NATURE

SATURDAY, DECEMBER 10, 1927.

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Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3032, VOL. 120]

The Technical Expert in the Civil Service.

IN every government department, much of the work dealt with to-day involves the consideration of problems which are of a technical character, and presents, in consequence, the need for close collaboration on the part of officers belonging to the administrative, financial, and technical branches of the department. In view of the importance and, in many instances, the complexity of the technical aspects of these problems, not only is it essential that the careers offered in the technical branches of the Civil Service shall be such as to attract men of the highest standard of qualifications, but it is also necessary that the status accorded to the technical officers shall in every way be equivalent to that of the administrative officers with whom they are required to co-operate, in order that their position in the official hierarchy may correspond with the magnitude of their responsibilities, and thus effectively ensure that due weight may be given to their proposals.

When the system of recruitment by competitive examinations was extended, now nearly sixty years ago, to the superior grades of the Civil Service, the work of government departments was almost entirely administrative in character, and the State had then only very recently entered upon its responsibility as the undertaker of an important technical enterprise, the telegraphs. The number, therefore, of men with a scientific training and technical experience required in superior positions in the Civil Service was strictly limited, and, in consequence, the competitive examination system did not apply to the technical staffs. But even then it was recognised that men of a superior standard of qualifications were required for the more important positions on the non-technical side of the Civil Service, and steps were accordingly taken to provide a career in the higher division (now the administrative class) which should prove attractive to graduates of British universities; and at one time a career on the administrative side was practically the exclusive privilege of those who had entered the Civil Service by the higher division competitive examinations.

Since the termination of the War, the administrative and clerical branches of the Civil Service have been completely reorganised on the lines of the Report of the Joint Committee of the Civil Service National Whitley Council issued in February 1920, and in connexion with this reorganisation an assimilation of the various grades of the administrative and clerical classes of the Civil Service has

been effected ; an improvement in the salary scales has, in some cases, taken place ; and provision has been made for recruiting the administrative class partly by selection from inside the service. However, a proportion of the vacancies in the administrative class will, in the future, still be filled by men selected for appointment to the public service by means of an open competitive examination in the subjects embraced by the various honours courses of university institutions. Again, on the recommendation of the Asquith Committee, the salaries of the permanent heads of the principal departments of the State were, in 1920, raised to £3000 per annum, being in the majority of cases an increase of 50 per cent. on the pre-War scales.

The developments which have been taking place in the activities of government departments during the past fifty years having had the effect of making administration dependent to an increasing extent on factors of a technical nature, their problems must, in many cases, be subjected even at the initiation stage to investigation at the hands of 'experts.' Further, where specialised knowledge is required, it is these 'experts' who have to work out the details ; and, in the subsequent stages, the duty necessarily falls upon them to supervise the execution of schemes, and they then become responsible for much of the administrative work involved.

The altered conditions affecting the work of government departments have naturally resulted, in recent years, in a considerable increase in the numbers of the established officers of the 'expert' class. The increase between the years 1914 and 1923 was approximately 36 per cent. At the same time, a higher standard of professional knowledge has been called for and obtained. In spite of this transformation, no attempt has, however, so far been made to bring about a classification of the professional group, nor has any general scheme been introduced to provide a career on the 'expert' side equivalent to that offered to the non-technical civil servant. Certain improvements in the salary scales of the various grades of the professional group have, it is true, taken place ; the salaries of the heads of the professional and technical departments have been raised, but the increases fall far short of the proportionate improvements in the salaries of the permanent heads of the principal departments of the State mentioned earlier, and the salaries of the professional and technical chiefs are to-day approximately two-thirds and one-half only of those of the administrative chiefs. This disparity between the salary scales of the technical and non-technical staffs is carried down into the lower grades ; it is not confined to the officers employed at the headquarters of government departments, but exists, although to a less marked degree, also in the cases of officers employed in the provinces.

It has further to be borne in mind that the differences in the salary scales are accentuated by the fact that promotion is normally quicker on the non-technical than on the technical side, and, therefore, the superior positions on the former side are, as a rule, reached at an earlier age, on an average, than positions on the latter side carrying equivalent responsibilities. The methods of entry into the various groups of the Civil Service differ so widely that a general comparison of the periods of time taken to reach the several salary scales of the administrative, clerical, and professional groups in the ordinary course of departmental promotion would be misleading. However, in order to provide a concrete illustration, the careers have been traced of six university graduates who entered the administrative class (old higher division) during the period 1905–1908, and an equal number of university graduates who entered the technical side of the same department, during the same period, under an open competition scheme, the average ages of the entrants into the two classes being about the same.

On the administrative side, the average time taken by these six officers to attain the salary scale £700–£900 (the maximum of which is reached after eight years in the grade) was $12\frac{8}{12}$ years ; one of these officers was promoted to an appointment on a salary scale £1000–£1200 (the maximum of which is reached after four years in the grade) $18\frac{10}{12}$ years from the date of entry into the service. On the other hand, on the technical side the average time taken by the six officers to obtain their first step of promotion to the grade carrying (in London) a salary scale £450–£550 (the maximum of which is reached after four years in the grade) was $15\frac{1}{2}$ years ; two of these officers were promoted to the next higher grade carrying (in London) the salary scale £600–£700 (the maximum of which is reached after four years in the grade) after serving, on an average, $18\frac{5}{12}$ years. It is perhaps not surprising, then, that of twenty-six university graduates recruited during the period 1907–10 on the technical side of the department in question, 68 per cent. should have resigned their appointments ; the high percentage of these resignations seems to indicate that, in this instance, the career provided on the technical side of the Civil Service is not sufficiently attractive to university graduates.

Further, the foregoing analysis shows clearly that to undertake specialist duties of a technical char-

acter in the Civil Service results financially in the penalising of the 'expert' officers. An attempt is sometimes made to justify the inequality of the salary scales of the technical and non-technical groups in the Civil Service on the supposition that the responsibilities of the officers in these two groups are in no way comparable, the implication being that the duties of the technical group are of an order inferior to those of the non-technical group, but no reasoned or satisfactory arguments have been advanced to support such a contention.

The more favourable treatment of the administrative group as compared with that of the professional group has occasionally been defended on the assumption that as it is the former group that sanctions the expenditure voted by the legislature, a wrong decision on its part would involve waste and a loss of public money. This argument, however, assumes that the decisions of the administrative group are always sound and correct, and it entirely overlooks the fact that when decisions affect the sanctioning of expenditure on technical projects, the question as to whether such expenditure will be prudent and profitable, or extravagant and wasteful, will depend wholly on the skill with which the technical details have been worked out; the ability of the technical officers who supervise its execution; and on the care in relation to administrative details exercised by them. Therefore, even in the event of a consistent absence of mistakes on the part of the administrative group, the actual avoidance of wasteful expenditure and of the unprofitable use of public money must, in the very nature of things, rest, so far as the preparation and execution of technical projects are concerned, directly on the skill, scientific knowledge, and technical experience of the professional group, that is to say, on factors which lie wholly and exclusively in the sphere of responsibility of this group.

The contention has also been advanced in the past that owing to the great diversity of the duties which fall on the professional group of the Civil Service, and the fact that it is made up of not less than a hundred grades, it is not possible to devise a suitable classification scheme for this group. This plea has, however, lost much of its force now that an Act has been passed in the United States providing for the classification of civilian positions within the district of Colombia and in the field services (American Classification Act of 1923—Public—No. 516-67th Congress: H.R. 8928). Under this statute the 'compensation schedules,' that is, salary scales, are grouped under five 'services,' namely, (1) the professional and scientific service; (2) the sub-professional service; (3) the clerical, administrative, and fiscal service; (4) the custodial service; and (5) the clerical-mechanical service. The numbers of grades in the several 'services' naturally vary, but a distinctive feature of the Act is that in the case of the two most important groups, namely, the professional and scientific service and the clerical, administrative, and fiscal service, the salaries of the topmost grades in each of them are identical, and in each of these 'services' certain grades, it is recognised, represent positions of equivalent responsibility, which is in each case clearly set out, and they accordingly carry salary scales with identical minima and maxima. It should further be noted that in this Act the professional and scientific service occupies the position of paramount importance.

The present-day methods of conducting the work in government departments are also, in some cases, open to grave criticism; they are productive of unnecessary duplication of effort, and consequently uneconomical. In practice, the reports of the heads of the professional and technical groups are addressed to the permanent head of the department, who, however, has frequently so heavy a burden to carry that he cannot personally deal with them, and the reports therefore pass into the hands of officers of various grades in his branch. The result is, as often as not, that attempts are made by clerical and administrative officers to criticise technical details, and a lengthy and wholly unnecessary correspondence, in consequence, ensues. In those departments in which the technical work is highly complex, and the magnitude of the operations carried on in relation thereto considerable, the whole of the duplication of effort referred to would be obviated if the burden of responsibility for the details of the technical work were definitely and unequivocally placed on the shoulders of the department's chief technical adviser. In certain cases the situation could, with advantage to the public service, be met by giving the administrative chief and the chief technical adviser a co-equal status, so that, whilst carrying out their respective duties in the closest collaboration, they should at the same time be held directly responsible to the Minister each for the work within his own sphere, instead of the latter being called upon, as is at present the somewhat illogical practice, to tender his advice to the Minister through the former.

If the unequal treatment of the administrative and professional groups in the Civil Service were merely a question of a certain class of officers being dissatisfied with its status, prospects, and remunera-

tion, the subject could be dismissed without further comment. However, the matter is one which is far more serious. Under the present organisation in the Civil Service, and the system of conducting business in government departments, it is at times impossible, much to the detriment of the public service, for the professional men to exercise effective control over professional work, no matter how expert they may be in the technique of their profession; further, a considerable waste of energy on their part is also often involved: hence the urgent need for a thorough reform in matters affecting the status of the technical expert in the Civil Service.

The Secrets of the Beauty Parlour.

Handbuch der gesamten Parfumerie und Kosmetik: eine wissenschaftlich-praktische Darstellung der modernen Parfumerie einschliesslich der Herstellung der Toiletteseifen nebst einem Abriss der angewandten Kosmetik. Von Dr. Fred Winter. Pp. x+947. (Wien: Julius Springer, 1927.) 69 gold marks.

WHEN Hotspur quarrelled with Henry IV. he excused himself on the ground that the King's Messenger "was perfumed like a milliner, and 'twixt his finger and his thumb he held a pouncet box, which ever and anon he gave his nose and took't away again." On the other hand, readers of "Romola" will remember that whenever Tito Melema did an unusually scurvy trick, his inventor left him in the hands of his learned friend Nello the barber, to be shaved, bathed, and perfumed, presumably in the hope that these processes might do something towards his moral regeneration.

It would be unreasonable to suggest that Hotspur and George Eliot respectively represent the attitude of men and women towards the use of cosmetics and perfumes, but it is a curious fact that while men have been known to carry their antipathy to odoriferous fluids so far as to postpone a necessary visit to the barber merely to avoid them, the majority of women like these things, buy them, and sometimes use them so lavishly as to be a source of discomfort to their neighbours.

The present-day demand for these glittering wares is enormous; their illustrated slogans occupy but do not always decorate, or should we say in the modern art slang add *décor* to, the hoardings everywhere, the flapper and her too evident toilet accessories are the unfailing standby of the journalist hard up for 'copy,' and the advent of a new artist in perfumery secures much free publicity in the press, especially in those quaint corners which editors still dedicate to 'ladies,' but which few intelligent women will admit reading. All this gives the trade in cosmetics and perfumes what Sir Lawrence Weaver might call a "smell of Babbitt," but it should be remembered that such modern necessities as soap, dentifrice, and medicinal preparations are none the worse, when their natural odour or flavour is covered, and that in this and other equally unobjectionable but less easily defined directions there is a large legitimate field for the exercise of the perfumer's art. It is primarily with such ends in view that Dr. Winter has approached his subject and compiled this book.

Nearly 300 pages are devoted to discussion of the great variety of raw materials used in the industry, and thanks mainly to copious use of constitutional formulæ for the components of essential oils, an enormous amount of information has been compressed into this space. Perusal of this section leaves the reader with the kind of feeling, which must be experienced by an intelligent artisan who has just completed a conducted tour of a continental picture gallery—a little bewildered, but satisfied that he has had all the starred pieces pointed out to him. So breathless is the pace that towards the end the guide has only time to ejaculate such things as—benzyl propionate, smells of jasmin with a suggestion of fruit—and to sketch the formula. It would be remarkable if the guide did not stumble occasionally, and on p. 63 he appears to confuse myristic with myristicinic acid, though it is clear elsewhere that he knows the difference between the two. Scattered through this section are practical hints, which have an academic interest for the chemist, such as the statement that mixtures of vanillin and anthranilic esters are liable to stain the skin yellow, an involuntary testimonial to the reactivity of aldehydes, and the note on p. 212 that alloxan when applied to the skin produces a pink tint, due to the traces of ammonia present in perspiration, whence it appears that the blush of the modern maiden may originate in at least two ways, physiological or chemical, the latter being due to this ingenious application of the murexide reaction. A short summary of the fermentation theory occupies less than a page, and is an excellent sample of Dr. Winter's skill in compression and his conscientious desire to leave no part of his subject untouched.

In the next section the author 'gets down' to practical perfumery and discourses on the form of cosmetic materials—distillates, creams, balsams, jellies, pastes, powders, emulsions, etc.—with

abundant descriptions and illustrations of machinery for producing these things and pages of formulæ for the delectation of the practitioner. Nor is the theoretical side neglected, for there are chapters on such fascinating subjects as the harmony of perfumes, the reaction mechanism of vapour waves, the mechanism of the mutual transformatory reactions of perfume materials, and the influence of the method of mixing on the tonality of the mixture. Writers on this subject have a habit of diverging into musical terms such as notes, tones, and harmony when mere science fails them in terminology. These chapters are quite interesting, as samples of that subtle differentiation which we all find useful from time to time, though some of us are inclined to scoff at the Teutonic temperament which alone seems capable of producing it. Dr. Winter also provides a full description of modern toilet soap manufacture, written on the lines just described and including quite useful chapters on the cleansing and lathering properties of different kinds of soap, which may be commended to those who desire to find a reason for the faith that is in them regarding some particular brand of shaving soap.

The last section deals with practical cosmetics, a subject about the present position of which Dr. Winter is not altogether happy, judging from his introductory remarks on quacks and their frequent occupation of a field which belongs to the physician. His discussion of the pharmacological action of some of the ingredients of cosmetics lends point to that suggestion, and, as he remarks, there is considerable danger in the indiscriminate use of such things as "eau mystérieuse," a perfumed solution of antipyrine, which on application to the skin deposits after a time a coherent coat of white powder; to theatrical artistes who must produce such effects he recommends instead a solution of phosphotungstic or phosphomolybdic acid. The section is full of curious information of this kind, and is at least a remarkable tribute to the assiduity with which specialists in the art of cosmetics have ransacked scientific knowledge, and the ingenuity with which they have applied, or perhaps misapplied, it.

A question asked in the House of Commons recently as to the possible dangers of the indiscriminate use of cosmetics seems to indicate that there are people who take a hygienic interest in these things. To them, as well as to those professionally interested, Dr. Winter's book may be cordially recommended as a source of accurate and recondite information, and beauty parlour specialists who can read German will find the volume a profitable investment. T. A. H.

Social Classes and Social Welfare.

Social Differentiation. By Prof. Cecil Clare North. (The University of North Carolina Social Study Series.) Pp. x + 343. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1926.) 11*s.* 6*d.* net.

A RECENT visitor to America whose object was to see something of the teaching of the social sciences in that country was advised on landing not to omit the University of North Carolina. How long, his informant added, the not conspicuously enlightened citizens of that State will tolerate the vigour and freedom of thought, especially in the dangerous region of social problems, now being displayed in their University, may be doubted. In any event, the study of the social sciences flourishes there at present. Sociologists are learning to regard *The Journal of Social Forces* as one of the best periodicals of its kind in any language, and to welcome additions to the series of studies to which the volume here reviewed belongs.

Prof. North has made a sane and careful examination of a problem of the first importance. His treatment is scientific. Unlike nine-tenths of those who deal with this subject, he is not the victim of any theory. The book cannot be called exciting; we have had, however, our full measure of exciting but superficial theories in sociology, especially from Europe. On the other hand, it is not ponderous, nor does it remind the reader of wading through wool, as do some of the contributions of his compatriots. What, he asks, are social differences? Why do they arise? And what is their relation to social welfare?

To the first question Prof. North replies that social differences may be divided into those of function, rank, culture, and interest. Of these, those due to differences in rank are the most important. They include differences in respect to rights, privileges, or esteem, which may be personal, political, economic, religious, or honorific. These differences are the foundation of 'classes' in the strict sense, and when membership of a class is hereditary, we may speak of 'castes.' It is perhaps a matter of doubt whether we should agree in regarding differences of interest as a separate form of social differentiation. It seems possible to resolve most of the examples here given of difference in interest into differences of function, rank, or culture. However that may be, there is clearly a close correlation between these various forms of social differentiation. A man's function will tend to carry with it a certain rank and a certain culture.

Prof. North divides the factors which bring about social differences into the social and the biological. To the latter he gives full weight. He thinks that slight but definite differences in intelligence exist between the average representatives of those performing various functions, and that considerable inherited differences exist between the true functioning groups on one hand and the pauper, thriftless, and criminal groups on the other. In this opinion he is probably justified. It may be remarked that this factor is becoming of greater importance. Modern society is elaborating a mechanism in the form of the educational ladder and vocational guidance whereby the young are being sifted and allocated to the functions they are most fitted to fulfil. Those engaged upon the improvement of this mechanism are wont to have us believe that there lies the path to social salvation. Everyone will be happy in his job and no one will envy anyone else, because it will be realised that those performing any given function are the best fitted for the job. This rosy picture is apt to be marred by the reflection that the capacities of the members of society may not be fitted to the functions. There may not be enough people, for example, innately suited to the routine which industry demands. Account also has to be taken of the fact that inclination by no means always corresponds to capacity. All those who think themselves fitted to rule are not qualified to do so.

Quite apart from these reflections, however, it may be seriously questioned whether, at least so long as rank differences persist, this biological sifting of the population is not likely to result in a dangerous segregation of the gifted members, dangerous to them and to those from whom they are separated, because there is sufficient common ground of humanity to make contact desirable, and dangerous to society because of the possible loss of the gifted through revolution or differential fertility.

Whatever may be the causes of social differentiation, its existence is of the utmost importance. Certain forms of social differentiation, chiefly those of rank, may bring unrest and sometimes revolution. For differences of rank there is little favourable to be said. On the other hand, without differences in function and culture, there is the danger of stagnation if not of decay. Functional differences may nevertheless result in unhealthy specialisation, as is the case with regard to the divorce between work by brain and work by hand to-day. The profoundly interesting study recently published by Rostovtzeff of the social and economic conditions in the Roman Empire seems to point to the conclusion that the decay of that civilisation was due to the failure to compose differences that Prof. North would call differences of rank; these led in the third century to convulsions to which an end was put by the fatal policy of the fourth century which enforced too great a uniformity.

Difficulties arising from differences of rank trouble modern society. The Russian solution seems to take the form of enforcing a uniformity which may be worse than the disease. There is no more urgent task than an examination of social differentiation in modern communities, with the object of ascertaining what differences are desirable and stimulating and what differences merely cause friction if nothing worse. Only when we have a clearer view than we possess at present of the functioning of society can we hope to apply rational control and so hope to pass beyond our present troubles. A. M. C.-S.

Electrons, Atoms, and Molecules.

Handbuch der Physik. Herausgegeben von H. Geiger und Karl Scheel. Band 22: Elektronen, Atome, Moleküle. Redigiert von H. Geiger. Pp. viii + 568. (Berlin: Julius Springer, 1926.) 42 gold marks.

THIS twenty-second volume of the "Handbuch der Physik" is divided into six chapters dealing respectively with electrons, atomic nuclei, radioactivity, the ions in gases, size and structure of molecules, and the natural system of the chemical elements. The treatment is exceedingly clear and complete, and the twelve contributors deserve high praise both for the excellence of the subject matter and for the successful way in which they have avoided overlapping. The production of the book, too, leaves nothing to be desired, and is worthy of the high standard we have grown to expect from Julius Springer. The numerous diagrams are uniform and very clear, and apart from the usual subdivisions of the chapters and sections of the book, a useful feature is the statement at the head of each page of the actual topic under discussion. A brief subject-index is given at the end of the volume, and a useful table of physical constants is included.

W. Gerlach presents, in Chap. i., an authoritative account of the various methods which have been used for the determination of the charge and specific charge of the electron, the principles and theory of each method being very clearly stated. The various results are critically discussed and the most probable values given. In his discussion of Ehren-

haft's work the author concludes that the evidence is opposed to the existence of the sub-electron.

In Chap. ii., Kurt Philipp describes the theory and experimental verification of the scattering of α-rays in their passage through matter, as well as the scattering of β- and X-rays. Determinations of the nuclear charge both by these methods and by the application of Moseley's law lead to the same results. This is followed by a brief account of the evaluation of the mass of atomic nuclei by the methods of J. J. Thomson, Aston, and Dempster. O. Hahn describes the experimental work by virtue of which the identity of the α-particle with the helium nucleus was established, and Lise Meitner shows how we may gain information on nuclear structure from a study of Geiger and Nuttall's law, from the regularities observed in the emission of radiations by successive radioelements, and from the consideration of β- and γ-ray spectra. The chapter closes with an illuminating account by Kirsch and Pettersson of work on atomic disruption by bombardment with α-particles.

The chapter on radioactivity, though brief, contains a valuable summary of the subject in its many aspects. In the section on radioactive disintegration, W. Bothe describes the general theory of disintegration and the most important cases of successive change which arise in practice. We are then introduced to the work on the experimental verification of the theory, with special reference to fluctuations, and this is followed by an outline of the principal methods used in determining the main constants of radioactive change. On pp. 143 and 218, perhaps too much stress has been laid on the calculated heat production due to radium and its products, for although the aggregate value approximately agrees with experiment, the constituent values differ appreciably from the recent experimental determinations by Gurney and by Ellis and Wooster respectively of the values to be attributed to the β- and γ-rays.

The various methods in use for detecting and measuring the activities of radioactive substances are admirably summarised by Stefan Meyer, who also deals with the preparation and main properties of each of the products in the three disintegration series, and gives a useful summary in tabular form of the constants of the radioelements. The application of the radioelements as indicators has been found of great service in a variety of chemical and physico-chemical investigations, and the results are ably summarised by O. Hahn, who also deals with the significance of radioactivity in the elucidation of problems connected with earth history. The calculation of the influence of radioactive heat on the cooling of the earth, given on p. 295, is due to Holmes, however, and not to Ingersoll and Zobel. Work on the thermal effect of potassium appeared too late to be included on p. 292, and we believe that the unsuitability of thorium minerals for age determinations (p. 302) is more satisfactorily explained on the basis of a recent paper by Holmes (*Phil. Mag.*, vol. i. p. 1066; 1926) than by the proposal put forward in 1917 by Lawson.

Chap. iv. contains a most valuable account of the ions in gases by Karl Przibram. After a historical introduction, an account is given of the main properties of an ionised gas, together with their theoretical interpretation. Next follows a very clear description of the different experimental methods and underlying theory for the determination of ionic mobilities, and of the influence of various factors such as pressure, temperature, and strength of field. The ionic mobility in gaseous mixtures is also discussed, and reference made to the abnormally high and low mobilities obtained under certain conditions. A section is devoted to the diffusion, recombination, and adsorption of ions, and the discussion of the kinetic theory of ionic constants is particularly welcome, for there are still many discrepancies between theory and experiment. Finally, after dealing with the charge, radius, and mass of ions, the chapter concludes with an account of the ionic wind, and the condensation of vapours on ions.

