NATURE

SATURDAY, FEBRUARY 20, 1926.

CONTENTS.

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. 2938, VOL. 117]

Racial Purification.

THE need for a radical change in the official attitude towards research into the causes of mental disorder has already been advanced in these columns. The problem afforded by the presence among us of a large number of persons suffering from congenital defects of varying severity, though allied and at some points inseparable from the problem of lunacy, has important differences. The hereditary factor is more obvious in cases of congenital mental deficiency than in most of the acquired conditions leading to certification under the Lunacy Acts. In 1923, Dr. Henry Brackenbury, writing in the *Eugenics Review*, acknowledged that "left to itself this sore of society shows no tendency towards cure. On the contrary, it becomes more accentuated generation by generation. Feeble-minded persons are more fecund than the normal; they have a tendency to mate together, and so to produce offspring markedly partaking of the parental characteristics." On January 20, 1926, with other signatories to a letter to the *Times*, the same writer said:

"It is an undoubted fact that although the majority of cases of mental defect are the result of inheritance, the proportion of cases who are the offspring of actually defective parents is, in relation to the whole, an extremely small one."

It is conceivable that these statements are reconcilable; but while we have at least one analysis by modern statistical methods to fall back upon, it seems only fair to adopt it. Only last autumn, the Galton Laboratory published conclusions based on statistical facts relating to children of British and alien parentage, including very dull and mentally defective subjects:

"For the practical purposes of prognosis there does not exist in the present material any correlation of the slightest consequence between the intelligence of the child and its physique, its health, its parents' care, or the economic and sanitary conditions of its home. . . . As the result of the investigations published in this paper, and in others from the Galton Laboratory, intelligence as distinct from mere knowledge stands out as a congenital character. Let us admit finally that the mind of man is for the most part a congenital product, and the factors which determine it are racial and familial; we are not dealing with a mutable characteristic capable of being moulded by the doctor, the teacher, the parent or the home environment." [1]

Following upon reports to the Governments of Sweden and New Zealand favouring the sterilisation of mental defectives, and a vigorously worded plea by Mr. Harold Cox in the *Spectator* for this method of racial purification in Great Britain, cogent arguments in favour of the proposal were set forth in the *Times* for January 18

[1] "Problem of Alien Immigration," by Karl Pearson and Margaret Moul, *Annals of Eugenics*, vol. 1, pt. i. Cambridge: University Press.

over the signatures of ten distinguished members of the medical profession. Claiming a "wide practical knowledge of mental deficiency" denied to these specialists, four office-bearers of the Central Association for Mental Welfare replied that the preventive effect would be slight and the resultant social evil considerable. Of the ensuing correspondence little can be said, except that it showed the conditions to be more favourable to argumentation about the problem than to the formation of sound opinion.

One of the duties of local authorities under the Mental Deficiency Act 1913 is "ascertainment." The total number of mental defectives "ascertained" up to the end of 1924 (England and Wales) was 48,778, for whom six local authorities have "realised the urgency of provision [of care] and have acquired estates on which to establish colonies." But ascertainment varies in different districts. In Oxford County Borough it is 4·17 a thousand; in South Shields County Borough it is 0·10 a thousand. Sixty-four local authorities have not yet "ascertained" one in a thousand of their populations, partly from inertia or parsimony or official discouragement, or a knowledge that all available accommodation was full to overflowing. But six local authorities average 3·28 a thousand. If this incidence prevailed for the whole country (and the true average as it affects the fitness of the population is not lower, but far higher), a number comparable with the total of lunatics at present under care would be added to the "ascertained" mental defectives. There appears to be no reason why a segregated mental defective should cost less to keep than a segregated lunatic, and there are at present 19,376 defectives in institutions similar to those provided for lunatics. This much is clear, then, that to pursue an adequate policy of segregation would involve the addition to the nation's incapacity bill of a sum comparable with the present lunacy administration, or about 7,000,000*l.* a year.

Setting aside the unpractical suggestion of the Board of Control that, since "one of the most serious difficulties arises from the fact that patients on licence are naturally apt to form friendships with members of the opposite sex, . . . we advise that whenever a defective who is out on licence appears to be contracting relationships with the opposite sex, the fact should be reported to the Local Authority concerned with a view to their taking such action as they may think is called for . . .,"[2] two proposals remain: (1) Sterilisation, which, in the language of the Board, "one or two Local Authorities and a judge of the High Court have even suggested"; and (2) the restriction of immigration.

The arguments put forward in favour of sterilisation are its simplicity and its efficacy so far as individual propagation is concerned. In the female, it is now customarily performed in the numerous cases where pregnancy is terminated by Cæsarean section owing to the presence of contracted pelvis. As so performed, each Fallopian tube is ligatured twice and the tube divided between the ligatures. In the male, the operation involves no entry into the abdomen and is thus of shorter duration, involving only an incision through the skin along the line of the vas deferens, separation of that tube from the accompanying blood-vessels, and its section, as in the female, between ligatures. On the whole, there is more rather than less to be said in favour of the operation in the female than in the male. There is now an extensive surgical experience of its good results. In the male, obliteration of the vas deferens, where it has occurred accidentally, has led to swelling of the testis, and the after-effects of ligature on both sides at puberty are not well known. But simple modifications of the operation in the male can be devised to obviate retention of the secretion from which alone these results can arise.

Objection to sterilisation is made on several grounds the validity of which in most cases it would be very difficult to prove.

(1) *That it does not obviate the necessity for institutional treatment.* It is clear, from police and other sources, that large numbers of defectives not yet ascertained do need care of one kind or another. The following case is from an area where "ascertainment" was only 0·38 a thousand. A mentally defective girl of 21 years of age. She was found to be suffering from venereal disease and to be pregnant. She is described as an imbecile suffering from partial paralysis to an extent which made it doubtful if she could survive her confinement. A charge was brought against her brother, a boy of seventeen, for having sexual intercourse with his sister. The family consisted of father and mother, said to be rather abnormal and simple, and a brother said to be feeble-minded. The imbecile girl and her feeble-minded brother slept in one bed. The judge said: "It is not for me to decide who is responsible for the terrible state of affairs which exists in your home. . . . Somebody is responsible for it, but I regard you as the victim and not the guilty person."[3] It is doubtful here whether any local authority would have considered segregation necessary for the father and mother; yet sterilisation would have served had it been practised.

Large numbers of cases might receive only relatively brief institutional treatment if sterilised in place of lifelong segregation, which is the *sine qua non* of the segregationists.

[2] Eleventh Annual Report of the Board of Control, p. 79. (H.M. Stationery Office.)

[3] Eleventh Annual Report of the Board of Control.

(2) *That many parents of defectives are not themselves defective.* From considerable personal acquaintance with mental defectives and their relatives, we are most suspicious of all evidence which appears to lend any support to this contention, notwithstanding the opinion of Prof. Jennings (of Johns Hopkins University) that "whatever eugenic measures are attempted, so long as biparental inheritance is kept up, the variety, the surprises, the perplexities, the melodrama that now present themselves among the fruits of the human vine will continue." It is a subject in which all manner of circumstances conspire to mislead the inquirer. While congenital malformations involving deficiency arise frequently and apparently sporadically, they give rise in most cases to extreme forms of mental defect and are almost wholly incompatible with social (or anti-social) behaviour. Such cases do not constitute a social problem and must not be confused with the degenerate tendencies which do.

(3) *That sterilisation might lead to a false sense of security and involve the intensification of other evils.* The irony of this argument lies chiefly in its source—those who claim "practical" knowledge of mental deficiency. It supposes an *absence* of the normal powers of self-control, prevision and obedience to social convention, and pretends that licence would result from the removal of the need for what is absent. Or it supposes that advantage would be taken by normal individuals of the sterilisation of imbeciles! The argument is scarcely worthy of serious consideration.

(4) *Popular opposition.* Probably, if the truth were known, the general public would go much further than any Government is likely to ask it to go for years to come.

There remains the alien contribution to racial deterioration. There appears to be no reason why we should not at least adopt the sound advice of Prof. Karl Pearson and his collaborator, founded on a basis of scientific inquiry foreign to official control: "Let us set a standard for immigrants, say 25 per cent higher than the mental and physical averages of the native population—and in the present state of our medical, physical and psychological anthropometry this is not an idle dream—and let us allow none to enter who fails to reach this standard."

There are many points upon which biologists may and do disagree with Prof. Karl Pearson, but it would be difficult to think of any one more pre-eminently fitted to direct such an investigation as would bring order out of the chaos of official facts and fancies and equip the nation with sound principles for action. Of clear knowledge at present we have next to none.

Fruit and Fruit Growing.

(1) *A Handbook of Hardy Fruits more commonly grown in Great Britain: Stone and Bush Fruits, Nuts, etc.* By Edward A. Bunyard. Pp. 258. (London: John Murray, 1925.) 10*s.* 6*d.* net.

(2) *Systematic Pomology.* By U. P. Hedrick. (The Rural Science Series.) Pp. xviii+488+24 plates. (New York: The Macmillan Co., 1925.) 17*s.* net.

(3) *The Lorette System of Pruning.* By Prof. Louis Lorette. Translated by W. R. Dykes. Pp. xliv+166. (London: Martin Hopkinson and Co., Ltd., 1925.) 7*s.* 6*d.* net.

(1) THIS book is the second and concluding volume of a work designed by the author to fill the place formerly occupied by Dr. Hogg's "Fruit Manual." The latter has been generally accepted by pomologists as the standard work of reference on varieties of fruit grown in Great Britain since it first appeared some fifty years ago, but nearly forty years have elapsed since the issue of the last edition. During that interval many of the most popular and widely grown present-day varieties have been raised and introduced and there has been, accordingly, an obvious need for either an up-to-date edition of the "Fruit Manual" or a new work of a similar character. For the preparation of such a work there is probably no British pomologist better qualified to undertake the task than Mr. Edward Bunyard.

The work lays no claim to completeness, the author stating in his preface to the first volume that he considers it unwise to include descriptions of varieties other than those which are more generally cultivated. Some limitation of the sort is necessary in a handbook of relatively modest size, for the number of varieties of the common hardy fruits grown in Great Britain is far larger than generally supposed. The element of selection of material thus introduced inevitably exposes the work to criticism as to the right of place of many of the sorts described. In the volume under review, which treats of all the hardy fruits except the apple and pear, a noteworthy omission is the Warwickshire Drooper plum, a variety of frequent occurrence in the important Evesham plum-growing area, while other sorts rarely met with outside a few nurseries and private gardens are included. Among strawberries, there is no reference to Laxton and Monarch, two kinds of some vogue in the earlier years of the present century, or to Ruskin, a leading Scotch variety.

Notwithstanding omissions of this kind, the book is of real assistance to the systematic pomologist, for the varietal descriptions are generally accurate, concise, and mostly the result of first-hand observation, which has enabled doubtful identities to be cleared up. In

the case of cherries and red currants particularly the work gains added value and interest from the author's own investigations in the systematics of those fruits.

(2) Prof. Hedrick's book on systematic pomology serves in many respects a similar purpose for the student of fruit culture in the United States and Canada. The more important and interesting varieties of hardy fruits grown in North America are described briefly; their history, when known, stated; and the author's conclusions on their merits generally given. Included in the list of sorts described are several kinds of European origin, and it is interesting to compare the observations on these growing under North American conditions with those on the same varieties under English conditions recorded in Bunyard's handbook. A similar remark applies to the varieties of American origin included in both works. It is suggestive of the different influence of American and English conditions to find the Ribston Pippin apple, now generally discarded in Great Britain on account of its susceptibility to canker, described by Hedrick as a variety producing hardy, vigorous, and long-lived trees; at the same time, Cox's Orange Pippin, the leading English dessert apple, also like Ribston Pippin a delicate sort, has not been considered of sufficient importance in American pomology to merit inclusion.

As the title indicates, the scope of this work is wider than that of the preceding. Systematic pomology, as defined by the author, is the study of the kinds of fruits and their relationships. He has, accordingly, in a series of introductory chapters, given a brief general description of the structure and arrangements of the various organs to enable the student to grasp the principles upon which the classification of varieties of the respective kinds of fruits is based. The volume is intended primarily for classroom work, and largely comprised of abbreviated material taken from the author's "Cyclopedia of Hardy Fruits" and the elaborate monographs on various fruits which have been prepared by him and published by the State of New York. It fills a distinct gap in pomological literature and, although concerned with American material, should prove of use as well as interest to pomologists generally.

(3) The third volume of the group is a translation of the fourth French edition of Prof. Lorette's book on his methods of pruning fruit trees, by the late Mr. W. R. Dykes, secretary of the Royal Horticultural Society.

The volume is mainly a description of a system of pruning evolved by the author after many years of practical trials at the School of Agriculture at Wagnonville, near Douai. The essence of the system is that the normal practice of pruning in winter is entirely discarded in favour of a series of summer treatments applied chiefly in June and July. By this means it is claimed that the energies of the tree can be concentrated on fruit production, the formation of unnecessary shoot growth being prevented. While at first sight the drastic removal of young leafy shoots in the height of the summer may appear to reduce rather than improve the tree's chance of accumulating adequate organic reserve food materials necessary for blossom and fruit formation, it is asserted that the result is the production of a large leaf area so situated that it promotes the development of fruit buds instead of unwanted extensive shoots. Suitable manuring is at the same time regarded as essential to maintain vitality.

The author lays stress on the individual details of his system, which render it fundamentally distinct from the older, generally practised form of summer pruning. Special attention is given to the form of the tree and the production of an evenly balanced branch system, in which the forced growth of "stipulary" buds plays an important part. The spacing of individual branches is another feature of particular concern. The directions for treatment given, which refer chiefly to the pear, are those which have yielded best results at Wagnonville, but minor modifications are considered necessary according to soil and climate. This point will be appreciated by those who have tried the method in some of the rainier districts in Great Britain.

Some measure of support for the system on scientific grounds is forthcoming from recent research on pomological physiology. In the original French the exact meaning of the author was not clear in places. The translator has allowed himself some latitude with advantage, and does well to direct attention to the difficulties arising from the want of an accepted nomenclature for the various types of lateral shoots of fruit trees.

The merits of the system have already been much debated, but there can be no doubt of the service which the author has rendered to scientific pomology in securing attention to the fundamental principles underlying all methods of pruning.

Biological Problems.

La concentration en ions hydrogène de l'eau de mer—le pH : méthodes de mesure; importance océanographique, géologique, biologique. Par R. Legendre. (Les problèmes biologiques.) Pp. vii + 291. (Paris: Les Presses universitaires de France, 1925.) 30 francs.

UNDER the above general title a series of monographs is being issued by the University Press, Paris. Of these the volume under review is the third. Dr. R. Legendre, Director of the Laboratory of Comparative Physiology in the École des Hautes Études,

Paris, is indeed to be congratulated upon the production of his monograph. It is well printed, lucid, contains a vast amount of detail skilfully woven into a consideration of a surprisingly large number of physiological and geological themes, and is, in short, interesting from cover to cover. It is to be hoped that it will have many English readers, for those in search of problems for research are given a wide field from which to select if they read the book.

Somewhat more than one-third of the book is devoted to a description of the methods of measuring hydrogen ion concentration; details necessary for practical work are given as well as a theoretical introduction to the subject—this, moreover, is written especially for the weak brother and is developed from a few fundamental principles. Chapters 2-4 deal with the alkalinity of sea-water, its changes with depth, season, and latitude, its relation to the precipitation of calcium carbonate and to the nature of oceanic deposits. This portion is of especial interest to the hydrographer and the geologist.

