miescher, Wettstein and Tschopp[4].

TABLE 1.

Testosterone Esters	Int. Unit measured on the capon's comb	Max. effect is attained on the
Testosterone-3, 17-diacetate	35 γ	10th day
,, -3-acetate-17-propionate, 140-141° F.	40 γ	12th ,,
,, -3, 17-dipropionate ..	45 γ	14th ,,
,, -3-acetate-17-*n*-butyrate, 97–98° F.	200 γ	15th ,,
,, -17-acetate	20 γ	7th ,,
,, -17-propionate	20 γ	9th ,,
,, -butyrate	60 γ	12th ,,

Capon's comb. As will be seen from Table 1, the effect of testosterone diesters on the capon's comb is in general less intense but rather more prolonged than that of the mono-esters.

Rats. Fig. 1 shows that also in the 10-day test (10 daily injections; examination on the 11th day) the effect of the enol-esters on the seminal vesicles of castrated rats is less than that of, for example,

testosterone propionate (Perandren). The longer the chain of the acid groups the less the effect. This also applies to the prostate.

A different picture is obtained if merely a single injection (2 mgm.) is given and the total temporal course of the effect is considered. The activity of testosterone diacetate on the seminal vesicles (Fig. 2) is between that of the monoacetate and that of the propionate. The remaining enol-esters, however, exercise a much more intensive influence. With these the maximum effect is considerably higher and is reached considerably later. Of all known compounds of the male sex hormone series, testosterone-3-acetate-17-butyrate exhibits the most prolonged effect. Forty days after a single injection, the weights of the seminal vesicles and prostate amounted to 140 mgm. and 190 mgm. respectively, and attained on the 50th day 90 mgm. and 160 mgm. respectively (controls : 14 mgm. and 45 mgm. respectively). In comparison the duration of the effect of a similar dose of testosterone is seven days and that of a similar dose of testosterone propionate about twenty days.

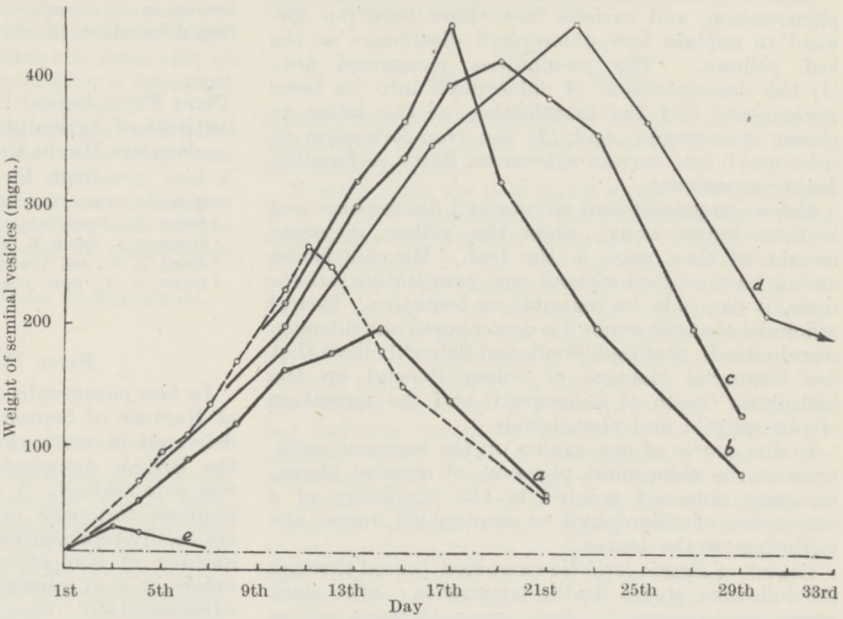

Fig. 2.

EFFECT OF TESTERSTERONE ENOL-ESTERS ON THE WEIGHT OF SEMINAL VESICLES (METHOD OF SINGLE INJECTION).

a : T-3,17-diacetate ; *b* : T-3-acetate-17-propionate ; *c* : T-3,17-dipropionate ; *d* : T-3-acetate-17-*n*-butyrate ; *e* : testosterone. T = testosterone. Broken curve : T-17-propionate.

The utilization of testosterone by the organism varies apparently according to the degree of esterification. An efficiency coefficient is calculated by comparison of the surfaces bounded by the respective curves and the abscissa, taking the value of testosterone as the unit (Table 2). Measured on the seminal vesicles, definitely greater coefficients are obtained than when measured on the prostate. Based on equimolecular quantities the efficiency coefficient of the esters would be still more favourable.

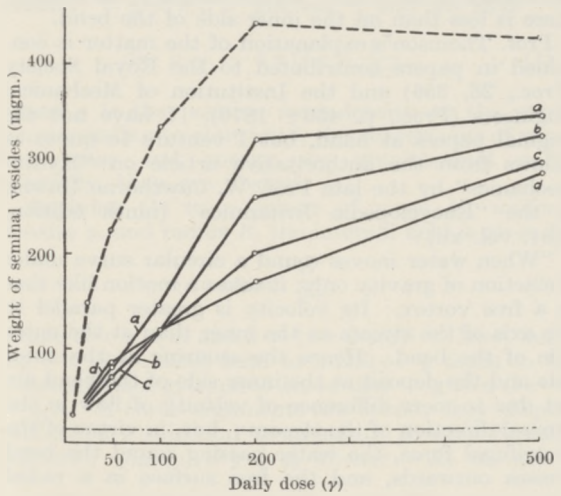

Fig. 1.

EFFECT OF TESTOSTERONE ENOL-ESTERS ON THE WEIGHT OF SEMINAL VESICLES (METHOD OF TEN INJECTIONS).

a : T-3,17-diacetate ; *b* : T-3-acetate-17-propionate ; *c* : T-3,17-dipropionate ; *d* : T-3-acetate-17-*n*-butyrate. T = testosterone. Broken curve : T-17-propionate.

TABLE 2.

EFFICIENCY COEFFICIENT OF THE ESTERS*, BASED ON TESTOSTERONE AS THE UNIT, USING SINGLE INJECTIONS OF 2 MGM.

Testosterone Esters	Seminal Vesicles	Prostate
Testosterone-3, 17-diacetate	28	25
,, -3-acetate-17-propionate	77	51
,, -3, 17-dipropionate	90	62
,, -3-acetate-17-*n*-butyrate	137	81
,, -17-propionate ..	33	23

* Determined by estimating the completion of the curves.

The hypothesis put forward earlier[2], that enol-esters of testosterone belong to the most active hormones, has been confirmed on rats (but not on capons). In the ten-day test, the enol-esters appear to have a lesser activity, but this is due to a somewhat delayed onset of effect ; their maximum effect being attained much later than on the eleventh day. Similar investigations to those dealt with in this report should be carried out on other animals, as apparently the efficiency coefficient varies according to the different species of animals.

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Changes in Chloroplast Pigments in Leaves during Senescence

Loss of chlorophyll in senescent leaves is a general phenomenon, and various views have been put forward to explain how chlorophyll disappears as the leaf yellows. The possibilities recognized are: (1) the decomposition of chlorophyll into its basic components and the transference of the latter to places of storage; and (2) the transformation of chlorophyll into certain substances likely to function during senescence.

Meyer[1] suggested that chlorophyll decomposes and is then borne away, while the yellow pigments remain as they were in the leaf. His conclusion having been reached without any quantitative estimations, it can only be regarded as tentative. Swart[2] concludes that chlorophyll is decomposed and nitrogen translocated. Stoklasa, Senft and Sebor[3] believe that the autumnal changes of colour depend on the hydrolytic fission of chlorophyll and the formation of phæophytin and phosphatids.

In the course of our studies on the seasonal variations in the chloroplast pigments of tropical plants, the data obtained pointed to the possibility of a conversion of chlorophyll to carotenoids during the yellowing of the leaves.

Leaves of *Bassia latifolia* examined passed through the following stages during senescence; after dark green, bright green 10 days, green 15 days, yellow green-yellow 6 days (at this stage yellow spots appeared along the marginal veins), almost yellow 2 days and then bright yellow. The results of the pigment analysis at these successive stages are set forth in the accompanying table.

Stage of senescence	Chlorophyll*	Carotin*	Xanthophyll*
Dark green	23·68	9·34	7·21
Bright green (5 days after the dark green stage)	17·95	10·41	7·91
Green (15 days after the dark green stage)	11·34	11·05	8·34
Yellow green-yellow (30 days after the dark green stage)	6·25	16·05	11·72
Almost yellow (36 days after the dark green stage)	1·16	17·25	14·21
Shedding (42 days after the dark green stage)	0·00	3·45	2·10

* Expressed as mgm. per 10 gm. of dry weight.