Karl F. Herzfeld is to be congratulated on his eminently readable and full treatment of the size and structure of molecules in Chap. v. In little more than one hundred pages the divers data are skilfully woven into a consistent scheme, and an interesting introduction is followed successively by an account of the methods used, and their results, of the position of the atomic nuclei in the molecule, and of the evidence on the structure of the electron shells. The last two sections of this chapter are by H. G. Grimm, and deal lucidly with molecular volumes, the size of ions and its relation to ordinal number, and with atomic volumes and dimensions. To have collected together successfully material of such variety must have been no easy task, and little of importance appears to have been overlooked. Attention may perhaps be directed to the fact that in the section on thin films only one of Adam's numerous papers in the *Proceedings of the Royal Society* is quoted.

The concluding chapter in the book is a useful and well-written statement of our knowledge on the natural system of the chemical elements, by Fritz

Paneth. He deals in turn with periodic and non-periodic properties, isotopy and the separation of isotopes, the distribution of the elements and atomic types in Nature, natural and artificial disintegration of the elements, and finally, with the interpretation of the experimental results from the viewpoint of the Rutherford-Bohr model of the atom.

Our Bookshelf.

Teaching Agricultural Vocations: a Manual for Teachers in Preparation and in Service. By Prof. Rolland Maclaren Stewart and Arthur Kendall Getman. Pp. vii+377. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 15*s.* net.

THIS American manual well indicates the change that has taken place in the point of view of agricultural educationists in the United States. It has arisen since the passing by Congress of the Agricultural Extension Act of 1914, and the Federal Vocational Education Act of 1917, and is a wide departure from the old strictly professional and pedagogic view of adjusting and co-ordinating science and practice in agriculture.

The aim of vocational education in agriculture has been well stated in these words: "It is the purpose of courses in Vocational Agriculture to aid in developing a type of American farmer who shall possess managerial ability and business capacity, an aptitude for farming, and the necessary technical knowledge and skill to produce and market his products, and also one who is capable of adapting himself to our constantly changing social and economic life."

Vocational education in agriculture is a young movement, and the manual before us, intended "for teachers in preparation and in service," indicates this by the amount of propaganda it contains, especially the first six chapters, intended no doubt for "teachers in preparation." That the movement has gained ground rapidly in the United States is indicated by the Reports of the Federal Board for Vocational Education in Agriculture, which shows that the 15,453 pupils in 1918 had increased in 1926 to 108,862, a gain of more than 600 per cent. It is, therefore, not surprising with such an increase that text-books and manuals are being published in increasing numbers.

This manual is a step forward in the right direction. It takes a wide, perhaps discursive, outlook, but it is free from cut-and-dry formulæ. It covers the four types of vocational agricultural instruction as given in all-day schools, short-unit course schools, part-time schools, and evening schools. Each chapter is closed with an annotated bibliography, which is a good feature, but the index requires amplification to make it serviceable as a manual. There is one point to which exception must be taken. The responsibilities or duties of a teacher of vocational agriculture, as enumerated at pages 6-8, call for an agricultural 'Pooh-Bah.' No doubt time and experience will correct this. To the English reader this manual will be of service for the insight it gives to the new movement in agricultural education in the United States.

R. HEDGER WALLACE.

The Chemical Elements and their Compounds: an Introduction to the Study of Inorganic Chemistry from Modern Standpoints. By Dr. J. A. V. Butler. Pp. xi+205. (London: Macmillan and Co., Ltd., 1927.) 6*s.*

THE merits of a book on atomic and molecular structure can be judged by a very simple test. If the book merely gives an account of the personal views and impressions of the author, in the form of a long essay on valency, its value is probably not very great; but if it is written with a full sense of historic values, and is based at every point on the study of the original sources, the narrative immediately becomes of permanent value as a guide to the serious student of science.

It is, therefore, a pleasure to find that Dr. Butler has shown no desire to 'push' his own views on valency, but, on the contrary, has made a very successful effort to show precisely what was done by Dalton, Davy, Berzelius, Faraday, Frankland, Arrhenius, Werner, Thomson, Rutherford, Bohr, and the Braggs. In many cases he has cited the exact words of the author, and in a still larger number of cases he has shown in a diagram the apparatus that was used in those crucial tests which will be regarded in the future as 'classics' of experimental research.

As a result, the reader is able to follow step by step the logical stages by which modern theories have been suggested, tested, and established. This careful reproduction of original material has the further merit of making the book useful not only to the elementary student, who may be receiving a first introduction to theories of atomic and molecular structure, but also to many advanced students, whose second-hand knowledge of the subject may be too sketchy to be adequate.

In addition to ten chapters of text and an epilogue, the book contains two appendices, the first dealing with "The Structure of Crystals," whilst the second is in the form of a "Periodic Table of the Elements, showing Arrangement of Electrons in Groups."

China: Land of Famine. By Walter H. Mallory. With a Foreword by Dr. John H. Finley. (American Geographical Society: Special Publication No. 6.) Pp. xvi+199. (New York: American Geographical Society, 1926.) 4 dollars.

THE greater part of China's millions exist—not live—on the starvation line. The grim spectre of famine stalks about the land. "Have you eaten?" is the common salutation. Yet, in spite of wars and pestilence, floods and droughts, the population continues to multiply, and the problem of the food-supply becomes more and more insistent. The struggle for mere existence has become indescribably hard. Little wonder, therefore, that national energy is being sapped and perception dulled, and

that a race at one time in the van of civilisation has become the prey of anarchy and misrule.

The author, who was attached to the China International Relief Commission, discusses in temperate but telling language the economic, natural, political, and social causes of the permanent food shortage within the country, and suggests corresponding remedies. Relief measures, he admits, are merely temporary palliatives. It is for the millions themselves to take the initiative and seek the guidance of modern science in the solution of the pressing problems of their country. This implies, however, the education of the masses under a stable and enlightened government, a condition which at the moment seems impossible of attainment. The book ends, therefore, on a minor key, with the warning that the unhappy fate of China should be carefully studied by the great nations of the west, whose remarkable progress is also in danger of becoming assailed by the dragon of over-population.

In Ashanti and Beyond. By A. W. Cardinall. Pp. 288 + 16 plates. (London: Seeley, Service and Co., Ltd., 1927.) 21*s.* net.

MR. CARDINALL has written a pleasant, readable book, full of good spirits and tempered with good sense. The author has had many years' experience in tropical Africa as a resident magistrate, and he writes mainly of his first journey and impressions. This method gives a clear picture of conditions which are changing rapidly, but the observations are necessarily superficial though accurate so far as they go. The book can scarcely be regarded as a contribution to anthropology, although many items of interest concerning native life, customs, and belief are mentioned, and this is to be regretted, as the author seems always to have been on excellent terms with the natives. Quite unexpected is the account of the snail industry; for the gathering, curing, and selling of snails for food by the forest peoples is so well organised as to be nothing less. The author states that no estimate has ever been made of their trade value, but that it must be 'colossal'; a few years ago the local chiefs forbade snail-catching for three years, for fear of complete destruction of the stock. Perhaps the most interesting part of the book is the description of the Great North Road from Kumasie which leads to "Timbucktu, the desert, and to the unknown mysteries of Africa." On the whole, one learns that, in spite of flies, "the land of death" is a cheery place for a sojourn so long as there is just enough work to do.

Running, Maintenance and Repair of Diesel Engines. By Philip H. Smith. Pp. 159. (London: Constable and Co., Ltd., 1927.) 3*s.* 6*d.* net.

A VERY practical treatise intended for those entrusted with the operation of Diesel engine plants, particularly land installations. The first two chapters are really *hors-d'œuvre*, dealing briefly with the selection of the type most suitable to requirements, and with the reliability of Diesel engines relatively to other prime movers. The index of reliability is determined from insurance claims, but the value of the conclusions arrived at cannot be assessed as the statistics are not given. It is not clear whether extent or number of claims is taken as the criterion.

The real business of the book commences in the succeeding chapters, which take a comprehensive survey of the defects liable to develop during the operation of the plant. Each part of the engine is separately dealt with and its usual and possible ways of failing on service are discussed. In each case the symptoms and the probable effect of the defect as well as the measures to be taken for avoiding and for rectifying it are fully described, and in those cases where the initial cause in not obvious, a thoughtful investigation is made into the probable origin of the trouble. Brief but useful notes are also given on the maintenance of proper running conditions, on indicator diagrams, and on valve setting. For its size the book contains a lot of useful information. Evidently the author has had a wide experience of Diesel engine operation, and the reader is given full opportunity to benefit from this valuable experience. L. M. D.

Abridged Callendar Steam Tables: Fahrenheit Units. By Prof. H. L. Callendar. Second edition. Pp. 8. (London: Edward Arnold and Co., 1927.) 1*s.* net.

THE tables are in a very useful form for the practical engineer. The properties of saturated steam are given for absolute pressures from 0·5 lb. to 500 lb. per square inch, at well-chosen intervals which do not amount to corresponding temperature differences of more than 2° to 3° F.

For dry steam (superheated and supersaturated) the total heat and entropy are given, in separate tables, at absolute pressures from 15 lb. to 500 lb. per square inch, the intervals corresponding to saturation temperature differences of 14° to 22° F., and superheats from −60° to +400° F., at intervals of 20° F. up to 200° F. and thereafter of 40° F.

A useful list of equations is given in a form convenient for reference. The tables are also published in centigrade units. L. M. D.

Vorlesungen über Thermodynamik. Von Prof. Dr. Max Planck. Achte Auflage. Pp. x + 287. (Berlin und Leipzig: Walter de Gruyter und Co., 1927.)

ALTHOUGH Prof. Planck's "Thermodynamics" first appeared thirty years ago, it remains still one of the clearest books on the subject at the present day. The eighth edition has 17 sections and about 40 pages more than the first, but the sections up to 280 are numbered as before. The additional sections deal with Nernst's theorem and its consequences. T is now used for the absolute temperature instead of ζ, certain proofs formerly based on the properties of a perfect gas have been made general, and the treatment of electrolytes has been improved. The new edition is well printed, but the paper of it compares unfavourably with that of the first edition.

Letters to the Editor.

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

The Radioactivity of Potassium.

THE work of Aston has shown that potassium, which has an atomic weight of 39·104 (Hönigschmid), is a mixture of two isotopes. The atomic masses of these are 39 and 41, and they are present in ordinary potassium in the proportion of 20 to 1 respectively. Potassium emits a fairly penetrating β-radiation, and we are led to inquire as to which of the isotopes is responsible for the emission of β-rays. It may be that there is a third isotope present in potassium, but in such small amounts that its detection by the mass spectograph is impracticable. Such a possibility has been discussed by Harkins (*Proc. Nat. Acad. Sci.*, vol. 11, p. 630; 1925), who considers that isotopes of mass 40 or 41, the former of which is unknown, are the ones most likely to be radioactive. Harkins considers the hypothetical isotope of mass 43 (Kossel: *Phys. Zeit.*, vol. 20; 1919) to be less probable.

We can arrive at a solution of the problem by carrying out a partial separation of the isotopes of potassium and examining the activities of the fractions obtained. By way of illustration we may suppose that such a partial separation leads to a concentration of the isotope 41, and that the atomic weight of the 'heavy' fraction is found to be 0·005 unit greater than that of ordinary potassium. The obvious conclusion from such a result would be that whereas ordinary potassium contains 5·20 per cent. of potassium 41, the 'heavy' fraction contains 5·45 per cent. of that isotope. If the radioactivity of potassium is to be ascribed to the isotope of mass 41, we should then expect to find that the activity of the 'heavy' fraction would be 4·8 per cent. greater than that of ordinary potassium. Should the activity be due to a hypothetical isotope of mass 43, the difference in activity would be $\sqrt{2} \times 4{\cdot}8$ per cent. On the other hand, if the activity be attributable to the chief isotope of mass 39, we should find that the heavy fraction would be 0·2 per cent. *less* active than ordinary potassium.

Shortly after they were successful in effecting a partial separation of the isotopes of mercury and of chlorine, by the method of ideal distillation, Brønsted and the present writer undertook an elaborate research on the separation of the isotopes of potassium. After several unsuccessful attempts the work was discontinued, as we were engaged on other more pressing problems. It was taken up again later by one of us (G. H.) in collaboration with Miss Løgstrup.

About one litre of molten potassium was introduced into the first of a system of Pyrex bulbs connected to a high vacuum. By means of an electric heater and an asbestos cylinder containing carbon dioxide snow the potassium could be distilled from the lower to the upper half of the bulb, and in this way repeated distillations were carried out, the apparatus being maintained at a high vacuum all the time. The later operations of ideal distillation were performed in the succeeding bulbs, the carefully purified liquid potassium being heated to about 160° C. and the cooled potassium surface on which condensation was to take place being cooled by solid carbon dioxide. It was arranged that the distance between the hot and cold surfaces was maintained at less than 1 cm. After each operation of ideal distillation about 1-2 c.c. of potassium residue remained, and this was transferred (*in vacuo*) to the next bulb. This operation was repeated ten times, and the whole of the residual heavy fractions were collected together so as to have ample material for an atomic weight determination. Full details of the distillation process will be published elsewhere.

Prof. Hönigschmid kindly undertook to determine the atomic weight of the residual heavy potassium fraction, and for this he found an atomic weight 0·005 (± 1) unit in excess of that of ordinary potassium. It was now necessary to compare the activity of the heavy fraction with that of ordinary potassium. Owing to the feeble radioactivity of potassium great difficulty was experienced in obtaining a sufficiently high insulation of the β-ray electroscope to ensure an exact comparison of the two activities, and ultimately it was decided to abandon this method in favour of the Hoffmann vacuum electrometer. Through the courtesy of Prof. G. Hoffmann the measurements were carried out in his laboratory at Königsberg. The difference between the activities of the heavy potassium fraction and ordinary potassium was found to be $4{\cdot}2 \pm 0{\cdot}7$ per cent. In each case the material was converted into potassium chloride for the purpose of measurement. This result is in good agreement with that to be expected from the observed change in atomic weight, on the assumption that the activity of potassium is due to the isotope of mass 41. We are thus led to the conclusion that the potassium isotope 41 is mainly if not solely responsible for the observed radioactivity of potassium.

If we make the assumption that in the case of rubidium the activity is also due to the heavier of the two isotopes 85 and 87, we get a simple general explanation of the greater intensity of the activity of rubidium as compared with potassium. The heavier isotope is four times more strongly represented in rubidium than in potassium, and hence the total activity of rubidium is approximately four times that of potassium. On the other hand, cæsium is a pure element, and the absence of radioactivity in the case of this element can readily be explained by similar reasoning, as suggested by Aston some time ago (*Ann. Rep. Chem. Soc.*, vol. 21, p. 258; 1924).

According to Holmes and Lawson (NATURE, vol. 117, p. 620; 1926) the most probable half-value period of potassium is $T_K = 1{\cdot}5 \times 10^{12}$ years. This value was obtained on the basis of very careful and detailed considerations of the relative β-ray activities of potassium, rubidium, and uranium, and by assuming that both the isotopes 39 and 41, *i.e.* the whole of ordinary potassium, are radioactive. Should the radioactivity be confined to the 41 constituent of the mixed element, it was shown that the half-value period of the isotope of mass 41 would be $7{\cdot}5 \times 10^{10}$ years (Holmes and Lawson: *Phil. Mag.*, vol. ii. p. 1224; 1926). Now it has been shown above that the radioactivity of potassium is to be ascribed to the isotope 41, so that the latter figure for the half-period is the true one. Radioactive measurements give no indication of the period of the common potassium isotope of mass 39, and this does not appear to differ from other stable elements in respect of its radioactivity.

The above conclusions in no way affect the interesting results obtained by Holmes and Lawson (*Phil. Mag.*, *l.c.*) on the radioactivity of potassium and its geological significance. From the calculated period of potassium 41 it follows that since the consolidation of the earth's crust about 2 per cent. of this isotope will have disintegrated, and we are led to the conclusion that at that early stage of the earth's history

the atomic weight of potassium would be 0·002 of a unit higher than it is to-day. Should they lack other methods, chemists of the very distant future will be able, by redetermining its atomic weight, to calculate the lapse of time since the first modern atomic weight determination of potassium.

If we assume that the emission of β-particles effects an alteration in the nuclear charge, the product of transformation of potassium will be a calcium isotope of atomic weight 41. We have seen that since the consolidation of the earth's crust about 2 per cent. of potassium of mass 41 will have decayed, so that the maximum amount of calcium 41 which has accumulated in potassium minerals during the whole of geological time will amount to only 0·1 per cent. of their potassium content. This should be capable of detection in determinations of the atomic weight of calcium which has been extracted from old potassium minerals.

G. HEVESY.
(Institute of Theoretical Physics,
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Institute of Physical Chemistry,
University of Freiburg (Baden).

A Theory of the Upper Atmosphere and Meteors.

IT has been clearly recognised that the force of gravity acting on the atmosphere of the earth will cause the heavier gases to settle downward by diffusion and the lighter gases to rise to the higher altitude, and that winds, if they exist, would by convection keep the composition of the air uniform at all elevations. The classical ideas of atmospheric pressures (for example, Humphreys, Jeans, Chapman, and Milne, etc.) have been based on the assumption that convection is negligible, at least above a 50 km. level, and that diffusion is the important factor in determining the partial pressures of the gases. In this note are presented some conclusions, to be published in detail later, which have resulted from taking into account convection and diurnal temperature variations in the high atmosphere.

The ordinary equations of diffusion show at once that if the air were uniformly mixed at all altitudes and then left free from all convection currents, there would be a constant flow of lighter molecules upward and of heavier molecules downward, which would be independent of the altitude until a level was reached where the diffusing gas would be in gravity equilibrium. This 'diffusion' level for hydrogen would move from infinity down to 142 km. in one day, at the end of five days it would be at a height of 127 km., and in 50 days it would be at 113 km. The corresponding levels for helium would be at 137, 120, and 106 km. respectively. The new calculations give hydrogen and helium contents above 150 km. roughly 1/100,000 of the values previously calculated.

Absorption of solar and terrestrial radiation must be taken into account in any discussion of radiation equilibrium in the upper atmosphere. Numerous writers have recognised this fact, but apparently none of them has made an attempt to calculate absorption coefficients or to estimate a difference of temperature for day and night, or winter and summer conditions. Water vapour above 11 km. absorbs a little more than 20 per cent. of black body radiation from below at earth temperatures, while carbon dioxide absorbs nearly 40 per cent. Ozone absorbs only about 2 per cent., but its presence is important because it absorbs about 4 per cent. of the solar radiation at an altitude where most of the re-radiation must be by the ozone itself. Temperature calculations based on these absorption coefficients show that for a 50° latitude above a height of 60 km. we should expect a temperature of about 250° K. during a winter day with a drop to 220° during the night, and a temperature of 370° during a summer day with a corresponding drop to 230° during the night.

The atmosphere at the base of the stratosphere cannot be in radiation equilibrium, but must receive more radiant energy than it loses both from above and below during a 24-hour day. The temperature condition of the earth's surface is in very unstable equilibrium. The loss in heat by radiation from the warm equator is much less than from the cooler polar regions. An increase in temperature at sea-level near the equator would not result in an increase in the energy lost by radiation from these regions, but would actually result in a decrease. Loss of heat by radiation from the earth depends not on the condition of the surface, but on the temperature at the base of the stratosphere and absorption in the stratosphere. A slight change in the carbon dioxide of the air would have a tremendous influence on the climate of the earth. If the carbon dioxide content of the air were increased from the present 0·03 per cent. to 0·1 per cent., tropical plants would probably grow in the polar regions. On the other hand, if this protecting sheet decreased from 0·03 per cent. to 0·01 per cent., ice would probably be found near the equator.

Since the present theory leads to low densities of the atmosphere above heights of 100 km. or so, densities much lower than those of classical tables, the facts about the appearances of meteors require explanation. It seems possible to do this following to a certain extent the ideas of Sparrow and departing from those of Lindemann. When a high-speed meteor strikes an air molecule, it is assumed that the energy of the impact violently ejects atoms, molecules, and possibly small particles of molecular dimensions from the body of the meteor. This ejected material, by virtue of its velocity, carries into the air the energy which eventually gives the light of the meteor trail. For example, when a nitrogen molecule strikes an iron meteor which has a velocity of 40 km. per second, the energy of the impact is sufficient to raise the temperature of 1800 molecules 1000° C., or to evaporate 56 molecules of iron, or to evaporate and ionise 24 molecules of iron. As a result of this impact, a mass roughly thirty times that of the nitrogen molecule is ejected from the meteor principally in the form of highly energised iron atoms which have velocities slightly greater than that of the meteor itself. The inelastic collisions of these iron atoms with the molecules of the air result in the visible trail.

The excitation energy of these collisions may be as high as 155 volts for nitrogen or 280 volts for argon. Much of this energy may be radiated in the ultra-violet or even soft X-ray region, and it is probable that not more than one-tenth of the total radiation is in the visible part of the spectrum. Therefore, the total mass of the meteor must be much more than that derived by Lindemann and Dobson from their considerations of the relation between the mass of a meteor and its light. The temperature changes in the upper atmosphere from evening to morning, and from winter to summer, given by the present theory, lead one to expect appearance of meteors at heights which are greater by, say, 5 km. in the evening than in the morning, and in the summer than in the winter. It would be interesting to know whether this difference has been observed.

H. B. MARIS.

Naval Research Laboratory,
Washington, D.C.,
Oct. 8.

Descent and Divergence.

IN Sir Arthur Keith's presidential address to the British Association at Leeds (Supplement to NATURE, Sept. 3, 1927), reference is made to "the zigzag line of man's descent." It seemed desirable, if possible, to have some graphic method of crystallising, as in a nutshell, the views of the present moment as deduced from the results attained by leading investigators in this field. To that end the adjoining chart (Fig. 1)

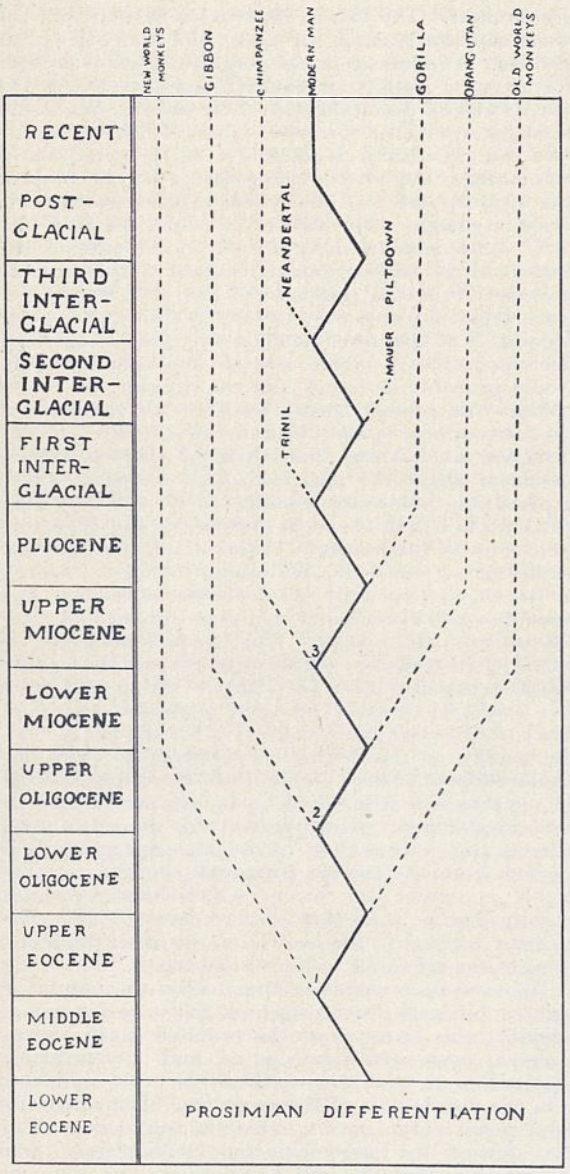

FIG. 1.

may be found useful, and a few words in justification of it may be permitted.