The remaining third of the book is occupied by a discussion of the biological problems which are connected with the hydrogen ion concentration or *p*H value of the sea. They include researches on respiration, photosynthesis, the mineral constituents of marine plants and animals, seasonal changes in the plankton, tropisms, composition of intracellular liquids, permeability, isoelectric points, ciliary movements, and the maturation, fertilisation, parthenogenesis, and division of the egg. There is also a brief, but useful, appendix on methods of maintaining sea-water in a condition fit for marine animals and upon artificial sea-water. A notable feature of the book is the large number of references given both to early and to the most recent work, including many researches carried out by Dr. Legendre himself, a fact which ensures that the volume is critical throughout and no mere compilation.

The reviewer would, however, point out that, in common with other distinguished physiologists, the author writes of the "tension" exerted by aqueous vapour and by carbon dioxide, instead of using the correct term pressure. As an example of the confusion due to the use of the term "tension" we may consider the Clark hydrogen electrode vessel, containing hydrogen gas—which exerts a pressure—also water vapour and carbon dioxide exerting "tensions." The total pressure is found by adding the pressure to the two "tensions."

A list of errata is issued with the book. In addition the following have been noted: P. 112, in ll. 1, 3, and 4 B means any monovalent base, but in l. 2 it stands for the element boron; p. 112, l. 17, for "mai" read "mars"; p. 147, l. 9 from bottom, for "mai" read "octobre."

It may also be remarked that C. B. Lipman's recent paper (Publ. No. 340, Carnegie Inst.) has shown that the views formerly put forward, concerning the precipitation of calcium carbonate in tropical waters being due to denitrifying bacteria, are incorrect. Winkler's method of estimating oxygen is given on p. 189 as involving titration with sodium sulphite, but thiosulphate is more generally used. The statement on p. 275 that artificial sea-water "ne permet jamais aucune culture" appears to be rather too vigorous an interpretation of Allen's results, and those of Drummond and Peach have, moreover, to be considered.

In conclusion, it may be said that the book augurs well for the success of the series, and is heartily recommended. W. R. G. A.

Experimental Physics.

(1) *A Laboratory Manual of Experiments in Physics.* By Prof. Leonard Rose Ingersoll. Pp. ix+220. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 10*s.* net.

(2) *Heat: an Elementary Text-Book.* By Dr. Ivor B. Hart. (Bell's Natural Science Series.) Pp. vii+226. (London: G. Bell and Sons, Ltd., 1925.) 3*s.* 6*d.*

(3) *Practical Physics: for the Use of Students of Natural Philosophy.* Part 2. (By the Staff of the Department.) Pp. 71. (Melbourne: Melbourne University Press, 1925.) n.p.

(4) *Individual Work in Science.* By Herbert McKay. Part 1. Pp. vii+97. Part 2. Pp. vii+97. Part 3. Pp. vii+97. 1*s.* 3*d.* each. Part 4: Teacher's Book. Pp. vii+95. 3*s.* 6*d.* (London: University of London Press, Ltd., 1925.)

(5) *An Introduction to Physical Science.* By Dr. Ivor B. Hart. Pp. xii+306. (Oxford: Clarendon Press; London: Oxford University Press, 1925.) 4*s.* net.

THESE books under notice are mostly concerned with instruction in practical physics, although their standard varies from that of an honours university course to an introductory school course.

(1) Prof. Ingersoll's laboratory manual of experiments in physics embodies the work of the elementary class in the University of Wisconsin. The book is prefaced by a useful introduction dealing with curve plotting, averages, errors, etc., and then proceeds to simple exercises with measuring instruments. There is little that requires comment in the selection of experiments, seventy-six in all, except that the section devoted to light, which contains only nine experiments, seems rather inadequate.

(2) The author of "A Student's Heat" has here

reproduced the elementary parts of that text-book with the view of meeting the requirements of matriculation students. The book follows orthodox lines and is well furnished with examples of a practical character. The historical aspect of the subject is not overlooked, and although the book is not intended to assist the student in carrying out laboratory exercises, the necessary fundamental experiments are well described and illustrated.

(3) The third book on our list is a series of about fifty experiments forming part of the physics course at the University of Melbourne. It ranges from the synthesis of periodic curves to the measurement of alpha-rays. The experiments are mostly of standard type, although some involve the use of apparatus (Prestwich fluid gauge, slip gauges, Michell viscometer) not commonly found in physical laboratories. It is a useful compilation.

In (4) we pass to the other end of the scale, the three small books included in this set being designed to meet the need of school teachers for small inexpensive books from which beginners can work with a minimum of supervision. Each book covers a one-year course in elementary physics, with forty-eight lessons distributed over the various branches of the subject. The course is well planned and carefully thought out, the experiments are concisely but sufficiently described, and most of the apparatus required is either home-made or easily procured.

An additional volume for the guidance of the teacher contains lists of the apparatus required, and gives suggestions for the distribution of the experiments in the class. The standard reached, even in the third-year course, is very elementary, and with the exception of the sections on measurement and mechanics, is almost wholly qualitative, but it provides a good introduction to the subject.

(5) The volume which appears at the end of our list is an introduction to physical science intended to steer a middle course between the Scylla of excessive concentration on accurate measurement and the Charybdis of snappy description of everyday physics divorced from the discipline of practical work. The author has certainly succeeded in producing a very attractive volume. The subjects are treated in an interesting and practical way, the illustrations are numerous and good, while the paper and type add considerably to the pleasure of using the book. The main defect is a lack of proportion in the treatment of the various branches of the subject. Magnetism, static electricity, and current electricity are dismissed in 28 pages, containing only two practical exercises, both in magnetism. On the other hand, the excellent section on hydrostatics extends to 82 pages and contains more than twenty practical exercises.

Our Bookshelf.

Port Development. By Dr. Roy S. MacElwee. Pp. xv+456. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 25*s.* net.

THE subject of port development may be regarded from two points of view: (1) physical, or constructional, and (2) commercial. It is from the latter viewpoint that Dr. MacElwee has written the work under notice, and in it he considers the various factors which make for the prosperity of a port, serve to foster its trade and to extend its influence. The Americans have a phrase which expresses their idea of treating the port itself as a negotiable instrument: they speak of "selling a port," meaning the disposal of its facilities to commercial and shipping customers. As Dr. MacElwee truly remarks, "Terminal facilities alone, important as they are, will not make a port a successful commercial gateway." It is necessary to impress the trading community with the advantages to be gained by making use of them, and, in this connexion, propaganda work and "solicitation" (Anglicé, canvassing) are of the greatest importance.

Dr. MacElwee is already well known in port circles on both sides of the Atlantic as the author of several works including "Ports and Terminal Facilities," the success of which has led him to amplify his treatment of the subject. In the present volume he deals with that section which comprises government administration, traffic and solicitation. The field admits of a wide purview and the book consists of four parts. Part I. treats of port development as a matter for serious consideration, and its value, nationally and locally. Part II. institutes a comparison between various typical ports of the world, with an analysis of their attractions to shipping. Part III. deals more particularly with details of port competition: balanced cargoes, tonnage markets, rail and water rates, etc., together with the costs and services at the respective terminals. Part IV. is devoted to the subject of free ports, that is, port areas which are exempt from the imposition of duties on goods landed for re-export.

As Commissioner of a thriving American port, with a wide personal experience extending to ports in the old world as well as the new, Dr. MacElwee writes with a thorough knowledge of his subject. He has collected a large amount of information from a number of sources, and his book will therefore prove a valuable work of reference. B. C.

The Scent of Flowers and Leaves: its Purpose and Relation to Man. By F. A. Hampton. Pp. vii+135. (London: Dulau and Co., Ltd., 1925.) 6*s.* net.

THIS book is in no sense a compilation, but a valuable contribution to the small literature of odour. The author offers a sound, but non-technical, review of theories of odour, and his classification of flower scents appears to be the best yet made. It is a revision of the suggestions of Kerner von Marilaun, bringing them up-to-date. For this, the author's qualifications are unique, as he successfully combines data from many fields in which he has experience. Previous classifications of odours have been incompletely documented

by sponsors experienced in one or two branches of science, and, while much remains to be done to systematise our knowledge of smell, the present classification is very suggestive. Much space is devoted to a discussion of the origin and development of scent, its function in the plant and elsewhere, and to our appreciation of it. The author's theory of human reaction to scents will be more acceptable than the crude and somewhat malodorous treatment usually accorded by the psychologist to the subject.

Garden lovers in the study, especially those planning a garden, will be greatly indebted to Dr. Hampton for the wealth of information on the history of scented plants and the arrangement of a scented garden. *Rosa gallica* (the Rose of Provins) is mentioned, but no connected history of this early variety is given. Printers' errors appear to be absent. The repeated spelling "benzine" and the use of "benzoloid" are unfortunate; "stereoptene" should be "stearoptene," and a much fuller index would be valuable. The statement that citral is the scent substance of citronella requires qualification.

The book has a pleasant literary style, and possesses personality. On account of the many interests associated with floral perfume, "Flower Scent" is certain to make a wide appeal, and needs only to be read to be enjoyed. HUGH NICOL.

Macrophotographie et microphotographie. Par F. Monpillard. (Encyclopédie scientifique: Bibliothèque de photographie.) Pp. xxxi+671. (Paris: Gaston Doin et Cie, 1925.) 25 francs.

THE two branches of the subject are not sharply distinguished, but, speaking generally, macrophotography concerns objects that are large enough to be seen, with at least some detail, by the naked eye, and need only a low magnification, if any, so that they are conveniently photographed by a lens of short focal length attached directly to the camera. Examples given by the author are a group of mounted butterflies and physiological dissections and preparations. Microphotography is the photography of smaller objects with higher magnifications, such that the use of a microscope stand is very desirable if not necessary. Many details are common to both methods of work, so that there is a distinct advantage in treating them together, especially as macrophotography is too often neglected in present-day text-books as belonging neither to ordinary photography nor (as we prefer to call it) photomicrography.

The author includes the use of polarised light, microspectrography, metallography, instantaneous microphotography and microcinematography, photography by means of ultra-violet light, stereoscopic work, microradiography, and stereoradiography. So many subjects obviously cannot be treated at great length in the space available, but the salient points of modern methods are given, and also a good deal of historical matter. It would be advantageous if the illustrations were of better quality and rather more numerous, and we may add that Mr. W. Thorp's method of making grating replicas was not by pressing with an hydraulic press thin celluloid upon an original Rowland grating, as is stated, but by pouring a solution of celluloid upon the original, and then stripping and mounting the resulting film. The volume should certainly be welcomed by scientific workers.

The Daubeny Laboratory Register, 1916–1923: with Notes on Scientific Researches carried out by Members of Magdalen College, Oxford. By R. T. Gunther. Vol. 3. Pp. vii+297-532. (Oxford: The Laboratory, Magdalen College, 1924.) 10*s.* 6*d.*

TWENTY years ago, Mr. Gunther published the first volume on the origin and history of Daubeny's principal benefactions to Magdalen College, Oxford, and in 1915 this was followed by a second volume. He now adds a third volume on work in the Daubeny laboratory from 1916 to 1923, and expresses regret that it is no longer possible to use Daubeny's building for scientific research or the housing of his collection. Changed conditions in the University seem to have been regarded as justifying the closing of the laboratory in 1923.

Mr. Gunther refers to his own researches in the volcanic region of Naples, which were directly stimulated by Daubeny's work and the collections he left to the College. He also gives some account of the recent discovery of Pleistocene mammalian remains in the College grounds, and publishes photographs of some fossil crocodilian vertebræ from the Kimmeridge Clay of Shotover, which appear to be unique in showing stains of the adjacent blood-vessels.

In addition to the record, the volume includes notes on some of the early naturalists associated with Magdalen College, and on others who have undertaken scientific research there. It also incorporates much matter of historical interest to the College, which Mr. Gunther has recovered from the archives while pursuing his researches on early science at Oxford.

The Dynamo: its Theory, Design, and Manufacture. By C. C. Hawkins. Sixth edition, revised throughout and largely rewritten. Vol. 3: *Alternators.* Pp. xviii+572. (London: Sir Isaac Pitman and Sons, Ltd., 1925.) 30*s.* net.

IN this volume the author discusses the design and working of the generators which produce alternating current. So many books and papers have recently been published on the subject that he finds it necessary only to give a rapid résumé of some modern developments. He confines himself to the more practical side of his subject, and the dynamo designer can at once compare his own formulæ with those given by the author. In 1909 Sir Thomas Lyle gave his theory of the alternating current generator to the Physical Society of London. Judging by results, however, it has proved a little too difficult for the practical designer and it is not mentioned by the author. To the student, however, it would prove interesting and instructive. The chapters on the turbo-alternator and the parallel running of alternators have been carefully written and should prove helpful to the engineer. The author, when discussing armature reaction, adopts and strongly advocates the two-reaction method of A. Blondel. This phenomenon is barely mentioned in the older books. For a full discussion of it a theory similar to Lyle's would have to be devised. We can recommend this volume to dynamo designers.

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.*]

Spinning Electrons and the Structure of Spectra.

So far as we know, the idea of a quantised spinning of the electron was put forward for the first time by A. K. Compton (*Journ. Frankl. Inst.*, Aug. 1921, p. 145), who pointed out the possible bearing of this idea on the origin of the natural unit of magnetism. Without being aware of Compton's suggestion, we have directed attention in a recent note (*Naturwissenschaften*, Nov. 20, 1925) to the possibility of applying the spinning electron to interpret a number of features of the quantum theory of the Zeeman effect, which were brought to light by the work especially of van Lohuizen, Sommerfeld, Landé and Pauli, and also of the analysis of complex spectra in general. In this letter we shall try to show how our hypothesis enables us to overcome certain fundamental difficulties which have hitherto hindered the interpretation of the results arrived at by those authors.

To start with, we shall consider the effect of the spin on the manifold of stationary states which corresponds to motion of an electron round a nucleus. On account of its magnetic moment, the electron will be acted on by a couple just as if it were placed at rest in a magnetic field of magnitude equal to the vector product of the nuclear electric field and the velocity of the electron relative to the nucleus divided by the velocity of light. This couple will cause a slow precession of the spin axis, the conservation of the angular momentum of the atom being ensured by a compensating precession of the orbital plane of the electron. This complexity of the motion requires that, corresponding to each stationary state of an imaginary atom, in which the electron has no spin, there shall in general exist a set of states which differ in the orientation of the spin axis relative to the orbital plane, the other characteristics of the motion remaining unchanged. If the spin corresponds to a one-quantum rotation there will be in general two such states. Further, the energy difference of these states will, as a simple calculation shows, be proportional to the fourth power of the nuclear charge. It will also depend on the quantum numbers which define the state of motion of the non-spinning electron in a way very similar to the energy differences connected with the rotation of the orbit in its own plane arising from the relativity variation of the electronic mass. We are indebted to Dr. Heisenberg for a letter containing some calculations on the quantitative side of the problem.