The chlorophylls ($a + b$) were determined by the procedure recently developed by us[4]: the measurement of light absorption of an alcoholic extract (80 per cent methyl alcohol) of plant pigments within a narrowly defined region of the spectrum, for which the chlorophylls ($a + b$) possess a marked absorption, while the absorption of the other pigments is infinitesimal. Carotin and xanthophyll were determined by a new spectrophotometric method, a description of which will appear shortly.

The data indicate that during the different stages of the yellowing of the leaf, as chlorophyll decreases, there is a corresponding rise in the carotenoids, the increase in carotin being more than that in xanthophyll. Further, at the shedding stage of the leaf, the carotenoids disappear almost completely.

On a consideration of the results presented here, in conjunction with the experimental results of Ewart[5] that carotin is present in greater amounts when chlorophyll is absent and carotin apparently decreases as chlorophyll increases, it appears that the increase in carotenoids during the yellowing of the leaves is a consequence of the disappearance and transformation of chlorophyll.

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River Flow around Bends

IN two paragraphs in the News and Views columns of NATURE of September 18, a lecture on "Rivers", delivered in connexion with the recent meeting of the British Association by Mr. R. Kay Gresswell, was summarized. A statement made in this report requires comment on the ground that, while undoubtedly representing a view held by a considerable number of competent geographers, geologists, and others, it is at variance with the facts as established experimentally many years ago by the late Prof. James Thomson.

The statement was as follows: "In turning a corner, the speed on the outside of the curve is always greater than that on the inside. This results in the water on the outside being able to take an additional load and so erode the bank." The erosion of the bank is incontrovertible; it is universally in evidence, but Prof. Thomson's investigations showed that the erosion is not due, as alleged, to greater velocity on the outside of the curve. On the contrary, the velocity there is less than on the inner side of the bend.

Prof. Thomson's explanation of the matter is contained in papers contributed to the Royal Society (*Proc.*, **26**, 356) and the Institution of Mechanical Engineers (*Proc.*, p. 456; 1879). I have not the original papers at hand, but I venture to quote as follows from the authoritative article on "Hydromechanics" by the late Prof. W. Cawthorne Unwin, in the "Encyclopedia Britannica" (ninth edition, 1881, vol. xii):

"When water moves round a circular curve under the action of gravity only, it takes a motion like that in a free vortex. Its velocity is greater parallel to the axis of the stream at the inner than at the outer side of the bend. Hence the scouring at the outer side and the deposit at the inner side of the bend are not due to mere difference of velocity of flow in the general direction of the stream; but, in virtue of the centrifugal force, the water passing round the bend presses outwards, and the free surface in a radial

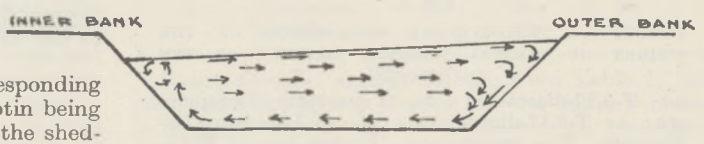

Fig. 1.

cross section has a slope from the inner side upwards to the outer side (Fig. 1). For the greater part of the water flowing in curved paths, this difference of

pressure produces no tendency to transverse motion. But the water immediately in contact with the rough bottom and sides of the channel is retarded, and its centrifugal force is insufficient to balance the pressure due to the greater depth at the outside of the bend. It, therefore, flows inwards towards the inner side of the bend, carrying with it detritus which is deposited at the inner bank."

This explanation of Prof. Thomson's, which he completely verified by experiment, has long been known to, and accepted by, river engineers, and it is unfortunate that, through unawareness of it, an incorrect, though admittedly plausible, view of the action of rivers at bends should still be entertained and disseminated.

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Gravitational Statics in Three Dimensions

THE commonly accepted case for three-dimensional gravitational statics is far from complete. On the Faraday tube hypothesis, a diagram shows that gravitational tubes of force attract laterally and exhibit a thrust longitudinally. Each pressure is $g^2/8\pi G$ dyne.-cm.$^{-2}$, where g is the field intensity and G Newton's constant. The field has energy $-g^2/8\pi G$ erg.-cm.$^{-3}$, the negative sign holding because if work is done against, that is, *added* to the field, for example, by expanding a sphere, the numerical value of the field's energy-volume integral is *diminished*, positive and negative energy being annihilated in the process, which naturally is reversible.

By the mass-energy relation, which, of course, need not be taken as proceeding from four-dimensional theory, we are forced to ascribe to the field a mass-density, $-g^2/8\pi G c^2$ gm.-cm.$^{-3}$, and we have

$$\text{div } g = -4\pi G\rho + \frac{g^2}{2c^2}, \quad \ldots \quad (1)$$

where ρ is the positive mass-density at the point. Corresponding to electricity, the conceptions of negative mass and energy are gravitational only; inertially, they are absurd.

Applying (1) to a sphere of mass M, uniform density ρ, and radius R, the internal field is given by

$$g = kc \tanh \frac{kr}{2c} \quad \ldots \quad (2)$$

where $0 < r < R$ and $k = (8\pi G\rho/3)^{1/2}$. Now, keeping $r < R$ let both tend to infinity. g tends to the constant value g, equal to kc, so that $-g^2/8\pi G c^2 = -\rho/3$. If these arguments are sound, they dispose of Einstein's objection[1] to an infinite Newton-Faraday universe. Again, if $g = g_0$ when $r = R$, we get

$$4\pi R^2 g_0 = 4\pi G M \sqrt{\frac{2}{\gamma}} \tanh \sqrt{\frac{\gamma}{2}} \quad \ldots \quad (3)$$

where $\gamma = GM/c^2R$. That is, the number of unit tubes threading the surface varies even with M constant.

The external field is given by

$$g = \frac{G\Delta}{\left(1 + \frac{1}{2}\frac{G\Delta}{c^2R}\right)r^2 - \frac{1}{2}\frac{G\Delta}{c^2}r} \quad \ldots \quad (4)$$

where $R < r < \infty$, and Δ is defined by $g_0 R^2 = G\Delta$, being related to M by (3). If $\gamma \ll 1$ and $r \gg R$, then in (4) we may replace Δ by M and reject the second term in the denominator on the right hand side. Differentiating, we get

$$\frac{\partial g}{\partial M} = \frac{G}{r^2}\left(1 - \frac{5}{6}\gamma\right),$$

which is simply the relativistic claim that a particle apparently loses mass when lowered slowly into a gravitational field.

Finally, since the field is not a true inverse square, it is not in equilibrium, the resultant force being clearly directed towards expansion. To approximate the conditions in our own universe, treated as a huge sphere the constituent particles of which are free to move, if we exclude all sources of energy-supply for this force but the field itself, spontaneous expansion will begin only if the total field energy can become more negative in the process so as to allow the further creation of positive energy. Actually, our universe cannot be infinite for its observed expansion would then be meaningless. This is impossible if $\gamma \ll 1$, but when γ compares with unity, it has a range of values satisfying this condition. Thus the recession of the spiral nebulæ is due, not to real repulsion, but to the field's intrinsic instability, and, *ceteris paribus*, such an expansion, once started, would become oscillatory. These high values of γ for a sphere make the total field energy comparable with the total positive energy, and exact evaluation (which for one of the two necessary integrals does not appear to be simple) would probably reveal that the algebraic sum of the quantities of all forms of energy is zero under these conditions. Applied to our universe, such a result is manifestly philosophically necessary and conclusive.

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[1] Einstein, A., "Relativity. The Special and the General Theory", pp. 105-106.

Snow Crystal or Snowflake

IN the introduction to his useful summary in NATURE of August 28, p. 345, of Prof. U. Nakaya's physical investigation on falling snow, Mr. G. Seligman writes: "he [Prof. Nakaya] proposes to continue to call a particle of falling snow a 'snow crystal' in preference to my 'snowflake'. As all snow, whether falling or having lain on the ground for months, is crystalline, the word 'snow crystal' is likely to lead to ambiguity. I admit that 'snowflake' ('simple' for a single crystal; 'compound' for an assemblage) is not perfect, but until a better word is devised it must, I fear, remain."