In one of the best osteological diagrams ever devised, T. H. Huxley portrayed a procession of anthropoids as "a single file of skeletons" from gibbon to man. Needless to say, he did not intend to suggest a simple series of transformations such as a mere glance at the illustration might mislead one into supposing, but to demonstrate, like Pierre Belon's parallel figures of the skeletons of bird and man published in the middle of the sixteenth century, the unity of plan of composition of these beings. Of course he knew that no zoological gradation of recent forms coincides with their geological succession. In the same inimitable essay ("Man's Place in Nature," 1863) there is a series of sections of the skulls of man and various apes "drawn so as to give the cerebral cavity the same length in each case, thereby displaying the varying proportions of the facial bones."

In the annexed chart the geological time-intervals are reduced to the same duration in order to bring out the corresponding evolutionary impulses which may be imagined to have stirred the nascent stocks to climatic fitness during those strenuous periods. Each stage advanced in a certain direction until what Prof. J. Arthur Thomson has aptly termed a 'strain-limit' was reached; the human way then became diverted to a new trend, while the simian strain continued along 'the lane that had no turning.' Some of the causes which were at work in effecting the first or platy-catarrhine divergence are sufficiently obvious, and it is interesting to find continental division joining forces with morphological divergence. The next parting of the ways, indicated on the chart, may be distinguished as the satyrine, and the third as the troglodyte divergence. These are milestones in human descent.

The censure which such a speculative chart justly deserves would be instructive should the line it takes become known.

ARTHUR WILLEY.

McGill University,
Montreal, Canada, Oct. 17.

Association in Liquids.

THE following seems to be a possible means of investigating the question of association. Without going into the experimental and mechanical difficulties, which are great but not insuperable, I will indicate briefly the general idea, and for that purpose will take the simplest optical system of several that might be used.

Consider a liquid contained in a tubular cell which is closed at the top by a semi-platinised plate and by a mirror at the bottom; with proper adjustment we shall observe a system of interference rings centred about the vertical axis of the cell.

Let the cell be mounted as a centrifuge and be fitted so that the speed of rotation, which is to be completely controllable, is known.

It is clear that on rotation there will be a movement of the rings across the field of view. Assuming that both the number of rings and the rate at which they pass can be noted, we get a complete insight into the changes in the 'optical density' of the liquid.

Knowing the speed of rotation and the compressibility of the liquid, we can calculate its bulk density at any point on the radius of the cell.

There are three cases to be considered.

(1) With a pure unassociated liquid we may take it that the calculated bulk density is reached practically instantaneously, so that even while the speed is changing it will coincide with the optical density.

(2) With a dilute solution the two densities will no longer coincide. The compressing effect will, as before, be instantaneous, but the difference between the two densities will, while the speed is changing, be dependent on the osmotic pressure and the rate of diffusion of the solute. Obviously the slower the rate of change of speed the less the discrepancy. When the steady state at any constant speed has been reached, the difference will be a measure of the concentration of the solute.

Thus it would seem that a solution can be distin-

guished from a pure liquid by seeing whether the rings continue to move after the constant speed is reached.

(3) With concentrated solutions, the effects are more complicated, but they need not concern us here.

Now it is easy to show that an associated liquid is but a special case of miscible liquids, and as such is subject to all the osmotic laws. If we select a liquid which is but slightly associated it would come under category (2), and, on centrifuging, the two sets of molecules would, in general, be temporarily separated; and if we know from other sources their relative concentration, valuable light on the type of association might be obtained.

It may be pointed out that the sensitiveness of the method is, among other things, proportional (approximately) to the depth of liquid under examination; thus using a long column and a suitable optical system it might be possible to separate isotopes which are not otherwise separable.

As bearing on the whole subject I would direct attention to a paper by the late Dr. C. V. Burton and me on the "osmotic theory of solutions" (*Phil. Mag.*, 1909, p. 598; there are printer's errors on p. 612), which may help in the matter; indeed, the optical method indicated above was devised by us so as to continue the centrifuging experiments mentioned therein; but I am not in a position to pursue the research any further.

Since writing the above I have seen Messrs. Raman and Krishnan's letter on "The Maxwell Effect in Liquids" (NATURE, Nov. 19). It would be interesting to see whether the 'optical' centrifuge could be used to test their theory; if, however, it takes time for asymmetric molecules to orient themselves, it will be difficult to distinguish between this effect and that caused by association.

BERKELEY.

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Absorption Experiments on Excited Molecular Hydrogen.

RECENT investigations on the band spectrum of helium and the many-lined spectrum of hydrogen seem to show that there is a far-reaching analogy between the arrangement and location of the electronic states of the term systems of the spectra of He, He_2, and H_2. For the spectra of He and He_2 this analogy has been discussed by Mullikan (*Proc. Nat. Acad. Sci.*, **12**, 158; 1925) and extended by the author (*Proc. Nat. Acad. Sci.*, **13**, 213; 1927). In regard to the correspondence between the electronic states of He and H_2, Richardson demonstrated a remarkable agreement between the term values (see Table I.) of certain band groups of the many lined spectrum of H_2 which he analysed (*Proc. Roy. Soc.*, **113**, 400; 1926) and the triplet system of the atomic helium spectrum. In the case of He_2 and H_2 the analogy can be carried further in detail, due to the fact that under the usual conditions of excitation the band groups of the triplet system of He_2 ('Main-series') and the corresponding groups in the many lined spectrum of hydrogen (Fulcher bands, etc., see *Proc. Roy. Soc.*, **113**, 368; 1926) appear in greater intensity than the band groups of the singlet system of He_2 ('Second series') and the corresponding groups of the many-lined spectrum of H_2. Furthermore, there appear relatively many lines in the Q-branches of the band spectrum of He_2 and in the many-lined spectrum of H_2, while the P- and R-branches fade out with comparatively low rotational quantum numbers.

Table I. gives a summary of the arrangement and magnitude of such of the electronic terms (in effective quantum numbers) of the spectra of He_2, He, and H_2 as have been analysed.

The existence of the well-known 2^3S state in the

TABLE I.

OBSERVED EFFECTIVE QUANTUM NUMBERS OF ELECTRONIC STATES IN HELIUM AND HYDROGEN.

	Triplet System.								Singlet System.						
	He_2-Molecule.			He-Atom.			H_2-Molecule.		He_2-Molecule.		He-Atom.			H_2-Molecule.	
	S.	*P.*	*D.*	*S.*	*P.*	*D.*	*S.*	*P.*	*S.*	*P.*	*S.*	*P.*	*D.*	*S.*	*P.*
1	..	..		..	..		..	..	0·744	..	0·744	..	..	0·919	..
2	1·788	(1·928)*	..	1·689	1·937	..	1·934	(1·928)*	1·853	..	1·850	2 009	..	1·919	1·695
3	2·810	2·928	3·013	2·697	2·933	2·997	..	2·937	..	2·964	2·857	3·011	2·998	(2·920)*	(2·695)*
4	3·818	3·928	..	3·700	3·932	3·997	..	3·939	..	3·965	3·858	4·011	3·998	..	..
5	..	4·928	..	4·701	4·932	4·997	..	4·941	..	4·966	..	etc.	..	..	..
6	..	5·927	..	..	etc.	..	..	5·941	..	5·964	..		..	..	..
		etc.						etc.							

* Calculated.

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Table I. gives a summary of the arrangement and magnitude of such of the electronic terms (in effective quantum numbers) of the spectra of He_2, He, and H_2 as have been analysed.

The existence of the well-known 2^3S state in the helium spectrum, and the fact that intercombinations between the triplet and singlet systems mentioned in Table I. have not been observed (except for the combination λ 591·56 found by Lyman in the helium spectrum, which he classifies as the transition $1^1S_0 - 2^3P_1$) led me to look for a corresponding metastable state of H_2 by absorption experiments in excited molecular hydrogen. The experimental conditions in the emission tube were chosen so as to produce the many-lined spectrum in particular. In the absorption tube a weak electric excitation of the hydrogen gas was used in order to excite any existing metastable states, that these might be the initial states of absorption for the radiation of the H_2-molecules in the emission tube. If there is any absorption it should be shown by self-reversal of certain band lines.

The absorption measurements which have been made over the whole region of the visible many-lined spectrum seem, indeed, to have the expected result. A number of intense lines, which are not distributed over the whole spectrum but are located in definitely bounded regions, distinctly show self-reversal, while other intense lines scattered over the whole spectrum do not show any absorption. The study of the series relations of the reversed lines is in progress. After further experiments the results will be published elsewhere in detail. It is intended to extend the absorption experiments to excited molecular helium.

L. A. SOMMER.

Jefferson Physical Laboratory,
Cambridge (Mass.),
Sept. 30.

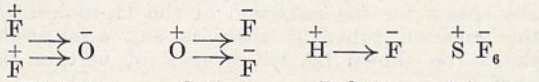
Oxide of Fluorine or Fluoride of Oxygen?

THE issue of NATURE of Nov. 5, p. 672, contains the news of a very important discovery made by Messrs. P. Lebeau and A. Damiens and communicated to the Paris Academy of Sciences on Oct. 3 (see *Comptes rendus*, pp. 652-654, 1927). In the preparation of fluorine by the electrolysis of the acid potassium fluoride, it was noticed that at the commencement of the operation, owing to the presence in the liquid of a small quantity of water, a new gas was obtained of which the formula has been established as F_2O, probably a monoxide of fluorine. In my view the new gas is not a monoxide of fluorine, F_2O, but a difluoride of oxygen, OF_2. The two formulæ are by no means identical, and it is interesting to note that a famous investigator like Prof. Lebeau has overlooked the true state of the matter, for he says that it is OF_2 (*i.e.* our F_2O, but he places the negative element first!) "paraissant être plutôt un oxyde qu'un anhydride."

Having been brought up on the electrochemical theory of Berzelius, I always regarded the chemical elements from the point of view whether they are, more or less, electropositive or electronegative—a point of view which was not accepted by my great teacher Mendeléeff (see Ostwald's "Klassiker," No. 68, p. 60)—and I was much gratified when Arrhenius in his electrochemical theory appeared as a 'Berzelius redivivus.' As regards the second series of the Periodic System or Classification of Mendeléeff (it was formerly called 'Law' in England, but the denomination 'Table' seems to me to be inadequate for a brilliant, fundamental, theoretical idea!) this series begins with a strongly electropositive element, lithium, and ends with the most negative of all elements, fluorine, thus:

$$+\text{Li Be B C N O F} - (\text{Ne}).$$

All the first five elements form oxides in which they are positive and the oxygen negative, and even ozone may be regarded as an oxide of (+quadrivalent) oxygen. But it was pointed out by me alone, in my lectures more than thirty years ago, in my introduction to Mendeléeff's Periodic System, 1907, and in Abegg's "Handbuch," vol. iv. 2, p. 2 (with Auerbach, 1913), that fluorine cannot form oxides, hydroxides, or oxy-acids, because it is more negative than oxygen. At the utmost a fluoride of oxygen $(O+)(F-)_x$ could exist. Indeed, this is the new gas discovered by Lebeau and Damiens: OF_2, not F_2O. The difference between the two formulæ is best seen on representing how the electrons pass from the positive to the negative atom:



The first formula is impossible, the second, third, and fourth are analogous. As the inner constitution of the difluoride of oxygen, OF_2 is different from that of the chlorine monoxide Cl_2O, it is easily understood that their chemical and physical properties will not be analogous.

It may be that a trace of this gas, possessing a peculiar odour, different from hydrofluoric acid or fluorine, was formed when I treated the new double oxide $Pb_5O_7 . 3H_2O$ with concentrated hydrofluoric acid (Manchester, 1881).

BOHUSLAV BRAUNER.

Bohemian Academy,
Prague, Nov. 8.

Winter Thunderstorms.

IN January last an appeal was made for reports of any thunder or lightning which might be observed before April 1, 1927 (NATURE, **119**, Jan. 22, 1927, p. 123). The census of storms was carried out in conjunction with the Meteorological Office, and efforts were made to obtain the co-operation of observers in all parts of the British Islands. Considering the whole of the six months from October 1926 to March 1927, thunderstorms occurred somewhere in the British Isles on 96 days out of 182. Details for the individual months are given in the following Table:

	England.	Wales.	Scotland.	Ireland.	British Isles.
1926					
October .	16	11	10	9	21
November .	18	11	10	12	20
December .	5	1	4	0	8
1927					
January .	14	8	16	14	23
February .	6	1	3	2	7
March .	14	5	3	7	17
Total (six months)	73	37	46	44	96

In England and Wales there were five prominent stormy areas, namely, Sussex and Surrey, Devon and Cornwall, the Severn valley, south-west Yorkshire and the Lake District. In Scotland and Ireland the central portions of the west coasts of each country were particularly disturbed. Similar features have been noticed in previous winters. A lane of no storms ran from Dorset to the Wash, and large portions of the northern English counties were also free from storms.

Considering the first three months only of each of the past five years, 1927, 1926, and 1924 were comparatively free from thunder, while 1925 was particularly stormy.

The investigation is being continued during the present winter, and I shall again be very grateful for reports of any thunder, lightning, or hail which may be observed by readers of NATURE before April 1, 1928. A note of the place, date, and time of the occurrence, with the direction in which the lightning was seen, especially at night, will be very valuable. Any additional information of the following character will, in the case of actual thunderstorms, be extremely welcome: (1) The time when the storm passed overhead, or was nearest, with its direction; how long it lasted; (2) severity of storm, much or little thunder or lightning; (3) whether accompanied by hail, rain, or snow; (4) direction and strength of wind; change of wind (if any); (5) whether there was a change in temperature during the storm.

S. MORRIS BOWER.

Langley Terrace,
Oakes, Huddersfield,
Nov. 19.

Science and Survival.

IN an article on page 613 of NATURE for Oct. 29, headed "Science and Survival," the reviewer of a book called "The Bridge" asks certain pertinent questions which deserve an answer. Unanswered, they may suggest to a student of the book erroneous hypotheses which will lead him astray. I appreciate the fairness of the review: my object is only to furnish the additional

information virtually asked for, in the interests of truth.

First, then, as to the identity of "a man in Cardiff," who might be erroneously regarded as a concealed source of normal information. This unspecified gentleman, I now find, is willing to give his name in confidence to the editor and to the reviewer; who will thus see that he is a responsible person, and emphatically not the kind of man who would give information to mediums, or attempt to spoil an experiment. As a matter of fact, he was not aware of the experiment until it was over; he never saw or communicated with Mrs. White at all after it had been planned. He was a mere initial incident, and to bring him into the matter would be to follow a false scent.

Next concerning Damaris Walker. First, if she had not happened to be living with her sister, unoccupied at the time, and therefore with leisure to try to develop her psychical faculty, the experiment on which the case is based would not have been started. Secondly, the information she gave was not, when she gave it, known to anyone in the house; nor was it readily ascertainable by inquiry. The music-room, for example, had not been decorated and arranged, as described, since Mrs. White had got into touch with Nea Walker. Thirdly, the descriptions given by Damaris Walker were not returned upon and amended afterwards; each record was complete and done with, before it was annotated by a survivor and so verified as correct.

The reviewer duly appreciates and directs attention to the difficulty involved in selection of incidents. I have had an opportunity of seeing the whole, and am able to assert strongly that no omission has been made in order to strengthen the case. Selection was necessary solely because of comparatively irrelevant or only distantly related matter, referring to "the group" and other people. It was difficult to determine how much to include and what to cut out. Advice of experts was taken, and the book thus kept within reasonable limits; but *never* was a weak point intentionally omitted.

OLIVER LODGE.

Normanton House,
Lake, Salisbury,
Nov. 26.

The So-called Viscid Secretion in Spawning Oysters.

IN literature dealing with the Flat or European oyster, *O. edulis*, the statement is frequently made that when the eggs are spawned into the mantle cavity they are held together there *and fastened to the gills by a white viscid secretion*. There is no doubt that this statement is incorrect and that what has been described as a white viscid secretion is an extrusion of blood-cells entangled in mucus. In a fairly recent publication (*Fish. Inv.*, 3, 1923: London, 1924) I have shown that when oysters are taken out of water—and especially when transported or retained out of water some time—in hot weather, an extensive diapedesis, or 'bleeding,' occurs. Now a large proportion of white-sick oysters, even after lying on a bench some hours, in the breeding, that is, warm, season, begin to 'bleed' more or less, in relation to the temperature and time out of water; further, many oysters spawn at the instant of dredging or *after* being taken out of water, and in such cases heavier bleeding than usual is liable to occur. It is, however, possible that a certain amount of—but not necessarily extensive—bleeding does normally occur at the act of spawning.

The concurrence of bleeding at or after the spawning act has given rise to the view that the embryos are actually fastened to the gills. In the course of recent work (*Jour. M.B.A.*, 4, 4; 1927) it was necessary to examine oysters, immediately after they were dredged, either on the foreshore or in sheds adjacent to the dredging boats. In a few cases individuals were found with eggs in a fertilised but unsegmented condition, that is, just spawned. In these critical cases there was no viscid secretion, nor was there any in these circumstances in a large percentage of cases where the embryos were white but in various stages of segmentation later than the 2-celled condition. Moreover, when a secretion of this kind is present, it generally occurs in isolated masses, and does not encompass the whole of the embryos.

The so-called viscid secretion is, therefore, a mass of blood cells entangled in mucus; it is formed when oysters are kept out of water in warm weather as a result of diapedesis. The blood cells are sloughed off the gill in mucus in variable quantities, sometimes in great numbers, and a variable number of embryos may also become entangled in the mucus, but the number of embryos so entangled is usually relatively very few. The cause of diapedesis in oysters is no doubt capable of an exact physical expression, which, however, still remains to be found.

J. H. ORTON.

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Plymouth.

An Unrecorded Constituent of Commercial Ethyl Ether.

FOR anæsthetic purposes a pure diethyl ether is now generally recognised as a desideratum. An opportunity recently arose for carrying out some experiments on the bromine absorption of commercial anæsthetic ethers, a standard solution of bromine in glacial acetic acid being added, and light excluded to avoid direct substitution of the ether by bromine. The products from six manufacturers absorbed bromine to different extents, as is shown by the following figures:—A, 0·6; B, 2·5; C, 7·5; D, 11·6; E, 13·6; F, 15·9. These are the numbers of c.c. of deci-normal bromine absorbed by 100 c.c. of the different ethers in the dark in one hour, which in the absence of aldehydes give a measure of the degree of unsaturation of the ethers. On examination of the bromination products of 2250 c.c. of ether C, among other constituents which are being further examined there was identified, as a major product, $\alpha\beta$-dibromovinylethyl ether (1 gram), which must have arisen from vinylethyl ether, $CH_2:CH.O.CH_2.CH_3$, b.p. 35°·5, present in the original ether. Vinylethyl ether was also present to a similar extent in freshly prepared ether, direct from the manufacturing still, which had never been exposed to light. It doubtless owes its origin to vinyl alcohol (acetaldehyde) functioning in the same way as ethyl alcohol in the Williamson process.

The instability of vinylethyl ether to acids with production of acetaldehyde is on record, but it also develops aldehyde on storage without acid and reacts towards Schiff's and Tollens' reagents as an aldehyde.

The question as to whether vinylethyl ether is the first product of the action of light on diethyl ether as postulated by Wieland is receiving attention. It may, however, be recorded that an old sample of solvent ether which was rich in peroxides—equivalent to 5·6 gm. of hydrogen peroxide per litre—contained a small amount of vinylethyl ether, as was shown by isolation of its bromine addition product.

HAROLD KING.

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Hampstead, N.W.3,
Nov. 18.

The Glaciers of Dauphiné.[1]

IN NATURE of Mar. 27, 1926 (vol. 117, p. 456), an account was given of the important glaciological work carried on by the French Direction Générale des Eaux et Forêts on the principal glaciers of the chain of Mont Blanc. A further volume of results has now been published relating to similar work on the glaciers of the Alps of Dauphiné, those descending from the great peaks de la Meije, les Écrins, and Mont Pelvoux. It will be remembered that the principal glaciers in question are as follows: On the north of the Meije group of peaks, facing the Romanche valley, in which is situated La Grave, there are the glaciers de la Meije, de Tabuchet, de l'Homme, de Rateau, du Lac, de la Girose, and du Mont-de-Lans; on the south side, facing the valley of Vénéon, is the glacier de la Selle; from the north-east and north-west flanks of les Écrins respectively descend the glaciers Blanc and de la Bonne Pierre, and between les Écrins and Mont Pelvoux, north of the latter, the glacier Noir; while from Mont Pelvoux and its flanking companion peak the Ailefroide descends on the west the glacier de la Pilatte.

All these glaciers have been under observation, survey, and accurate measurement since the year 1911, and some of them since 1909, with the exception of the two first War years, 1914 and 1915, right up to the present time, the report giving the results up to 1924. In addition, the glaciers of the Grandes Rousses group, north-west of the Meije-Écrins-Pelvoux chain, those of Saint Sorlin, des Quirlies, des Malâtres, du Grand Sablat, de Sarennes, and des Rousses, have also been observed.

From the commencement in 1909, when the glaciers de la Selle, de la Girose, and du Mont-de-Lans were studied, it was obvious that the period of retrogression, hitherto for many years so obvious, was coming to an end, if it had not actually terminated, so that the time chosen for this great survey of glaciological movement was most propitious. The official observers of the Département des Eaux et Forêts had the advantage of the collaboration of Profs. Blanchard and Flusin of the University of Grenoble, and of Prof. Bénévent of the École Supérieure.

The first results obtained in 1909 showed that while the glacier de la Selle was still very slightly in retreat, the Girose and Mont-de-Lans glaciers had really begun to advance, the snout of the last-mentioned glacier being thrust forward nine metres beyond its position in 1908. Moreover, the general appearance of both glaciers had changed enormously, much of the ground hitherto left bare at the sides during the retreat having been recovered. When observed again in the summer of 1910, a very stormy year of great snow blizzards, all three glaciers showed a clear advance.

In 1911 the observations were extended to the glaciers de la Meije, du Lac, du Rateau, and the six glaciers already named of the Grandes Rousses, and the advance found to be general, a clear frontal (snout) advance of all the glaciers being revealed by the measurements, together with a great augmentation of the upper snowfields and névé. The next summer, 1912, was very wet and cold, and avalanche residues persisted to quite an unusual extent, so that the snow augmentation above, on, and about the glaciers was very remarkable.

In 1913 the observations were further extended so as to include the glaciers de la Pilatte (the Refuge Carrelet above La Berarde being the base of operations) and de la Bonne Pierre, and similar advances with all were observed, except in the case of the last-mentioned glacier, which still showed a slight retreat.

The War at first prevented the regular continuance of the work, but happily means were found in 1916 to recommence the observations. By this time all the Dauphiné glaciers had advanced considerably, even the Bonne Pierre having thrust its snout forwards by ten metres. The glacier de la Selle had so greatly enlarged that all the stakes (jalons), ladder-scales, and other fiducial marks were totally buried and lost; and the avalanche snow from the Col de la Lauze (the well-known glacier pass at the head of the Girose glacier, by which one passes over from La Grave to St. Christophe on the Le Berarde road) had so accumulated on the St. Christophe side over against the de la Selle glacier as to have obliterated completely the medial moraine of the latter. The 1917 observations also afforded similar results, but without the exceptional snow deposits.