This result suggests an essential modification of the explanation hitherto given of the fine structure of the hydrogen-like spectra. As an illustration we may consider the energy levels corresponding to electronic orbits for which the principal quantum number is equal to three. The scheme on the left side of the accompanying figure (Fig. 1) corresponds to the results to be expected from Sommerfeld's theory. The so-called azimuthal quantum number k is defined by the quantity of moment of momentum of the electron about the nucleus, $kh/2\pi$, where $k = 1, 2, 3$. According to the new theory, depicted in the scheme[1] on the right, this moment of momentum is given by $Kh/2\pi$, where $K = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}$. The total angular momentum of the atom is $Jh/2\pi$, where $J = 1, 2, 3$. The symbols K and J correspond to those used by Landé in his classification of the Zeeman effects of the optical multiplets. The letters S, P, D also relate to the analogy with the structure of optical spectra which we consider below. The dotted lines represent the position of the energy levels to be expected in the absence of the spin of the electron. As the arrows indicate, this spin now splits each level into two, with the exception of the level $K = \frac{1}{2}$, which is only displaced.

In order to account for the experimental facts, the resulting levels must fall in just the same places as the levels given by the older theory. Nevertheless, the two schemes differ fundamentally. In particular, the new theory explains at once the occurrence of certain components in the fine structure of the hydrogen spectrum and of the helium spark spectrum

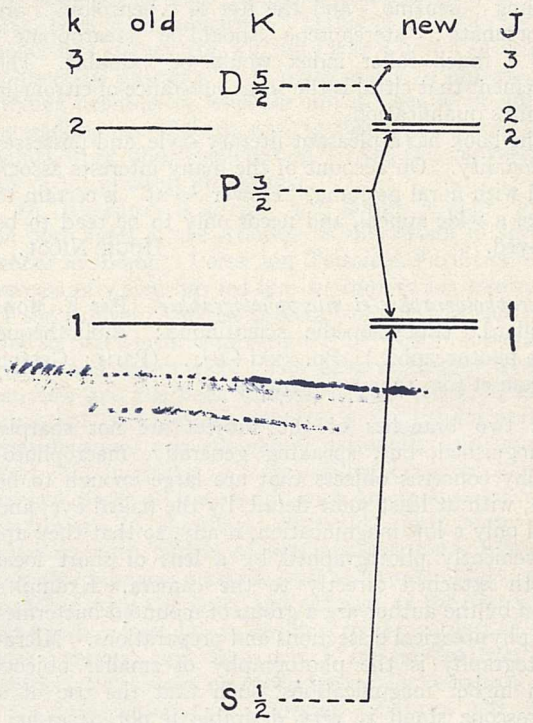


FIG. 1.

which according to the old scheme would correspond to transitions where K remains unchanged. Unless these transitions could be ascribed to the action of electric forces in the discharge which would perturb the electronic motion, their occurrence would be in disagreement with the correspondence principle, which only allows transitions in which the azimuthal quantum number changes by one unit. In the new scheme we see that, in the transitions in question, K will actually change by one unit and only J will remain unchanged. Their occurrence is, therefore, quite in conformity with the correspondence principle.

The modification proposed is specially important for explaining the structure of X-ray spectra. These spectra differ from the hydrogen-like spectra by the appearance of the so-called "screening" doublets, which are ascribed to the interaction of the electrons within the atom, effective mainly through reducing the effect of the nuclear attraction. In our view, these screening doublets correspond to pairs of levels which have the same angular momentum J but different azimuthal quantum numbers K. Consequently, the orbits will penetrate to different distances

[1] Quite independently of the ideas discussed here, a scheme of levels corresponding to this figure has been previously proposed by the writers (*Physica*, 5, 266, 1925), on the ground of the formal analogy between spectral structures. From similar formal considerations, this scheme has recently also been arrived at by J. C. Slater (*Proc. Washington Acad.*, December 1925).

from the nucleus, so that the screening of the nuclear charge by the other electrons in the atom will have different effects. This screening effect will, however, be the same for a pair of levels which have the same K but different J's and correspond to the same orbital shape. Such pairs of levels were, on the older theory, labelled with values of k differing by one unit, and it was quite impossible to understand why these so-called "relativity" doublets should appear separately from the screening doublets. On our view, the doublets in question may more properly be termed "spin" doublets, since the sole reason for their appearance is the difference in orientation of the spin axis relative to the orbital plane. It should be emphasised that our interpretation is in complete accordance with the correspondence principle as regards the rules of combination of X-ray levels.

The assumption of the spinning electron leads to a new insight into the remarkable analogy between the multiplet structure of the optical spectra and the structure of X-ray spectra, which was emphasised especially by Landé and Millikan. While the attempt to refer this analogy to a relativity effect common to all the structures was most unsatisfactory, it obtains an immediate explanation on the hypothesis of the spin electron. If, for example, we consider the spectra of the alkaline type, we are led to recognise in the well-known doublets regular spin doublets of the character described above. In fact, this enables us to explain the dependence of the doublet width on the effective nuclear charge and the quantum numbers describing the orbit, as well as the rules of combination.

The simplicity of the alkaline spectra is due to the fact that the atom consists of an electron revolving round an atomic residue which contains only completed electronic groups, which are magnetically inert. When we pass to atoms in which several electrons revolve round a residue of this kind we meet with new features, since we have to take account of other directing influences on the spin axis of each electron besides the couple due to its own motion in the electric field. Not only does this enable us to account for the appearance of multiplets of higher complexity, but it also seems to throw light on the so-called "branching" of spectra, which usually accompanies the adding of a further electron to the atom, and for which hitherto no satisfactory explanation has been given. In fact, it seems that the introduction of the concept of the spinning electron makes it possible throughout to maintain the principle of the successive building up of atoms utilised by Bohr in his general discussion of the relations between spectra and the natural system of the elements. Above all, it may be possible to account for the important results arrived at by Pauli, without having to assume an unmechanical "duality" in the binding of the electrons.

So far we have not mentioned the Zeeman effect, although the introduction of the spinning electron was primarily suggested by the analysis of the anomalous Zeeman effects shown by the components of multiplet structures. From the point of view of the correspondence principle, this effect shows that the influence of a magnetic field on the motion of the atom differs considerably from that to be expected if the electron had no spin. In fact, from the well-known theorem of Larmor we would expect the effect on any spectral line to be of the simple Lorentz type, quite independently of the character of the multiplet structure. Therefore the appearance of the anomalous Zeeman effects has hitherto presented very grave difficulties. However, these difficulties disappear at once when, as assumed, the electron has a spin and the ratio between magnetic moment and angular momentum of this spin is different from that corresponding to the revolution of the electron in an orbit large compared with its own size. On this assumption the spin axis of an electron not affected by other forces would precess with a frequency different from the Larmor rotation. It is easily shown that the resultant motion of the atom for magnetic fields of small intensity will be of just the type revealed by Landé's analysis. If the field is so strong that its influence on the precession of the spin axis is comparable with that due to the orbital motion in the atom, this motion will be changed in a way which directly explains the gradual transformation of the multiplet structure for increasing fields known as the Paschen-Back effect.

It seems possible on these lines to develop a quantitative theory of the Zeeman effect, if it is assumed that the ratio between magnetic moment and angular momentum due to the spin is twice the ratio corresponding to an orbital revolution. At present, however, it seems difficult to reconcile this assumption with a quantitative analysis of our explanation of the fine structure of levels. In fact it leads, in a preliminary calculation, to widths of the spin doublets just twice as large as those required by observation. It must be remembered, however, that we are here dealing with problems which for their final solution require a closer study of quantum mechanics and perhaps also of questions concerning the structure of the electron.

In conclusion, we wish to acknowledge our indebtedness to Prof. Niels Bohr for an enlightening discussion, and for criticisms which helped us distinguish between the essential points and the more technical details of the new interpretation.

G. E. UHLENBECK.
S. GOUDSMIT.
Instituut voor Theoretische Natuurkunde,
Leyden, December 1925.

HAVING had the opportunity of reading this interesting letter by Mr. Goudsmit and Mr. Uhlenbeck, I am glad to add a few words which may be regarded as an addition to my article on atomic theory and mechanics, which was published as a supplement to NATURE of December 5, 1925. As stated there, the attempts which have been made to account for the properties of the elements by applying the quantum theory to the nuclear atom have met with serious difficulties in the finer structure of spectra and the related problems. In my article expression was given to the view that these difficulties were inherently connected with the limited possibility of representing the stationary states of the atom by a mechanical model. The situation seems, however, to be somewhat altered by the introduction of the hypothesis of the spinning electron which, in spite of the incompleteness of the conclusions that can be derived from models, promises to be a very welcome supplement to our ideas of atomic structure. In fact, as Mr. Goudsmit and Mr. Uhlenbeck have described in their letter, this hypothesis throws new light on many of the difficulties which have puzzled the workers in this field during the last few years. Indeed, it opens up a very hopeful prospect of our being able to account more extensively for the properties of elements by means of mechanical models, at least in the qualitative way characteristic of applications of the correspondence principle. This possibility must be the more welcomed at the present time, when the prospect is held out of a quantitative treatment of atomic problems by the new quantum mechanics initiated by the work of Heisenberg, which aims at a precise formulation of the correspondence between classical mechanics and the quantum theory.

N. BOHR.
Copenhagen, January 1926.

Carnot's Cycle and Efficiency of Heat Engines.

IN NATURE of August 29, 1925, there was published on p. 326 an extract of a paper read by Dr. Haldane before the Institution of Mining Engineers at Cardiff on June 16, in which he advances a somewhat unusual view as regards the efficiency of the Carnot cycle.

A defence of the orthodox view was made by Prof. Porter on October 3, p. 497, and by Mr. Butler on October 24, p. 608. Prof. Porter demonstrates quite clearly that for any given temperatures a higher efficiency is always obtained with the Carnot cycle than with that proposed by Dr. Haldane.

In reply to his critics Dr. Haldane has since published a further paper in which he maintains his original view. Since, however, a correct appreciation of the thermo-dynamics of the cycle of a heat engine underlies all engineering practice, a matter so fundamental should not permit of any misunderstanding. It is, therefore, desirable to determine at what point Dr. Haldane diverges from the orthodox treatment.

The efficiency of a heat engine is the ratio of the heat converted into work to that which is received

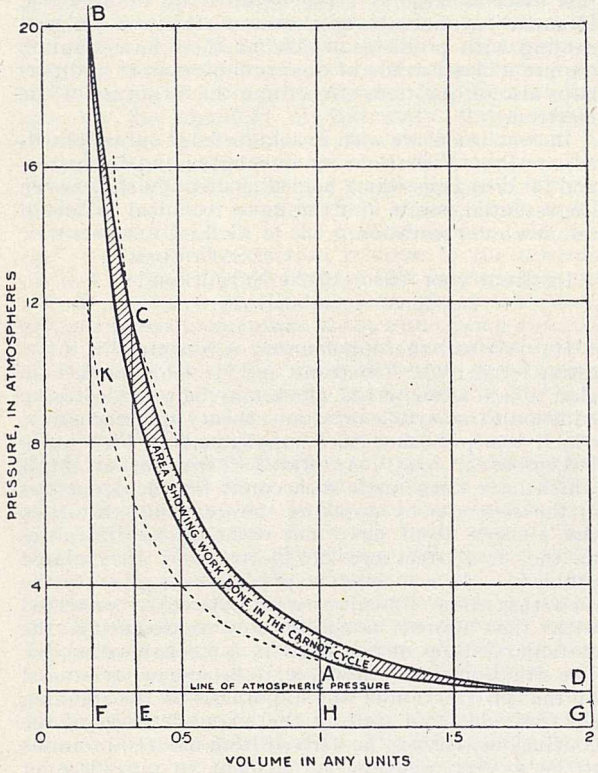


FIG. 1.—Dr. Haldane's diagram of Carnot cycle with lower absolute temperature 50 per cent. below upper.

by the engine from the source of the heat. The Carnot cycle consists of the following processes :

Isothermal expansion with work done by the working fluid on the piston during the reception of heat.

Adiabatic expansion with work done by the working fluid on the piston at the expense of the intrinsic energy of the fluid.

Isothermal compression during which work is done by the piston on the working fluid whilst heat is rejected; and adiabatic compression during which energy is restored to the fluid equal to the work done on it by the piston.

It is only during one of these processes, namely, isothermal expansion, that the working fluid receives heat from the outside source.

Now Dr. Haldane in his second paper considers the case of a Carnot cycle for a perfect gas with the absolute temperature of the source double the absolute temperature at which heat is rejected, and the efficiency therefore, by the usual theory, 50 per cent. He reasons as follows :

"The work W done by the air during expansion is represented by the area BCDGF [see Fig. 1 reproduced from Dr. Haldane's second paper]. The work w done on the air during compression is represented by the somewhat smaller area BADGF. The net work $W - w$ done in the cycle is represented by ABCD, hence the efficiency is according to the contention of my paper $(W - w)/W$, and we can see at once that this is very small and far below 50 per cent."

It is clear, therefore, that Dr. Haldane is led to a wrong determination of the efficiency of the cycle, because he adopts an unusual valuation for the amount of heat received, which he takes to be equal in equivalent units to the total work done during expansion, whereas the heat actually received by the working fluid from the source of heat is only that which is absorbed during isothermal expansion, and in the case of a perfect gas is equal to the work done during that process only. It is not surprising, therefore, that he arrives at too low a value for the efficiency of the Carnot cycle.

From a careful perusal of Dr. Haldane's papers, he appears to contend that the heat received by the working fluid during the process of isothermal expansion is not the total amount received. There must, he argues, be added the heat equivalent of the work done against the fluid during adiabatic compression in order to arrive at the total heat which the fluid receives.

Since, however, this work of compression is deducted from the work done during expansion in order to arrive at the net work of the engine, it will be seen that it is obtained from the engine itself, and should not be charged against what the engine receives from the source of heat. By so charging it, Dr. Haldane really debits the cycle with this part of the negative work twice over ; he uses it to reduce the net work done as in the orthodox treatment, and he also uses it to increase his value for the total heat received.

STANLEY S. COOK.
The Parsons Marine Steam Turbine Co., Ltd.,
Turbinia Works, Wallsend-on-Tyne,
January 25.

REFERRING to Dr. Haldane's recent paper on "The Maximum Efficiency of Heat Engines," an abstract of which appeared in NATURE of August 29, 1925, it was difficult when reading the paper to grasp the precise basis upon which the majority of Dr. Haldane's reasoning rests. Some light was thrown on this obscurity, however, by Dr. Haldane's reply to the discussion of his paper. On p. 409, vol. 69, Part 5, of the *Transactions of the Institution of Mining Engineers*, he says :

"When, however, the amount of heat (supplied) is the same in the two cases, the Carnot cycle is always relatively inefficient as compared with the corresponding Haldane cycle. . . . Prof. Porter quite rightly points out that in the Haldane cycle, the difference between T_1 and T_2 is greater than in the Carnot cycle."

It thus appears that Dr. Haldane maintains that the efficiency of different heat engine cycles must be compared on a basis of a given amount of heat supplied, and not, as in the orthodox view, on a basis of temperature range.

That a temperature range is essential to the working

of a heat engine is a matter of common observation, with which, presumably, even Dr. Haldane agrees. Carnot summed up the situation in the converse statement: "Wherever there exists a difference of temperature, motive power can be produced." Carnot went on to show that the efficiency of a thermo-dynamically reversible cycle is proportional to the temperature range solely, and that for a given temperature range no heat engine cycle can possibly be more efficient than a thermo-dynamically reversible one.