I regret to have to disagree with Mr. Seligman, who is doing so much to revive the study of snow and glaciology in Great Britain, but I cannot accept his use of the word snowflake to describe the single ice crystals of which snow is composed. In the choice of scientific words great care must be taken not to extend the meaning of words in common use beyond their ordinary significance. Now the compound word 'snowflake' has a very definite meaning in the English language and is applied only to that variety of atmospheric precipitation which occurs in the form of loosely cohering masses of ice crystals. To quote

the "Concise Oxford Dictionary": "Flake—light fleecy tuft or piece, esp. of snow." It is the 'fleecy' quality which is essential to a snowflake, and this fleecy quality is given by the cohering together of a number of ice crystals. It is, therefore, an inadmissible extension of the word snowflake to apply it to the individual ice crystals composing the flake, which have nothing fleecy about them and would not be described as snowflakes if exhibited individually to anyone familiar with the English language but unacquainted with the nature of snow.

I may mention that Prof. Nakaya's use of the terms snowflake and snow crystal is in full agreement with the practice of the Meteorological Office as set out in the "Meteorological Glossary" published by the Office.

G. C. SIMPSON.

Meteorological Office,
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London, W.C.2.
Sept. 7.

I AGREE with Sir George Simpson that the word 'snowflake' is not a perfect description of a single ice crystal falling as snow (indeed I said so in the passage which he quotes), but can a better be found?

'Snow crystal' is not good, for after having fallen the snow particles remain snow crystals or crystallites right through the *firn* stage until they become the *ice* crystals of pure glacier ice. Therefore in a description of snow phenomena it is continually being found that some separate designation is required to differentiate between snow crystals in the falling and the fallen states, *the more so because their characteristics in the two states are quite different.*

My 'flake' is not quite so bad as Sir George suggests, for I chose it after consulting "Webster's Dictionary", which gives: "A loose, filmy or scale-like mass; a film; a flock; lamina; . . . and on turning to 'lamina' I find: "A thin plate or scale."

I may say that Prof. Nakaya has now accepted my nomenclature; nevertheless, I am still not completely satisfied with it and will gladly accept a better name for the particle of fallen snow, though not, I fear, the appellation 'snow crystal' which, as I have tried to show, applies equally to the falling and the fallen condition, and is therefore ambiguous.

GERALD SELIGMAN.
(Chairman of the British Group of the International Commission of Snow.)

Warren Close,
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Points from Foregoing Letters

A PHOTOGRAPH showing an enlargement of the green mercury line in the third-order spectrum obtained by means of an aluminized diffraction grating with 30,000 lines to the inch is submitted by Prof. R. W. Wood. Gratings with 15,000 lines to the inch give high concentration of light in the first-order spectrum and have been used with very good results at Mt. Wilson Observatory. Replicas of such gratings made by flowing on them a nitrocellulose solution have been successfully used by the Lick and Harvard Observatories for studying the extreme red and infra-red spectra of the stars, and for obtaining the distribution of the different gases in nebulæ. Prof. Wood hopes to prepare both plane and concave gratings by the use of plastics and a moulding process.

A table showing the wave-lengths of a number of new lines in the spectrum of the corona observed during the solar eclipse of June 19, 1936, is given by Prof. R. Sekiguti, who discusses some of the features of the spectrogram. The new observations confirm the existence of the line 4725 A. This and other lines are close to certain lines in the spectra of nebulæ and novæ. Prof. F. J. M. Stratton remarks that if Prof. Sekiguti's identification is accepted, then in the lines 6548 and 6584 we have evidence, for the first time, of a known element in the corona, since these lines are ('forbidden') lines in the spectrum of nitrogen (N II).

Experiments by Prof. G. Hevesy, Dr. K. Linderstrøm-Lang and N. Nielsen indicate that, unlike plants, yeast cells immersed in a solution containing 'labelled' (radioactive) phosphorus atoms (as phosphates) do not take up or exchange such atoms. This may mean either that all the phosphorus in the yeast is in bound organic form (as hexosephosphates or adenylphosphoric acid) or that yeast cells are impermeable to phosphate ions except when growing.

Dr. H. Weil-Malherbe finds that the addition of coenzyme I to α-glycerophosphoric dehydrogenase does not affect its ability to take up oxygen and to dehydrogenate α-glycerophosphoric acid. A powerful dehydrogenating enzyme was obtained from horse brain by using pyocyanine as carrier.

Dr. K. Miescher, W. H. Fischer and E. Tschopp report on the effect of enol-esters of testosterone on the capon's comb and on the sexual organs of the rat. They state that the enol compounds produce on the rat, but not on the capon's comb, the strongest and longest duration of all hitherto known male hormones.

Prof. B. N. Singh and N. K. Anantha Rao find that in the tropical plant *Bassia latifolia*, as the leaves grow old and the amount of green colour (chlorophyll) decreases, there is an increase in the carotin and xanthophyll colouring matter, but these also disappear almost completely at the shedding stage of the leaf.

Dr. B. Cunningham points out that the widely held view that, at a river bend, the speed of the water on the outside of the bend is greater than on the inside, does not agree with the observations of the late Prof. J. Thomson. He found a vortex type of motion which led to the velocity being greater on the inner side of the bend. The erosion of the outer side is due, in these circumstances, to a transverse current of water which flows along the bottom towards the inner side, carrying with it detritus.

S. D. Emslie develops the Faraday tube hypothesis for the treatment of gravitation and, by introducing the mass-energy equation, arrives at a relation for the field intensity which, he claims, disposes of Einstein's objection to an infinite Newton-Faraday universe. Further considerations lead him to the view that the recession of the spiral nebulæ is due, not to a real repulsion, but to the field's intrinsic instability, so that an expansion once started would become oscillatory.

Research Items

Palæolithic Man in Norfolk

SOME time ago, Mr. J. E. Sainty made known the discovery of a palæolithic hand-axe at South Acre, Norfolk (*Proc. Preh. Soc. E. Anglia*, **7**, Part 3). More recently he has found others lying upon the stone heaps in the pit, and there is little doubt that these specimens are referable to some phase of the Clacton III industry. During September, Mr. Reid Moir and Mr. J. B. Calkin visited South Acre and found, at a depth of about 15 ft. in the deposit, exposed there upwards of forty Clacton flakes and rough-outs. This deposit is of a remarkable character, being composed of great numbers of large flints and other stones embedded in a hard sandy matrix very rich in manganese. The gravel—if such it can be called—exhibits no signs of stratification, but is contorted and twisted by glacial action or solifluxion to a marked degree. Though this is the case, and while it is claimed by some that the process of solifluxion inevitably gives rise to extensive flaking upon flints, transforming them into rostro-carinate and other early forms, it is significant that the Clactonian specimens from South Acre show no signs of such flaking. They are patinated white, and in nearly every case show little or no abrasion. The deposit in which they are found is clearly to be correlated in time with the uppermost Cannonshot gravel of Norfolk, which in its turn equates with the Upper Chalky Boulder Clay of Suffolk. The South Acre implements were made, therefore, at the close of the well-known Hoxne interglacial period, which intervened between the deposition of the Kimmeridgic and Upper Chalky Boulder Clays. Moreover, at Slindon in Sussex, Mr. Calkin discovered a palæolithic floor resting upon a raised beach and covered by Coombe Rock. The specimens from this floor are precisely similar to those from South Acre both in their forms, technique and condition ; and the deposits at both sites rest at 124–130 O.D., while each also is rich in manganese, which has attached itself freely to the flint implements. Thus, it is now possible to link up the Combe Rock of Slindon with the South Acre deposit, and this with the Upper Chalky Boulder Clay. It is evident that the glaciation responsible for the laying down of these various deposits was of no mean order. The South Acre gravel is more than 20 ft. in thickness, while as far south as Slindon a considerable deposit of Coombe Rock was accumulated.

Research at Cullercoats

THE report of the Dove Marine Laboratory, Cullercoats, Northumberland, for the year ending July 31, 1936, published by the Marine Laboratory Committee of Armstrong College (1937) and drawn up by the director, Prof. A. D. Hobson, shows a very satisfactory progress in all directions. Herring investigations by Mr. Storrow and Mrs. Cowan, chiefly on behalf of the Ministry of Agriculture and Fisheries, continue as before, and observations are also made on the Tyne salmon, a full account of which has already been published in the annual report of the Tyne Salmon Conservancy Board for 1935. The mussels in the Esk Estuary were examined on behalf of the North-Eastern Sea Fisheries Committee in view of increasing bait supply. Transplantation of several tons of mussels has given good results, and it is recommended that further supplies be transplanted. Dr. Bull continues his studies on conditioned responses in fishes. He has now begun to investigate the ability of fishes to perceive alterations in the rate of current flow. Special attention is given to those environmental factors which might be expected to affect purposive movements of fishes or condition their migration, most of this work being of a pioneer nature. Papers on herring investigations and on mussel transplanting are included in the report, and in addition there are two very interesting contributions, "The Development of *Capitelloides giardi* Mesnil" by J. A. Day, which was breeding in the aquarium and offered a good opportunity for study of the life-history, and "Notes on the British Species of the Genus Galathea Fab.", by H. O. Bull. The latter effectively solves the much-debated problem concerning the validity of the species *Galathea nexa*, which is shown both in structure and in the nature of the larva to be a distinct species.