The general advance of the Dauphiné glaciers at this time is more remarkable than that referred to in the previous report on the Mont Blanc glaciers, inasmuch as the precipitation is much less than that occurring in the Chamonix district. At La Berarde, for example, the average is only half what it is at La Tour at the northern end of the Chamonix valley. In the summer of 1918, however, it began to look as if the advance were only a secondary one, and not to be compared with the great advance of the seventeenth century, which began in 1580, or the later one which showed its maximum in the beginning of the nineteenth century. For the growth had slackened or ceased in many cases by 1918, although some of the glaciers still showed a clear advance, for example, the glacier de la Bonne Pierre and the glaciers Blanc and Noir, which had now come under observation and had exhibited a thrust of snout forwards by so much as ten metres each. The year 1919 was a great snow year, so much so that the glaciers and their moraines were too much snow encumbered to enable any valuable conclusions to be drawn. There were two exceptions, however, for the glaciers de la Meije and Tabuchet showed very clearly increases in length of no less than seventy and thirty-five metres respectively, and the Meije had also thrown up a new moraine ten metres high. By 1921, nevertheless,

[1] "Ministère de l'Agriculture: Direction générale des Eaux et Forêts." 2e partie: Eaux et Génie rural. Service des Forces hydrauliques. Études glaciologiques. Tome 6. Pp. ii+179+16 planches. (Paris: Ministère de l'Agriculture, 1927.)

retrogression was manifested, the Girose glacier having retreated six metres since 1919, the Meije nine metres on one tongue of its snout and thirty on the other, the Rateau by two metres, and the Tabuchet by twelve and twenty-five metres on its two fronts.

In reality, however, this retrogression was but temporary, caused mainly by the rarity of snow in the winter of 1920–21 and the relative dryness of 1921. For when the summer of 1922 came round the glaciers had all again clearly advanced, or had at least formed a front of clear blue ice as if the minimum were passed and advance were looming ahead again. That this view was correct has since been clearly proved by the measurements made during the summers of 1923 and 1924. In 1923, for example, the Grandes Rousses glaciers showed unmistakable frontal advances since their last measurement; for example, the glaciers des Rousses and des Quirlies had each elongated by three metres, and the Saint Sorlin by fourteen metres. In 1924 the glacier du Mont-de-Lans exhibited an advance of sixteen metres since 1921, the glacier du Lac ten metres, the glacier de la Meije seven metres, the glacier du Tabuchet thirteen metres, and the glacier de l'Homme five metres. The positions of 1919 have thus not only been recovered but also passed, and the fronts were all of clear, beautifully clean ice, while a considerable increase of superficial rapidity of movement was also observed, a sure sign of advance.

Hence it seems certain that we are now really in a period of true advance of the glaciers of the Dauphiné Alps, a result in line with that derived from the Mont Blanc glaciological survey. The work on these Dauphiné glaciers has been much more arduous, however, as the writer can testify from having actually seen some of the observers at work. On one occasion a number of them were lost for five hours in a terrific snow blizzard on one of the Meije glaciers, and only reached the refuge hut when frost-bitten and on the point of exhaustion. Such accurate work as is recorded in this report, carried out under such conditions, will be appreciated by all who read it, and most of all by those who know the ground, and the danger and tragic history of this group of mountains, the terrible Meije and its sister peaks, the last of the great Alpine peaks to be trodden by the foot of man.

A. E. H. TUTTON.

The Development of Human Physiology.[1]

By Dr. C. G. DOUGLAS, C.M.G., F.R.S.

IN physiology our task is to study the nature of the phenomena which characterise normal life, as shown in the individual organism. At the outset it would perhaps seem presumption on our part to turn our attention to what we must admit to be the most complicated and highly-developed organism, namely, man, before we have been able to elucidate at least the main features of the life-process of more lowly forms; should we not do better to argue from the simple to the complex?

In the last fifty years we have seen the wide extension of what I may term the analytical method of physiological investigation, the attempt to differentiate the various components in the complex system which we call life, and to study in detail each of these components in turn and to render clear the phenomena peculiar to each. The organism is in this method treated as a series of systems—we speak, for example, of the nervous system, the circulatory, the respiratory, and the excretory systems—which, though no doubt but parts of a whole, are yet capable of being treated within limits as independent. In pursuing this method we have a perfectly definite aim, for we are trying to establish elementary facts about the different parts of the body without some knowledge of which we feel, and feel rightly, that a general conception of the whole is impossible. No one can deny that we have acquired in this way a mass of information which is essential to the whole study of physiology, nor is there any reason to suppose that the future will witness any diminution either in number or importance of the contributions thus made to knowledge.

[1] From the presidential address delivered to Section I (Physiology) of the British Association at Leeds on Sept. 2.

The bulk of this information has been attained by the deliberate and careful investigation of animals by experimental methods, and as I am going to plead the cause of human physiology, may I say at once, lest any one should misconceive my purpose, that I do not believe that progress in physiology and in medical science to the lasting benefit of mankind is possible without employing such methods. But, while acknowledging the great debt which we already owe to these investigations, and my firm conviction that their further prosecution will be fully justified in the future, I have to face the question whether the method has not in reality some limitations.

We are bound, I think, to admit frankly that direct observation by methods involving operative procedure on the anæsthetised animal cannot by itself give us the full answer that we require. I have defined physiology as the study of the nature of the phenomena which characterise normal life, and normal life involves constantly varying activity of all the different organs of the body. Under the influence of an anæsthetic our subject is no longer normal, and we have perforce deliberately to close our eyes to that fundamental aspect of life—ceaselessly varying natural activity. We are forced to adopt methods of investigation which are essentially highly artificial; the stimuli which we employ are usually coarse, and the changes to which we subject the organs gross, compared with the delicate alterations to which these same organs respond in natural life.

If we are to understand life we must ultimately adopt methods of investigation which do not interfere with the normality of the organism or its power of self-maintenance; and clearly, so long as

we keep this aim before us, we are perfectly justified in making our observations on any animal the study of which we think will help to solve our problem. The conditions will be satisfied so long as our experimental treatment, whether that involves operative procedure or not, does not materially prejudice the delicate regulation of bodily functions which is so evident in the normal intact animal. The point which I want to emphasise is that, in the study of normal physiology, man is in many instances a far more advantageous subject for investigation than are the lower animals.

It may be urged that, so far as concerns the natural variations in activity of everyday life, we may study the lower animals just as profitably as man. But can we guarantee that any animal, even though highly trained, will provide the particular state of activity that we may require at the moment? Man at least will conform with our requirements, and will maintain at request either rest or any degree or type of activity which we may desire. What is more, he, though himself the subject of investigation, can help us to make our observations, and very often intelligent co-operation on the part of the subject may render easy experimental procedure which would otherwise be impossible. We gain, too, the advantage of learning the subjective impressions of the person on whom we are making our experiments.

A review of the advances made in recent years in our knowledge of the general metabolism and energy exchange, of the regulation of the respiration and circulation, of the function of the kidneys, digestive organs, and nervous system, and of the general adaptation of the body to alteration of environment justifies the assertion of the advantage derived from studying the human subject; for experiments on man have already thrown much light on the actual quantitative changes in organ activity during normal life, on the close functional linkage of different organs and on the power of adaptation to altered circumstances. Direct experiments on anæsthetised animals, on the other hand, very often afford information about potentialities in the body rather than actualities.

The more we examine the normal behaviour of the body the more is it brought home to us that the maintenance of the natural life and integrity of the organism depends on the closest co-ordination of all its different parts; all the organs are interdependent, and can have no real existence save as active components of a corporate whole. Life consists of a delicate balance of all the different functions, a balance that is being continually adjusted so as to ensure the maintenance of the true functional capacity of the organism in its struggle for self-preservation in a constantly varying environment. As an agent in securing this exquisite co-ordination a physico-chemical change in the blood stream may at one moment be prominent, at another moment a nervous reflex. Very frequently both factors co-operate, the physico-chemical change ensuring perhaps strict quantitative co-ordination of activity, the nervous reflex offering the advantage of speed and simultaneity of response in parts of the body remote from another. The two factors are not antagonistic; one is not gradually supplanting the other, but each plays its part in its own peculiar sphere.

When we recognise the exactness of the co-ordination of the different functions in normal life, we cannot fail to appreciate the relative crudity of some of the experimental methods we are forced to use in physiology. Methods that interfere with the mutual interdependence of the different organs can only give us a partial insight into the problem of life, and if we use these methods, we must correct the impression that we gain by comparison with the true normal.

When we review the development of physiological thought in the last quarter of a century, we cannot close our eyes to the fact that investigations on man are becoming of increasing importance, and that the contribution made by human physiology does not involve mere matters of detail. There is something of far more importance than that, for the evidence of balanced interaction of the functions of the different organs with the preservation of the functional integrity of the whole, which is so convincingly brought home to us in experiments on the human subject, has made us appreciate that in physiology the organism as such, be it man or one of the lower animals, is our unit, and that, whatever methods we may employ in our investigations, we must keep that essential fact before us. In the problem of what is meant by life we have set ourselves the most complicated puzzle in existence. I firmly believe that human physiology, limited though our knowledge may as yet be, has already given us a vague glimpse of the final picture which we hope to complete, and has put us in a better position to fit together the individual fragments, the tiny components of the puzzle, which we have been accumulating in such profusion in years past.

The truth is that we cannot confine ourselves exclusively to any one method in physiological investigation. Unless we deliberately study the normal organism in its entirety, I do not see how we can gain any adequate conception about what is really implied by life, but once we have begun to gain that conception we can employ the methods of detailed analysis about which I have spoken earlier with hope of real success. There has been a tendency of late to differentiate the subject of bio-chemistry from physiology, but this distinction, though it may have the merit of administrative convenience, can have no real justification if the ultimate aim of the physiologist and bio-chemist is, as I suppose, the same, namely, the investigation of the nature of living processes. Physiology and bio-chemistry in fact merge into one another, and if we call to our aid the resources of chemistry and physics, that need not imply that we are any the less physiologists, but we have to be on our guard that we do not by imperceptible degrees turn from the path of biology into that of pure chemistry and, in so doing, miss the goal that we set out to attain. If an example is needed of the application of

chemical and physical methods of investigation to the normal living organism, I would point to the work that has been done on human physiology, for it seems to me that a just claim may be made that in that there is represented at least one aspect of true chemical physiology.

In our enthusiasm for research we are apt to overlook the fact that unless our teaching can keep pace with our research the general advance of learning must be seriously impeded. I cannot help feeling that our teaching of physiology would be more satisfactory if human physiology occupied a more prominent position. I am not thinking so much in this connexion of advanced teaching, for the number of students who take advanced courses is relatively small and it is fairly easy to arrange suitable work for limited numbers. The great majority of students who take up the study of physiology do so as a preliminary to a medical career, and but few of them in the end pass on to advanced courses, and it is of the elementary teaching of physiology required as a preliminary to the study of clinical medicine, or an antecedent to more advanced honours courses, that I wish to speak.

So far as the theoretical side of physiology is concerned, books enough and to spare are available; and if the student is dissatisfied with his textbook or his teachers he can turn, unless he is appalled at the prospect, to the ever-increasing number of monographs, reviews, and special volumes which offer to him information on almost every conceivable branch, however obscure, of physiology. It is, I think, the practical instruction in physiology with which we may legitimately find fault. We are, I suppose, in part tied by tradition, in part handicapped in our laboratories by the accumulation of apparatus of bygone days, and it is easy to point to lack of funds as an excuse for continuing in the same path as those who preceded us. The fact remains that so far as elementary practical physiology, as distinct from bio-chemistry, is concerned, reliance is still largely placed upon an experimental treatment of some of the rudimentary phenomena exhibited by amphibian muscle and nerve. I do not deny that some of these experiments do afford information which is of value to the student, but I am also prepared to maintain that others are merely artificial, and but relics of the past that would be better omitted, and that they in no way represent the viewpoint of the present day in this branch of physiology. But though experiments on muscle and nerve still figure largely in the physiological curriculum, it is noticeable that simple experiments illustrating the progress of more recent years are gradually being introduced, and that in some laboratories a far more serious attempt has been made to remodel the curriculum than in others, and to afford an opportunity for gaining acquaintance with some of the facts of human physiology.

Such a change in outlook is very welcome. When dealing with a subject which is so rapidly progressive as physiology, I feel that we are bound to reconsider our methods of teaching at intervals, if we are to render those whom we instruct reasonably conversant with the actual state of knowledge at the time; mere addition to the curriculum is of no use, what is needed is reconstruction. Do not think that I say this in any carping spirit. After all, some facts have become so firmly established in the past as to have become axiomatic, and we must be content to accept many of these without constant repetition of their proof if time is to be found to give the student some indication of the experimental developments which have led to alteration and extension of our earlier conceptions. If practical courses of instruction are to play their full part and not degenerate into simple exercises in skilful manipulation, they must be brought into line with current physiological thought; they must, even though the experiments be simple, help to convince the student of the meaning and truth of what he reads. I am certain myself that a serious attempt to incorporate even in elementary courses experiments on human physiology will be amply justified.

I confess frankly that in my own case if I want to understand the facts of physiology I have to think of what they might mean to me in my own person; I cannot think easily in terms of lower animals. I have got to translate the information before I can use it. I do not believe that I am peculiar in this respect. Many a student would, I am sure, acquire a deeper and more real interest in physiology if his attention was directed to some of the essential facts of human physiology at an early stage in his instruction. Show him something of what really happens in himself in the natural course of his daily life, awaken his curiosity about the way in which these events are actually accomplished, and he will then more readily understand the significance of what he learns from other sources. As it is, he runs the risk of being overwhelmed by the literature of the subject that he is studying and of losing himself in details which he cannot place in the right perspective: he too often fails to see the wood for the trees. The quantitative interdependence of function in the body can be well illustrated by simple experiments in human physiology; and a more convincing introduction to those quantitative conceptions which must form the basis of physiology, as of other branches of natural science, can be gained, I think, in this way than by, say, a few quantitative bio-chemical analyses which, essential though they may be in themselves, can scarcely be more than exercises in method in the early days of a student's career.

These students are for the most part going to follow the profession of medicine, and in the short time available our aim must be to develop their powers of thought and initiative that they may be the better equipped to face the future when they go out into the world; and if they leave us with only the recollection of a medley of seemingly disconnected facts, it is quite intelligible that they may fail to grasp what physiology really means, and that a gulf, for which there can be no justification, will deepen between physiology and medicine. Physiology is not medicine: the physician sees a

side of life which the physiologist does not meet in the cold aloofness of the laboratory. The art of medicine is not based merely on the application of skilled technique; it demands in addition a full and sympathetic comprehension of human nature with all its hopes and fears, its frailty and courage. Yet the more the physiologist can find out about the characteristics of normal life the greater will be his service to medicine, for a knowledge of the normal cannot but help us to estimate with greater certainty the influence of the abnormal, and the underlying principles of adaptation of organ activity which we as physiologists recognise in the functional changes which exhibit themselves in everyday life; and, in the reactions to alterations of environment, have their counterpart in medicine in the natural efforts at compensation for the effects of injury or disease, a compensation which it must be the aim of the physician to encourage and assist.

There is yet another field in which scope may be found for human physiology. In the growing complexity of the modern world the improvement of the general standard of life is a matter which appeals to all of us. Physiologists have already played a prominent part in investigations into the means by which conditions may be improved and risk reduced in industrial processes, into the factors which affect the efficiency and welfare of the working classes, and into the influence of diet on health. Problems such as these, the solution of which is of direct benefit to the community at large, call for the practical application of physiological principles. We ought not to regard applied physiology as something distinct, as something to be divorced from the more academic study of theoretical physiology; it should be looked upon as the natural extension of our researches in the laboratory. These practical problems in their turn often suggest new lines of inquiry, new methods of approach, by which the science of physiology may be still further advanced.

Obituary.

Prof. R. A. Lehfeldt.

PROF. ROBERT ALFRED LEHFELDT, professor of economics at the University of the Witwatersrand, Johannesburg, whose untimely death is reported from Cape Town, was born at Birmingham on May 7, 1868, and thus was in his sixtieth year. Lehfeldt's initial education and pursuit of science was largely the outcome of strenuous personal endeavour. Obtaining a scholarship at St. John's College, Cambridge (1886), he secured a first class in both parts of the Natural Science Tripos. Meanwhile he read for a London degree, eventually taking his D.Sc. in physics. On leaving Cambridge, Lehfeldt occupied a post as demonstrator in physics at the University of Sheffield (then Firth College); later, he became professor of physics at the East London Technical College, remaining there until appointed (1906) to the chair of physics, Transvaal Technical Institute, Johannesburg, a post resigned on his acceptance (1917) of the professorship of economics in the University of the Witwatersrand.

Among several papers by Lehfeldt published in the *Philosophical Magazine* are: "A Potentiometer for Thermocouple Measurements" (1903), and "The Treatment of Electrodynamics" (1909). He translated from the German, Van 't Hoff's lectures on theoretical and physical chemistry (3 vols., 1898–1900), also Nernst's theoretical chemistry (Macmillan, 1904), revised in accordance with the fourth German edition. He was the author of a text-book of physical chemistry (general theory) in the series edited by Sir William Ramsay (1904, a new impression appearing in 1920). Lehfeldt was a valued worker for the Royal Society's "Catalogue of Scientific Papers," series 1884–1900. His services are referred to, along with other coadjutors, in Vol. 13 (1914).

In certain fields of economics Lehfeldt was a persistent advocate. The *Economist* published on Nov. 6, 1926, the first of a series of five articles of his (afterwards appearing in pamphlet form) entitled "Controlling the Output of Gold." A proposition embraced the setting up of an international commission charged with the duty of buying out and becoming the owner of the gold-bearing and gold-producing ores of the world. Lastly, the *Economist* on Sept. 24, 1927, published suggestions leading to a more economic mode of currency in England.

In early years Lehfeldt was reticent, difficult of approach, and somewhat inclined to moodiness. Unfortunately, it would seem that these general characteristics, so far from diminishing with time, gathered force. Notwithstanding, he accomplished much sound work in science and in cognate subjects, and his old associates at home and those overseas will deeply deplore his premature decease.

Prof. Ludwig Darmstädter, director of the State Library, Berlin, died on Oct. 18. A native of Mannheim, Darmstädter was educated at the Universities of Heidelberg, Leipzig, Berlin, and Paris. About twenty years ago he presented to the State Library, Berlin, his valuable collection of porcelain and of autographs and other documents relating to men of science. This collection, known as the "Dokumenten-Sammlung Darmstädter," has developed until it is probably the largest of its kind. His best-known work is the "Handbuch zur Geschichte der Technik und Naturwissenschaften."

We regret to announce the following deaths:

Dr. M. Bamberger, emeritus professor of inorganic chemistry at the Technische Hochschule in Vienna, on Oct. 22, aged sixty-six years.

Dr. R. A. Herman, lecturer in mathematics in the University of Cambridge, on Nov. 29, aged sixty-six years.

Lord Kenyon, K.C.V.O., president of the National Museum of Wales, on Nov. 30, aged sixty-three years.

Prof. Perley F. Walker, dean of the school of engineering of the University of Kansas since 1913, who was known for his work on steam and gas power engineering, on Oct. 17, aged fifty-two years.

News and Views.

AT first sight a student referring to a text-book would think that the evolution of the Proboscidea is a comparatively easy matter to understand. The picture of a straight line of descent from the little Moeritherium, through Palæomastodon, Mastodon, Stegodon, and so on up to the later mammoths and elephants, seems very easy to read. Closer examination, however, and a reference to the enormous literature on the subject, reveal a most complicated state of affairs. There is an immense number of families, genera, species, and sub-species of elephants already described, many of them still inadequately known; there is still no very clear agreement of what constitutes a specific character in an elephant; and there are many widely diverging views as to the real relationship of the various forms one to another. As species of elephants, *e.g. E. antiquus*, *E. trogontherii*, *E. primigenius*, *E. meridionalis*, are so often used as time markers, it is essential that we should have a clear idea as to what they are and as to their inter-relationships. Yet we find specimens described as intermediate by some authorities and the statement hotly denied by others.

THE fact is that the taxonomy of the elephant group is in the greatest confusion. Prof. Osborn's forthcoming memoir may confidently be expected to clear up the situation in some degree, in that it will present the facts so far as they are known at the present time. It cannot be expected to be a final pronouncement, because the evidence is not yet complete. Facts are still needed, and every new one that comes to light is important. The Upnor elephant, for example, now mounted in the British Museum, has yielded some new facts, and rather surprising ones, to what we know about *E. antiquus*. In producing some new facts, Prof. Dart's description in the Supplement to this issue of NATURE of new proboscidian material from South Africa is therefore greatly welcome. If this most interesting discovery adds for the moment to our perplexity, it is nevertheless additional evidence which, in time and with the discovery of further material, will in the future yield its quota to the solution of the filiation, distribution, migration, and general knowledge of the group.

AT the anniversary dinner of the Royal Society, held on Nov. 30, Mr. Baldwin, the Prime Minister, as principal guest, proposed the toast of the Society, of which he was recently elected a fellow. It should be said that the inclusion of certain persons not actually engaged in scientific pursuits is a practice sanctioned by long usage. In the Society's original statutes of 1663, whether wisely or not—and there were mundane considerations—it was provided that every one of His Majesty's subjects having the title and place of baron, or any other higher title and place, and every one of His Majesty's Privy Council, might be elected. With slight variations these intentions were preserved down the years, until, in course of time, such persons formed a panel or privileged class. As regards foreign members, the procedure was different altogether. In 1765 it was resolved that no foreigner be proposed for election "that is not known to the learned world, by some publication or invention." Discussion in 1873 on a motion to require in the privileged class, "evidence of ascertained special power and disposition to forward the aims of the Society from exceptionally personal, or official advantages of position," ended by limiting the privileged class to princes of the blood royal and members of the Privy Council.

STATUTES enacted by the Royal Society in 1902, and still followed, abolished the clause relating to privy councillors, simply providing that once in every two years the Council *may* recommend not more than two persons who "either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society." It is permissible to say that the implications of this statute seem clear enough. The opportunities of the chief officer of State in the scientific arena are recurrent and understood; as political moves they would be an affront to science. No one doubts that Mr. Baldwin will honour the bill, and that inclination and temperament will be allied in furtherance of aims which bring science into touch with schemes that affect the national well-being. We are mindful that Mr. Joseph Chamberlain, as a Government official, passed the word that research and preventive measures in tropical diseases were necessary and must be undertaken. What followed made history.

A CORRESPONDENT recalls the interesting fact, in connexion with Mr. Baldwin's election, that in recent times three precedents can be recorded for the election of a Prime Minister into the Society whilst holding the seals of office. The instances are: Mr. Disraeli, elected on Feb. 10, 1876; Mr. Gladstone, elected on Jan. 13, 1881; the Earl of Oxford and Asquith (then Mr. Asquith), elected Nov. 5, 1908. The first-named was formally admitted by Dr. J. D. Hooker on June 1, 1876, that being the day fixed for the election of ordinary fellows. Amongst these (and surviving) were Prof. H. E. Armstrong and Sir David Ferrier. Mr. Gladstone was admitted on May 19, 1881, on which occasion William Crookes read a paper, "On Discontinuous Phosphorescent Spectra in High Vacua." Sir William Thiselton-Dyer, who had been elected a fellow in the previous year (1880), survives, and, indeed, may have witnessed Mr. Gladstone sign the charter book.

CONSIDERABLE interest has been aroused by the report in the press that concessions were believed to have been granted to a British syndicate for the purpose of utilising the vast mineral resources of the Dead Sea. This interest was reflected in the very pertinent questions put in Parliament a few days ago. From the reply given in the House of Commons by Mr. Ormsby-Gore, it appears that although it has been decided in principle to grant a concession to

certain individuals, the terms and conditions are still under negotiation. The potassium salts of commerce are derived largely from the Stassfurt deposits in Germany. At the outbreak of the War in 1914, these supplies were closed to the Allies and a serious dearth ensued. The waters of the Dead Sea are heavily charged with mineral salts. They are estimated to hold in solution some 2000 million tons of potassium chloride, a quantity that may be regarded as practically inexhaustible from a commercial point of view. In the event of war, these supplies, if accessible, might be extremely valuable to the British Empire, and considerable anxiety has been manifested lest Germany or some other foreign power should acquire controlling interests over these supplies.