Now Dr. Haldane's cycle is not thermo-dynamically reversible. Carnot's cycle is thermo-dynamically reversible; therefore, Dr. Haldane's cycle cannot possibly be more efficient than Carnot's cycle. Further, since, by definition, efficiency $= \frac{\text{work done}}{\text{heat supplied}}$, it is evident that efficiency is a ratio independent of the actual magnitudes of the quantities involved, so that to base a comparison of efficiencies on a given quantity of heat is valueless.

In his second published reply to his critics, Dr. Haldane abandons this point of view and attacks the particular theorem, that is, he tries to prove that Carnot wrongly assessed the efficiency of a reversible cycle as $1 - (T_2/T_1)$.

The real thermal efficiency, as Dr. Haldane correctly says, is given by the fraction $(H-h)/H$, when H is the total heat communicated to the working substance and h the heat energy or heat equivalent of the work lost in recompression, but, by total heat communicated, Dr. Haldane says he means the heat supplied from the source during isothermal expansion, *plus* the heat accumulated in the working substance during adiabatic compression. This reasoning leads for the efficiency of the Carnot cycle to

$$\left\{\frac{T_1 - T_2}{T_1 + \frac{(K_v T_1 - T_2)}{R \log_e x}}\right\}.$$

Since, however (as Dr. Haldane himself admits on p. 394 of his original paper), the work done by the engine during adiabatic expansion is exactly equal to the negative work done during adiabatic compression, it is evident that the only source from which the engine receives its heat is the external source. This is the accepted view, and it leads to Carnot's expression for the efficiency, namely, $1 - (T_2/T_1)$.

ROBERT DOWSON.

C. A. Parsons and Co., Ltd.,
Heaton Works,
Newcastle-on-Tyne, January 26.

Chemical Effects produced by Resonance Radiation.

DR. RIDEAL having started an investigation of reactions which we discovered last spring, and which one of us (H. S. T.) stated publicly in Oxford so late as last October were being further studied, it seems desirable to place on record some of the results to which such further studies have led, especially as they show a marked divergence from the results of Hirst and Rideal (NATURE, **116**, 899, December 19, 1925).

We are quite unable to subscribe to the conclusion of Hirst and Rideal that hydrogen and oxygen combine very slowly both in the absence and presence of mercury vapour, and only combine rapidly in the presence of a layer of liquid mercury. Our experiments show that hydrogen and oxygen, with the concentration of mercury vapour obtained by bubbling these gases through liquid mercury at room temperatures, will combine rapidly in the presence of the resonance radiation from the cooled mercury arc. Furthermore, we have shown that hydrogen peroxide is a prior product of reaction appearing in marked quantities at high rates of gas flow, whereas with slower rates of flow the peroxide formed decreases and the water formed increases. In this manner we have been able to cause the gases to react to produce either exclusively hydrogen peroxide or mixtures of this with water. We have further shown that many hundred molecules of hydrogen peroxide are produced for every mercury atom passing through the zone of radiation, and that mercuric oxide is formed. The removal of mercury vapour in this manner may have given rise to the anomalous results of Hirst and Rideal. In the absence of mercury vapour, no peroxide or water is formed under our experimental conditions, but the shorter wave-lengths in the mercury arc do produce a certain amount of ozonisation, which also occurs even when mercury vapour is present.

The quantity of hydrogen peroxide produced varies with several factors; the rate and composition of gas flow, the temperature, the concentration of mercury vapour, and the intensity of illumination. We shall record in more detail elsewhere the experimental data thus obtained.

Since hydrogen peroxide is demonstrably present in the gas phase, it is obvious that a liquid mercury surface must influence the velocity in some manner, since it has long been known that hydrogen peroxide is readily decomposed at a mercury surface. We have, however, no data, in a very considerable body of experimental work, which would assign any of the *photosensitised* process to the liquid mercury. Nor does there appear to be any sound theoretical reason why mercury atoms in a liquid surface should be more effective than those in the gas phase. Cario and Franck showed also that the quenching of the fluorescence of mercury vapour by hydrogen was proportional to the chemical reaction which could thereby be produced. Secondary effects similar to that just mentioned in the presence of hydrogen peroxide will also effect the velocity in the combination of hydrogen and ethylene and in the combination of hydrogen and carbon monoxide, in these cases, however, adversely. For we have shown that the resonance radiation causes a polymerisation of ethylene with the formation of liquid condensation products, and formaldehyde polymerises to solid products as we pointed out in our initial communication on the subject.

We are inclined to assign the variability of reaction rate in the presence of liquid mercury at room temperature entirely to variations in the concentration of mercury vapour caused by removal as mercuric oxide and irregular renewal due to skin effects on the liquid surface. By operation at higher temperatures (60°-70° C.) such variable behaviour completely disappears, as shown by one of us (A. L. M.) in a recent paper (*J. Phys. Chem.*, **30**, 34, 1926). Our view is strengthened by actual measurements of absorption of resonance radiation by mercury in the presence of various gases, material which will also shortly be published.

We have markedly improved the technique of the study of the chemical effects produced by resonance radiation as exemplified by the apparatus already described by one of us (A. L. M.), and by a new form of apparatus, through which, by building the arc system around the quartz reaction vessel, we avoid the use of quartz-mercury arcs and can operate with Pyrex glass arcs.

HUGH S. TAYLOR.
A. L. MARSHALL.
J. R. BATES.

Princeton University,
Princeton, New Jersey,
January 20.

Genes and Linkage Groups in Genetics.

IT is clearly profitless to continue this correspondence further, since Prof. MacBride will not keep to the point which I raised. The correspondence started because I objected to Prof. MacBride attacking the *genetical* theory of linkage owing to his disagreement with the *cytological* interpretations of the chromosome theory. To my mind, he has not only not cleared up this point, but has made confusion worse confounded by dragging in yet a third issue, namely, the *evolutionary* question of the importance of mutations for phylogeny. I would like, however, to make the following brief remarks.

(1) Prof. MacBride has not attempted to answer any of the questions I asked him in my last letter concerning linkage, but has again taken the opportunity of doing something much easier, namely, setting forth his general views about wholly unrelated topics, such as evolution. The only genetical points on which I have gathered his views are (1) that a unit-factor is a "change," which is either a slip or a grave error; (2) that a linkage-group is some sort of constitutional disease. This was, as I wrote in my last letter, the only interpretation which I could put on his statements. He has not contradicted this interpretation, so that we must assume he accepts it, although I confess it seems to me to be, quite literally, meaningless. He has further stated that he "does not regard Morgan's units as having any validity whatever." This sweeping statement, of course, also denies all validity to Mendel's units and all factors assumed by subsequent Mendelian workers!

He has not even deigned to give us an explanation (which, on his views, is badly needed) of the old-established fact that whereas in some crosses involving two or more Mendelian factors, the F_2 ratios are different according to which way the factors enter the cross (*i.e.* what is usually called linkage), in other crosses they are not (*i.e.* what is usually called independent assortment).

In both my previous letters I have pointed out that I was only concerned with the interpretation of certain well-known genetic facts. Prof. MacBride at one moment refers to the facts I adduced as "elementary Mendelism" and in the next breath denies that they are facts. Until he has discussed them, readers of NATURE may be pardoned if they do not accept his general condemnations.

(2) The statement that Morgan's unit-factors "are avowedly assumed in order to make his observations fit a preconceived theory" is inaccurate, as any one will perceive who looks at the article on Drosophila in "Bibliographica Genetica," vol. 2, or still better Bridges and Morgan, Carnegie Institution Publication, No. 327, the section on methods.

(3) As Prof. MacBride has made some assertions about the unimportance of mutations in evolution, I would refer readers of NATURE to a recent summary of observations on mutations and Mendelising characters in wild species of birds by Stresemann, the well-known ornithologist, in *Verh. Deutsch. Zool. Ges.*, vol. 30, 1925, which shows how far this view is from the truth.

(4) I cannot leave Mr. Tate Regan's letter of January 16 without a word of comment. He mentions various probably mutant characters of fish which, if I understand him aright, tend to appear together in Nature; and this set of characters he calls a "linkage-group." Mr. Regan might have made sure of the definition of a linkage-group before writing his letter. I can here only assure him that if he will look the matter up he will find that his usage bears no resemblance whatever to the accepted use and definition. The characters in this case appear together owing to some common developmental cause, which quite possibly may have a single-factor genetic basis. The linkage in a linkage-group is not concerned with individual (zygotic) development, but with the distribution of genetic factors to the gametes; and it is between a number of separate unit-factors which may have no special developmental relationship. To use the term linkage-group as Mr. Regan has done would be to confuse the mechanism of developmental physiology with the mechanism of segregation and distribution of the hereditary constitution.

JULIAN S. HUXLEY.

King's College,
Strand, W.C.2.

Nitrogen in the Sun.

THE occurrence of nitrogen in the sun is still an open question. No familiar lines, for example, λ3995, have yet been detected in the Fraunhofer spectrum, but the presence of the element is indicated by the cyanogen bands.

It appears that the difficulty of identifying nitrogen by its line spectrum can be traced to the nature of the spectrum itself. Under the ordinary conditions of excitation, nitrogen gives several classes of band spectra, while lines obtained under a higher stimulus, including λ3995, have been assigned by Fowler to N^+. The arc lines of nitrogen itself are evidently lost between these two stages. Kiess (*Journ. Opt. Soc. Am.*, June 1925) has recently elucidated this point. He finds that the chief lines of nitrogen lie either in the extreme ultra-violet or in the extreme infra-red, so that workers confining themselves to the usual spectroscopic region miss them completely.

Kiess has given, in the paper mentioned above, a provisional classification of the arc lines. The principal lines are in the Schumann region, λ1742·81, 1745·31, etc., . . ., but the next strongest group from λ8656 to λ8629 constitutes a *pp'* combination. There is another *pp'* group at λ8200, but they come from a higher level. It is interesting to see whether these lines occur in the Fraunhofer spectrum. On examining the excellent photographs of the infra-red spectrum of the sun given by Meggers (*Astro. Journ.*, vol. 47, p. 1), the presence of some of the lines was clearly observed, while the others were found to occur rather faintly. A complete comparison was not possible, as the author had no access to a full list of the wave-lengths of the infra-red solar lines. Miss C. Payne in her recent monograph "On Stellar Atmospheres" does not mention the occurrence of any nitrogen line in the sun or in any low temperature star. The only nitrogen line which can be identified without ambiguity in the stellar sequence is λ3995. This, however, does not occur in the sun; it occurs, according to Payne, first in the *A*0 class, and Fowler assigns it to N^+.

If this identification of the arc lines of nitrogen in the sun is verified, it will enable us to fix with some definiteness the energy of dissociation of N_2. Some years ago, the present writer calculated from the experimental data of Langmuir that the energy of dissociation of N_2 is of the order of magnitude $1{\cdot}50 \times 10^5$ gm. calories. Recently, Eucken (*Annalen der Chemie*, Band 440, p. 111) has discussed the thermo-chemical data on this point, and he comes to the conclusion that the energy of dissociation of N_2 cannot be less than $4{\cdot}4 \times 10^5$ gm. calories, or thrice the value calculated by the present writer. If this were the case, nitrogen would not be dissociated at all in the sun, and the atomic spectrum cannot occur there. Calculation shows that it would be appreciably dissociated only in the *A*0 class. But, as we have already mentioned, these stars show the lines of N^+,

coming from a level (2*s*) higher than the normal. Hence Eucken's calculations seem to be quite beyond the mark.

Eucken finds from the same line of argument that the energy of dissociation of O_2 cannot be less than $4{\cdot}25 \times 10^5$ calories.

If this were true, no atomic oxygen can occur in the sun. But it is well known that Runge has identified the oxygen triplet λλ7772, 7774, 7775 in the Fraunhofer spectrum. According to Hopfield, the excitation potential for these lines is from 8 to 9 volts, so that in the sun, oxygen is not only completely dissociated, but also a considerable fraction of O-atoms is brought to a higher level. The argument is, therefore, fairly decisive that in the case of O_2, Eucken's calculations are very wide of the mark.

MEGHNAD SAHA.

Physics Department,
University of Allahabad,
December 26, 1925.

Winged Pollen-grains and Flowering Plants (Angiosperms).

IN a recent discussion (Linnean Society, January 21) on the relationship between Dr. Hamshaw Thomas's new race of Jurassic fossil plants, the Caytoniales, and modern flowering plants, the challenge thrown out that winged pollen-grains are not to be found among existing Angiosperms was accepted, and the genus Sararanga (Pandanaceæ) was brought forward as possessing such. This appears to be incorrect. The genus was founded by Hemsley in 1894 (*Journ. Linn. Soc.*, **30**, 216) on the female flowers. Later the male flowers were described by Stapf in Hooker's "Icones Plantarum," **26** (1899), and the pollen-grain is there stated to be "ellipsoideis minute papillatis," and depicted so in a figure. There is no mention of wings (air-vesicles), nor are such shown in the drawing. I have myself examined the pollen from dried material and have failed to find the least trace of anything of this nature. Besides the original species (*S. sinuosa*), one other has since been added to the genus, founded only on a fruiting specimen.

Being suddenly confronted with Sararanga, as I was making my statement that winged pollen-grains do not occur among existing Angiosperms, naturally prevented my making the point I intended, especially as the genus was then new to me. Possibly also it was unknown to nine-tenths of the audience, who might therefore have left with the impression that as both the Caytoniales and Sararanga had winged pollen-grains, this feature in common favoured some affinity between them, and strengthened the supposed relationship between this new fossil group and the flowering plants generally. Hence this letter.

As the challenge is still open, my point might still bear statement. The probable possession of winged pollen-grains (microspores) by the Caytoniales indicates this race of plants as having been wind-pollinated (anemophilous). Dr. Thomas, assuming on other grounds that there is an affinity between the two races of plants, argues from these winged pollen-grains that the primitive Angiosperms could not have been insect-pollinated (entomophilous). How is it, then, that such supposed primitively anemophilous Angiosperms as the Screw Pines (Pandanaceæ) and the catkin-bearing families (Amentiferæ) have not retained this efficient mechanism for the conveyance of pollen through the air? On the view held by the writer that all existing flowering plants were probably descended from entomophilous stock, and that where anemophily occurs it is derivative and not primitive as in Gymnosperms, the absence of winged pollen-grains is understandable. Perhaps geologically there has not yet been time for their evolution, even in those forms, such as some of the Amentiferæ, which were probably among the earliest to substitute anemophily for entomophily.

At the meeting, stress was laid on the resemblance between the male panicle of Sararanga and Antholithus, the probable microsporophyll of the Caytoniales. This, however, can only be superficial, unless our morphological conceptions are at fault; for we are attempting to compare a shoot-structure (inflorescence) with a leaf-structure (a sporophyll or part of one). The resemblance is also strong between the individual tuft of microspore-bearing bodies of Antholithus and the male flower of Pandanus. This again can surely have no phylogenetic significance; for there is evidence that the unisexual flowers of the Pandanaceæ have been derived by reduction from hermaphrodite ones. In the male flower of Freycinetia, a genus belonging to this family, a rudimentary gynœcium is actually present.

J. PARKIN.

Blaithwaite, Wigton, Cumberland,
January 27.

The Leaping Salmon.