Plant Ecology of Limestone Pavements

IN a paper read before Section K (Botany) of the British Association meeting at Nottingham, Miss A. Bennett discussed the ecology of the limestone pavements at Hutton Roof and Farleton, Yorkshire. Vegetation of limestone areas depends on three types of ground configuration, namely, pavements, escarpments and screes. Exposure to weather and angle of slope control the accumulation of soil and hydrogen ion concentration, and these of course affect the type of vegetation. One important biotic factor is that of grazing, which keeps the vegetation at the subclimax stage. A certain mixture of plants occurs owing to invasion of vegetation from nearby siliceous soils. The detailed distribution of certain species has been studied. For example, the bane-berry (*Artœa spicata*), has been recorded as following a fault, but being unable to traverse a ten-mile glacial drift. As a dynamic ecological hypothesis, formulated from her records of the static ecology, the author suggests that in this area certain virgin country is being colonized and in others denudation has occurred and the vegetation is retreating.

Metamorphic Rocks of Unst, Shetland Island

PROF. H. H. READ has dealt with the polymetamorphic rocks of the Valla Field Block, one of the tectonic units of Unst. (*Trans. Roy. Soc. Edinburgh*, 59, Part 1 (6), 195–221 ; 1937). The metamorphic history of this block has been divided into three stages, each characterized by the type of pressure-temperature factors then operative. The First metamorphism was controlled by fairly high temperature and considerable stress ; the Second by lower temperature and much greater stress ; and the Third by low temperature and very localized strong stress. In true pelitic rocks, three distinctive mineral assemblages characterize the three metamorphic episodes. In calcareous rocks, diopside-bearing rocks of the First metamorphism are replaced by tremolite-bearing rocks in the Second, and the tremolite is

mechanically deformed during the Third. The change from diopside to tremolite takes place under about the same conditions as the change from biotite to chlorite in pelitic rocks. In rocks of other types—siliceous, hornblendic, pegmatites and injection-rocks—the mineral assemblages of the First metamorphism are stable throughout the Second and Third, though these minerals are deformed and often completely shredded-out during the later episodes. The general conclusion is advanced that in retrogressive metamorphism the stability of an assemblage depends on the bulk-composition of the rock, and that no mineral can be considered adequately apart from the rock in which it occurs.

Distribution of Electricity in Thunderclouds

Sir George Simpson and F. J. Scrase (*Proc. Roy. Soc.*, A, 161, 309) have investigated the distribution of electricity in thunderclouds by a very direct method. A sounding balloon carries a trailing wire about 20 m. long terminated by a point at the lower end and a system of points at the upper end. When the balloon goes through a region of high potential gradient a point-discharge current flows in the wire. In a break in the circuit a paper disk soaked in a chemical solution is included, and the passage of a current leaves a characteristic discoloration at the positive electrode. The disk is rotated by a clock, and the direction of the point discharge current can be obtained from the traces. An idea of the magnitude of the potential gradient could be obtained from the width of the trace, and when the currents were very large the paper was charred by sparking. The height of the balloon was recorded continuously. Simultaneous records of electric field near the ground were taken. The results show that the most typical thundercloud has a positive charge at the top, a negative charge over most of the remainder, and a concentrated region of positive charge somewhere near the base. The authors consider that the breaking-drop theory of Simpson explains the concentrations of positive charge in the base of the cloud. The explanation of the positive electrification at the top of the cloud is sought in the presence of ice crystals or snow in these regions, which become electrified by friction or in some other way. The explanation given by C. T. R. Wilson, involving the electrical polarization of the falling drops, is held to be invalidated by the low temperatures of the relevant regions in the cloud, which are supposed to contain ice crystals rather than water drops. The paper contains considerable discussion of the configurations of thunderclouds. The results are not inconsistent with the idea that the circulation of electricity in the atmosphere is maintained by thunderstorms and shower clouds.

Absorption Edges in the Soft X-ray Region

H. W. B. Skinner and J. E. Johnston (*Proc. Roy. Soc.*, A, 161,420) have investigated the structure of the absorption edges of some metals in the wave-length region 100–300 A. These edges correspond to transitions from an inner electron shell to the conduction-electron levels of the metal, and their fine structure therefore provides a method of investigating the distribution of the conduction levels. The spectrographic apparatus is a concave grating used at a small grazing angle, and Ilford *Q* plates are used. The absorbing metals were used as thin foils obtained by evaporation on to a celluloid film supported on naphthalene which was then sublimed away. No light source giving a continuous spectrum was available, and a condenser spark in vacuum, usually with copper or silver electrodes, was used. A special technique of photographic photometry was developed to deal with the difficult conditions of a fluctuating source of line spectrum. Absorption curves were obtained for the *K* edge of Li in the metal and in LiOH, the *L* edges of Mg, and the *M* edges of Cu, Ni. A paper connecting these edges with the electron theory of metals is promised.

Ionosphere Disturbances

Dr. J. H. Dellinger has summarized the results obtained by the world-wide co-operative study of the fading out of high-frequency radio transmission for short periods during daylight, and the simultaneous perturbations of terrestrial magnetism (*J. Research, U.S. Bur. Stand.*, August 1937). Half the 118 disturbances investigated were accompanied by solar eruptions seen as sudden increases of brightness of large patches of the sun's surface. A detailed discussion of the observations leads Dr. Dellinger to the conclusion that the whole of the effects may be explained as due to an increase of ionization of a *D* layer of the atmosphere below the already known *E*, F_1 and F_2 layers at heights 120 km., 220 km. and 320 km. respectively, at which radio waves are as a rule reflected. This ionization, he considers, is due to an electromagnetic radiation of a penetrating type and of a frequency far greater than that of light, emitted in all directions from eruptions on the surface of the sun. During the eighteen months of observation there is some indication of a 55-day period in the disturbances. Further observations are likely to add materially to our knowledge of the sun.

Pierre Gassendi (1592-1655)

A short memoir, entitled "L'Œuvre Astronomique de Gassendi" by Prof. P. Humbert of the University of Montpellier recalls the work of one of the most notable observers in the first years of telescopic astronomy (Actualités scientifiques et industrielles, 378. Pp. 32. Paris : Hermann et Cie., 1936. 8 francs). Pierre Gassendi was a philosopher, theologian, mathematician and, pre-eminently, an astronomical observer whose precise records of observations might well serve as precepts to be followed by astronomers of the present day. He was a diligent observer of sunspots (especially from 1620 until 1626), a joint compiler with Peiresc of one of the first maps of the moon, an observer of a number of solar and lunar eclipses between 1621 and 1654, of occultations, planetary phenomena, the comets of 1618 and 1652, the great aurora of 1621, and of parhelia. But perhaps the observation which gave him the greatest pleasure was that of the transit of Mercury on November 7, 1631, which Kepler had predicted in 1629. This first observation at Paris ever made of a transit of Mercury had its counterpart in England in 1639, when Horrocks and Crabtree observed the rarer phenomenon of a transit of Venus across the sun's disk—the sole prediction of which Horrocks had derived just before the event when working on his corrections of Kepler's Rudolphine Tables of 1627. Eight years earlier, Gassendi had, indeed, watched the sun's disk on four consecutive days for the transit of Venus of 1631, as predicted by Kepler, but the transit took place on December 6 when inaccessible to observation from Europe.

Invertebrates of the Faroes*

PUBLISHED at the expense of the Carlsberg Fund and accordingly sold at a very reasonable price, this monograph will appeal to a wide circle of workers interested in taxonomy and geographical distribution.

Most of the sections on marine Crustacea are by K. Stevensen and, of the Decapoda, twenty-nine species are now known from these islands. The majority of them seem to be rare, having only been taken a few times, or even a single time, and only six species are really abundant. Although the Faroes are only about 160 miles from the Shetlands, their Decapod fauna is comparatively poor, since the last-named islands contain forty-eight or forty-nine species. It seems that the deeps south-east of the Faroes are impassible to numerous littoral and sub-littoral species. Of the Amphipoda only twelve species were previously known, while the present work brings up their number to no fewer than sixty-one species. The greater number of these belong to the epi-fauna (living among algæ or Hydroids, etc.) and the majority are common north-west European or arctic-boreal species. Previous records of the Isopoda and Tanaidacea are contained in works of H. J. Hansen (1913 and 1916). The present work contains only two species not listed by this author. Of the Mysidacea, Cumacea and Nebaliacea, only seven species are at present recorded, which is a very small number as compared with ninety-eight species for surrounding waters (Iceland, Shetlands (or Scotland) and Norway).