LORD LOVAT stated in the House of Lords that the Government is fully aware not only of the economic importance of the Dead Sea deposits, but also of the political questions that may arise in the event of these deposits being worked. This, in so far as it goes, is reassuring. It must be borne in mind that the whole scheme is at present merely in an experimental stage. Whilst, as a purely chemical proposition, it may not be difficult to prepare the different salts in a sufficient state of purity to meet modern requirements, the placing of these salts upon the European market at competitive prices may be no easy task. The level of the Dead Sea is some 1300 feet below that of the Mediterranean, and Jaffa, the nearest port, is hemmed in by rocks to seaward which effectively bar the approach of any but the smallest boats. Thus the problem of transport alone, in a country which is devoid of fuel, in the face of the ready accessibility of the Stassfurt deposits, is one of considerable magnitude.

THE Institute of Chemistry of Great Britain and Ireland, which was founded in 1877 and incorporated by Royal Charter in 1885, celebrates its jubilee on Dec. 14 and 15. In the proceedings the fellows and associates of the Institute will be joined by members of nine allied chemical societies and institutions and their ladies. On Wednesday, Dec. 14, there will be a conversazione and reception by the president, Prof. Arthur Smithells, and Council of the Institute, and on the following evening a dinner, at which the president will occupy the chair, both events taking place at the Wharncliffe Rooms, Hotel Great Central, Marylebone. For this year the jubilee dinner will take the place of the annual Chemical Dinner. An exhibition of films illustrating British industries in which chemistry is applied has been arranged for Thursday morning, Dec. 15, and on both days the Council Room, Library, and Laboratory at 30 Russell Square, W.C.1, will be open to members of the participating organisations. Documents, portraits, apparatus, and prints of historical interest will be on view, and the Institute's collection of lantern slides illustrating the history of chemistry will be displayed. On Dec. 15, the Master and Wardens of the Worshipful Company of Salters will entertain the officers of Institute and representatives of other societies at luncheon. The Institute of Chemistry, which is well known as a body which grants certificates of competency in various branches of the profession with the object of maintaining a high standard of scientific and practical proficiency, and deals also with questions of status and professional conduct, now has a membership roll of more than 5300 fellows and associates practising in all parts of the Empire, and 800 student-members. There are sixteen local sections, and a number of honorary corresponding secretaries who act for the Institute in the Dominions and Colonies, and in the Empire of India.

IMPERIAL CHEMICAL INDUSTRIES, LTD., has taken yet another important step in the direction of promoting closer relations between so-called 'pure' and 'applied' chemical research. By its establishment of a research council, which will function as an advisory board and clearing house for ideas, a close liaison will be effected between industry and the universities. The connexion thus strengthened between those engaged in academic and industrial pursuits provides a stimulus for the flow of vitalising force in both directions; not only will the scheme lead to efficiency of action and economy of effort in the attack on industrial problems, but it should also lay the foundations of a greater appreciation of the industrial situation by academic research workers. This is the first body of its kind to be established in Great Britain, although the value of similar organisations has been amply demonstrated in other countries. The scheme will doubtless play a significant part in helping to place British practice on more than competitive terms with modern achievements and organisations elsewhere. The council will be presided over by Sir Alfred Mond, and the other members will be: Dr. G. C. Clayton, M.P., Col. G. P. Pollitt, Mr. J. Rogers, Dr. F. A. Freeth, Dr. E. F. Armstrong, Dr. R. E. Slade, Mr. H. A. Humphrey, Sir Frederick Keeble, Prof. F. G. Donnan, Prof. R. Robinson, Prof. W. A. Bone, Prof. F. A. Lindemann, and Dr. E. K. Rideal, with Major A. E. Hodgkin as secretary.

ON Nov. 23, Sir Alfred Mond gave his presidential address to the Institute of Fuel, which has resulted from the union of the Institute of Fuel Technology and the Institution of Fuel Economy Engineers. He announced that Mr. Frank Hodges would be the new president, and gave an account of the plans and policy of the new body. The address, which was of a general character, dealt with economic rather than scientific problems. There was, however, a hint of a method, now under probation, for reducing the ash of coal to 2 per cent.—an achievement so desirable that it seems too good to be true. A new application of pulverised fuel was mentioned—the use of coal dust in place of oil in the Diesel engine. The realisation of such an engine might open a new vista to the coal trade. Sir Alfred advocated more study and care to prevent size reduction of coal in transport and handling, for this usually involves a diminution in market value. On the economic side he pleaded for amalgamation of units, for reorganisation of the coal

industry, for reduction of the personnel by pensioning the older men, the relief of rates, taxes, and transport costs, the assistance of the State in raising the capital necessary for modernisation, as, for example, in the case of coke oven installations.

READERS of NATURE will note with special interest Sir Alfred Mond's views on industrial research—his advocacy of its intensification by the use of whole teams where now individuals work. This he regards as necessary not merely to ensure progress but even to maintain our position. The coal industry seems to offer a wide field for the scientific advancement which is necessitated by international competition. This applies both to production and selling. Thus he holds that the sale of coal of a guaranteed uniform standard would assist the export trade more than the cutting of prices, which has been the normal economic weapon of our collieries. The programme of this meeting of the Institute of Fuel was interesting, and the papers of importance to actual problems. The aims of the new body are wholly beneficent, but appear to be covered by already existing organisations. Opinions differ as to whether it can accelerate technical progress. So far as the scientific worker is concerned, the multiplication of institutions, with attendant drain on purse, time, and energy, may hinder as much as help.

A PAPER on national electricity supply was read to the Institute of Fuel on Nov. 23 by Sir Philip Dawson. He pointed out that whilst in Great Britain only 40 per cent. of the total motive-power required for industry is electric, in Germany the percentage is 70, in the United States 65, and in Belgium 56. In Great Britain large reserves of coal remain unworked because of their high ash content. They could easily be worked with the rest of the seam and sold at a cost of from four to five shillings per ton at the pit's mouth. This fuel has a calorific value about double that of the brown coal so successfully utilised in Germany, but so far little or no attempt has been made to utilise it in Great Britain. In the future these poor qualities of coal, which it does not pay to transport, should be used in the form of pulverised fuel to produce electricity at the colliery. In England, only 14 per cent. of the coal mined is cut mechanically. This compares with 47 per cent. in Scotland. The excess gas produced in steel works should be utilised for generating electricity, as this could be profitably supplied to the network controlled by the Central Electricity Board.

SIR PHILIP DAWSON stated that we are only beginning to reap the benefits of co-operation and co-ordination in the generation and transmission of electricity. Wherever interconnexion has been carried out, it has resulted in greater safety and more perfect continuity of supply. In Sir Philip's opinion, the result of the 1926 Act should bring about, in the best sense of the word, a national and not a nationalised supply of electricity in Great Britain. In the discussion, Sir Arthur Duckham said that for the supply network in the Clydeside area, the first scheme put forward by the Central Electricity Board, not a single colliery has offered to supply electricity to the system. It is possible that in the future the collieries will utilise for their own purposes electric power from the network, some of which is generated by water, instead of economically generating it themselves by their own low grade fuel.

ONE or two years ago, Dr. Karolus, of Dresden, claimed to have achieved television by means of apparatus which transmitted 100,000 units of the image in one-tenth of a second. We now learn from the *Times* of Nov. 30 that his system of transmitting photographs and papers which may be coloured—except green, blue, and mauve, which are not recommended—by telegraph wires has been adopted by the Austrian telegraph department. The pictures sent may portray persons or drawings, cheques, structural plans, documents, or writings by hand or type. The size of the picture or type must not exceed 4 inches by $7\frac{1}{2}$ inches, the minimum being 4 inches by $1\frac{1}{2}$ inches. The paper must be opaque and the writing clear and easily read. It is stated that the largest strip will accommodate 400 words in pearl type. The charge for the transmission of the smallest permissible picture from Vienna to Berlin is 7*s*. 11*d*., each additional $1\frac{1}{2}$ square inches costing 2*s*. A reduction of about 25 per cent. is made if the picture is transmitted during the night hours, that is, between 9 P.M. and 8 A.M. The Siemens' Electrical Company, which is producing the apparatus, has modified Karolus's original system. Full details will be awaited with interest, as the transmission of coloured prints and photographs by telegraphy has hitherto not reached the commercial stage.

MOST hearty congratulations are due to the veteran Prof. W. Cawthorne Unwin, F.R.S., who, on Monday next, enters on his ninetieth year. Born at Coggleshall, Essex, he was educated at the City of London School, and on leaving became a pupil in the firm of William Fairbairn, Manchester. Next he undertook the managership of some engineering works, thereafter filling a post as an instructor in the Royal School of Naval Architecture and Marine Engineering, South Kensington. He was professor of hydraulic engineering at the Royal Indian Engineering College, Coopers Hill, from 1872 until 1885; afterwards, for twenty years (and these were fruitful in effort) he taught the principles of engineering at the Central Technical College, City and Guilds of London Institute. Prof. Unwin is a past president of the Institutions of Civil and Mechanical Engineers. At the latter there hangs a portrait of him by Mr. Harold Speed.

DR. R. T. A. INNES, who is retiring at the end of this year from the post of Director of the Union Observatory, Johannesburg, was born in Edinburgh, and when a young man went to Australia. To the *Monthly Notices* of the Royal Astronomical Society of 1892 he contributed a paper on the secular perturbations of the earth by Mars. In 1896 he joined the staff of the Cape Observatory as secretary, librarian, and accountant. Although forming no part of his official duties, he executed three valuable pieces of astronomical work: (1) A revision of the Cape Photographic *Durchmusterung*; (2) a general catalogue of

southern double stars, of which he discovered 280 with a 7-inch equatorial; (3) observations of variable stars. In 1903 he was, on Gill's recommendation, appointed Director of the Meteorological Observatory of the Transvaal. Gradually astronomical equipment was obtained for the Observatory, and many of the photographs of Mr. Franklin-Adams' survey were taken at the Johannesburg Observatory by Mr. Wood, Dr. Innes' assistant. Dr. Innes set his heart on a large visual refractor for double-star work. Owing to the difficulty of obtaining optical glass and to the War, he suffered the disappointment of long delay; and it was only two years ago that a 26-inch refractor was received. He continues his interest in the motion of sun, moon, and planets, and the cause of the small but persistent differences from tables based on gravitational theory. Following the example of Gill, he has welcomed at Johannesburg astronomers from the northern hemisphere, where he is able to supply sky and equipment and thus makes up for a small staff.

THE seventieth birthday of Prof. S. G. Navaschine, the distinguished botanist, will be celebrated in Moscow on Dec. 21 at a special meeting to be held in the University, where congratulatory addresses and greetings will be presented to him. Prof. Navaschine is a foreign or corresponding member of a number of national and botanical societies, and his botanical work is highly esteemed over a wide circle. Letters or telegrams of congratulation should be addressed to Prof. M. I. Golenkin, director of the Botanic Garden, University of Moscow, U.S.S.R.

ON Nov. 30, the portrait of Prof. J. A. Fleming, painted by Sir William Orpen, was presented to University College, London, by the chairman of the Portrait Fund Committee, Mr. Campbell Swinton. The gift was received on behalf of the College by Lord Chelmsford, chairman of the College Committee, and Prof. Coker, Dean of the Faculty of Engineering. In making the presentation the chairman gave an engaging account of the eminent artist's method of producing so strikingly successful a result. Lord Chelmsford, in acknowledging the gift, said that Prof. Fleming's life and work have shed lustre on the College, and that more than 2000 students have passed through his hands, three of whom have been presidents of the Institution of Electrical Engineers. Prof. Coker also testified to the distinguished career of Prof. Fleming, both as teacher and investigator. The chairman then presented Prof. Fleming with a copy of the portrait. In accepting it, Prof. Fleming briefly outlined the growth of his Department of the College, and stated that he intended presenting the copy to the Institution of Electrical Engineers. This he did on the following evening. The copy of the portrait was received by the president of the Institution, Mr. Page, who thanked Prof. Fleming for his gift in very cordial and appreciative terms.

AT the annual general meeting of the fellows of the National Institute of Agricultural Botany at Cambridge on Dec. 2, Sir Daniel Hall, who presided as chairman of the Council, submitted the annual report and presented to Sir Matthew Wallace the John Snell Memorial Medal for 1926. Papers were then read dealing with different aspects of the testing and control of agricultural seeds. Mr. A. W. Monro, of the Ministry of Agriculture, dealing with the administrative aspect, recalled that the regular testing of seeds for purity and germination began in Germany in 1870 and Denmark in 1871. Ireland established an official seed-testing station in 1900, Scotland in 1914, and England and Wales in 1917. Legislative control in the United Kingdom began with the Irish Weeds and Agricultural Seeds Act of 1909, and was extended to the whole country by the Testing of Seeds Order in 1917. This was superseded by the Seeds Act, 1920. The basic principle of the Order and the Act is to let the farmer know what he is buying by compelling the seller to disclose the essential facts—origin, variety, purity, and germination—in the case of the principal agricultural seeds. Seed merchants, taken as a whole, comply readily with the regulations, but farmers who sell seeds to their neighbours are apt to ignore them. The information required by the Act is obtained by tests at the official stations—Cambridge, Edinburgh, and Belfast—or at one of the 88 private stations licensed by the Ministry. In the opinion of Mr. Monro, the principal effects of the Act have been to raise the quality of the bulk of the seed supplies, so far as purity and germination are concerned, to the high standard that has long been observed by the best merchants, and to drive off the market the lower grades of grass, clover, and root seeds.

MR. ALFRED EASTHAM, the Chief Officer of the Official Seed-Testing Station for England and Wales, read a paper on the technical aspects of seed testing. Essential though accuracy is in seed testing, it is now generally recognised that the efficiency of the routine work depends upon constant investigation of the underlying principles and their adaptation to the changing character of the seasons. In addition to these routine investigations, there are many special problems under examination at the Cambridge Station. Examples of these problems are (*a*) the loss of vitality in seeds and the bearing which storage conditions have upon the rate of loss, and (*b*) seed-borne diseases. Both are of much importance to all who are interested in seeds, and during the past four years a great deal of time has been spent upon them. A seed-testing station's first duty is to report on the purity and germination of the samples it tests; but, though high percentages of purity and germination are most desirable, too much value should not be placed upon them. The nationality of the seed, its vigour, and the nature of the impurities present must be kept in view. Strain is of the first importance, and, provided it is free from harmful impurities, seed of a good strain but of comparatively low purity and germination is much to be preferred to seed of a poor strain, however high its purity and germination; for the latter might easily fail to produce a satisfactory crop.

THE Library of the Chemical Society will be closed for the Christmas holidays at 1 P.M. on Friday, Dec. 23, and will reopen at 10 A.M. on Thursday, Dec. 29.

MR. S. ZUCKERMAN, of the University of Cape Town, has been appointed to the research fellowship in anatomy, and Miss Eleanor Margaret Brown, of University College, London, to the aquarium research fellowship, offered by the Zoological Society of London.

FOR the meeting of the British Association to be held next year in Glasgow on Sept. 5-12, under the presidency of Sir William Bragg, the following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Prof. A. W. Porter; Section B (Chemistry), Prof. E. C. C. Baly; Section C (Geology), Mr. E. B. Bailey; Section D (Zoology), Prof. W. Garstang; Section E (Geography), Prof. J. L. Myres; Section G (Engineering), Sir William Ellis; Section H (Anthropology), Sir George Macdonald; Section I (Physiology), Prof. C. Lovatt Evans; Section J (Psychology), Prof. T. H. Pear; Section K (Botany), Prof. R. H. Yapp; Section L (Education), Prof. A. Smithells; Section M (Agriculture), Dr. J. S. Gordon. The president of Section F (Economic Science and Statistics) will be announced later.

AT an extraordinary meeting of the General Committee of the British Association, held on Dec. 2, the president, Sir Arthur Keith, in the chair, it was resolved to put forward an application for a Royal Charter for the Association. Mr. A. A. Campbell Swinton was warmly thanked for his generous offer to bear the cost of obtaining the charter. It was also resolved "that the General Committee gratefully accepts Mr. Buckston Browne's generous offer to vest Downe House in the Association, and authorises the president to make any suitable arrangements for the custody of the property in the interval between the acquisition thereof and the granting of a Charter."

A LIFE-SIZE bronze statue of the late Dr. John A. Brashear, well known as the maker of numerous large telescopes and astronomical instruments, and the founder of the new Allegheny Observatory, has been placed in the rotunda of the Observatory and was unveiled on Nov. 24, the anniversary of his eighty-seventh birthday. The statue is the work of Mr. Frank Vittor, and is a gift to the University of Pittsburgh from a number of Dr. Brashear's life-long friends.

THE following officers and new members of council of the Cambridge Philosophical Society have been elected for the session 1927–28: *President*, Dr. H. Lamb; *Vice-Presidents*, Prof. J. T. Wilson, Prof. A. Hutchinson, Prof. G. I. Taylor; *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. F. P. White, Mr. R. H. Fowler, Mr. F. T. Brooks; *New Members of Council*, Mr. W. H. Mills, Mr. M. H. A. Newman, Dr. H. Hamshaw Thomas, Dr. J. Needham; *New Member of Philosophical Library Committee*, Mr. R. H. Fowler.

AN International Exhibition and Conference on Light and Heat in Medicine and Surgery will be held at the Central Hall, Westminster, on Dec. 13-16. The work of the conference will be divided into three sections, dealing with light and heat in medicine and surgery, scientific research in relation to the practice of actinotherapy, and recent advances in optics, respectively. The exhibition will be opened at 2.30 P.M. on Dec. 13 by Sir Alfred Mond. The exhibition and conference are being organised by the *British Journal of Actinotherapy*, 17 Featherstone Buildings, London, W.C.1, from which tickets of invitation and vouchers for reduced railway fares can be obtained.

REFERENCE was made in our issue of April 30, p. 649, to the nineteenth meeting of the Australasian Association for the Advancement of Science, to be held at Hobart during the week commencing Jan. 16. A further programme recently received enables us to give more particulars of the meeting. The presidential address by Mr. R. H. Cambage will be on the development of some early Australian floras. Sectional presidential addresses are topical, and refer mainly to Australian conditions. In addition to papers in the various sections, discussions have been arranged on research in relation to manufacturing industries in Australasia (physics, chemistry, and engineering sections), animal nutrition and pasture deficiency (chemistry, agriculture, and veterinary science sections), structure of colloids (chemistry and physiology sections), the marketing of fruit (economics section), the pharmaceutical chemist in the community and micro-chemical methods in testing pharmaceutical products (pharmaceutical section).

A RUBBER Exhibition was opened at the Imperial Institute, South Kensington, on Dec. 2, by Mr. Hacking, Parliamentary Secretary of the Department of Overseas Trade, and will remain open until Dec. 31. This exhibition, admission to which is free, is the first of a series of short exhibitions of Empire products which will be held from time to time at the Imperial Institute. It has been arranged in conjunction with the Rubber Growers' Association and is divided into two parts, the first dealing with the production of raw rubber, and the second, with manufacture and application. A series of specimens of wild rubber plants, which were the only source of rubber until the modern plantation system was evolved, are shown; at the present time, this source is responsible for only about 5 per cent. of the total world production. Two allied rubber products are also exhibited, *i.e.* balata and gutta-percha. Both of these are chemically similar to rubber, although they differ in their physical properties. Further exhibits illustrate various processes of manufacture of raw rubber. The Research Association of British Tyre and Rubber Manufacturers has contributed an exhibit showing the compounding ingredients employed in the manufacture of rubber articles, and the Ceylon Rubber Research Scheme (which has its laboratories at the Imperial Institute) illustrates various investigations in connexion with the perishing of rubber and variations in its plasticity. About fifty firms have contributed to the exhibition. A film showing the production of raw rubber and its utilisation in manufacture is being displayed in the adjoining cinema. Lecture tours are also arranged for those who care to avail themselves of these facilities.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A junior secretary (male) in the External Registrar's department of the University of London—The Secretary, University of London, South Kensington, S.W.7 (Dec. 16). A graduate assistant in mechanical engineering at the Wakefield Technical College—The Director of Education, Education Offices, Town Hall, Wakefield (Dec. 17). A Paterson research scholar in the cardiographic department of London Hospital—The House Governor, London Hospital, E.1 (Dec. 19). An additional research fellow in the department of glass technology of the University of Sheffield—The Registrar, The University, Sheffield (Dec. 23). A junior assistant at the National Physical Laboratory with a good honours degree or equivalent qualifications in engineering—The Director, National Physical Laboratory, Teddington (Dec. 24). A principal of the Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (Dec. 31). A lecturer in inorganic and physical chemistry at the Sir John Cass Technical Institute—The Principal, Sir John Cass Technical Institute, Jewry Street, E.C.3 (Dec. 31). An assistant lecturer in geography in the University of Manchester—The Registrar, The University, Manchester (Jan. 11). An assistant in the department of art of the National Museum of Wales—The Director, National Museum of Wales, Cardiff (Jan. 14). An entomologist and a plant breeder in the Agricultural Department, Iraq; the entomologist must have had specialised training in entomology and experience of research work and of pest control measures; the plant breeder must have had specialised training in genetics and, preferably, experience of plant breeding work—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1. An adviser in mycology for the Bristol Province under the Advisory Scheme of the Ministry of Agriculture and Fisheries—The Registrar, The University, Bristol.

Our Astronomical Column.

NEW COMET.—The tenth cometary discovery of 1927 is reported from Melbourne in a telegram distributed by the I.A.U. Bureau, Copenhagen. It was made by Mr. J. F. Skjellerup on Dec. 3 at 17 h. 30 m., U.T., in R.A. $16^h\ 12^m\ 12^s$, S. Decl. 53° 57′. The comet was of the third magnitude, and had a tail 3° long; it was moving towards the sun.

It appears very probable that this is De Vico's long-period comet 1846 IV., which has been searched for by southern observers since 1920. If so, its period is $81\frac{3}{4}$ years, and its perihelion passage about Dec. 15. No one has computed the perturbations of this comet since 1846, and it is possible to represent the position within a few degrees by the unperturbed elements; moreover, if identical, it would be only one-third of a unit from the earth, so any departure from its predicted place would appear exaggerated. If the identity is right, it will cross the equator about the time of perihelion, and will then pass in to high north declination. The period is several years longer than the predicted one, but that causes no surprise. The comet Brorsen-Metcalf, 1847 V., returned in 1919, nine years before it was expected. Mr. Skjellerup made several cometary discoveries when he lived in South Africa, but this is the first he has made since he moved to Melbourne.

DETECTION OF A NEW NAKED-EYE CEPHEID.—*Harvard Observ. Circular* 316 contains the interesting announcement that the fourth magnitude star Beta Doradus has just been discovered to be a Cepheid variable, with a photographic light-range of 1·4 magnitude, and a visual one of nearly a magnitude. Miss Applegate was the first to suspect the Cepheid character, which she did by noting periodic changes in the type of spectrum; R. E. Wilson on the same grounds classed the star as a pseudo-Cepheid, not knowing of the light variation. This was not easy to detect photographically, the star's image being too large on most plates for accurate measures; but by a lucky chance, several images were found on plates with ten minutes' exposure taken in 1925 and 1926 for the light-curve of Nova Pictoris. The adopted period is 9·841696 days, and on plotting the observations with this period the variation is quite evident. The light-curve is symmetrical on each side of maximum and minimum, without any sign of a second harmonic. Prof. Bailey's visual photometric observations made in 1899 at Arequipa were examined; it was found that his observations of this star showed an unusually large range, and in consequence he took a number of extra observations of it. These are now found to conform well with the adopted curve, but Bailey did not discover that the variation was regular.