DR. DAVID STARR JORDAN'S letter in NATURE of January 16 induces me to send a photograph which excels, I think, even that to which he refers. Its beauty lies in the fact that the markings on the fish,

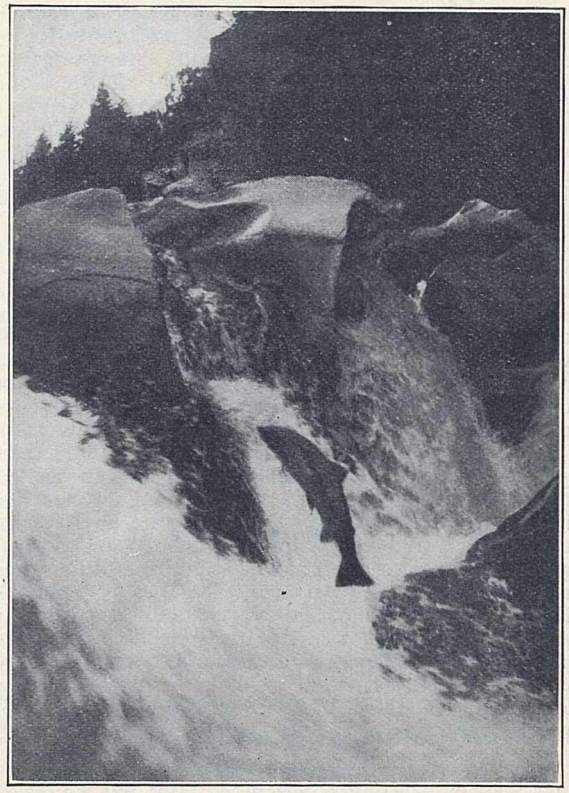


FIG. 1.

its eye, and even its mouth, are clearly visible; in all other photographs of leaping salmon which I have seen, the fish has been a mere silhouette.

The photograph was taken at the well-known "Salmon Leap" on the River Garry at Struan, Perthshire, in August 1924. The fall is some twelve feet high, and it was an evening when the water was fairly full and the salmon were particularly lively in

their efforts to scale the fall. It is possible, by scrambling down over the rocks, to get quite close to the water, and we were rather wetter than was comfortable by the time our exposures—three in all—were made. Of these, one showed a small fish, far away from the camera, one was utterly blank, and the third, here reproduced (Fig. 1), showed a fish of twenty to thirty pounds at a distance of about fifteen feet from the camera. This particular fish failed at this attempt, since it jumped more than high enough, but not far enough to reach the unbroken water above.

Often an ill-directed jump would result in a fish's striking its head against the bare rock with a crack which could be heard fifty yards off; it is a marvel to me that such a blow does not break the salmon's head, but it appears to be without effect, for they continue to come up undaunted.

The obtaining of a photograph such as this is always the accompaniment of a considerable amount of luck, and I account myself fortunate in having secured this one, which has been admired by many as a fine example of its kind.

HARRY B. WALKER.

The University,
Edinburgh, January 23.

Weather Prediction from Observation of Cloudlets.

SOME three years ago I had explained to me by an Irish land official, whose duties are largely carried out in the open air in South Kerry, a method of weather prediction which is much the same as that described in NATURE by Sir G. Archdall Reid. Attention was fixed on a small fragment of cloud; if the cloud increased in size, rain was to be expected within a few hours at most; if the cloud decreased, no rain was to be expected for some little time. I have had numerous opportunities of testing this method, and I do not recall any occasion on which the forecast made was not borne out by events.

The occasions on which my tests were made were all in unstable weather conditions of the kind in which, while hoping for a fair period, one nevertheless takes out a mackintosh to be on the safe side. These are doubtless the conditions referred to by Dr. Lockyer when he writes of "doubtful afternoons." The clouds observed were never cirro-cumuli, but always either small detached fragments of cumulus or fracto-stratus, commonly known as "scud," and at a height of, probably, not more than 3000 feet. It seems scarcely likely that in settled fine weather one would think of applying any test for imminent rain, but in such an event Capt. Cave's criticisms would no doubt be found to be well grounded. It seems possible that the differences between Sir Archdall Reid's and Capt. Cave's opinions in this matter may be due to Sir Archdall's regarding as a general method of prediction one which is applicable only in particular conditions, namely, those of showery uncertain weather, and, it may be, in particular localities; and also, to some extent, to the lack of precise definition of the type of cloud to be observed.

C. D. STEWART.

Westwood, Cahirciveen,
Co. Kerry, January 23.

Polyploidy and Sex Chromosomes.

PROF. RUGGLES GATES introduces hybridity with chromosome incompatibility as a possible source of polyploid series in plant genera. In my note I deliberately refrained from referring to this theoretical possibility because neither in intrasectional crosses nor in the widest possible intersectional willow crosses known to me does the remotest approach to total chromosome incompatibility occur. Furthermore, in my opinion, such a state of affairs is not likely to arise, or to have arisen, in Salix hybrids.

Even if it were possible, other complications, which Prof. Gates seems to have overlooked, would ensue. Consider a cross between two diploid Salix species A and B, A supplying the male parent and B the female. Let the sex chromosomes of the former species be designated X and Y and of the latter X′ and Y′; then, so far as the sex chromosomes are concerned, the male of A is of composition XY, and the female of B of build X′X′. It follows, therefore, that the hybrid males will have a sex chromosome formula of X′Y, and the hybrid females the composition XX′. If no reduction division takes place in hybrid sporogenesis, as the hybridity theory of polyploidy demands, the F_2 generation, although tetraploid, will have the formula X′X′XY, and only one sex is developed!

Prof. Gates instances several cases (to which, as a result of my own researches, I could add others both in animals and plants) in which polyploidy has originated in experimental work, but in none of these is the real difficulty raised by the failure of the duplication of the sex chromosome complement in polyploid Salices met. By quoting from the work of my colleague Dr. Blackburn and myself ("A Preliminary Account of the Chromosomes and Chromosome Behaviour in the Salicaceæ," *Annals of Botany*, vol. 38, p. 361, 1924) on the cytology of Salix in which we found peculiar relationships in respect to chromosome size, and by postulating secondary changes, he simply emphasises my original statement that, by the discovery of only one pair of heterochromosomes in the males of polyploid willows, the origin of polyploidy is thrown open for further consideration.

In conclusion, whilst directing attention to the innocent-looking remarks on the transformation of sex chromosomes into autosomes, I venture to leave them, with their far-reaching implications, to provoke their own comments.

J. W. HESLOP HARRISON.

Zoological Laboratory,
Armstrong College,
Newcastle-upon-Tyne.

Mutant Groups in Nature, *Gentiana campestris* var. *alba*.

PROF. JULIAN HUXLEY (NATURE, October 3, 1925, p. 497) may be glad to know that his example of mutant white-flowered *Gentiana campestris* has its analogue in Zetland. There, on the slopes of Whiteness Voe, is a very large group of white-flowered specimens, outnumbering the normal form, and I saw several good-sized patches in the remote island of Balta. There is also a considerable group on the slopes of Ben Lawers and on Glen Lyon. I saw no intermediates, although in the Isle of Wight there is a large colony of white Origanum and intermediates which are also almost certainly crosses of the white and normal plants. One might add that I brought a single red-flowered *Kentranthus ruber* to my garden about twelve years ago; seedlings came up and they remained constant, but last summer a white-flowered plant appeared. However, there seems to be a permanence in the white-flowered *Gentiana campestris* and in the albino *Geranium Robertianum* which continues for many years. It was very noticeable on one side of the Brazen-face outside Funchal; there it evidently seeded down the hill-slope.

G. CLARIDGE DRUCE.

Optical Rotatory Dispersion.[1]

A TRIBUTE TO THE MEMORY OF BIOT (1774–1862).

By Prof. T. M. LOWRY, F.R.S.

LAST year, in Amsterdam and in Paris, we celebrated the jubilee of the foundation in 1874 of the science of stereo-chemistry. The year before, in Paris and in Strasbourg, the centenary of the birth in 1823 of Louis Pasteur was commemorated. This series of celebrations would be incomplete unless it covered also the 150th anniversary of the birth in 1774 of the French physicist, Jean Baptiste Biot. For, apart from Biot's pioneer work on optical rotatory power, there could have been no discovery of molecular dissymmetry by Pasteur; and, apart from the study of molecular dissymmetry, we should have known very little of "chemistry in space."

THE DISCOVERY OF ROTATORY DISPERSION.

One might have supposed that the discovery of optical activity would have preceded that of rotatory dispersion; that, after the rotation of the plane of polarised light had been discovered, further research would have shown that this rotation varied with the wave-length of the light. This, however, is the opposite to what actually happened, for it was the colours resulting from the unequal rotation of light of different wave-lengths by a plate of quartz that first attracted the attention of Arago (*Mém. Inst.*, 1811, 12, 93) and thus led to Biot's discovery of the laws of optical rotation.

In view of the fact that Biot was thus led to a knowledge of optical rotatory power through a study of the phenomena of rotatory dispersion, it is not surprising that he always included measurements of dispersion in his work on optically active substances. The example thus set would probably have been followed generally, but for the discovery in 1866 of the Bunsen burner. This device, which made it easy to produce monochromatic light of one colour, was fatal to the study of dispersion, since no other monochromatic light could be produced with equal ease. The custom therefore arose of measuring the optical rotatory power of organic compounds for one wave-length only; and even physical chemists, seeking to discover the influence of solvent, concentration, temperature or chemical constitution on rotatory power, were content to work with sodium light only, and thus to record a single point on a curve of unknown form. Biot, however, always recognised the supreme importance of dispersion in his studies of optical rotatory power, and this fact alone brings his work into closer relation with the researches of the twentieth century than with those of the nineteenth.

THE LAW OF INVERSE SQUARES.

In his first memoir (*Mém. Inst.*, 1812, 1, 1-372) Biot only recorded the fact that the rotations produced by a plate of quartz decreased progressively with change of colour from violet to red (pp. 256-257). In his second memoir (*Mém. Acad. Sci.*, 1817, 2, 41-136), however, he undertook a more exact "Recherche de la loi des rotations des différens rayons simples dans le cristal de roche," and as a result he was able to announce immediately his well-known Law of Inverse Squares, $\alpha = k/\lambda^2$. For this law Biot was able to claim that "si elle n'est pas la loi de la nature elle en approche du moins assez pour pouvoir lui être substituée dans toutes les observations" (p. 85). It is noteworthy that Biot arrived at this important law in spite of the fact that he had no source of monochromatic light, and that his only wave-lengths were Newton's values for the boundaries of the different colours.

Special interest attaches to the graphical method which Biot used in order to express his Law of Inverse Squares. For this purpose Biot plotted along a horizontal axis the square of the wave-length of the light, and in a vertical direction the thickness of the plates

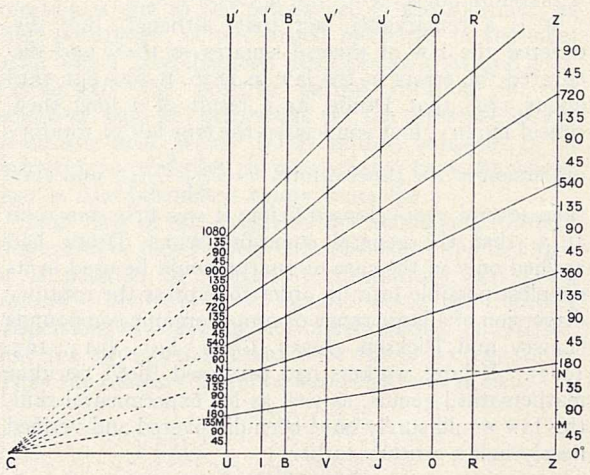


FIG. 1.—Biot's linear diagram. This diagram, in which the reciprocal of the rotatory power of quartz is plotted against the square of the wave-length of the light, is of the same type as those now used in the graphical method of testing for "simple rotatory dispersion."

of quartz required to produce rotations of 180°, 360°, 540°, etc., in light of a given colour. The law of inverse squares was verified (i) by a linear relation between $1/\alpha$ and λ^2, (ii) by noticing that the line passed through the origin, *i.e.* that on extrapolation to $\lambda^2 = 0$, $1/\alpha$ became 0 also, and α became infinite.

Having established the law of inverse squares for quartz, Biot at once proceeded to apply it to those liquids in which he had just discovered the existence of optical rotatory power, and in particular to oil of turpentine (pp. 91-103), and to an aqueous solution of cane-sugar (pp. 103-114). The method adopted was to balance the rotation of the liquid against that of quartz plates selected so as to produce an equal and opposite rotation in the light transmitted through a piece of deep red glass. In each case the compensation appeared to be exact, proving that the law of inverse squares applied just as well to the liquid as to the rock crystal. Some years later, however, when trying to compensate lævorotatory turpentine against a dextrorotatory oil of lemon, either in separate tubes

[1] From a lecture delivered before the Société de Chimie Physique, in Paris, on December 9, 1925.

or mixed, Biot observed "une compensation très approchée, mais non pas complète, ni surtout générale pour tous les rayons" (*Comptes rendus*, 1836, 2, pp. 542 and 543). A very exact compensation was obtained when cane-sugar and invert-sugar were balanced against one another (*Ann. Chim. Phys.*, 1844, 10, 35), but the experiments with turpentine and oil of lemon proved clearly that the law of inverse squares was not exactly and universally true.

What then must be done in order to find the exact law of rotatory dispersion? Biot had the key in his own hands, and could have solved the problem with certainty if the experimental methods then available had provided data of sufficient exactness for a rigid test of the law. Thus, it is only necessary to plot $1/\alpha$ against λ^2 for a series of optically-active compounds, in order to discover that there is often an exact linear relationship between these two quantities. The straight line does not pass, however, through the origin at $\lambda^2=0$, but intersects the axis of zero rotation at a finite distance from the origin, *e.g.* at a point given by $\lambda^2=\lambda_0{}^2$. The true law of rotatory dispersion is therefore not $\alpha=k/\lambda^2$, but $\alpha=k/(\lambda^2-\lambda_0{}^2)$.

It is a remarkable fact that, although Biot discovered the law of inverse squares in 1818, and discovered the errors in the law in 1836, it was not until about 1898 that Drude, as a result of a long theoretical inquiry, first enunciated the true law of rotatory dispersion in the general form $\alpha=\Sigma\frac{k_n}{\lambda^2-\lambda_n{}^2}$; and even then several years elapsed before it was first shown, in 1913, that the general equation (which Drude had applied only in the case of quartz) could be used in its simplest possible form in order to express the rotatory dispersion of a large range of simple organic compounds (Lowry and Dickson, *Journ. Chem. Soc.*, 1913, 103, 1067). If later workers had possessed Biot's peculiar mathematical genius, as well as his experimental skill, this law would surely have been discovered and verified nearly half a century earlier.

The Discovery of Anomalous Rotatory Dispersion.