Of the Cirripedes it is noteworthy that six species were known from the Faroes so long ago as the year 1800 and, since then, only five have been added to that number. The marine Ostracoda have hitherto remained almost totally unknown and, in the present work, fifteen species are dealt with, but some of them could not be named with certainty. The majority are widely distributed and common. The fresh-water Crustacea are discussed by E. M. Poulsen, and forty-one species are enumerated: while they show features recalling the more arctic regions, those of temperate zones predominate.

Of other Arthropods, P. Hammer and K. L. Henriksen discuss the Myriapoda, of which seven species are identified: all these occur also in Britain excepting the Chilopod *Pachymerium ferrugineum*. Among the Insecta, K. L. Henriksen describes the members of several of the smaller orders. The only Thysanuran recorded is *Petrobius balticus*, a species often confused with *P. maritimus*. Of the thirteen species of Collembola the main part consists of Palæarctic forms, widely distributed on the Continent as well as in Great Britain. The only Orthoptera are *Forficula auricularia* and *Blatta orientalis*. The Mallophaga comprise thirty-one species, but this total is obviously incomplete since no parasites off the puffin are recorded. While dragonflies, mayflies and stoneflies are unrepresented, and there is only a single Neuropteron (*Boriomyia betulina*), seventeen species of Trichoptera are recorded. In the account of the Lepidoptera by N. L. Wolff thirty-two species are enumerated. The only butterflies are *Pyrameis atalanta* and the cosmopolitan *P. cardui*. None of the moths is endemic.

The concluding part of the volume is A. West's account of the Coleoptera, wherein some 156 species are enumerated. The Carabidæ, with twenty-six species, and the Staphylinidæ, with sixty-five species, are the only two large families at all well represented. A predominating feature is the close resemblance of the Coleopterous fauna of the Faroes with that of Scotland and Norway. Only five Faroese species have not been found in Scotland and only three have not been discovered in Norway, while sixty-three species do not, apparently, occur in the Shetlands. The last-named islands, however, have not been so thoroughly investigated as the Faroes. The orders Hemiptera, Diptera and Hymenoptera are not included in the present issue.

When complete the work will be published in three volumes, each in two parts. The whole is expected to be completed in 1938.

A. D. IMMS.

* The Zoology of the Faroes. Edited by Ad. S. Jensen, W. Lundbeck, Th. Mortensen and R. Spärck. (Published at the expense of the Carlsberg-Fond.) Vol. 2, Part 1: Crustacea, Myriopoda, Insecta I. Pp. iii+346. (Copenhagen: Andr. Fred. Høst and Søn, 1937.) 15*s*.

West Middlesex Main Drainage

THAT part of the county of Middlesex lying to the west of the Finchley and Barnet Ridge has an area of about 160 square miles and is drained by four main streams, the Colne, the Ash, the Crane and the Brent and their tributaries, all of which flow to the Thames above London. In the post-war years the population and industries of this district increased and developed so rapidly that the twenty or more local authorities acting individually were unable to keep pace with the requirements, particularly in respect of sewerage and sewage disposal. Mr. David Mowat Watson has given the history of the scheme which was adopted to deal with this problem, and a description of the works and their design and construction (*J. Inst. Civ. Eng.*, April), for which he has just been awarded the Telford Gold Medal of the Institution of Civil Engineers.

In 1921 the average density of population per acre was 4·8 and in 1931 this figure had risen to 7·5, the greatest density in this latter year being 25·5. For the purposes of design an ultimate average of 23 was assumed, and the maximum rate of flow provided for was 240 gallons per head per day. The Act of Parliament which authorized the scheme empowered the County Council to construct trunk sewers for a wet weather flow of this amount, to make the necessary connexions with local sewers, to provide for gauging the sewage flow from each of the constituent authorities, to build purification works at Mogden with outfalls to the Thames at Isleworth Ait, and sludge disposal works at Perry Oaks.

Owing to the abnormally rapid development of the area, the Ordnance maps were out of date, the district had to be re-surveyed and about seventy

miles of existing sewers located. Over the greater part of the district the clay is overlaid with about twenty feet of water-bearing ballast and, to avoid trouble, the sewers were located in the clay, in which tunnelling is comparatively easy. In this connexion, the author notes that the contractors showed a growing preference for tunnelling, as it eliminated the heavy road charges and the costs and delays of diverting gas, water and other mains which open trench work involves.

A circular section was adopted for all sizes of sewers, as the higher velocity at low flows which might be expected from the egg-shaped section was deemed to be outweighed by the advantages of lower cost, increased resistance to external pressure and less loss of head. The lining of the larger sewers was best engineering brickwork, while pipes of aluminous cement were principally used in those less than 4 ft. in diameter. Although these tubes have a smoother surface initially, it was held that, over a long period, the average surface of brickwork is better; the roughness coefficients used in the Flynn-Kutter formula were 0·013 for brick, cast-iron and glazed stoneware, and 0·015 for cement pipes. The paper gives many valuable notes on the design of sewers, and describes the methods of effecting the junction of the local sewerage systems with the main trunk sewers. As the latter are at many points at a depth of 60 feet below ground, the design of backdrops and cascades forms an important feature, and several of these and the methods of effecting flood relief of the rivers are illustrated.

For the purpose of ensuring that each district gets its fair share of the use of the sewers and of providing as much research information as possible of local storms and flows, a complete system of gauging has been installed. For various reasons, standing wave flumes were considered most suitable, and from tests made it is anticipated that a degree of accuracy of two per cent at full flow to six per cent at one thirtieth flow can be obtained.

At the Mogden works the purification of the liquid sewage is effected by the sludge activation process, and to ensure freedom from smell and also to utilize the available gas for power and heat, the sludge is subjected to complete anærobic digestion. Large storm-water tanks have been constructed and these are in continuous use for partial treatment. In a partially digested state, the sludge is pumped seven miles to Perry Oaks, where the secondary digestion, drying and final disposal by tipping are carried out. The complete isolation of the drying beds from adjacent lands has been ensured by sinking a puddle wall through pervious clay and keying it into the London Clay. This method is regarded as unique, and was a necessary and wise precaution to prevent soakage finding its way into potable water. By means of this scheme, which was completed in May 1936, twenty-seven small sewerage works have been replaced by one large system.

Museums and the People

AT the present time museums, taking them all in all, are undergoing an interesting and critical stage of development. Some began and remain as collections of curios and some have degenerated to that condition, but the majority are striving in one way or another to test the reactions of the community, in efforts to discover the lines which hold out most hope of stimulating interest. The success or failure of these efforts is a matter of moment to the people as well as to the museums themselves, for upon it depends the place which museums are to take in the life of the community as centres of education and of intellectual and æsthetic pleasure. For many of our local museums, perhaps for most, this place is still undecided, and accordingly advice upon the most promising lines of progress by a museum official of experience and standing ought to fall upon open ears.

At the Newcastle conference of the Museums Association held in July, Dr. W. E. Swinton of the British Museum (Natural History), in a paper which has appeared in the *Museums Journal* (September), gave sound advice upon the improvement of collections. He justly pointed to the hesitancy of many municipalities to give proper financial backing to the museums under their care, a hesitancy to be observed particularly in the appointment of suitably paid curators with knowledge and training for posts which have their own peculiar difficulties and make their own special demands. Thanks to an awakening conscience and to the efforts of the Carnegie United Kingdom Trust, that position is improving, and "many municipal authorities to-day feel, though vaguely it may be, that a natural history museum is somehow an asset to the community".

Granted a suitable curator, what of the collections themselves? In the first place the local natural history museum should concern itself with the objects of its own neighbourhood, and secondly, it should present these in such a way that the visitor should be induced to take a fresh or increased interest in the local fauna, flora and geology. That implies ruthless elimination of surplus specimens, so that room may be gained for a few well-selected groups in natural habitats, well lit and clearly, instructively and yet simply labelled.