Beta Doradus is one of the stars in the *Nautical Almanac* list, its magnitude being 3·81, spectral type *F5p*, proper motion according to Eichelberger − 0·0031 sec. in R.A., + 0″·005 in decl. The absolute magnitude from the period-luminosity curve is − 1·9, giving a parallax of 0″·0043, and a distance of 760 light-years.

SOLAR ACTIVITY DURING 1926.—The final values for the mean daily area of sunspots and Wolf's sunspot number for the year 1926 have recently been published by the observatories of Greenwich and Zürich respectively (*Monthly Notices R.A.S.*, Nov. 1927, and *Astronomische Mitteilungen*, Nr. 116). The mean daily area of spots, corrected for foreshortening and expressed in millionths of the sun's hemisphere, is stated to be 1262 and the Wolf's sunspot number 63·9. Mean daily areas for periods of a solar rotation (Greenwich) and spot numbers for each month (Zürich) are also given in the respective publications.

The following table shows the progress of the present sunspot cycle since the last minimum in 1923:

Year.	Mean Daily Area.	Wolf's Number.	Mean Solar Latitude of Spots.
1923	55	5·8	6°·4* / 24°·4†
1924	276	16·7	22°·7
1925	830	44·3	20°·2
1926	1262	63·9	18°·6

* Old cycle spots. † New cycle spots.

The average provisional spot-number for the first six months of 1927 is 79, but since June the sun's activity has fallen off somewhat. Judging from the trend of the mean latitude of the spots—a fairly sure indication—the maximum year of the cycle should be 1928.

Research Items.

MEGALITHIC MONUMENTS IN THE MARIANAS.—In the *Scientific Monthly* for November, Lieut.-Commander P. J. Searles describes the remarkable Lat'te or monuments composed of upright monoliths surmounted by hemispherical capitals, usually in two parallel rows of four to six stones in a row and running parallel to the seashore or a river bed. The stones are of remarkable size. Two of the largest monuments are in Tinian. Their stones are eighteen feet in circumference at the base, and twelve feet high, the capitals being five feet high and six feet in diameter. Each monolith weighs 30 tons. In an unpublished manuscript of a Spanish Governor of the middle of the last century, it is stated that human bones were found in a hollow on the top of a monolith forming part of the 'House of Taga,' a chieftain who, according to tradition, buried his daughter on top of one of the monoliths. Recent investigations indicate that the Lat'te were not dwelling-houses as has been thought, but monumental religious structures marking sites of ceremonies, cannibal feasts, and burials. The mutilated condition of skeletons found in or near them points to cannibalism. In Guam the Lat'te are connected with three areas, of which the first is the burial place, in which all the bodies are carefully orientated with feet to the water and head inland; next, an area devoted to warriors or the victims of cannibal feasts, as indicated by broken skulls, broken limbs, or weapons or parts of weapons embedded in the skeletons; thirdly, an area in which are found remains of ornaments, pottery, weapons, stone implements, etc. How the Lat'te were built is unknown, but in size and in the skill and industry required to build them they are comparable to Stonehenge.

THE SCAPEGOAT IN INDIA.—Although the custom of using the scapegoat as a means of expelling diseases is extinct or on the verge of extinction in most parts of India, Dr. Sunder Lal Hora has been fortunate enough to come across an example among the Gonds in the Bilaspore district of the Central Provinces. The animal stuffed, and with its insignia, is to be exhibited in the Ethnographical Gallery of the Indian Museum, Calcutta. By careful investigation, a full account of the method of procedure was obtained and has been recorded in *Journal and Proceedings of the Asiatic Society of Bengal*, vol. 21, No. 3. When a disease such as smallpox is raging, the village resorts to the ceremony of *Nikasi*. A female goat is purchased by public subscription, and is adorned with ornaments usually affixed to the image of a goddess. An anna is stuck in the middle of the forehead and near it six yellow spangles. A string of yellow lac beads is placed round the horns, to which is attached a peacock's feather standing between the horns. Beads of various colours, red and yellow predominating, glass bangles, and coloured threads are also used to ornament the goat. The significance of these rests in the fact that they are the ornaments of a goddess. It is clear that in the course of the ceremony the goat becomes the goddess of the disease. The disease is removed by the goat being passed on from village to village until she reaches her own temple or is devoured by wild beasts on the way.

EYESIGHT TESTING.—The issue of the *Dioptric Bulletin* for September contains the papers read at the International Congress at Oxford in September last, organised by the British Optical Association, and is a volume of about 240 pages. Most of the 32 papers dealt with technical matters, but there were some of general interest dealing with eyesight tests. Dr. F. A. Woll of New York gave the results of his tests of the eyesight of 552 freshmen entering college in 1926. Of these, only 136 had normal vision, 156 had slight hyperopia, 32 wore glasses for it, and 35 more needed glasses; 122 wore glasses for myopia and 49 others needed glasses. Mr. R. O. Raphael gave an account of the work done by the Industrial Fatigue Research Board in demonstrating the relation between good sight and industrial efficiency of the workman. As examples he gave cases in which provision of suitable glasses raised the earnings of groups of employees 10, 15, and 27 per cent. respectively.

PHILIPPINE FISHES.—The Sparoid and Rudder fishes of the Philippines are described by A. W. Herre and H. R. Montalban in the *Philippine Journal of Science* for August last. Four genera of the Sparidæ and two of the Kyphosidæ are found to occur, whilst the authors add four species of sea-bream to the records for those islands. Keys, accompanied by plates, are given for the identification of all the species, but it should be borne in mind that distinctions based on the colours of the fishes are very slender, and are to be avoided if possible. Members of both families are highly prized as food, and provide a basis for important hand-line fisheries in Japan and Formosa. The various species of sea-bream form one of the main sources of supply for a dried-fish industry carried on at Sitankai, in the Sulu archipelago.

A THUMB CLAW IN FOWLS AND DUCKS.—T. Kageyama (*Proc. Imp. Acad. Tokyo*, July 1927) records the presence of a claw on the thumb in domestic fowls. Out of 131 fowls examined, 111 had the claw on both right and left thumbs, 12 on the right thumb and 3 on the left, while 5 had the rudiment of a claw on both thumbs. Of 14 ducks observed, 12 had a well-developed claw on both right and left thumb. The presence of a claw is not therefore of rare occurrence, as is often supposed.

SIZE AND COLOUR INHERITANCE IN IMPATIENS.—The inheritance of a character not frequently met with in flowers, namely, difference in size of certain petals, has been studied by B. S. Bedell, of the Imperial College of Tropical Agriculture, Trinidad (*Gardeners' Chronicle*, Oct. 29, 1927). The species investigated was *Impatiens balsamifera*, and the characters selected were the size of the posterior lateral petal and the colour of the flower. The petal in question may be quite small, simply a small lobe overlapping the anterior petal, or it may be large or equal in size to the anterior. It has been found that 'smallness' and 'largeness' constitute a simple Mendelian pair of characters, with 'smallness' dominant and 'largeness' recessive, the characters segregating after crossing in approximately typical Mendelian proportions. In the case of colour, it has been shown that in the varieties dealt with there is a colour factor, in the absence of which the flower and stem become white and green respectively. If it is associated with a blueing factor, the flower will be purple, or if with a reddening factor, the flower will be scarlet; if both are present, in addition to the colour factor, the flower will be magenta.

VIRUS DISEASES.—Probably the most important line of endeavour in plant pathology research at the present time is connected with investigations of virus diseases, which have also stimulated some interest in medical research circles on account of a possible analogy with cancer. The Agricultural Experiment

Station of the Michigan State College has just issued *Bulletin* No. 80, on the virus diseases of raspberries, by C. W. Bennett. Five distinct virus diseases have been distinguished, and considerable experimental work has been done in investigating the aphids responsible for transmitting the diseases from plant to plant. Specimens of *Aphis rubiphila* were able to communicate the infection after being away from contact with infected plants for forty-eight hours. There is also considerable evidence to show that the same species can carry the virus and infect healthy plants after a period of more than three weeks. No evidence was obtained to indicate the presence of virus in the egg stage of the aphis. Girdling experiments on infected plants showed that virus failed to pass the girdled part, indicating that the virus moves in some part of the bark. The sieve-tubes would seem to be the most natural channels for such movement, which showed some evidence of a correlation with food translocation. The movement of virus through a plant seemed relatively slow, and some of the canes of diseased plants remained healthy until the spring following infection. Wide varietal range of susceptibility, apparent immunity and tolerance in relation to the different virus diseases, were found in the raspberry group.

THE PHOTOGRAPHIC ACTION OF H-RAYS.—Some applications of this method for studying H-particles are described by M. Blau in *Communication* No. 208 from the Institut für Radiumforschung in Vienna. The best results were obtained with dental X-ray films, which after exposure at a large angle of incidence to protons from paraffin, showed well-defined linear sets of discrete spots, which were somewhat more widely spaced than if they had been produced by α-particles. The emulsion was sensitive to a number of the particles the residual range of which in air was less than 2 cm. The results with disintegration protons were less satisfactory, and were qualitative rather than quantitative, but a number of records were made with retrograde particles, which, it is claimed, support the general contentions of the Vienna school, and show in particular that the carbon nucleus can be disrupted.

THE ELECTRON THEORY OF METALS.—In an article in *Die Naturwissenschaften* of Oct. 14, Prof. A. Sommerfeld points out that if Fermi's system of quantum statistics is adopted, the free electrons in a metal at room temperature are equivalent, so far as departure from classical theory is concerned, to a molecular gas which is almost at the absolute zero, and that this hypothesis leads to important modifications of the expressions for several of the properties of metals. A conspicuous success of the application of this principle is the deduction of the Wiedemann-Franz relation between the electrical and thermal conductivities, with a factor of proportionality which is much closer to that found experimentally than that predicted by Prof. Lorentz for a Maxwellian distribution of energy. The constants of the thermo-electric circuit also prove to be at least of the right order of magnitude, although the formulæ from which they are obtained are very different from those used perviously, but the Volta series is the reverse of that found in practice. Prof. Sommerfeld considers that the weak point in his theory is the assumption—which is also inherent in most of the older work—that the mean free path is a purely geometrical quantity, determined by the space-lattice, but that in spite of this, the application of the new system of statistics has removed a number of discrepancies between theory and experiment, and should be capable of extension to other phenomena, amongst which he includes tentatively ferromagnetism.

PERMALLOY SUBMARINE CABLES.—The use of permalloy, a material of high magnetic permeability, as a covering for the copper conductor of a long submarine cable has multiplied the signal speed attainable nearly ten times. In a paper by Mr. J. J. Gilbert, published in the *Bell System Technical Journal* for July, the results of laboratory experiments to determine the 'constants' of the lines prior to laying are described. When it is remembered that the actual cable when laid is subjected to a hydrostatic pressure which sometimes exceeds 10,000 pounds per square inch, it will be evident that measurements of the characteristics of the cable when subjected to this stress can only be made in the laboratory on a very small scale. The properties of the dielectric are affected by the pressure, and it is probable that the permeability of the permalloy is also affected. It is found that measurements of the capacity of the laid cable and the damping of the signals and their time of propagation, supplemented with laboratory measurements of eddy current losses, are sufficient to determine the four constants assumed in the mathematical theory, provided we know the relative resistances of the return paths for the signals in the sea water and in the armouring of the cable respectively. The experimental results make it highly probable that the electrical conductivity of the earth at the bottom of the sea is very much smaller than that of sea water. Experiments on three laid cables are described, and the methods of computing their constants are discussed.

INCREASING THE LIFT OF AN AEROFOIL.—The work recently described by Prandtl before the Royal Aeronautical Society has apparently stimulated research of a very practical kind at Government research stations in Great Britain. Prandtl has shown that the state of flow behind a body moving in a fluid may undergo enormous change by withdrawing some of the fluid in the rear of or on the boundary of the body when turbulence is setting in. In aerofoils it is very important if possible to increase the maximum lift coefficient. This has been effected to some extent by the use of the Handley Page slot, whereby stalling is delayed to a much larger angle of incidence, and hence increased lift is obtained. It is known that the stall occurs when the stream lines break away from the upper surface of the aerofoil as a result of a reduction in energy under the viscous forces. In R. and M. No. 1100, on "Wind Tunnel Experiments on the Effect on the Maximum Lift of withdrawing and discharging Air from the Upper Surface of an Aerofoil," by Perring and Douglas (London: H.M. Stationery Office, 1927. 6*d*. net), some experiments on an aerofoil are described where the air is discharged or removed from its upper surface. The aerofoil was fitted with slots along its span and provided with a means for measuring lift while air was discharged or withdrawn through these slots. By discharging air tangentically along the upper surface from a point near the leading edge a considerable increase in maximum lift is obtained, while a steady improvement occurred as the quantity of air discharged was increased. Similar results were obtained when the air was discharged into the aerofoil. The effect was dependent principally on the quantity of air concerned, and only to a minor extent on its velocity through the slot. The position and shape of the slot appear in this investigation to be very important, and better results are likely to be obtained in the near future. The importance of this investigation can scarcely be overestimated, and if successful, it provides a striking illustration of the application of model hydro-dynamic experiments to full scale practice.

A New Theory of the Cast Irons.

OF the papers submitted to the Iron and Steel Institute at its recent meeting on Sept. 20-22 in Glasgow, one at any rate stands out as a contribution of far more than usual interest. Carbon may exist in the unhardened irons and steels in the free state, in all probability as graphite, or combined with the iron as the carbide Fe_3C. In the steels the latter form is almost invariably the one present, while in the grey irons it is graphite. The relationship of these two forms has been by no means cleared up, though in general it has been assumed that in the stable condition the solid material would contain the carbon in the graphitic form, the carbide being a metastable constituent. This is represented in thermal equilibrium diagrams by superposing the one for the graphitic metal upon that for alloys containing carbide. This double diagram has been admittedly incomplete and unsatisfactory, and a noteworthy contribution is made to the subject by Prof. D. Hanson, who, on both experimental and theoretical grounds, now offers a single diagram in which phase fields are deliminated in which both types of carbon are to be found.

The most generally accepted diagram, that in which both the iron–carbon and the iron carbide equilibria are independently shown suggested by Roozeboom, Benedicks, and others, is shown in Fig. 1.[1] Graphite is represented as the stable phase at all temperatures below the solidus, and the dotted lines in the figure represent, therefore, the graphite equilibrium. Alternatively, Rosenhain has suggested that the carbide equilibrium is the stable one. Prof. Hanson has now considered the results which would follow from a change over from one system to the other as the temperature is varied. If, for example, graphite is the stable form at temperatures up to, say, 1000° C. and carbide stable at higher ones, then the dotted line separating the austenitic phase from one in which free graphite or carbide also exists must cross the ordinary cementite line at that temperature, and thence onwards up to the solidus will lie to the right. As a result, a type of diagram similar to that of Fig. 2 will be found. It is, perhaps, right to point out that although the advance copy of Prof. Hanson's paper does not refer to the fact, some such suggestion has already been put forward by Honda.

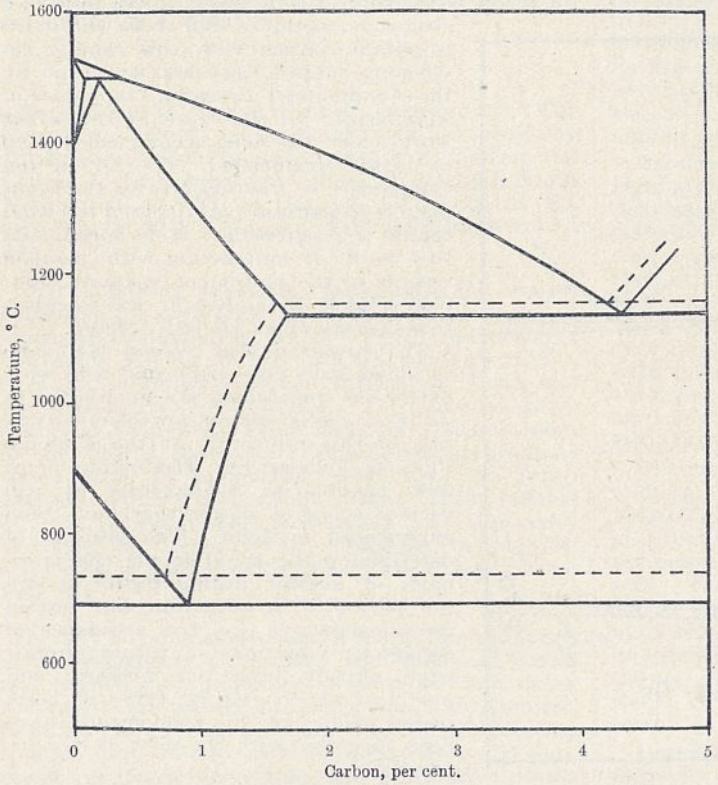

FIG. 1.[1]

The normal cast irons and steels are not, however, pure binary alloys and represent sections through at least a ternary model, silicon being for the present purpose the most important addition. Where the amount of this is insufficient to cause the introduction of a new phase its effects upon a diagram such as Fig. 2 are considered, and in the light of the experimental evidence obtained, it is shown that these results can be represented completely by a diagram of the form of Fig. 3 and by no other.

It is yet too early to say how completely the new hypothesis and diagram fit in with all the established facts regarding the relationships of iron, graphite, and carbide.

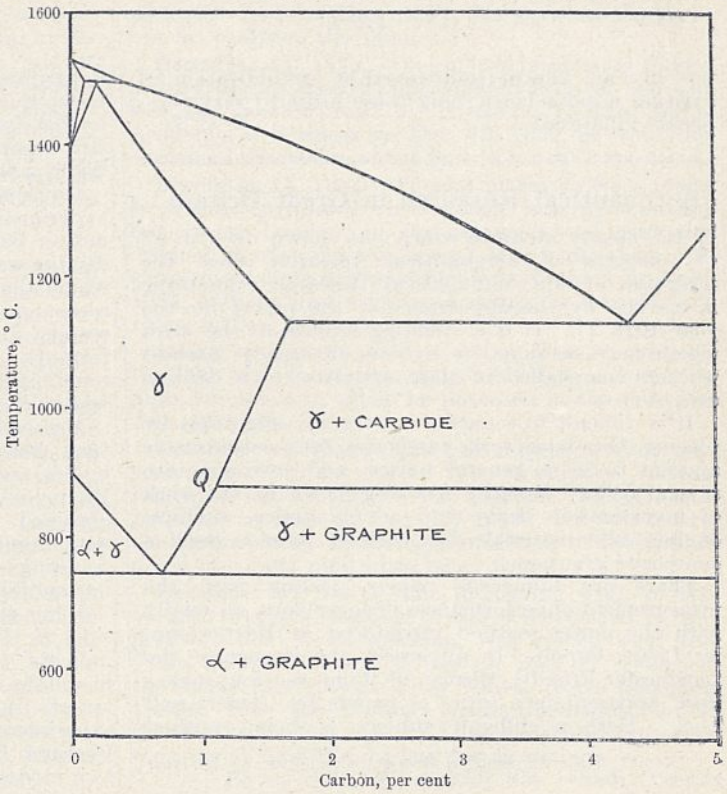

FIG. 2.

[1] This and the other illustrations are reproduced by courtesy of the Iron and Steel Institute.

Certain facts regarding the presence of graphite in carbon steels, particularly those which have been cold worked, do not appear to be altogether in accord with the new ideas, but this is probably merely a question of the exact position of the limits of the phase fields. To Dr. Hanson the credit is due for opening up

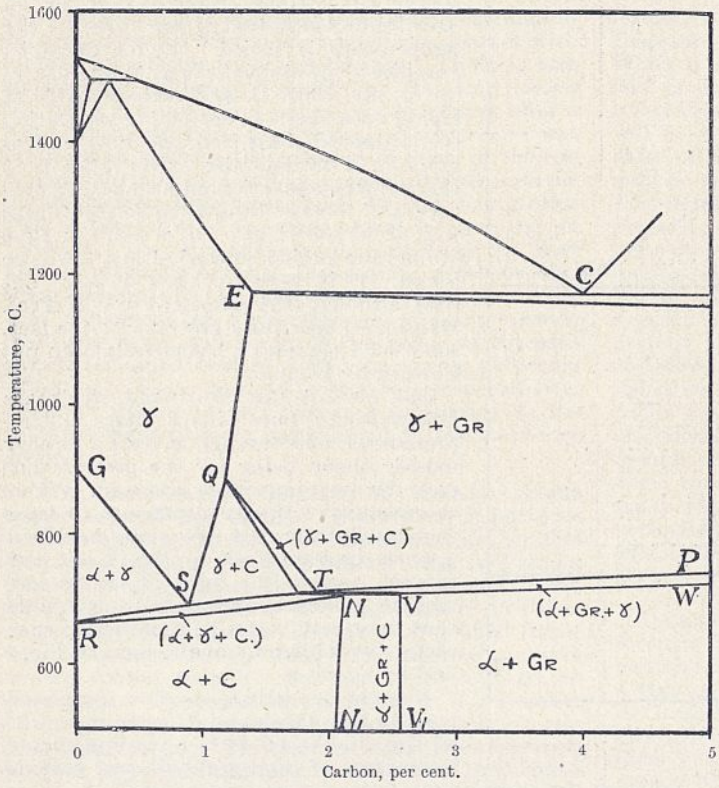

FIG. 3.

possibly an almost undreamed-of simplification of existing notions concerning these hitherto very complicated materials. F. C. T.

Aeronautical Research in Great Britain.[1]

THE steady advance which has shown itself in all aspects of aeronautical research since the inception of the Aeronautical Research Committee is marked by the appearance of the report for the year 1926–27. It is a standing tribute to the work which may be done by a team of steady, earnest workers marshalled in their activities to a definite end.

It is difficult to separate out the investigations by placing them in separate categories, for a considerable amount is of a general nature and overlaps into several fields. Broadly speaking, however, the work of investigation deals with aerodynamics, airships, engines, and materials, but each of these is itself a composite group.

There are numerous papers dealing with the measurement of performances of aeroplanes, especially with the newer method introduced at Martlesham, by Lieut. Capon. In air-screws the impact of the Lanchester-Prandtl theory of fluid motion makes itself apparent in a series of papers by Glauert and Lock. Here a difficult subject is being pushed several stages further. A problem to which members of the research staffs concerned have devoted close study is that of generation and avoidance of spinning in aeroplanes, and this year sees the production of a considerable volume by Gates and Bryant, where the whole of the subject is discussed in the form of a special monograph. For those who strive to retain contact with this rapidly developing subject, this new departure by the Aeronautical Research Committee of summarising in this form at stages the work which has been accomplished is to be highly commended. The further development of the subject by the complete representation of a spin in the wind tunnel is progressing. It is hoped that this work, in conjunction with detailed records of the motion of spinning aeroplanes taken at the R.A.E., will elucidate those points which are still obscure.

The suspicion that recent aeroplane accidents have been associated with wing flutter has constrained the Committee to set up a special section for the investigation of this problem. At the National Physical Laboratory, Teddington, it is now possible to demonstrate at will various types of flutter that have been experienced in flight. The problem of determining the aerodynamic characteristics of aircraft during flutter is still the subject of investigation, but certain recommendations for the avoidance of dangerous vibrations in future aircraft have already been put forward, and modifications to existing types of aeroplanes exhibiting this phenomenon have been suggested with the view of its suppression.

A new departure is seen in the development of a tailless aeroplane by Captain Hill. While various experimental difficulties had been experienced with the lightly loaded aeroplane of this type, these have now been overcome, and some development may be looked for in the near future. It is reported that this aeroplane is quite stable and controllable in flight at large angles of incidence.