The first reference to the optical rotatory power of tartaric acid is contained in a "Mémoire sur la polarisation circulaire et sur ses applications à la chimie organique" (*Mém. Acad.*, 1835, 13, 39-175). At the conclusion of a list of optically-active oils and syrups, it is recorded that a certain solution of tartaric acid gave a rotation of +8·5° for white light, and that the rotation was "plus forte sur les rayons les moins réfrangibles." The memoir itself, which records in a "note additionnelle" the important discovery of the inversion of cane-sugar (pp. 174-175), does not appear to contain any reference to this entry in the table; but three years later, Biot presented to the Academy a long memoir (*Mém. Acad. Sci.*, 1838, 15, 93-279) devoted entirely to the study of the rotatory power of tartaric acid under different conditions. In this memoir, stress was laid on the fact that tartaric acid was almost unique in its failure to obey the law of inverse squares. The existence of a *maximum rotatory power* for green light was indicated in a table (p. 236), which shows the rotation for light of different colours of a solution containing 34·27 per cent. by weight of tartaric acid. The memoir also contains a clear prediction of the existence of a second form of anomaly, namely, a *reversal of sign*, as indicated by the fact that the limiting values for 0 per cent. of water were negative for low temperatures and for short wave-lengths. This prediction was fulfilled when Biot, in 1850, found a negative rotation in the cold, glassy, anhydrous acid (*Ann. Chim. Phys.*, 1850, 28, 353). The more elaborate work of Bruhat (*Trans. Faraday Soc.*, 1914, 10, 89) has shown that, under these conditions, negative rotations are observed at 15° C. for all wave-lengths less than 5600 Å.U. Negative rotations have also been observed repeatedly in subsequent years, especially in concentrated solutions, and for light of short wave-length (see especially Lowry and Austin, *Phil. Trans.*, 1921, A, 222, p. 280).

Simple and Complex Dispersion.

Biot divided optically-active substances into two classes: (i) those which obeyed, at least approximately, the Law of Inverse Squares, (ii) those which made no pretence of obeying it. In the latter class he included tartaric acid, whilst its salts were included in the former class.

These two classes are now generally described as showing *normal* and *anomalous* rotatory dispersion respectively. The distinction between them depends on whether the dispersion-curve remains on the same side of the axis throughout the region of transparency (so that α, $d\alpha/d\lambda$, and $d^2\alpha/d\lambda^2$ are of constant sign), in which case the rotatory dispersion is *normal*, or whether it cuts the axis of zero rotation in the region of transparency, in which case the dispersion is *anomalous*. In the latter case the dispersion-curve exhibits all the well-known anomalies, *e.g.* an *inflexion*, *maximum* and *reversal of sign*; but, as these become less marked, they vanish successively into the infra-red region, where we have no means of following them experimentally. It is therefore impossible in many cases to decide whether a dispersion is really normal, or whether the dispersion-curve may be expected to cut the axis at some wave-length beyond the limit within which visual readings can now be made.

In my own work I have adopted Biot's original classification, with one essential modification, namely, that I have substituted the equation $\alpha=k/(\lambda^2-\lambda_0{}^2)$ for Biot's Law $\alpha=k/\lambda^2$. Substances of which the rotatory power can be expressed by the equation $\alpha=k/(\lambda^2-\lambda_0{}^2)$ are said to show *simple rotatory dispersion* (Lowry and Dickson, *Trans. Faraday Soc.*, 1914, 10, 961; Lowry and Richards, *Journ. Chem. Soc.*, 1924, 125, 2511), whilst substances which do not obey the law of simple rotatory dispersion are said to exhibit *complex rotatory dispersion*. The difference between a simple and complex dispersion is seen most clearly in the ultra-violet region, where the course of the dispersion can be followed right up to the limit of transparency of the medium, within which alone the dispersion equations are valid. I therefore prefer to retain, in this modified form, Biot's original method of classifying rotatory dispersions, according as they do or do not obey a certain law, rather than to be guided exclusively by the presence or absence in the visible spectrum of gross anomalies, such as an inflexion, maximum or reversal of sign.

Although only a small correction is needed in order thus to convert Biot's law into the Law of Simple Rotatory Dispersion, this correction is of great importance, since if all optically-active substances obeyed the Law of Inverse Squares, all rotatory dispersions would be normal, and all would be identical with one another, *e.g.* $\alpha 4358/\alpha 5461 = (5461)^2/(4358)^2 = 1{\cdot}52$. The superposition of two normal dispersions, even if of opposite signs, would then always give rise to a normal dispersion of the same magnitude, and no form of anomalous rotatory dispersion could be developed by this process.

THE ORIGIN OF ANOMALOUS ROTATORY DISPERSION.

(*a*) *Anomalous Rotatory Dispersion produced by Optical Superposition.*—The secret of the origin of anomalous rotatory dispersion was disclosed by Biot in 1836, when he showed that *anomalous rotatory dispersion can be produced in transparent media by the superposition of two normal rotations of opposite sign and of unequal dispersion.* This superposition may be entirely optical, *i.e.* two independent columns of liquid may be balanced against one another by inserting them end to end in the same polarimeter; or the liquids may be mixed in the same tube. Both methods were used by Biot in compensating lævorotatory turpentine against dextrorotatory oil of lemon, in the experiments already described (*Compt. rend.*, 1836, *2*, 543).

These two cases are easily understood, since the existence of two independent partial rotations of opposite sign can be demonstrated quite conclusively. Much more complicated are those cases in which a single optically-active compound, such as tartaric acid or α′-bromocamphor, gives rise to anomalous dispersion, since in these cases it is impossible to isolate from the medium a dextrorotatory and a lævorotatory component. Here again, however, a correct lead was given by Biot when he described his researches on the rotatory power of tartaric acid, under the title "Mémoire sur plusieurs points fondamentaux de mécanique chimique," since he evidently regarded the problem as fundamentally chemical and not merely physical in character.

(*b*) *Origin of Anomalous Rotatory Dispersion in Tartaric Acid.*—Biot's view that the changes of rotatory power which tartaric acid undergoes under the influence of bases, of boric acid, of water and of alcohol, are chemical in origin, was developed in a more concrete form by Arndtsen, who spent the summer of 1858 in working on rotatory polarisation in the laboratory of M. Verdet at the École Normale Supérieure.

To Arndtsen's view, that the anomalous rotatory dispersion of tartaric acid is due to the superposition of the opposite rotations of two interconvertible forms of the acid, I have given consistent support. In addition to making a careful study, during a period of more than twenty-five years, of the conditions under which a reversible isomeric change can take place in solution, I have proved (Lowry and Cutter, *Journ. Chem. Soc.*, 1925, 121, 532) that the anomalous rotatory dispersion at 20° C. of pure recrystallised ethyl tartrate can be expressed with perfect accuracy *as the sum of two simple partial rotations*, by means of the equation

$$[\alpha] = 20{\cdot}005/(\lambda^2 - 0{\cdot}03) - 20{\cdot}678/(\lambda^2 - 0{\cdot}056).$$

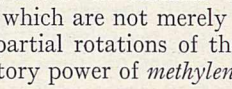
This dispersion is anomalous, and a simple calculation serves to locate the *inflexion* at 6950 Å.U., the *maximum* at 5630 Å.U., and the *reversal of sign* at 4245 Å.U. In the same way the rotatory power of a 50 per cent. solution of tartaric acid in water at 20° C. can be expressed (Lowry and Austin, *Phil. Trans.*, 1922, A, 222, p. 293) by the equation

$$[\alpha] = 17{\cdot}485/(\lambda^2 - 0{\cdot}03) - 12{\cdot}080/(\lambda^2 - 0{\cdot}074).$$

This dispersion is anomalous, like that of the ester, and calculation shows (in agreement with direct experiment) that the *inflexion* occurs at 6376 Å.U., the *maximum* at 5373 Å.U., and the *reversal of sign* at 4140 Å.U.

The latter equation is of interest because Longchambon (*Compt. rend.*, 1924, 178, 951; *Bull. Soc. fr. Min.*, 1922, 45, 161) has proved that solid tartaric acid is lævorotatory and has a "normal" dispersion. Moreover, it gives a dispersion-ratio $\alpha 4358/\alpha 5780 = 2{\cdot}14$, which agrees closely with the ratio 2·2 deduced *for the negative partial rotation* in the above equation (Lowry and Austin, NATURE, Sept. 20, 1924, 114, 430). There can, therefore, be little doubt that this negative partial rotation is due to the persistence in the solutions, as Biot postulated, of unchanged molecules of the solid acid, which Longchambon describes as α-tartaric acid. Conversely, the positive partial rotation in our equation can be attributed to the presence of the β-tartaric acid, which Longchambon supposes to be formed by a reversible chemical change from the α-acid, just as Biot postulated ninety years ago.

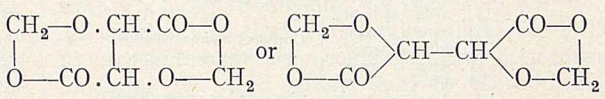
This view of the origin of the anomalous rotatory dispersion of tartaric acid is confirmed by the fact that it is possible to prepare dextrorotatory and lævorotatory derivatives of tartaric acid, the rotatory dispersions of which are not merely *normal* but *simple*, like the two partial rotations of the above equations. Thus the rotatory power of *methylene-tartaric acid*,



(Austin and Carpenter, *Journ. Chem. Soc.*, 1924, 125, 1939), can be expressed by the equation

$$[\alpha] = -24{\cdot}627/(\lambda^2 - 0{\cdot}0446),$$

whilst the rotatory power of *dimethylene tartrate*,



can be expressed (*ibid.* p. 1945) by the equation

$$[\alpha] = +34{\cdot}168/(\lambda^2 - 0{\cdot}03132).$$

There can be little doubt that the lævorotatory compound is a derivative of pure α-tartaric acid, whilst the dextrorotatory compound is a derivative of pure β-tartaric acid. This conclusion is confirmed by the fact that, although the dispersion constants are not identical with those of the two partial rotations in the above equations (which are themselves variable from compound to compound), the dextrorotatory compound has a smaller dispersion constant than the lævorotatory compound.

Exceptional interest attaches to the acetyl-derivatives. In this case, Austin and Park have shown

(*Journ. Chem. Soc.*, 1925, 127, 1926) that the rotatory power in dry acetone of *diacetyl-tartaric acid*,

$$\begin{array}{l} CH_3.CO.O.CH.CO.OH \\ \qquad\qquad\quad | \\ CH_3.CO.O.CH.CO.OH \end{array}$$

can be expressed by the equation

$$[\alpha] = -6{\cdot}508/(\lambda^2 - 0{\cdot}0833).$$

In the same way the rotatory power in dry acetone of *diacetyl-tartaric anhydride*,

$$\begin{array}{l} CH_3.CO.O.CH.CO \diagdown \\ \qquad\qquad\quad | \qquad\quad\;\; O \\ CH_3.CO.O.CH.CO \diagup \end{array}$$

can be expressed by the equation

$$[\alpha] = +18{\cdot}354/(\lambda^2 - 0{\cdot}0507).$$

In this case again, therefore, the rotatory dispersion of the two derivatives is simple, and the dextrorotatory compound has the smaller dispersion constant. In

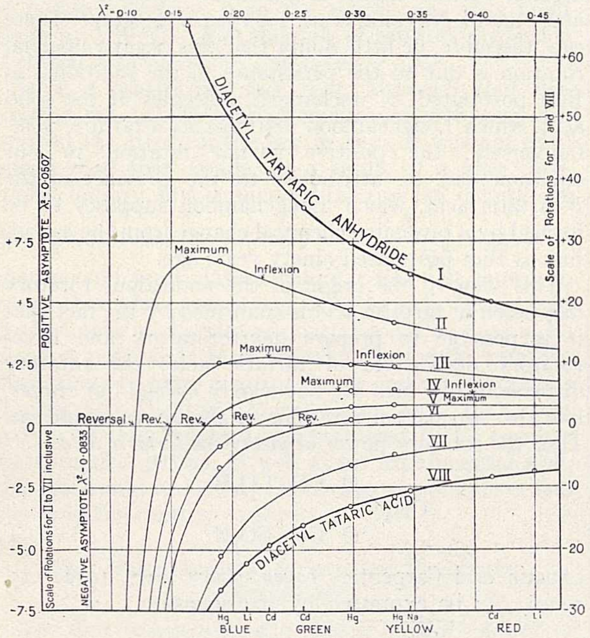
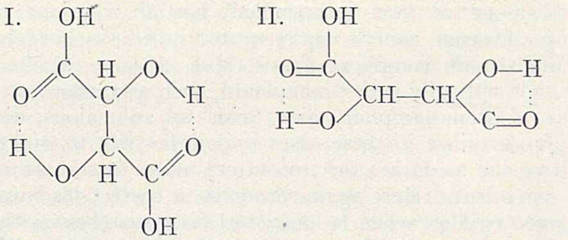


FIG. 2.—Mutarotation and rotatory dispersion of diacetyl-tartaric anhydride in wet acetone at 20° C.

I.	Initial rotations.	Simple (dextro).
II.	After $38\frac{1}{2}$ hours.	Complex and anomalous (with reversal of sign).
III.	After 45 hours.	
IV.	After 49 hours.	
V.	After 51 hours.	
VI.	After 53 hours.	
VII.	After $61\frac{1}{2}$ hours.	Complex but normal (lævo).
VIII.	Final rotations.	Simple (lævo).

wet acetone, however, the anhydride is not stable, and is gradually hydrolysed to *diacetyl-tartaric acid*. Since the rotations of the two compounds are opposite in sign, and their dispersion constants are of unequal magnitude, all the conditions necessary to produce anomalous dispersion are present in the solution. Thus, a freshly prepared solution of the anhydride, which gave a *simple dextrorotation*, soon showed a *complex and anomalous dispersion*, owing to the development in the free acid of a negative partial rotation with a high dispersion coefficient. This complex and anomalous dispersion was transformed in turn into a *complex and normal dispersion*, when the negative term had become predominant over the whole range of wave-lengths; and finally, when hydrolysis was complete, the solution showed only the *simple lævorotation* of the free acid (Austin and Park, *loc. cit.*). This case is of special importance, since it provides a working model of the mechanism postulated by Biot, by Arndtsen, and more recently by Longchambon, in order to account for the development of anomalous rotatory dispersion in solutions of the free acid.

The ease of transformation of α into $\alpha \rightleftharpoons \beta$ tartaric acid suggests that the difference between the two compounds involves a rearrangement of structure which is even less drastic than a keto-enolic change. I therefore formed the opinion some years ago that the difference between the two forms of the acid might depend merely on an arrest, in two favoured positions, of the free rotation of the molecule about the single bond between the two central carbon atoms. The clear recognition of the bivalency of hydrogen (Lewis, "Valence," 1923, p. 109; Lowry and Burgess, *Journ. Chem. Soc.*, 1923, 123, p. 2111; Lowry, "Nouveaux aspects de la théorie de la valence," *Bull. Soc. Chim.*, 1924, p. 9) has, however, made it possible to assign to tartaric acid alternative formulæ I. and II. (Lowry and Austin, NATURE, 1924, 114, p. 431) which appear to fulfil all the essential conditions required for a graphical representation of the α- and β-tartaric acid of Longchambon. There is, however, not enough evidence available to show which of these formulæ should be assigned to α-tartaric acid and which to β-tartaric acid.