Dr. Swinton properly suggests that no zoological series is complete without the inclusion of fossil forms in their systematic position, presumably to illustrate the course of evolution. But why not take the bull by the horns and arrange selected series specially to illustrate evolution and other general truths, for that would be education at its best; and the ordinary visitor who could visualize evolution from the systematic exhibits of most museums would be a miracle himself. The time will come when systematic collections, except for the merest skeleton of classification and other defined purposes, will be relegated to cabinets where identifications and detailed comparisons can best be made, and galleries will largely be given over to exhibits which stimulate observation of the habits and adaptations of living things, and which lead visitors gently to appreciation of the great truths which lie behind structure and development and evolutionary progress. J. R.

The Palao Biological Station

THE Tropical Biological Station, founded by the Japan Society for the Promotion of Scientific Research, was opened officially in April 1936 with a staff consisting of a director and three researchers drawn from Japanese universities. Its laboratory is situated to the south of Kororu Island in lat. 7° 21′ N., about the middle of the main Palao series. The whole group lies 500 miles east of the Philippines and consists of three or four small atolls to the north, a single elevated limestone island to the south and in the centre a great bank about 80 miles long by 15 miles broad with six main islands and more than two hundred islets. Most of the land is situated to the east with fringing reefs, while a great barrier to the west encloses a long narrow lagoon, which reaches a depth of more than thirty fathoms. Andesite and crystalline limestone form the land, the latter in terraces mainly in the southern half. Historically, the group is interesting for Karl Semper ("Animal Life", 1881), on the evidence collected there, was one of the first of that long series of field workers to dissociate himself from Darwin's theory of universal oceanic subsidence to explain the formation of atolls and barrier reefs.

The laboratory is a frame building with sheds and small boats, and provides accommodation for four research workers, who have to devote their attention to biological studies of coral reefs; their expenses are paid by the Society, and each stays at least four months. It is situated on a bay, or secondary lagoon (Iwayama), almost entirely enclosed by high land, which here forms the meeting place of limestone and andesite. The bay is studded with many elevated limestone islets and has depths up to fifteen fathoms; it lies next to that area where Mikimoto cultures his pearls. Well protected from the trade winds and with small currents, corals grow in great variety, so far 116 species representing 43 genera having been collected. Most are "very delicate and brittle" and "show poor growth" so that the hoped-for comparisons with the vigorous growth of open lagoons and of sea reefs will be difficult. On the other hand, possessing protected environments where corals can be easily planted, the bay should be excellent for the study of the biology and variation of species.

Among the separate reports which follow, Fujio Hiro describes twenty-five cirripedes, leaving their interesting coral commensals to a future paper. He also studied crabs forming galls on corals, these due to the growth of coral around the young crab which has settled upon it. There is little new here beyond what Potts told us, except to show that the cavities produced vary greatly. A hydrographical study by Matsuya discloses in the bay higher temperature and silica and lower chlorinity, oxygen, *p*H and phosphates than in the ocean waters. Noboru Abe undertook the development of *Fungia* from the planula to the commencement of skeletogenous formation. Fertilization occurs in the gonad at full moon, and the planula there formed is liberated at new moon from September until April. It attaches itself on the third day and the first septa commence to form on the seventh; the growth curve shows a marked and suggestive slowing as soon as the septa commence to form. The development is said to be much delayed by an absence of light; but a deeper study is necessary before many interesting features can be understood. J. S. G.

University Events

BIRMINGHAM.—On October 14 H.R.H. the Duke of Kent, as patron of the Hospitals Contributory Schemes Association, visited Birmingham to attend the annual meeting of the Association. His activities included a visit to the new Hospitals Centre and Medical School, after which at a special degree congregation the Chancellor of the University (Viscount Cecil of Chelwood) conferred on His Royal Highness the degree of LL.D.

With the object of securing closer contact between the University and the two Birmingham municipal hospitals at Dudley Road and Selly Oak, five of the professors of the Medical Faculty of the University have been appointed as part-time consultants to the hospital staffs. The professors are Sir Beckwith Whitehouse, Mr. W. H. Wynn, Mr. Philip Cloake, Mr. William Gemmill and Mr. Seymour Barling. The appointments have been made by the Birmingham Health Committee.

CAMBRIDGE.—G. Metcalfe, of Clare College, has been appointed to the Frank Smart University studentship in botany.

G. S. Gough, of Pembroke College, University lecturer in engineering, has been elected into a fellowship at Trinity College on appointment as lecturer in mechanical sciences. C. H. Bamford has been elected into a fellowship at Trinity College for research in natural sciences. He obtained a 1st Class in Part I, Natural Sciences Tripos (1933) and in Part II (1934), (Chemistry). D. M. A. Leggett has been elected into a fellowship at Trinity College for research in applied mathematics. He obtained a 1st Class in Part I, Mathematical Tripos (1932), and in Part II (1934), Wrangler (*b*) distinguished; Rayleigh Prize, 1936.

The Council of the Senate has reported that the University will eventually benefit under the will of the late Mr. William Charles Wilson, of St. John's College, to the extent of about £15,000. No conditions are attached. The Council is of the opinion that, in view of Mr. Wilson's interest in the alleviation of human suffering, it would be appropriate to use his bequest for the furtherance of some allied branch of research. It is recommended that the bequest be applied to the provision of an extension of the Psychological Laboratory. Should this recommendation of the Council be approved, the Rockefeller Foundation has promised to give £11,360, spread over a period of five years from January 1, 1938, towards the cost of developing the Department of Experimental Psychology.

SHEFFIELD.—A contribution of £5,000, being the second instalment of the contribution of £10,000 promised by the City Council, has been made to the University Extension Fund.

E. T. Goodwin and T. D. H. Baber have been appointed assistant lecturers in mathematics, and Dr. Helen Mellanby part-time demonstrator for medical and dental students in the Department of Zoology.

The following resignations have been received: Mr. J. W. Frame, of his post of lecturer in mathematics; Mr. J. Jenkins, of his post of lecturer in civil engineering; Dr. E. S. Duthie, of his post of demonstrator in pathology.

Science News a Century Ago

The Aurora Borealis

The Times of October 25, 1837, quoted from the *Leamington Chronicle* the following description of an aurora borealis. "Nearly the whole population of Leamington appeared, with ourselves, wonder-struck, last evening, by the appearance which is seldom witnessed in this locality—viz., the aurora borealis. This gorgeous and most sublime spectacle was visible from 6 until half-past 7 o'clock. The clouds in the north-east appeared as if suffused with the reflection of a vast mass of crimson flame. The stars seen through this brilliant medium had an extraordinary appearance, for the brilliancy seemed to be heightened by the surrounding glory. A gentleman who stood near us on the bridge, and who has resided in countries where the aurora borealis is a frequent visitor, directed our attention to a singular novelty in the effect of this striking atmospherical spectacle as it appeared about half-past 6 o'clock. At that period dense lines and dark clouds in parallel perspective lines spread from the far south-east, narrowing by regular gradations, and converging towards that flood of splendid light which 'pavillioned with its thousand glorious dyes' the whole northern horizon."

Arthur Woolf, 1766-1837

On October 26, 1837, the famous Cornish engineer, Arthur Woolf, died at The Strand, Guernsey, to which he had retired four years previously. A mechanical engineer of the first rank, whose engines were noted for their fine finish, he was one of the last of the contemporaries of Watt, who made the Boulton and Watt steam pumping engine the admiration of the world. The Hornblowers, Bull, Trevithick, Harvey and others all had a share in the improvement of the Cornish pumping engine, which by about the time of Woolf's death had a 'duty' of more than 100 million ft. lb. per cwt. of fuel as compared with the 30 millions for engines at the beginning of the century. Some of the engines constructed by Woolf himself had cylinders of 90 in. diameter with a 10 ft. stroke, and at one time he had more mining engines under his charge than any other engineer in Cornwall.

Born at Camborne in 1766, Woolf served an apprenticeship as a carpenter, and then moved to London where he was fortunate enough to find employment in the shop of the famous mechanician Joseph Bramah, in Pimlico, having for one of his fellow workmen Henry Maudslay. When nearly thirty years of age he left Bramah to erect some engines for Hornblower, in Durham, and on his return to London secured the post of engineer to Meux's Brewery, having charge of the machinery and apparatus. Here he installed plant for heating water by waste steam, invented a cast-iron tubular boiler and made his first engine in which the steam was expanded successively in a high-pressure and a low-pressure cylinder; an important type of engine to which long afterwards the name of a 'compound' engine was given. At first he placed his cylinders side by side at the end of the overhead beam, but later on placed the high-pressure cylinder nearer the centre of the beam, an arrangement adopted later on by McNaught.