On the purely scientific side, some interesting experiments are detailed on the two-dimensional airflow behind a flat plate inclined at various angles. Studies are made of the frequency and velocity with which the individual vortices pass down stream and measurements are made of vortex strength. The results show a very fair agreement with Karman's formula, the longitudinal spacing of the vortices remaining constant for a distance of several plate widths down wind.

Meanwhile, at Cambridge, an experimental water-tank has been erected, in which two-dimensional bodies are towed through water. By this means a Reynolds' number of approximately 10^4 has been obtained, and it is hoped to produce results shortly with numbers so high as 5×10^5. Thus an approach is being made to the corresponding number for normal flight, namely, 3×10^6.

While stress has here been laid on the aerodynamic side of this year's report, this is done merely to indicate the kind of advance which shows itself in all the other sections under the influence of systematic and co-ordinated research work. As an experiment in organised research, the Aeronautical Research Committee may in many respects be taken as a model.

[1] "Report of the Aeronautical Research Committee for the [year 1926–27." (London: H.M. Stationery Office, 1927.) 2s. net.

University and Educational Intelligence.

CAMBRIDGE.—Mr. W. Dawson, Gonville and Caius College, has been re-appointed reader in forestry. Mr. T. M. Harris, Christ's College, has been appointed demonstrator in botany.

A COURSE of twelve Swiney lectures on "The Geological History of Scotland" will be given by Dr. R. Campbell in the lecture theatre of the Imperial College of Science (Royal College of Science), South Kensington, at 5.30, on Dec. 12, 14, 16, 19, 21, 23, and Jan. 2, 4, 6, 9, 11, and 13. Admission will be free.

THE following travelling fellowships for women graduates, for the academic year 1928–29, are included among those announced by the British Federation of University Women, Crosby Hall, Cheyne Walk, S.W.1, from the secretary of which application forms and regulations may be obtained: The Rose Sidgwick Memorial Fellowship, value £400, for research work in the United States, to a British woman graduate (latest date of application, Feb. 15). An International Junior Fellowship, value £250 (offered by the International Federation of University Women), for research in biological or physical science, or in mathematics (latest date of application, Feb. 15).

IT may be remembered that a committee composed of representatives of teaching and industrial bodies and learned institutions was formed in 1925, under the chairmanship of the late Right Hon. Lord Emmott, to inquire into the relationship of technical education to other forms of education and to industry and commerce. A report embodying some of the chief results of the committee's investigations was discussed at a meeting held in the Regent Street Polytechnic, London, on Nov. 18, under the chairmanship of Sir Robert Blair. The report was approved, and it was agreed that it be submitted to the President of the Board of Education. The following deputation was appointed to wait upon the President of the Board of Education in this connexion: Sir Robert Blair, Sir Benjamin Gott, Mr. W. Prescott (Federation of British Industries), and Mr. J. Wickham Murray.

THE annual meeting of the Geographical Association will be held at the London School of Economics, Houghton Street, London, W.C.2, on Jan. 4-9. Dr. Vaughan Cornish will deliver his presidential address, "Harmonies in Scenery," on Jan. 7; the address will also be broadcast from 2LO by Dr. Vaughan Cornish on Jan. 9. Lectures have been arranged by Dr. Marion I. Newbigin on the geographer and the study of climate (Jan. 5), Sir John Russell on Palestine and its agricultural possibilities (Jan. 5), Prof. Rodwell Jones on the prairie provinces of Canada (Jan. 6), and Sir E. Humphrey Leggett on economics and administration in British East Africa (Jan. 7). On Sunday, Jan. 8, the Rev. Canon C. S. Woodward will preach at Evensong in Westminster Abbey on "International Relations in the light of Geographical Science." Visits to the Imperial Institute and to demonstrations of educational films are being arranged, and a publishers' exhibition will be open on Jan. 5-7. All communications regarding the meeting should be addressed to the honorary secretary, Prof. H. J. Fleure, 11 Marine Terrace, Aberystwyth.

Calendar of Discovery and Invention.

December 11, 1691.—Prior to the use of steam for pumping engines, experiments were made on the employment of gunpowder for the production of motive power. In the "Calendar of State Papers" is the following entry: "Decr. 11th, 1691.—Warrant for a grant to Sir Samuel Morland of the sole use for 14 years of his invention for raising water out of pits, etc., to a reasonable height, by the force of powder and air conjointly."

December 11, 1863.—In 1838 two English chemists, Dyar and Hemming, patented a process for producing carbonate of soda by the action of ammonium bicarbonate upon sodium chloride, but all attempts to manufacture by this process failed until the Belgian chemist, Ernest Solvay, devised modifications in it which were patented by him in England on Dec. 11, 1863. With his brother Alfred, Solvay started works near Brussels in 1866. In 1873 a licence was granted to Brunner and Mond, and by 1914 there were throughout the world 23 separate works engaged in the Solvay ammonia-soda process capable of producing nearly 2,000,000 tons of soda-ash annually.

December 12, 1901.—It was on Dec. 12, 1901, in a room in a disused barracks on Signal Hill, St. Johns, Newfoundland, that Senatore Marconi heard faintly in a telephone the groups of three dots, constituting the morse letter *S*, transmitted from Poldhu in Cornwall. The detector used was a self-restoring coherer and the aerial a thin wire carried to a height of 400 feet by a kite. One feature of the experiment was that its success disproved the theory then widely held, that the transmission of radio signals over great distances would be impossible owing to the curvature of the earth.

December 14, 1874.—On this day Cornu communicated to the Paris Academy of Sciences the result of his redetermination of the velocity of light. His methods were fundamentally the same as Fizeau's, but his precision was greater.

December 15, 1859.—One of the landmarks in the history of the spectroscopic examination of the sun was the memoir read by Kirchhoff to the Berlin Academy of Sciences on Dec. 15, 1859, in which he explained the nature of the lines in the solar spectrum.

December 15, 1904.—Though attempts were made from time to time to elect women into the Linnean Society of London, it was always found that the original charter did not permit this being done. A supplemental charter was therefore obtained in April 1904, and the first election of women as fellows took place on Dec. 15 of that year.

December 16, 1883.—To Gottlieb Daimler we owe the first high-speed internal combustion engine with high compression, which he patented in Germany on Dec. 16, 1883.

December 17, 1849.—The well-known form of pressure gauge with the curved tube of elliptical section was invented by the French engineer Bourdon and patented by him on Dec. 17, 1849. He was led to the invention by observing the motion of the end of a coil of copper pipe when being tested.

December 17, 1903.—The pioneering work of the Wright brothers, leading to the construction of the first practical flying-machine, was spread over the years 1896-1903; and it was on Dec. 17, 1903, on the lonely sandhills at Kitty Hawk, North Carolina, U.S.A., that the brothers made their first flights. Orville Wright flew first for 12 seconds, and the same morning Wilbur Wright flew for 59 seconds.

E. C. S.

Societies and Academies.

LONDON.

Geological Society, Nov. 16.—W. D. Lang, L. F. Spath, L. R. Cox, and Helen Marguerite Muir-Wood: The belemnite-marls of Charmouth, a series in the Lias of the Dorset coast. Pale marls, lying in the Lias above beds with Echioceras and below those with Androgynoceras, extend along the Dorset coast for about four miles. Forming the third, and highest, Lias precipice on Black Ven, they are soon truncated by the eastern slope of that cliff, but reappear eastwards to form the second precipice at the western end of Stonebarrow Cliff. They descend to the beach at Westhay Cliff, and form a gentle syncline, so that the lowest beds are carried beneath the tide opposite Westhay Water. They rise for a short distance on Ridge Cliff, but soon are thrown down and out of sight by the Ridge Fault. Thereafter only the highest beds of the belemnite-marls are seen. The marls contain few beds in which ammonites are well preserved. Ammonite-remains, however, are to be found throughout, and although the preservation is often poor, a sequence has been established. Except at a few horizons, belemnites are not common below the belemnite-marls; but they abound in the marls, and, if the outstanding forms are carefully collected, they show, like the ammonites, limited ranges and a crowded sequence. The gastropod molluscs are few in number of species and not suitable for showing zonal distribution. The same may be said of the lamellibranchs. The ammonites are only of local value in establishing a sequence.

Royal Meteorological Society, Nov. 16.—C. E. P. Brooks: The influence of forests on rainfall and run-off. Of the water vapour which is condensed as rainfall over the land, about two-thirds is provided by evaporation over the oceans, and the remaining third by evaporation and transpiration over the land. The latter contribution is made up of the evaporation of rainfall intercepted by foliage, evaporation from the soil, and transpiration. As percentages of an average rainfall of 30 inches a year, the amounts are: (*a*) for forests: interception 15, evaporation from soil 7, transpiration 25; (*b*) for crops: evaporation from soil 17, transpiration 37; (*c*) for bare soil: evaporation 30 per cent. Thus replacement of forests by crops tends to increase the supply of moisture to the air, and therefore the general rainfall slightly; replacement by bare soil would decrease the general rainfall slightly. Replacement of forests by crops would decrease the run-off by 15 per cent. and make it less regular; replacement by bare soil would increase the run-off but would make it highly irregular. A forest 30 feet high adds about 30 feet to the effective height of the ground, and this should increase the local orographical rainfall by one or two per cent. At Mauritius, deforestation has resulted in a decrease by two or three per cent., while in Sweden, Germany and India the rainfall at forest stations is about one per cent. greater than that at neighbouring stations in the open. Under average conditions the total effect of fog and dew is slight.—C. K. M. Douglas: The secondary depression on the night of January 28-29, 1927. The discontinuities associated with this intense and deepening secondary depression were examined in detail by means of autographic records at a number of stations. About 70 miles behind the first cold front there was a 'dry front,' with a rise of temperature and sharp fall of relative humidity, separating air kept cold and damp by the rain, and air behind the rain area which had been warmed at the dry adiabatic rate when it descended. Near the centre of the secondary depression a 'secondary warm sector' was developed after the original warm sector was 'occluded,' *i.e.* displaced entirely from the lower layers of the atmosphere.—E. Kidson: The circulation of the atmosphere over Melbourne. It is possible to obtain estimates of wind velocity at high levels by means of nephoscope observations with accuracy sufficient at least for most purposes. No other means is at present available for securing a comparable amount of data for the same levels in a climate such as that of Melbourne. These upper winds are freed from the purely local effects, though large-scale local effects are still of great importance.

Linnean Society, Nov. 17.—N. E. Brown: The South African species of Iridaceæ in Thunberg's herbarium. Carl Pehr Thunberg was born in 1743, and in due course became a pupil of Linné, and afterwards professor of botany at Upsala. He sailed from Europe on Dec. 30, 1771, and landed at Cape Town on April 17, 1772, the journey occupying fifteen weeks. Thunberg stayed in South Africa nearly three years, and sailed to Java on Mar. 2, 1775. During his stay he made three extensive journeys, and in two of them was accompanied by Francis Masson, who was sent to collect living plants for the Royal Botanic Gardens at Kew. Thunberg sent or brought back from the Cape a large collection of dried plants and described them in numerous separate pamphlets and in his "Prodromus Plantarum Capensium" and "Flora Capensis."—A. W. Exell: Some hybrids of *Cotoneaster frigida* Wall. Various hybrids of *C. frigida* Wall. have arisen at the Bagshot nurseries of Messrs. Waterer, Sons and Crisp. One or two of these are of considerable horticultural value.—George Matthai: Exhibition of photographs and drawings of recent Meandroid Astræid corals. The photographs represent nearly all the known species of recent Meandroid Astræids, and refer to material collected from the Indo-Pacific (including the Red Sea) and the Atlantic regions as well as to type-specimens in the European and American museums. They were taken with the view of showing the probable limits of genera and species, the range of skeletal variation within each species, the appearance of the soft parts and of stages in the growth of colonies, and illustrate, for the first time, many of the types of previous authors. The drawings are illustrative of the histology of polyps after decalcification, and have been made from serial sections. The plates will accompany a forthcoming monograph in which a revised classification of the group is made from a comparative study of their hard and soft parts and of existing type-specimens.

CAMBRIDGE.

Philosophical Society, Oct. 29.—G. C. Steward: On the lens interferometer. The lens interferometer offers a method of examining the aberrations of an optical system by means of the interference fringes given by a wave of light which has passed through the system—which therefore is distorted by the aberrations impressed upon it—and an 'ideal' wave which would be given by a 'perfect' system. An examination is made of the various types of fringes to be expected in the presence of the different geometrical aberrations of the symmetrical optical system. The basis of the investigation is an 'aberration function,' previously introduced, associated with the characteristic function of Hamilton. This aberration function sums up in itself all the geometrical aberrations of the optical system and depends upon these aberrations alone.—J. A. Gaunt and W. H. M'Crea: The emission of radiation by a quadripole electric moment on the quantum mechanics. Dirac's quantum mechanical

theory of dispersion is adapted to calculate the radiation from the quadripole moment of a system. It is applied to the quadripole radiation of a Planck oscillator ($\Delta n = 2$) and to the case of a rotating rigid homopolar diatomic molecule.—G. H. **Aston**: The amount of energy emitted in the γ-ray form by radium E. A method of finding the order of magnitude of the small amount of energy emitted in the γ-ray form by radium E is given. The method involves a comparison of the ionisations of the γ-rays of radium E, radium B, and radium C. The energy is also estimated in another manner, and the two methods agree in showing that the γ-ray energy is of the order of 1 per cent. of the β-ray energy, *i.e.* about 3000 volts per atom disintegrating. Only one γ-ray quantum is emitted in about thirty disintegrations, and it is suggested that this γ-radiation has a continuous spectrum.—W. H. **M'Crea**: (1) The specific heat of water vapour and the theory of the dissociation of water vapour at high temperatures. The elementary (quantum) theory of the specific heat together with dissociation accounts quite satisfactorily for the observed specific heat of steam. The dissociation theory is applied in such a manner that it also checks the observed values of the dissociation and enables one to estimate certain molecular constants from them. The range of temperature considered is about 100° C.–2000° C. (2) The specific heat of carbon dioxide and the form of the CO_2 molecule. Neither the linear nor the triangular model hitherto given for the carbon dioxide molecule accounts properly for the observed specific heat curve. A hypothesis on which the molecule changes from the first to the second form when a certain vibration becomes excited is suggested. It gives better agreement for the specific heat and seems to explain some anomalies of the band spectrum. The effect of the interaction between vibration and rotation on the specific heat at high temperatures is considered.

PARIS.

Academy of Sciences, Nov. 7.—H. **Deslandres**: Contribution to researches on the secondary spectrum of hydrogen and also on other spectra. The strongest bands of this spectrum appear to be due to the molecule H_3, already proved to exist by J. J. Thomson with the mass spectrograph.—C. **Matignon** and J. **Calvet**: The chemical properties of pure aluminium. Commercial aluminium, purified by Hoope's electrolytic method, contains from 99·8 per cent. to 99·98 per cent. of aluminium. Solutions of caustic soda attack commercial and purified aluminium similarly, and the two cannot be distinguished by attack with this reagent. The purified metal, however, is very resistant to attack by hydrochloric acid (2·65 normal).—Pierre **Termier**: Some results of the Congress of the Carpathians Association held at Bucharest in September 1927.—A. **Kolmogoroff**: The law of large numbers (theory of probabilities).—R. **Risser**: A formula representing the living population. A modification of Altramare's formula on the probability of life.—B. **Gambier**: Contact of skew curves. The theorem of Meusnier and generalisations. The intrinsic equation of a surface.—Richard **Birkeland**: A general proposition on hypergeometric functions of several variables.—**Mandelbrojt**: A recent work of Widder and Gergen.—Edm. **Lahaye**: The application of a new method of integration to the equations $y' = R(x, y)$ where R is rational in y.—Félix **Leprince-Ringuet**: The properties of wire cables [pit shaft] deduced from statistics, trials, and results obtained in use.—J. **Grialou**: Plane vertical rotational movement of perfect liquids. Flow through an orifice.—Th. **de Donder**: The problem of n bodies in the theory of relativity.—Georges Henri **Huber**: The influence of surfaces of atmospheric discontinuity on the propagation of short [radio] waves.—J. **Risler**: The phenomena of gas absorption and equilibrium of pressure in lamps without filament. The introduction of a small quantity of anthraquinone into a two electrode valve, used as a rectifier, maintained a pressure of about 0·1 mm. The efficiency of the rectifier remained steady for several hours.—C. **Mihul**: The structure of the spectrum of O II.—Emilio **Damour** and A. **Thuret**: The determination of the temperatures of commencement of fusion and of tempering of industrial glass.—Vasilesco **Karpen**: Batteries with non-attackable electrodes.—G. **Athanasiu**: The radioactivity of the warm springs of the Bains d'Hercule, Roumania.—Fred **Vlès** and Mlle. Madeleine **Gex**: The optical properties of sulphonecyanine in different saline solutions and their application to the comparison of salts.—L. **Abonnenc**: The surface tension of aqueous solutions of acids.—Mlle. M. **Pernot**: The system mercuric iodide, potassium iodide and water. No evidence has been obtained of the salt $HgI_2 2KI \cdot 2H_2O$. The only crystalline species indicated by the diagram is HgI_2KI, H_2O.—Ch. **Quillard**: Measurement of the oxidisability of aluminium and its commercial alloys after activation with mercuric chloride. The metals were treated with mercuric chloride solution, washed, rapidly dried, introduced into a calorimeter and the rise of temperature noted. It is shown that the method will serve for the rapid differentiation of aluminium alloys from the point of view of their corrodibility.—Amand **Valeur** and Paul **Gailliot**: The mechanism of the reactions accompanying the formation of Cadet's oil. The effect of heating a mixture of potassium acetate and arsenious acid gives a complex liquid the starting-point of which may be regarded as methylarsenic.—E. **Raguin**: Antestephanian transport phenomena in the substratum of the crystalline strata of the great coal ridge of the French Central Plateau.—G. I. **Verescagin**: New studies of Lake Baikal.—Joseph **Lévine**: The rôle of ozone in the atmosphere.—Henri **Coupin**: The nitrogen nutrition of *Penicillium glaucum*.—Pierre **Lesage**: The precocity and final yield in the thermobiology of plants and variations with latitude.—Lucien **Daniel**: The variations of descent in grafted Jerusalem artichokes.—Costantino **Gorini**: Dysgenesic milks.

CALCUTTA.

Asiatic Society of Bengal, Nov. 7.—H. Bruce **Hannah**: Indian origins. It is suggested that the old Dasyus of Sapta Sindhavah introduced Nature worship into northern India in Vedic times; that they became the Brahmans of Kuruland; that Taxila was a city of theirs; and that the 'finds' recently made at Harappa and Mohenjo-Daro were Dasyuan and have nothing to do with Sumer.—W. **Ivanow**: Notes on Khorasani Kurdish.—Mrs. C. **de Beauvoir Stocks**: The Khyber Hazari. This tribe inhabits the Lolab valley in Kashmir, but their original home is in the Hazara district to the east of Afghanistan.—R. D. **Banerji**: The Indian affinities of Ainu potteries. Three types of Ainu pottery discovered among the shell mounds of the sea coast of north-eastern Japan and preserved in the Museum Shoshu-Kan, show a marked resemblance to Indian prehistoric pottery of the Copper Age. The first of these is a suspension vessel, numerous examples of which have been discovered in Baluchistan, Mohenjo-Daro and Harappa. The second is a 'wine cooler.' Such vessels with handles have been discovered in Japan and Baluchistan and without handles in Taxila and Baluchistan. The third type is a bird-shaped vase, numerous examples of which have been discovered at Mohenjo-Daro and Harappa. It resembles the famous dove-vase from

Knossos.—D. N. **Majumdar**: A few types of Ho Songs.—C. J. **George**: South Indian Aphididae. The results of a preliminary survey of the aphid fauna of South India, with special reference to the species found in the neighbourhood of Coimbatore, is given. This is a first step towards devising control measures against plant lice in those parts.

ROME.

Royal Academy of the Lincei: Communications received during the vacation.—J. **Hadamard** and E. **Landau**: Entire functions of finite species.—C. **Foà**: The neurochemical mechanism of vagal inhibition in the heart of mammifers. Further experiments show that, in the heart of mammifers, vagal inhibition is accompanied by liberation of a substance of inhibiting effect, and that this is probably destroyed rapidly in the texture of the myocardium where it is produced and does not pass into the coronary reflux circuit unless the conditions of permeability of the cardiac fibre are altered, for example, by sprinkling the isolated heart with Ringer-Locke solution.—A. **Russo**: Attenuation of the sexual power of the impure gametes which accomplish the second accessory conjugation in *Cryptochilum echini*.—L. A. **Herrera**: Imitation of organised forms by means of sodium stearate. Further experiments, with ordinary petrol and sodium stearate, confirm the importance of the fatty acids in morphogenesis.—R. **Caccioppoli**: Multilinear and higher degree functionals.—G. **Krall**: Infinitesimal variation of Green's functions relative to pluri-connected plane fields.—R. **Mazet**: Complements to a note on the oscillation of a liquid in communicating vessels.—G. **Thomsen**: The rotation of the earth in relativistic mechanics.—A. **Merola**: Photometric observations of the new variable in the constellation Auriga.—M. **Baruzzi**: Periodic courses of the mean diurnal temperature at Modena.—F. **Eredia**: The resultant direction of the wind at various altitudes deduced from observations of pilot balloons at Vigna di Valle (Bracciano).—F. **Rasetti**: The intensity of a prohibited potassium line. Investigation of the anomalous dispersion by Puccianti's method gives for the doublet $4^2S - 3^2D$, λ4642, of the potassium spectrum a number of dispersion electrons one million times less than for the first doublet of the principal spectral series, λ7665, 7699.—A. **Ferrari**: Crystalline structure of the bivalent chlorides: Anhydrous cobalt and nickel chlorides. These chlorides exhibit the same structure as magnesium chloride, being rhombohedral and pseudo-cubic. The rhombohedra constituting the elementary cells contain 16 molecules and have for a the following values: $MgCl_2$, 10·16; $CoCl_2$, 10·02; $NiCl_2$, 10·00 A. The calculated densities are respectively 2·41, 3·43, and 3·45.—L. **Mascarelli**: Contribution to the knowledge of diphenyl and its derivatives. Interpretation of the phenomena of optical isomerism. Of various diphenyl derivatives examined, only 2 : 2′-diamino-6 : 6′-dimethyldiphenyl appears to be resolvable into optical antipodes. This compound was obtained by treating 2-iodo-3-nitrotoluene with powdered copper and reducing the resultant 2 : 2′-dinitro-6 : 6′-dimethyldiphenyl. Under the action of d-tartaric acid it gives a sparingly soluble salt which is converted by ammonia into a lævorotatory isomeride of the original compound.—A. **Desio**: The Miocene molluscs of Porto Bardia and of the oasis of Giarabub.—M. **Piazza**: The presence of scorodite in certain tungsten minerals of Portugal.—E. **Sereni**: Investigations on the chromatophores of the cephalopods. Experiments on *Octopus vulgaris*, *Eledone moschata*, *Loligo vulgaris*, *Sepia officinalis*, *Sepiola elegans*, etc., show that, with gradual heating, a certain exaltation of the pulsatory activity of the chromatophores often appears between 25° and 30°, this being followed, at 37°-39°, by a general and reversible expansion. On the other hand, on cooling, complete retraction of the chromatophores is observed between 10° and 5°, and evident diminution of the electrical excitability below 5°. The chromatophores exhibit only slight sensitiveness to variations of the osmotic pressure. As regards the influence of various cations, both the alkali metals and those of the alkaline earths have a contracting effect; with the former, this is greatest for potassium and least for sodium, and with the latter, greatest for barium and least for magnesium.—G. **Cotronei**: Time of development of the humoral-nervous correlations. Investigations on amphibia.