(*c*) *Origin of the Quasi-anomalous Rotatory Dispersion of Camphor*.—Although the rotatory dispersion of camphor is *normal*, it depends on the superposition of two partial rotations of opposite sign, and is therefore *quasi-anomalous* (Lowry and Cutter, *Journ. Chem. Soc.*, 1925, 127, p. 608). What, then, is the origin of these two opposite partial rotations? Tschugaeff has shown that anomalous rotatory dispersion can be produced by superposing the opposite partial rotations of two radicals in the same molecule, as in *l*-menthyl *d*-camphorsulphonate (*Trans. Faraday Soc.*, 1910, 10, 73). I have adopted this view in the case of camphor, with a novel assumption as to the nature of the asymmetric radicals. Thus I suppose that the high-frequency negative partial rotation of camphor is associated with the two saturated quadrivalent asymmetric carbon atoms. On the other hand, it is clear that the positive partial rotation, which is controlled by a dispersion constant corresponding approximately with the wave-length of the ketonic absorption-band (Lowry and Cutter, *Journ. Chem. Soc.*, 1925, 127, 611), is in some way linked up with the double bond of the $>C=O$ group. I have therefore suggested (Lowry and Walker, NATURE, April 19, 1924, 113, 565) that although a carbonyl radical in a symmetrical molecule possesses a plane of symmetry, this is no longer true in an unsymmetrical molecule. As

evidence of this absence of symmetry, I have adduced the fact that camphor gives unequal yields of borneol and isoborneol on reduction, proving that the two links of the double bond are of unequal strength. It is, therefore, a mere unjustified analogy which has led to the assumption that the carbonyl-group of camphor is a symmetrical radical, and no further evidence is required to justify the view that the carbon atom of the ketonic group is in fact an asymmetric carbon atom, *i.e.* that it possesses an *induced asymmetry*, in view of the influence upon it of the *fixed asymmetry* of two of the saturated quadrivalent carbon atoms. This property of induced asymmetry appears to be very frequent in unsaturated optically-active compounds, and can be used in order to account for the presence of low-frequency partial rotations in many compounds in which the unsaturated group is not too far removed from the fixed asymmetric centres.

In this address I have presented an intimate mixture of Biot's researches with those of my colleagues of the present day. The fact that so intimate a blend is possible is in itself a tribute to the genius of Biot, whose work, although carried out with the mechanical equipment of the nineteenth century, was always conceived in the spirit of the twentieth century.

The American Bison: A Questionable Experiment.

By Dr. JAMES RITCHIE.

THIRTY-EIGHT years ago the sum total of American bison had been reduced from the millions of a century earlier to a number estimated by Hornaday at 1091, and there was a prospect that the species might become extinct. The situation was saved by the action of the Governments of the United States and of Canada, each of which placed remnants of the dwindling herds under protection in large reserved areas. The rapidity with which the protected animals recuperated is well illustrated by the history of the Canadian herd. In 1907 the Dominion Government, acting through the Department of the Interior, purchased the 709 members of the herd owned by Michael Pablo of Montana, which can be traced back to 4 wild calves captured by an Indian in 1873. By 1909 the Pablo herd had been set at large in the Buffalo National Park at Wainwright, an area 15 miles long and 13 miles wide, and in 1925 this herd was found to number approximately 12,000 head, the increase in sixteen years being about 11,300. The future of the species in Canada, therefore, seems to be assured. So far, the success of the experiment of protection has been all that could be desired.

A new difficulty now faced the authorities in Canada. The area of close on 200 square miles set aside for the original herd was insufficient to support the new numbers, and some method of reducing the numbers and of disposing of the annual increase had to be devised. Some 2000 have been slaughtered for food and robes, some have been transferred to other parks, including a pair sent to the Scottish Zoological Park in Edinburgh, and more than 1600 have been transported northward for 700 miles to Wood Buffalo Park in the North-West Territories. The Wainwright stock now reduced to about 8000, or about one to 16 acres, must be still near the food limit of the area (10 acres to one sheep is a rough guide to the food capacity of Scottish mountain pastures), but arrangements are being made for the disposal of the annual increase, which in the full herd amounted to 1500 individuals a year. It is, however, to the transference of large numbers to Wood Buffalo Park that attention is here particularly directed.

The Department of the Interior is to be congratulated on the success of the work of transference; for, by means of specially designed cars and barges, 1634 bison were moved by rail and water for 700 miles with only 8 casualties. But the transference gives rise to some doubt from the scientific point of view.

In Wood Buffalo Park there existed the only herd of wild bison which has survived, and these, the "wood buffalo," have been separated from the "plains buffalo" of the reserves as a distinct race, *Bison bison athabascæ*, characterised by its larger size, darker colour, more dense and silky hair, and larger and more incurved horns. Whether these characters are due to innate variation emphasised by segregation, or are simply the evidences of the effect of a different environment, is not known. At any rate, this race has now little likelihood of survival as a pure strain, for amongst its members, which probably do not exceed 1500 in number, have been deposited 1600 individuals of the contradistinctive race of the plains; and the wardens report that "the plains and the wood buffalo are mingling freely and that there is every prospect of the complete amalgamation of the two herds."

From the scientific point of view the opportunity of making an interesting experiment has been missed. Had the surplus plains buffaloes been deposited in an area similar in latitude, vegetation and climate to Wood Buffalo Park, but isolated from it, instead of in the Park itself, the wood buffalo race would have remained uncontaminated, and time would have shown whether in the new environment the plains buffalo would have assumed the distinctive characters of the wood buffalo. Had it turned out that these characters were wholly environmental, as they may well be, an interesting biological correlation would have been proved, and no objection could then have been taken to fortifying the wood buffalo herd by the addition of plains individuals.

In the meantime two suggestions may be made. First, in view of the possible swamping and disappearance of the distinctive wood buffalo as the result of crossing, it should be assured that several pure-bred typical specimens of that race find a place in one or more of the Dominion or other great museums. Secondly, if it be possible, the next batch of surplus plains buffaloes to be transferred from Wainwright should be placed in a northern area other than Wood Buffalo Park, with the view of establishing a new and independent herd in which the influence of climate might be watched. The result would finally condemn or vindicate the 1925 experiment of commingling the two racial forms.

Obituary.

MR. B. N. PEACH, F.R.S.

THE death of Benjamin Neeve Peach on January 29 has removed one of the most conspicuous figures from the Scottish geological world. Born in 1842, he had retired from the Geological Survey of Scotland in 1905, but advancing years and recurrent attacks of rheumatic gout did not prevent him from taking a keen interest in every kind of investigation and discovery in the fields of research which he had cultivated.

Peach was born in Gorran, Cornwall, and his father, Charles W. Peach, was a notable man, who, although a Customs officer of comparatively humble station, had trained himself in geology and biology until he was well known for his original contributions to natural science. He was the friend of Sir Roderick Murchison, Hugh Miller, Robert Dick, and many other eminent scientific workers. The boy attended school at Peterhead and Wick (Caithness) and passed on to the Royal School of Mines (London), where he studied under Huxley, Ramsay, and many of the first teachers and investigators of the time. Benjamin Peach entered the Geological Survey in due course, and after a short period of work in London with Salter, the palæontologist, started field work on the Scottish staff. His colleagues included such men as Archibald Geikie, James Geikie, John Young, and at a later date, W. Gunn and John Horne, men of brilliant ability who were destined to make their department famous by their researches. At their head were two great geologists, Sir Roderick Murchison and Sir Andrew Ramsay. Each of the group had his individual merits and claims, but Peach in some ways was the most brilliant of them all.

The love of biology, which Peach probably acquired from his father, was one of his principal interests. For many years he acted as palæontologist to the Geological Survey of Scotland and did a vast amount of routine work. His special field, however, was the fossil Crustacea, and on these he has left some short monographs and papers. He ascribed his interest in this group to the teaching of Huxley, and by his high artistic skill he was able to furnish all the drawings required to illustrate the memoirs.

It was as a field geologist, however, that Peach especially shone. His experience was vast, for there was scarcely a parish in Scotland in which he had not worked or visited at some period. His early work was in the Scottish Midland valley, where a great variety of rocks, sedimentary and igneous, lay open to his scrutiny, and the glacial and alluvial deposits were of great diversity and presented many problems then awaiting solution. In course of time he began work in the Highlands and was one of the leaders of that band who settled the obscure questions involved in the great thrust zones of the north-west. From there his work spread over many parts of that delightful but puzzling country. When Lapworth's discoveries in the Scottish Silurian rocks necessitated revision of the published maps, Peach and Horne undertook the work and carried it to completion with triumphant success.

Peach's wide experience of field work, however, was only one of the factors that contributed to his pre-eminence. Peach had in especial degree the gifts that make a great field geologist. With great physical strength and activity, he combined a restless passion for investigation that left no stone unturned that seemed likely to conceal some evidence. He had the most wonderful ingenuity and an imagination that amounted almost to inspiration. In difficult ground where the evidence was scanty and obscure, he tried every possible hypothesis and his judgment was seldom at fault. With these he had the rarest faculty of all, that of seeing in three dimensions, and in all sectional planes, the structural anatomy of the country he was mapping; so that each bit of evidence was fitted immediately into its place. No other geologist of his time had this faculty in the same measure except Charles Lapworth of Birmingham.

To his great gifts as a geologist were added the most charming personality and a striking physique. To his last days Peach had the boisterous spirits of a schoolboy. Full of humour and endowed with innumerable good stories, which he retailed in broad Scotch, he was a centre of attraction in every social gathering. His influence on young men was remarkable, and probably the greatest service he did to science was the training he gave to successive generations of young geologists, partly by precept (of which he was very lavish) but principally by example and by lessons in the field. To accompany Peach for a few weeks in the field (in the Highlands especially) was a liberal education for a young geologist; and by his rich store of recollected facts, his penetrating acuteness in observation, his rapid and logical deductions, and the lightning-like rapidity with which he read the riddles of geological structure, he inspired his assistants with a love of the work and a knowledge of the best and most rapid methods of getting accurate results. It was not easy going, for Peach made each field day an arduous task, both physical and mental, but the reward was certain.

In the study and the office Peach was a different man. His knowledge of geological cartography was profound, and his drawings, sketches, sections and maps were never at fault and were often of the greatest merit. As a writer, however, he was less successful. He hated the slow labour of the pen. Although fluent of speech, he was a slow and involved writer, and only by patient effort could he express his thoughts in clear sequence and exposition. Fortunately, however, his defects were more than compensated by the great literary skill of his friend and colleague Dr. John Horne, who formed with Peach a partnership that produced many geological monographs now known as classics in every country where geology is studied. Ably supported by their colleagues, these two geologists achieved magnificent results in many fields of geological work. Their faculties blended so perfectly that each produced his best in their joint enterprises, and they have dominated the progress of Scottish geology for the last forty years.

The list of geological papers, monographs, and memoirs to which Peach contributed is a very long one, but they mark only a portion of his activities. His published maps and the manuscript maps that show his field results are to the initiated even more instructive. Such work, for example, as his survey of parts of Assynt, of Arthur's Seat, and of the graptolite zones of

the south of Scotland, indicates the hand of the master. For many years he gave devoted service to the geological mapping of Scotland, and so long as men take interest in Scottish geology his memory will endure.

J. S. F.

DR. W. E. HOYLE.

THE death of William Evans Hoyle, D.Sc. (Oxon.), on February 7, at Porthcawl, has removed from this world one who, to the deep regret of his many friends, had for the last year or two been compelled by ill-health to withdraw entirely from that active participation in their pursuits to which for half a century they had been accustomed.

Born at Manchester, in 1855, Hoyle was by circumstances inclined to the profession of his father, William Jennings Hoyle, an engineer connected with both Whitworth's and Armstrong's. But his education at Owens College and afterwards at Oxford, which he entered as an exhibitioner in natural science at Exeter College, being elected later a junior student of Christ Church, turned his thoughts to the mechanism of the animal body, and this attraction was intensified by the influence of the great teacher, Rolleston. Thus it was that, after taking a first class in natural science, and qualifying at St. Bartholomew's Hospital for M.R.C.S., Hoyle was glad to become demonstrator in anatomy at Owens College and, not long after, to migrate to Edinburgh as a naturalist on the editorial staff of the *Challenger* Expedition. This division of interests bore at first similarly divided fruit: the year 1883 saw papers by him on primary epithelioma of the lung and on a new species of Octopus, while 1886 produced his translation of Leuckart's "Parasites of Man" as well as his report on the Cephalopoda collected by the *Challenger*. After this it was the cephalopods that conquered; on that fascinating group Hoyle produced a series of reports and papers, including reports on the cephalopods collected by Herdman at Ceylon (1904), by Stanley Gardiner at the Maldives and Laccadives (1905), by the National Antarctic Expedition (1907), and the Scottish National Antarctic Expedition (1912). Valuable and thorough though they were, these works did not introduce any startling changes in our conception of the group; apart from the systematic aspect, the chief study to which they led was that of phosphorescence in the cephalopods and other animals of the deep sea. Hoyle's knowledge of recent cephalopods was summarised in his presidential address to Section D of the British Association at Leicester (1907).

Meanwhile his systematic work and his training in the *Challenger* Office had qualified Hoyle to act as curator of a large collection. A chance arose for transferring him to the Zoological Department of the British Museum, but failed owing to the opposition of the staff, which did not like to see promotion checked by the appointment of senior men from outside. There was, I know well, no objection on personal grounds. The result, whether gain or loss to the British Museum, was a gain to Hoyle's own development and to the museum world. What London rejected, Manchester seized: Hoyle was made curator of the Manchester Museum, at Owens College, and, under the guidance of Sir William Boyd Dawkins, entered on his career as a great museum curator and administrator. He studied his new profession, as all museum-men should do, from every side. Methods of exhibition, of conservation, of storage and arrangement, of registration, and of card-indexing, all benefited from his active mind. He even trespassed on the field of the librarian, and was, I believe, the first in England to apply the Dewey decimal system, which he used in his catalogues of the libraries at the museum and the Conchological Society. All the results of his museum experience were communicated by him to the Museums Association, of which he was an original member, becoming its president in 1906. At the yearly gatherings of that body, as in all meetings of zoologists, his sagacity and his humour were alike welcome.

When, in 1909, a National Museum was to be established for Wales, the governors took the unprecedentedly wise step of first getting a director. Hoyle was their choice, a fact which he jestingly ascribed less to his own merits than to his name "Evans." On his own suggestion, he was at once sent abroad to complete his already extensive knowledge of the great museums. The plans were drawn to his specification and emended after criticism by himself and an independent expert. To the wisdom of the governors in trusting to Hoyle's initiative and direction is due the high position of that Museum to-day. We all regretted that he should have had to retire before receiving public acknowledgment of his great services.

F. A. BATHER.

WE regret to announce the following deaths:

Prof. D. S. Capper, from 1902 until 1921 professor of engineering at King's College, London, on February 12, aged sixty-one years.

Prof. W. O. Crosby, emeritus professor of geology in the Massachusetts Institute of Technology, known for his work on ore deposits and on the geology of the Boston Basin, Alaska, and the Rocky Mountains, on December 31, aged seventy-five years.

Prof. F. Y. Edgeworth, fellow of All Souls College and emeritus professor of political economy in the University of Oxford, president in 1912–14 of the Royal Statistical Society, and joint editor for many years of the *Economic Journal*, the organ of the Royal Economic Society, on February 13, aged eighty-one years.

Dr. Ernst Ehlers, professor of zoology since 1874 in the University of Göttingen, on December 31, aged ninety years.

Dr. Sigmund Exner, emeritus professor of physiology in the University of Vienna, and a member of the Vienna Academy of Sciences, on February 6, aged eighty years.

Prof. J. F. Gemmill, F.R.S., professor of natural history, University College, Dundee (University of St. Andrews), and first president of the parent society of the Scottish Marine Biological Association, on February 10.

Sir John Burchmore Harrison, Director of the Department of Science and Agriculture, in British Guiana, the author of numerous papers on the chemistry of tropical products, on February 8, aged sixty-nine years.

Sir George Holmes, K.C.B., K.C.V.O., honorary member and for more than twenty years secretary of the Institution of Naval Architects, on February 13, aged seventy-seven years.