After spending the years 1797–1806 at the Brewery, Woolf joined Humphrey Edwards in partnership as an engine maker in Lambeth. The partnership lasted only five years, when Woolf returned to Cornwall, where he erected at least six compound pumping engines. By 1824 the single-cylinder, however, had been greatly improved, and it was shown that with the steam pressures then in use—20–30 lb. per sq. in.—there was no advantage in compounding, and it was therefore with the development of the single-cylinder engine that Woolf's last work was done. He was engineer to the important groups of mines known as the Consolidated Mines and United Mines, and was also associated with the Hayle engine works of Harvey. Working in the dark, as they were, as to the theory of heat engines, Woolf and his fellows yet made a great contribution to steam engineering.

John Mackintosh (? –1837)

Dr. John Mackintosh, an eminent Edinburgh physician, the date of whose birth is not recorded, was born at sea on return of his mother from America, whither she had accompanied his father, Captain Mackintosh, on service. He studied medicine at Edinburgh, where he qualified in 1808, and was then appointed medical officer in the Royal Artillery. After serving in the West Indies, South Africa and France with the army of occupation after the battle of Waterloo, he settled in practice in Edinburgh, where he became physician to the General Brown Square Dispensary and later professor of obstetrics and practical medicine in the School of Medicine and Surgery. In 1822 he published a work entitled "A Treatise on the Disease Termed Puerperal Fever, Illustrated by numerous Cases and Dissections", the disease at that time being very prevalent in Edinburgh and Leith. In the following year he began a course of lectures on midwifery and diseases of women and children, and proved a very successful lecturer. In 1825, in compliance with a request from the Edinburgh students, he delivered a course of lectures on the "Principles of Pathology and Practice of Physic". His chief work, which had the same title, was first published in 1828 and was extremely popular among students and general practitioners both in England and America, so that it went through four editions. He devoted a good deal of his time to the investigation of cholera and made some important additions to the knowledge of its morbid anatomy. His death, which was due to typhoid fever, took place on October 28, 1837.

Subterranean Forest

The *Gentleman's Magazine* of October 1837 contains an account of the following interesting discovery: "The labourers who are excavating the common sewer in High St., St. Giles, Westminster, lately discovered just opposite the church two elm trees, in a high state of preservation at a depth of about 15 feet under the surface of the ground, lying completely across the part undergoing excavation, and being parallel to each other, though at a distance of several yards. They were obliged to be sawn through, and the pieces which were removed to the surface were each about nine feet long and five in circumference. These trees were supposed to have belonged to a forest which once covered this and the surrounding district. On examination the exhumed timber was found to be as sound as if it had been felled only a few months. The superincumbent strata were composed of common rubble, clay and sand, the whole of which was remarkably dry to the above depth."

Societies and Academies

Paris

Academy of Sciences, August 9 (*C.R.*, 205, 345-380).

RAYMOND HAMET : Demonstration of the direct vaso-constrictive action of a nicotinic substance, cytisine.

MLLE. DIGNA VAN STOLK and ROLAND LEROY DE LENCHERE : Folliculin and dihydrofolliculin in the urine of pregnant mares.

August 23 (*C.R.*, 205, 397–428).

GEORGES CLAUDE : The search for aeroplanes lost at sea. Results of a practical application of the method (use of fluorescin) proposed by the author.

DIMITRI RIABOUCHINSKY : The vortex shaft method of hypersupport.

B. CABRERA : The moments of some cations of the rare earths and Weiss magnetism.

LUCIEN DANIEL : New experiments on acquired heredity in the leek.

ARYEH DVORETZKY : The arguments of the singularities of analytical functions.

LÉOPOLD ESCANDE : Flow through a valve.

PIERRE VERNOTTE : The convection currents in experiments on thermal conduction.

GEORGES FOURETIER : The precipitation of tricalcium phosphate and of hydroxyapatite.

C. F. GOODEVE and F. D. RICHARDSON : The existence of chlorous anhydride. A repetition of the experiment described by Kantzer (*C.R.*, 155, 158) for the preparation of Cl_2O_3 fails to confirm his conclusions : spectroscopic examination showed that only chlorine dioxide is formed.

LÉON CALEMBERT : Contribution to the geological study of the culminating massif of Ouarsenis (Algeria).

HUBERT GARRIGUE : The measurement of the radioactivity of the air enclosed in the snow layer, near the soil, in the mountains.

MAURICE LANGERON : New statistical and mycological observations on human favus in Morocco.

MME. VERA DANTCHAKOFF : The action of the female sex hormone on reptiles.

August 30 (*C.R.*, 205, 429–452).

PIERRE LEJAY : Measurements of gravity in Normandy and Brittany. Tabulated results for measurements of g at 21 stations in Normandy and Brittany.

ANDRÉ HAARBLEICHER : Curves which are their own isogonal inverse with respect to a triangle.

W. K. TURKIN and P. E. DUBUQUE : Theorems on infinite groups.

PAUL PETRY : The determination of pressures and velocities in breaking waves. Measurements made on waves breaking on a jetty.

MAURICE D'OCAGNE : Remarks on the preceding note, pointing out that this is the first time such measurements have been attempted.

HORIA HULUBEI : Contribution to the study of the K emission spectrum of gallium (31) and of germanium (32).

RENÉ GIBERT : The *p,p'*-dimagnesium compounds of diphenyl. The favourable role of magnesium iodide.

WILLIAM HENRI SCHOPFER : The action of the constituents of aneurin on yeasts (*Rhodotorula rubra* and *R. flava*).

MARCEL AVEL : The experimental study of the morphogenesis of the central nervous system in the regeneration of the head of worms.

Y. RAOUL : The evolution of hordenine in barley and the ultimate relations of this alkaloid with the tyrosine.

Geneva

Society of Physics and Natural History, July 1.

CH. BAEHNI : The male inflorescence of *Scyphostegia borneensis*. Following the discovery of a male specimen of this plant it would appear that the classification of the latter in the family of the Moraceæ or in any other family of the nettles is erroneous. The exact systematic position of this plant is at present doubtful.

ALB. PERIER : Some critical observations on the torus mandibularis and on its ultimate phylogenic signification. A detailed analysis shows that two varieties of mandibular hyperostoses must be considered : (*a*) the torus mandibularis alveolaris and (*b*) the torus mandibularis arcuatus. The examination of two series of mandibles, Genevan and Bushman, on which these toriform arrangements are encountered, shows that the torus mandibularis is not specifically Asiatic, as has been supposed hitherto.

P. WENGER, CH. CIMERMAN and A. CORBAZ : The micro-estimation of cobalt by means of anthranilic acid. The authors have established a gravimetric micromethod for the determination of cobalt by means of anthranilic acid.

CH. CIMERMAN and P. WENGER : (1) The micro-separation of zinc by means of *o*-oxyquinoline in acetic solution. (2) The volumetric micro-estimation of zinc in alkaline solution. The authors have established the conditions for the micro-separation of zinc with the cations NH_4, K, Na, Li, Mg, as well as a micro-estimation of zinc in alkaline solution.

E. BRINER and E. PERROTTET : Complementary results on the catalytic action of ozone in the oxidation of aldehydes. The influence of the peroxide present. This catalytic action is shown by an increase in the absorption velocity of the oxygen ; the presence of peracids increases this velocity as measured by the bubbling method.

D. MONNIER, B. SUSZ and E. BRINER : The Raman spectra of acrylic acid and of methyl methacrylate, both monomer and polymerized. The disappearance of the frequencies of the vinyl group in the polymer shows that the latter is a substance no longer containing the double bonds of the monomer.

L. MISCH and VAN DER WYK : The structure of crystallized azulene. Interference analysis with X-rays of azulene has furnished a whole series of crystallographic constants, which from this point of view suggests that this substance is allied to naphthalene.

EUG. PITTARD and HAYRI AZIZ SEYLAN : Prognathism, cranial capacity and area of the occipital perforation in the anthropoids. The authors have studied various skulls of gorillas, orang utans, chimpanzees, and gibbons. It follows from this work that the construction of the cranio-facial edifice is somewhat different in the anthropoids, according to the genus under examination.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, October 25

UNIVERSITY OF LEEDS, at 5.15.—Dr. F. Simon: "The Temperature Region below 1° Absolute".*

BEDSON CLUB, KING'S COLLEGE, NEWCASTLE-UPON-TYNE, at 6.30.—Prof. G. I. Finch: "Electron Diffraction and Surface Structure" (Bedson Lecture).

Wednesday, October 27

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Prof. Raymond Pearl: "The Natural History of Population" (succeeding lectures on October 28, November 1, 3 and 4).*

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY (at King's College, Strand, W.C.2), at 8.—Dr. A. F. Titley: "Paracelsus: A Résumé of Some Controversies".*

Thursday, October 28

CHEMICAL SOCIETY, at 5.30.—Prof. C. H. Desch, F.R.S.: Le Chatelier Memorial Lecture.