SYDNEY.

Linnean Society of New South Wales, Aug. 31.—J. R. **Malloch**: Notes on Australian Diptera (12). This part deals with the family Tachinidæ. Two new genera and four new species are described. Keys to genera and species are given with many useful notes.—I. M. **Mackerras**: Notes on Australian mosquitoes (Diptera, Culicidæ). Part 2. The zoogeography of the subgenus Ochlerotatus with notes on the species. In this part, evidence is brought forward to support the opinion that both groups of this subgenus of Aedes colonised Australia from South America, one entering this country from the north and the other from the south. A key to adult females is given and the status of the various species is discussed. One species and one variety are described as new.—A. G. **Hamilton**: The xerophytic structure of the leaf in the Australian Proteaceæ. Part 1. The author gives a general account of the methods adopted by the Proteaceæ to lessen transpiration, and points out that several recognised devices are not found in the order, as leaflessness, bloom, wax or varnish, hygroscopic salts, and ethereal oils. Hairiness, too, is not developed to the extent it is in the South African Leucadendron, although many of the Grevilleas and Banksias have densely hairy undersides to the leaves. The conditions leading to xerophylly are discussed, and the view expressed that the main factor is the edaphic conditions. From the fact that favourable conditions do not lead towards the mesophytic form, it is surmised that the xerophytic characters have been so long fixed that no alteration is possible. The structure of the flat-leaved Hakeas is then described, several remarkable modifications being noted. One of the most striking features is the enormous development of sclerenchyma (columnar, detached masses, and fibrous).—G. A. **Waterhouse**: Australian Hesperiidæ. Part 1. Notes and new subspecies. In this paper an alteration of the sequence of the genera in the subfamily Trapezitinæ is given, a new species allied to *Hesperilla crypsargyra* is described and figured, new subspecies of *H. donnysa* and *H. chrysotricha*, and the hitherto unknown female of *Toxidia crypsigramma* are described and figured.

Royal Society of New South Wales, Oct. 5.—R. H. **Cambage**: The vertical growth of trees (2). Nails were placed one foot apart in young trees of various species of Eucalyptus, Angophora, Acacia, and Grevillea. From four to eleven nails were inserted, and though some trees increased their length by 50 per cent. in five years, and one by 160 per cent. in one year, there was practically no extension of the stem up to the highest nail, but the trees grew from the summit or growing-point.

Official Publications Received.

BRITISH.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 20: The Influence of Separation and Pasteurisation on the Size and Distribution of the Fat Globules in Milk and Cream. By Dorothy A. Beckett. Pp. 303-317+1 plate. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Department of Agriculture, Jamaica. Entomological Bulletin, No. 4, Parts 1 and 2: Catalogus Insectorum Jamaicensis. By C. C. Gowdey. Pp. ii+114+xiv+10+ii. (Jamaica, B.W.I.: Government Printing Office, Kingston). 2s.

Treatment of Tuberculosis: Costs at Residential Institutions. (Memo. 122A/T.) Pp. 21. (London: Ministry of Health.)

Melbourne Observatory. Hourly Values of the Magnetic Elements at Toolangi in 1925. Observed and reduced under the direction of Dr. J. M. Baldwin. Pp. vii+37. (Melbourne: H. J. Green.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 33: The Possibilities of Power Alcohol and certain other Fuels in Australia. By G. A. Cook. Pp. 106. (Melbourne: H. J. Green.)

British Photographic Research Association. Report for the Year 1926-27. Pp. 15. (London.)

Proceedings of the Society of Psychical Research. Part 103, Vol. 36, November. Pp. 515-576. (London: Francis Edwards.) 4s. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 65, No. 371, November. Pp. 977-1024+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Government of India: Department of Industries and Labour (Public Works Branch). Irrigation in India: Review for 1925-26. Pp. 10+37. (Simla: Government of India Press.)

The Lancaster Astronomical and Scientific Association. Annual Report, June 1927, Session 1927-1928. Pp. 27. (Lancaster.)

The Proceedings and Transactions of the Nova Scotia Institute of Science, Halifax, Nova Scotia. Vol. 17, Part 1, Session 1926-1927. Pp. ix+107+iii. (Halifax, N.S.)

The Merseyside Aquarium Society. Annual Report and Proceedings, First Session, 1926-27. Pp. 22. (Wallasey.)

Bureau of Education, India. Pamphlet No. 24: Notes on Garden Work in a Village Primary School. By A. C. Dobbs and Rai Sahib S. N. Sil. Pp. ii+9+4 plates. (Calcutta: Government of India Central Publication Branch.) 7 annas; 8d.

The Journal of the Astronomical Society of South Africa. Edited by Dr. H. Spencer Jones. Vol. 2, No. 2, October. Pp. 39-88+3 plates. (Cape Town.) 1s.; to non-members, 2s.

Philosophical Transactions of the Royal Society of London. Series B, Vol. 216, B. 431: On the Causes and Ecological Significance of Stomatal Frequency, with Special Reference to the Woodland Flora. By Dr. E. J. Salisbury. Pp. 65. (London: Harrison and Sons, Ltd.)

Aeronautical Research Committee: Reports and Memoranda. No. 1081 (M. 49): The Flexure of Thin Cylindrical Shells and other "Thin" Sections. By L. G. Brazier. (E.F. 175.) Pp. 22+8 plates. 1s. net. No. 1097 (Ae. 276): The Flow of Air and of an Inviscid Fluid around an Elliptic Cylinder and an Aerofoil of Infinite Span, especially in the Region of the Forward Stagnation Point. By A. Fage. (A.3.a. Aerofoils-General, 56a.—T. 2163a.) Pp. 20+2 plates. 1s. net. (London: H.M. Stationery Office.)

Canada. Department of Mines: Mines Branch. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories), 1925. General Review of Investigations. By B. F. Haanel and R. E. Gilmore. (No. 671.) Pp. viii+184+7 plates. (Ottawa: F. A. Acland.)

County Council of the West Riding of Yorkshire. Twenty-third Annual Report of the Education Committee, 1926-27. Pp. ii+105. Handbook of the Education Committee. Part 2, Higher Education, Section 9: Regulations relating to Training of Teachers, 1928. Pp. iv+14. Part 2, Higher Education, Section 10: Regulations relating to Scholarships and Exhibitions, 1928. Pp. iv+50. (Wakefield: Education Department.)

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 29, Part 4, Session 1926-27. Pp. xxv-xxxii+311-445+vii. (Edinburgh.) 7s. 6d.

Memoirs of the Department of Agriculture, Trinidad and Tobago. No. 3: A Catalogue of the Trinidad Lepidoptera Heterocera (Moths). By William James Kaye and Sir Norman Lamont. Pp. viii+144+xv+2 plates. (Trinidad, B.W.I.: Government Printing Office, Port-of-Spain.) 5s.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1926. Pp. iv+37. (Trinidad, B.W.I.) 6d.

The National Institute of Agricultural Botany. Eighth Report and Accounts, 1926-27. Pp. 20. (Cambridge.)

FOREIGN.

Proceedings of the United States National Museum. Vol. 72, Art. 15: The Australian Land Shell, *Thersites bipartita*, and its Allies. By William B. Marshall. (No. 2711.) Pp. 16+3 plates. Vol. 72, Art. 17: On some Terrestrial Isopods in the United States National Museum. By Hans Lohmander. (No. 2713.) Pp. 18. (Washington, D.C.: Government Printing Office.)

Sveriges Geologiska Undersökning. Ser. Ca, No. 19: Die Zoantharia Rugosa von Gotland (Bes. Nordgotland) nebst Bemerkungen zur Biostratigraphie des Gotlandium. Von Prof. Dr. R. Wedekind. Pp. 95+30 Tafeln. 8 kr. Ser. Ca, No. 20: Strässa och Blanka Järnmalmsfält Geologisk Beskrivning. Av Per Geijer. (Summary: The Iron Ore Fields of Strässa and Blanka.) Pp. 48+5 Taylor. 5 kr. (Stockholm.)

Publications of the Astronomical Observatory of the Warsaw University. Vol. 3, Part 2: Determination of Latitude by the Method of Equal Altitudes of Different Stars (Piewzow's Method) and the Corresponding Star-Pairs for Northern Latitudes 20°-40° and for the Epoch 1930.0. Vol. 1: Northern Latitudes 20°-25°. Part 2: The List of Stars. By Prof. M. Kamieński. Pp. 44. (Warsaw.)

Sveriges Geologiska Undersökning. Ser. C, No. 340: Örträsket och dess tappningskatastrofer. Av G. Lundquist. Pp. 56+1 Tavla. 1 kr. Ser. C, No. 341: Jordskalv i Sverige 1919-1925. Av K. E. Sahlström. Pp. 34+1 Tavla. 1 kr. Ser. C, No. 342: Brattforsheden, ett värmländskt randdeltekomplex och dess dyner. Av N. G. Hörner. Pp. 208+2 Tavlor. 3 kr. Ser. C, No. 343: Some Mineral Associations from the Norberg District. By Per Geijer. With Analyses by Artur Bygdén. Pp. 32. 1 kr. Ser. C, No. 344: Ancylus- och Litorinagränser inom geologiska kartbladet Gusum. Av Gunnar Assarsson. Pp. 29+1 Tavla. 1 kr. Ser. C, No. 345: Klassifikation av svenska åkerjordar. Av Gunnar Ekström. Pp. 161. 2 kr. (Stockholm.)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Special Bulletin No. 164: Diagnosing Orchard Ills. By V. R. Gardner, R. H. Pettit, C. W. Bennett and W. C. Dutton. Pp. 70+8 plates. Special Bulletin No. 165: Management Methods in the Raspberry Plantation. By A. H. Teske and V. R. Gardner. Pp. 34. (East Lansing, Mich.)

Berichte der Naturforschenden Gesellschaft zu Freiburg i. Br. Herausgegeben von Prof. Dr. J. L. Wilser. Achtundzwanzigster Band. Erstes Heft. Pp. 238. (Freiburg i. Br.)

Bulletin of the American Museum of Natural History. Vol. 57, Art. 2: Diptera of the American Museum Congo Expedition. By C. H. Curran. Pp. 33-89. (New York City.)

University of Oregon Publication. Geology Series, Vol. 1, No. 2: A Quantitative Mineralogical and Chemical Classification of Igneous Rocks. By Edwin T. Hodge. Pp. iii+133-200. (Eugene, Oregon.) 1.25 dollars.

Proceedings of the United States National Museum. Vol. 72, Art. 1: Description of *Ancylostoma pluridentatum*, a Hookworm of Carnivores, and a Review of the Genus Ancylostoma. By Benjamin Schwartz. (No. 2697.) Pp. 9. Vol. 72, Art. 9: New Species of Two-Winged Flies of the Family Cyrtidae, with a new Genus from the Philippines. By J. M. Aldrich. (No. 2705.) Pp. 4. Vol. 72, Art. 10: Additions to the Upper Cretaceous Invertebrate Faunas of the Carolinas. By Lloyd W. Stephenson. (No. 2706.) Pp. 25+9 plates. Vol. 72, Art. 13: Miscellaneous Notes and Descriptions of Ichneumon-Flies. By R. A. Cushman. (No. 2709.) Pp. 22. Vol. 72, Art. 21: The Oxidation of Meteoric Irons with Comparative Descriptions of two new Examples of Magnetic Iron Oxides from Terrestrial Sources. By Earl V. Shannon. (No. 2717.) Pp. 15. (Washington, D.C.: Government Printing Office.)

United States Department of Agriculture. Department Circular 423: The Use of the Electrolytic Bridge for Determining Soluble Salts. By R. O. E. Davis. Pp. 14. (Washington, D.C.: Government Printing Office.) 5 cents.

CATALOGUE.

Standard Catalogue, Vol. 1, 1928 edition. Chemistry, including Apparatus for the Teaching of and Research Work in Chemistry, Organic and Inorganic; with Special Sections on Industrial Chemistry, also Assay and Meteorological Apparatus. Pp. xxii+1142. (London: Baird and Tatlock (London), Ltd.)

Diary of Societies.

SATURDAY, DECEMBER 10.

MATHEMATICAL ASSOCIATION (at Bedford College for Women), at 3.—F. C. Boon: A Mathematical Course for Post-Matriculation Non-Specialists.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (at Newcastle-upon-Tyne), at 3.—A. M. Bryan: A Contribution to the Solution of the Problem of Underground-Haulage Accidents, with Special Reference to the Northern Mines Inspection Division.—*Open for further discussion*:—Feeding and Treatment of Animals Below Ground and Stabling, by W. S. Rider; Remarks on the Mines (Working Facilities and Support) Act, 1923, by J. S. Robinson.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. J. M. Stratton: Recent Developments in Astrophysics (I.).

BRITISH PSYCHOLOGICAL SOCIETY (Extraordinary General Meeting) (at Royal Anthropological Institute), at 3.—Consideration and Decision as to Proposed Alterations of the Rules of the Society.—(Annual General Meeting.)—Prof. Mary W. Calkins: Self Psychology.

MINING INSTITUTE OF SCOTLAND (at Royal Technical College, Glasgow), at 3.—Papers open for discussion:—Miners' Nystagmus, by Dr. J. S. Haldane and Dr. T. Lister Llewellyn; An Improved Face Conveyer, by A. V. Reis; The Transport of Injured Persons Underground, by D. Davidson.

PHYSIOLOGICAL SOCIETY (in Department of Physiology, Bedford College), at 4.—J. P. Bouckaert: Factors influencing Muscle Viscosity.—W. H. Craib: Electrical Responses from a Strip of Curarised Skeletal Muscle under Various Conditions.—K. E. Harris: Observations upon a Histamine-like Substance in Skin Extracts.—T. Lewis: The Active Relaxation of Capillaries and Venules in the Reflex Flare.—H. Florey: The Diaphragmatic Lymphatics and Absorption from the Peritoneal Cavity.—F. R. Curtis: Differences between the Activities of Adrenaline and Ephedrine.—F. C. W. Davies and M. Rabinovich: The Effects of Subcutaneous and Intraperitoneal Injections of Oxygen upon the Oxygen Saturation of Arterial Blood.

MONDAY, DECEMBER 12.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Dr. Vening Meinesz: Gravity Survey by Submarine via Panama to Java.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.—Wing-Comdr. T. S. Rippon: The Danger Instincts.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Branch) (at Queen's Hotel, Birmingham), at 7.—Dr. A. F. Burstall: Experiments on Various Gaseous Fuels in a High-Speed Internal Combustion Engine.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Prof. E. W. Marchant: High-Frequency Currents (Kelvin Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—D. B. Hoseason: Squirrel-Cage Induction Motors.
INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. R. Hay: Age Hardening of Alloys.
RAILWAY CLUB (25 Tothill Street, S.W.), at 7.30.—K. Brown: The Story of a Derelict Line—the Chesterford and Newmarket Railway.
INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Swansea).
MEDICAL SOCIETY OF LONDON.—Dr. E. Callender: Dr. Gordon Holmes, Sir Maurice Craig, and others: Debate on Insomnia.

TUESDAY, DECEMBER 13.

ROYAL SOCIETY OF MEDICINE (Therapeutics Section), at 5.—Dr. H. H. Dale, Dr. G. Graham, and others: Discussion on The Action of Synthalin.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William H. Bragg: A Year's Work in X-Ray-Crystal Analysis (IV.).
INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—H. R. Ricardo and others: Detonation in Motor Fuels (Symposium).
INSTITUTION OF CIVIL ENGINEERS, at 6.
ILLUMINATING ENGINEERING SOCIETY (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street, W.C.), at 6.—J. L. H. Cooper: An Investigation of Electric Lighting in the Engineering Industry.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—M. P. Villard: On the Chemical Effects of Radiations.—H. W. Lee: Change of Focus when the Object possesses Great Depth.—P. P. O'Shaughnessy: The Rate of Desilveration of the Wet Collodion Silver Bath.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.15.—W. McClelland: The Applications of Electricity in Warships.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—Dr. S. R. Illingworth: Notes on Coal Research.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—F. H. Clough: The Stability of Large Power Systems.
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—E. Hatschek: Some Properties of Jellies (Lecture).
BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at 8.15.—Prof. T. P. Nunn: Anthropomorphism in Science.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Dr. M. Culpin: A Study of the Minor Psychoses: their Clinical and Industrial Importance.
ILLUMINATING ENGINEERING SOCIETY.—J. L. H. Cooper: An Investigation of Electric Lighting in the Engineering Industry.
INSTITUTION OF MECHANICAL ENGINEERS (Swansea Branch).—J. Adamson and F. Jones: Reduction of Steel Works Costs by the Use of Waste-Heat Boilers.

WEDNESDAY, DECEMBER 14.

SOCIETY OF GLASS TECHNOLOGY (at University College), at 2.40.—J. H. Davidson and Miss V. Dimbleby: The Analysis of Opal Glasses.—Miss V. Dimbleby and Prof. W. E. S. Turner: The Durability of Iron-Containing Glasses.—Dr. S. English, H. W. Howes, and Prof. W. E. S. Turner: The Effect of Iron Oxide on the Properties of Glass.
ELECTRICAL ASSOCIATION FOR WOMEN (at 85 Newman Street, W.), at 3.—H. H. Berry: Colectric System of Heating.
ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. E. W. Hope: The Changed Conditions of Quarantine.
ROYAL METEOROLOGICAL SOCIETY, at 5.—Sir Napier Shaw, R. G. K. Lempfert, and Miss E. E. Austin: International Commission for the Upper Air: Report on the International Days of 1923.—Sir Napier Shaw: Geopotential and Height in a Sounding with a Registering Balloon.—L. F. Richardson and R. E. Munday: The Single-layer Problem in the Atmosphere and the Height-integral of Pressure.—L. F. Richardson, D. Proctor, and R. C. Smith: The Variance of Upper Wind and the Accumulation of Mass.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. E. Greenly: The Lower Carboniferous Rocks of the Menaian Region of Carnarvonshire: their Petrology, Succession, and Physiography, with Palæontological Notes by Dr. Stanley Smith.
INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Branch) (at Engineers' Club, Manchester), at 7.—G. J. Rackham: The Modern Motor Bus.
ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street, W.C.), at 7.—Miss M. G. Reading and others: Discussion on Some Difficulties in dealing with Consumers.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—H. Caird: Ship Ventilation.
GLASGOW UNIVERSITY ALCHEMISTS' CLUB (in Glasgow University), at 7.30.—Dr. R. M. Bronte: Medicine and Crime.
MERSEYSIDE AQUARIUM SOCIETY (at 1 Falkland Road, Egremont), at 7.30.—F. Jefferies: The Diseases of Fish and their Diagnosis.
BRADFORD ENGINEERING SOCIETY (jointly with Society of Chemical Industry, Society of Dyers and Colourists, Textile Institute, Bradford Textile Society, and Bradford Scientific Society) (at Mechanics' Institute, Bradford), at 7.30.—H. P. Hird: Low Temperature Carbonisation (Lecture).
ROYAL SOCIETY OF ARTS, at 8.—Major R. G. H. Clements: The Evolution of Modern Road Surfaces.
FOLK-LORE SOCIETY (at University College), at 8.—Prof. H. J. Fleure: Race Contacts in Folk-tale; with illustrations from Wales.
LANCASTER ASTRONOMICAL AND SCIENTIFIC ASSOCIATION (at Storey Institute, Lancaster), at 8.—E. W. H. Piper: Wells Cathedral.
EUGENICS SOCIETY (at Royal Society), at 8.30.—Sir Bernard Mallet: Problems for Research arising out of the Population Conference.
ROYAL SOCIETY OF MEDICINE, at 9.30.—Sir Alexander Houston: The Romance of London's Water Supply.

THURSDAY, DECEMBER 15.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. K. Munster Strom: Recent Advances in Limnology.—Dr. T. A. Stephenson: Species among the Cœlenterata.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. E. T. Whittaker: The Influence of Gravitation on Electromagnetic Phenomena (Lecture).
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. Kewley: Petroleum Natural Gases and their Derivatives (II.).
INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—D. B. Hoseason: Squirrel-Cage Induction Motors.
INSTITUTE OF METALS (Birmingham Local Section) (jointly with Birmingham Metallurgical Society and Staffordshire Iron and Steel Institute) (at Engineers' Club, Birmingham), at 7.—Dr. L. Aitchison: Duralumin.
INSTITUTE OF PATENTEES (at Caxton Hall), at 8.—A. Ryner: The Commercialisation of Inventions in this Country.
INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).—Sir William H. Bragg: Application of X rays to the Study of the Crystalline Structure of Materials (Thomas Hawksley Lecture).

FRIDAY, DECEMBER 16.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at Imperial College of Science), at 2.30.—Dr. G. H. Rodman: Insectivorous Plants and How They Live (Lecture).
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—L. H. Fry: Some Experimental Results from a Three-Cylinder Compound Locomotive.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—E. B. Watton: Automatic Voltage Regulators.
INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Section) (at College of Technology, Manchester), at 7.—G. C. R. Parker and R. C. Bond: Short Papers.
MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group, Informal Meeting), at 7.—F. C. Tilney: The Halation Fallacy.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—P. J. Haler: Hardening and Quenching throughout the Ages.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group, jointly with Liverpool Section).—C. S. Garland: Oil Pollution of Seas and Harbours, and a Remedy.

SATURDAY, DECEMBER 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. J. M. Stratton: Recent Developments in Astrophysics (II.).

PUBLIC LECTURES.

SATURDAY, DECEMBER 10.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: The Legacy of Egypt.

MONDAY, DECEMBER 12.

UNIVERSITY COLLEGE, at 5.15.—H. Jenkinson: Seals, Mediæval and Modern.
EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Principal C. Crowther: Modern Ideas of Pig Feeding.

TUESDAY, DECEMBER 13.

UNIVERSITY OF LEEDS, at 8.—St. John Ervine: Some Impressions of America.

WEDNESDAY, DECEMBER 14.

KING'S COLLEGE, at 5.30.—Prof. R. Peers: Adult Education.
LONDON SCHOOL OF ECONOMICS (at National Telewriter Co., Ltd., 20 Bucklersbury), at 6.—Demonstration of the Telewriter.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8 (for Workers in the Building Trades).—E. Law: Hampton Court Palace.

CONFERENCES.

DECEMBER 13 TO 16.

INTERNATIONAL CONFERENCE ON LIGHT AND HEAT IN MEDICINE AND SURGERY (at Central Hall, Westminster).

Dec. 13 *and* 14 (Section 1).—Light and Heat in Medicine and Surgery:—Dr. F. Nagelschmidt: Ultra-violet and Bioluminescence.—Dr. L. G. Dufestel: Contra-indications for Ultra-violet Therapy.—Dr. F. Hernaman-Johnson: Conjoint Ultra-violet Radiotherapy and Internal Medicine.—Dr. J. Saidman: The Therapeutic Uses of Infra-red Rays.—Dr. E. P. Cumberbatch: Recent Advances in Diathermy Treatment.—Dr. H. S. Banks: The Place of Actinotherapy in Public Health Work.

Dec. 15 (Section 2).—Scientific Research in Relation to the Practice of Actinotherapy:—Prof. Leonard Hill: The Ultra-violet in Sunlight and Artificial Sources.—Prof. I. M. Heilbron: Vitamin D and its Relation to the Irradiation of Foodstuffs.—Dr. F. H. Humphris: Can the Chemist and Physicist be of Use in Actinotherapy?—(Section 3).—Recent Advances in Optics:—S. G. Tibbles: Light and Vision.—I. Spiro: The Treatment of Certain Common Eye Diseases in the Young by General U-V Irradiation.—Dr. K. R. Smith: Eye Muscle Training.—Dr. F. W. Edridge-Green: Colour Vision.

DECEMBER 15.

JOURNÉES MÉDICALES D'EGYPTE (at Cairo).