Friday, October 29

GEOPHYSICAL DISCUSSION (at the Royal Astronomical Society), at 4.30.—"Variation of Latitude" (Opener: Dr. Spencer Jones, F.R.S.).

ROYAL SOCIETY OF MEDICINE, at 9.15.—Philip Guedalla: "The Method of Biography" (Lloyd Roberts Lecture).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER IN MATERIA MEDICA AND PHARMACOLOGY in the Welsh National School of Medicine, The Parade, Cardiff—Secretary (October 25).

HEAD OF THE CHEMISTRY DEPARTMENT of the Northampton Polytechnic, St. John Street, London, E.C.1—Principal (October 31).

HEAD OF THE CHEMISTRY DEPARTMENT of the Burnley Municipal College—Director of Education, Education Offices, Burnley (November 3).

PRINCIPAL of the St. Helens Municipal Technical School—Director of Education, Education Office, St. Helens (November 6).

ASSISTANT IN THE DEPARTMENT OF NATURAL HISTORY in University College, Dundee—The Secretary.

Official Publications Received

Great Britain and Ireland

Miscellaneous Publications of the International Tin Research and Development Council. No. 6: The Role of Technical Information in Industrial Research and Development. By Dr. C. E. Homer and Dr. E. S. Hedges. Pp. 9. (London: International Tin Research and Development Council.) Free. [710

Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1937. Pp. 24+4 plates. (Kirkhill: Hannah Dairy Research Institute.) [810

Bacon Development Board. Bulletin No. 2: Substitutes for Cereals in Pig Keeping. Pp. 62. (London: Bacon Development Board.) 2*s*. [910

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1699: Report on Puss Moth Accidents, complete with Appendices. Pp. 388+19 plates. (London: H.M. Stationery Office.) 30*s*. net. [910

The English Golf Union Year Book, 1937. Pp. xii+196+48. (Northwood: Rawlinsons Library.) 2*s*. 6*d*. [910

Management Library. Progress Report for the Five Years ended 30.6.37. Pp. 4. (London: Management Library.) [910

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, 26th October 1937. Pp. 44. (Newcastle-upon-Tyne: Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne.) [1110

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 1, No. 7: The Middle Devonian Fish Fauna of Achanarras. By C. Forster-Cooper. Pp. 223–240+8 plates. 5*s*. Vol. 59, Part 1, No. 8: On a New Longheaded Dipnoan Fish from the Upper Devonian of Scaumenac Bay, P.Q., Canada. By W. Graham-Smith and Dr. T. S. Westell. Pp. 241–266+2 plates. 4*s*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1110

Proceedings of the Royal Society of Edinburgh, Session 1936–1937. Vol. 57, Part 3, No. 21: On the Immature Stages of some Scottish and other Psyllidæ. By Dr. K. B. Lal. Pp. 305–331. 2*s*. 3*d*. Vol. 57, Part 3, No. 22: Some Distributions associated with a Randomly Arranged Set of Numbers. By Dr. W. O. Kermack and Lieut.-Col. A. G. McKendrick. Pp. 332–376. 4*s*. Vol. 57, Part 3, No. 23: On Rotating Mirrors at High Speed. By Sir Charles V. Boys. Pp. 377–378. 6*d*. Vol. 57, Part 3, No. 24: *Geonemertes Dendyi* Dakin, a Land Nemertean in Wales. By A. R. Waterston and H. E. Quick. Pp. 379–384. 6*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1110

Society for the Promotion of Nature Reserves. Handbook. 1937. Pp. 44. (London: Society for the Promotion of Nature Reserves.) [1110

Other Countries

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1935, under the direction of Dr. S. C. Roy. Reduced and tabulated under the direction of Dr. S. C. Roy and Dr. K. R. Ramanathan. Pp. xiv+A74+B41+C2+D15. (Delhi: Manager of Publications.) 9.14 rupees: 16*s*. 6*d*. [410

Report of the Forest Department, British Honduras, for the Year 1936. Pp. 19. (Belize: Forest Department.) [510

University of Illinois: Engineering Experiment Station. Circular No. 28: An Investigation of Student Study Lighting. By Prof. John O. Kræhenbuehl. Pp. 36. 40 cents. Circular No. 29: Problems in Building Illumination. By Prof. John O. Kræhenbuehl. Pp. 28. 35 cents. Circular No. 30: Papers presented at the Twenty-fourth Annual Conference on Highway Engineering held at the University of Illinois, March 3–5, 1937. Pp. 134. 50 cents. Reprint No. 11: Third Progress Report on the Joint Investigation of Fissures in Railroad Rails. Pp. 30. 15 cents. (Urbana, Ill.: University of Illinois.) [510

U.S. Department of Agriculture. Circular No. 390: Flour-Mill Insects and their Control. By G. A. Dean, R. T. Cotton and G. B. Wagner. Revised edition. Pp. 40. 5 cents. Miscellaneous Publication No. 271: A Revision of the Leafhoppers of the *Macrosteles* Group (*Cicadula* of Authors) in America North of Mexico. By H. E. Dorst. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office.) [510

Smithsonian Miscellaneous Collections. Vol. 96, No. 5: The Male Genitalia of Orthopteroid Insects. By R. E. Snodgrass. (Publication 3442.) Pp. 107. (Washington, D.C.: Smithsonian Institution.) [710

League of Nations: Health Organisation. Report of the Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene, held at Bandoeng (Java), August 3rd to 13th, 1937. (Official No.: A.19.1937.III.) Pp. 120. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 2*s*. 6*d*. [710

Brooklyn Botanic Garden Record. Vol. 26, No. 4: Prospectus of Courses, Lectures and other Educational Advantages offered to Members and to the General Public, 1937–1938. Pp. iv+355–376. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [810

Kenya Colony and Protectorate: Department of Agriculture. Annual Report, 1936. Part 2. Pp. ii+102. (Nairobi: Government Printer; London: Crown Agents for the Colonies.) 2*s*. 6*d*. [910

Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 6, No. 19: The Orbit of the Eclipsing Binary Ar Aurigæ. By W. E. Harper. Pp. 311–316. (Victoria: Dominion Astrophysical Observatory.) [1110

In Memoriam, Joh. Ev. Purkyně, 1787–1937. Pp. iv+102. (Pragae: Purkyňova Společnost.) [1110

Proceedings of the Conference on Maternity and Child Welfare, 12th to 13th December 1936, Madras. Pp. vii+165+xiii. (Egmore, Madras: Health Propaganda Board.) 8 annas. [1110

Department of Agriculture: New South Wales. Science Bulletin No. 56: Plant Breeding in New South Wales; Tenth Year of Progress, 1935–36. Pp. 56. (Sydney: Government Printer.) [1110

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 108: The Basaltic Soils of Northern Tasmania. By C. G. Stephens. Pp. 40. Bulletin No. 109: The Variability of Plant Density in Fields of Wheat and its Effect on Yield. By H. Fairfield Smith. Pp. 28. (Melbourne: Government Printer.) [1110

Oil Production from Coal viewed from an Australian Standpoint. Report by Sir David Rivett. Pp. 22. 1*s*. Oil from Coal: Second Report of the Committee appointed to inquire into the Question of establishing a Plant in Australia for the Production of Oil from Coal by the Hydrogenation Process. Pp. 6. 6*d*. (Canberra: Commonwealth Government Printer.) [1110

Summary Proceedings of the Thirty-fourth Meeting of the Indian Central Cotton Committee, Bombay, held on the 2nd and 3rd March 1937. Pp. 94. (Bombay: Indian Central Cotton Committee.) 1 rupee. [1110

University of Michigan: School of Forestry and Conservation. Circular No. 2: The Spruce Gall Aphid (*Adelges abietis* Linnæus) in Southern Michigan. By Bill Howard Wilford. Pp. 36. 20 cents. Circular No. 3: The Walking Stick as a Forest Defoliator. By Samuel A. Graham. Pp. 28. 20 cents. (Ann Arbor, Mich.: University of Michigan Press.) [1110

Science Reports of the Tokyo Bunrika Daigaku, Section C. No. 6: The Nappe Theory with reference to the North-Eastern Part of the Kwantô-Mountainland. By Haruyosi Huzimoto. Pp. 215–244+plates 30–34. 60 sen. No. 7: Past Glaciers and the Present Topography of the Japanese Alps. By Gakuro Imamura. Pp. 62+19 plates. 60 sen. (Tokyo: Maurzen Co., Ltd.) [1110

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