News and Views.

AN interesting address, which we hope to publish next week, upon Prof. Einstein's researches on relativity and the theory of gravitation, was delivered at the annual general meeting of the Royal Astronomical Society on February 12, by the president, Dr. J. H. Jeans. The gold medal of the Society, which was awarded by the Council to Prof. Einstein, was handed to the foreign secretary, Prof. H. H. Turner, for transmission to him; and with it, remarked Dr. Jeans, went "the most cordial wish of the whole Society that the future may bring with it health, vigour and further scientific triumphs of the kind that have already made him one of the outstanding figures of modern science; and I think we may anticipate the verdict of posterity and add, one of the outstanding figures also in the history of human thought." The following translation of a letter from Prof. Einstein, acknowledging the award of the medal, was read to the meeting: "He who discovers a line of thought which permits us to penetrate even a little deeper into the eternal mystery of Nature, is greatly privileged. He who, in addition, is encouraged by recognition, sympathy and help from the best minds of his time, experiences more happiness than any one can realise. In this spirit I thank you from the bottom of my heart for the great honour of which you have found me worthy. I should have wished to come to you in person to receive the gold medal, but unfortunately it is impossible for me to do so."

IT is announced by the Foreign Office that Dr. Hu Shih, Dr. V. K. Ting, and Dr. C. C. Wang have accepted the invitation of Sir Austen Chamberlain to serve as Chinese members of the committee which is to advise the Foreign Secretary as to the utilisation of the funds of the Boxer Indemnity. Two of these appointments are in accordance with a provision of the China Indemnity Application Act that at least two members of the advisory committee shall be Chinese; the third fills a vacancy created by the death of Sir John Jordan, and follows a decision that it was desirable to increase the Chinese membership. Each of the three newly appointed members has had a distinguished career. Dr. Hu Shih, now professor of philosophy and English at Peking, was educated at Cornell and Columbia; Dr. V. K. Ting, who is general manager of the Peipiao Coal Mining Co. and honorary director of the Chinese Geological Survey, studied at Cambridge, Glasgow, and Freiburg; while Dr. Wang, after graduating at Yale as a civil engineer, became closely associated with Chinese railway development and administration and has interested himself in various philanthropic and social movements.

THE announcement of these additions to the membership of the advisory committee should go some way towards reassuring Chinese opinion as to the *bona fides* and goodwill of the British people. The reasons for the continued hostility and distrust of the Chinese towards 'foreigners,' particularly as represented by the British, are temperately set forth by Mr. Frederic Anson in the February issue of the *Fortnightly Review* in an article entitled "The Chinese Point of View." Mr. Anson points out that this intense suspicion of everything foreign is due to the fact that a tranquil and exclusive nation has had forced on it from without a western organisation which has made its influence felt, not only in the Treaty Ports, but also in every province, and that owing to the principle of extra-territoriality, this influence is entirely beyond Chinese control. This principle has been, and is, applied rigidly without adaptation or flexibility as China shows signs of development and progress. Further, the students sent abroad to study western civilisation, on their return, finding no prospect in native enterprises, turn to business openings under foreign management; but they find themselves handicapped as against foreigners, often their inferiors in capacity; while they are entirely debarred from social intercourse owing to racial prejudice. It is, therefore, scarcely remarkable that the Chinese regard the foreigner as mainly aiming at exploitation pure and simple. Mr. Anson's article as a whole enforces the need for such a sympathetic understanding of Chinese character and culture in those who have dealings with them as can only result from close study from what, for lack of a better term, can only be called the anthropological point of view.

A PROVISIONAL committee has been appointed to draft the constitution of a society within the University of London for promoting interest in the welfare of animals, Capt. C. W. Hume, of Birkbeck College, being appointed secretary. This step was taken at a meeting held at Birkbeck College on February 12, after a lecture by Capt. Fergus MacCunn, assistant secretary of the Royal Society for the Prevention of Cruelty to Animals. The lecturer stated that while a certain amount of prosecution is unfortunately unavoidable at present, some 4000 persons being convicted annually of the grosser forms of cruelty, infinitely more reliance is placed on the educational weapon, and in order to improve its efficiency the advice and co-operation of the educational profession is earnestly desired by the Society. Should the present movement become established in the University of London, efforts will be made to extend it to other centres of learning. Interesting features of the Society's work to which reference was made included (*a*) the holding of prize essay competitions, for which nearly 1,000,000 children compete annually; (*b*) the horse purchase scheme, whereby the services of a veterinary surgeon are provided free of charge to any ex-service man who requires to buy a horse; (*c*) the offer of a prize of 200*l*. for the design of a humane rabbit trap, no really satisfactory design having yet appeared; and (*d*) the humane destruction, at one centre alone, of nearly 60,000 stray cats and dogs, many of which might have proved a source of danger to human health.

IN his discourse delivered at the Royal Institution on February 12 on "Red and Blue Colouring Matters

of Flowers," Prof. R. Robinson said that the work of Willstätter showed that the anthocyanin pigments of flowers, fruits, and blossoms are substances which form differently coloured salts with acids and with bases. Thus many different shades may be produced by variations of the acidity or alkalinity of the cell-sap alone. The molecules of all the anthocyan pigments contain the same fundamental nucleus (with 15 carbon atoms), distributed round which various atomic groupings may be attached in eleven different positions. A sugar always occupies one of these positions and may be detached by the action of boiling aqueous acid. The pigment, transformed by loss of its combined sugar, retains its original colour and is now called an anthocyanidin. All the known anthocyanins can be ultimately degraded to one of three fundamental anthocyanidins, all of which have been prepared artificially. The Indians of Central America in the vicinity of the Orinoco prepare a red pigment called 'carajura' or 'chica' from a species of bushrope. This contains the characteristic nucleus of the anthocyanidins, so apparently carajura proclaims a fourth anthocyanidin. The pigments of flowers are of very little interest to the dyer, since the colours are evanescent. Nevertheless, many of the most beautiful of artificial colouring matters, for example, the unsurpassed rhodamines, possess very similar central, tinctorial molecular groupings.

ACCORDING to an announcement which appeared in the *Times* of February 15, Mr. John D. Rockefeller, Jr., has offered to King Fuad and the Egyptian people the sum of 10,000,000 dollars (2,000,000*l.*) for the purpose of building and maintaining a new museum in Cairo and, in conjunction with it, an archæological institute to be housed in a separate building. The offer was recently conveyed to King Fuad by Prof. James H. Breasted, the well-known Egyptologist of the University of Chicago, who has been appointed by Mr. Rockefeller to act as a member of the Board of Trustees of the Fund, of which the other members are Mr. Everit Macy and Mr. Raymond B. Fosdick, both of New York. It is intended that the new museum and institute should work in co-operation with the Egyptian Service des Antiquités. Details of the arrangements of the offer are to be discussed by representatives of the Egyptian Government and of Mr. Rockefeller at an early date. This munificent gift, which is said to be the largest amount ever offered in a single sum for the promotion of humanistic studies, will be of inestimable value both to the investigation of Egyptian culture and civilisation and to archæology at large. It has long been impossible to display the mass of material which has been gathered from the various excavations in Egypt in a manner adequate to the needs of students. The increase in space in a museum fully equipped on modern lines with material for the preservation of specimens, and adequately staffed with trained officers working in conjunction with the neighbouring archæological institute, will provide a stimulus to research of which the effect is difficult to estimate fully on this first announcement.

THE sessional programme for 1925–26 of the Institut d'Ethnologie and the Facultés et Établissements publics d'Enseignement supérieur of the University of Paris makes liberal provision for courses of instruction in the various branches of ethnology with special reference to the French colonial possessions. At the Institut, descriptive ethnography and descriptive linguistics are covered by M. Marcel Mauss and M. Marcel Cohen respectively. M. M. Delafosse lectures on the linguistics and ethnography of Africa, and M. Jean Przyluski on the ethnography and linguistics of Eastern Asia and Oceania. Among the lectures to be given under the Faculties of the University are courses on the races of the French colonies by Dr. R. Verneau, the customs of Madagascar by M. Julien, the customs of French West Africa by M. Delafosse, moral, religious and family rites in Australia and in the Sudan and Nigeria by M. Mauss, Indo-Chinese religions by M. Przyluski, and on the social, family and religious organisation of the Moslems by Prof. Doutté, Mahommedan law being also covered in a course by Prof. Morand. In sociology a general course is given by M. Fauconnet, and Prof. Cabaton will deal with the geography, history and institutions of Indo-China. M. Brunhes, in the department of human geography, deals with "The Problem of the Pacific." In linguistics, provision is made for instruction in the languages of practically all the native populations of the French possessions, including Arabic, Berber, the Sudanese languages, modern Indian, Malagasy, Malay, Siamese, Annamese and Cambodian.

THE fifth annual report of the British Electrical and Allied Industries Research Association, which was presented at the annual meeting of the Association on February 12, is instructive and interesting. The period covered was the end of the five years' agreement with the Department of Scientific and Industrial Research. As the grants guaranteed by the Department are now on a diminishing scale, the Association has to look to other sources for enlarged contributions. The minimum requirements for the year are 16,000*l.*, of which the Department pays 8000*l.*, but five years ahead it will only pay 1600*l.* There are a very large number of committees, and representatives of all the interests concerned are present at the meetings. The Department appointed a committee to examine the work in progress, which has reported favourably. In particular it commended the work done on the phenomena of switching, arcing, and insulation. Although it was thought that the Association should not build a laboratory of its own in which to carry out all the investigations, yet in the opinion of the committee it might usefully supplement existing facilities, like the National Physical Laboratory, by the provision of a small laboratory for preliminary researches. The Association acts as a clearing-house for problems of common interest to the whole industry. It is also a great stimulus to the application of scientific methods in commerce. It has to be remembered, however, that an association of this kind does not obviate the necessity of research in pure science. It should and

does act as an incentive to individual research. It is this latter kind of research which is in the greatest need of encouragement. We are glad to read that Prof. H. L. Callendar has extended his steam turbine researches to cover temperatures and pressures of 850° F. and 1500 lb. per sq. in. respectively, novel methods having been invented to cope with the experimental difficulties. Mr. Ll. B. Atkinson has been re-elected chairman of the Association, and at the luncheon which followed the annual meeting, he gave an inspiring address on British contributions to the world's progress in science and invention.

In a paper by G. H. Farnes published in the *Wireless Engineer* for February, some remarkable phenomena observed in high-powered transmitting radio stations are described. In a large commercial station during alterations to the room housing the aerial inductance, it was found necessary to erect a temporary wooden wall. One day this became damp and consequently was slightly conducting. The high frequency currents induced in it by the currents in the coil caused it to heat up and ultimately burst into flame. On another occasion, three damp planks formed a triangle and the heating due to the eddy currents quickly set them on fire. The iron lock on the door is often unbearably hot due partly to hysteresis. A watch worn in the neighbourhood of the aerial is put out of order owing probably to magnetisation of the hair spring. This often happens in the neighbourhood of a dynamo. When the point of a pencil is held near a metallic object like the case of an instrument, a torrent of sparks sometimes ensues. On one occasion when two people in the room shook hands, a stream of sparks came from one hand to the other. Out-of-doors the large porcelain strain insulators are sometimes found practically molten inside. A portion of the barbed wire fence round the aerial site becomes so hot by the induced current that it cannot be touched, and sparks can be drawn from it by holding a piece of metal near it. A stay wire has been found red hot owing to the induced eddy currents. The top of a 460-foot high wooden lattice mast caught fire owing to sparking. As it cost 5000*l.*, and if allowed to burn would close down the station, two firemen climbed up the mast by means of the diagonal bracing members and cut away the burning portions with their axes. Since Hertz's time these phenomena have often been observed on a small scale. We now have to guard against them in commercial undertakings.

The library co-operation movement initiated by the Association of University Teachers has gained momentum and made satisfactory progress during the past year. A large and steadily growing number of libraries of a university, learned, or specialist character in all parts of the British Isles have accepted, though in a few cases with reservations, the inter-library lending proposals put forward, and the increased facilities for research thus secured have already proved useful to investigators in many fields. The Joint Standing Committee on Library Co-operation appointed at last year's Conference has provided for as full as possible a utilisation of these facilities by setting up an Inquiry Office (located for the present in the University of Birmingham) which endeavours to discover copies of any publications required by research workers, and, if successful, reports whether they would be lent temporarily to the inquirer's library on the application of the librarian. Thanks mainly to the generosity of the Carnegie United Kingdom Trust, this information, though usually involving considerable clerical and postal expenses, can be supplied free of charge. There has been a steady increase in the stream of inquiries, and up to the present about seventy per cent. of the publications inquired for, though nearly all rare or foreign, have been reported as obtainable on loan from one or more British or Continental libraries. The compilation of a list of periodicals not included in the recently issued "World List of Scientific Periodicals" has also been begun. Though confined at present to periodicals in the possession of British libraries, and intended primarily to facilitate the work of the Inquiry Office, this list may eventually prove to have a wider usefulness. If published it would prove a valuable supplement to the existing World List.

To a series of articles in the *Forum* on the food resources of the world in relation to future wars, Mr. V. Stefansson contributes to the January issue a paper on Polar pastures. He estimates that of the 3,000,000,000 acres of land in the northern hemisphere that lie north of the region of possible wheat cultivation, the greater part is grazing land which is suitable for the reindeer and musk-ox or ovibos. He points to the successful breeding of the reindeer in Alaska, where, since the introduction of domesticated deer from Siberia between 1892 and 1902, the herds have been doubling every three years. The raising of musk-ox in reindeer lands would be practicable because the reindeer feeds on lichens in winter and uses grass only in summer, while the musk-ox eats grass all the year round. In the Arctic tundras the number of reindeer is limited by the winter food, which is only about one-tenth of the summer supply. This leaves scope for large herds of musk-ox. A use of the musk-ox in addition to the supply of meat would be for the production of fine wool, which has been proved to have the qualities of good merino. In addition it does not shrink. Mr. Stefansson estimates that the Arctic grasslands could support a hundred million reindeer and five times as many musk-ox with a total annual meat production of 55,000,000,000 pounds of meat.

According to the *News Bulletin of the U.S.S.R. Society of Cultural Relations*, a number of expeditions have been organised by the Russian Academy of Sciences and other scientific institutions, with the object of exploring the regions lying beyond the Polar circle in European and Asiatic Russia. One of these expeditions was engaged in explorations of the northern section of the Ural Mountains, previously considered to be impassable. Rare specimens of plants and animals were collected. There were also indications of platinum deposits and petroleum in

this region, and surface coal was found in the valley of the river Pechora. The polar expedition of the Academy has made a geological and geographical investigation of Novaya Zemlya. Topographical charts were made for the first time in the central part of the Northern Island. The expedition discovered three uncharted lakes, and three new bays on the eastern part of the islands. Preparations are being made for an expedition to the Nicholas II. Land, discovered by Vilkinsky in 1913. This territory has hitherto remained entirely unexplored. An expedition under Prof. Gorodkov is exploring the tundra region between the estuaries of the rivers Ob and Yenisei. A commission sent to the Yakutsk territory for the purpose of ascertaining the amount of arable land available for colonisation found large tracts suitable for agriculture along the rivers Lena and Amga.

THE first number of a new Russian periodical, *Journal de Biologie et de Médecine expérimentales*, published by the State Scientific Institute of the Commissariat of Public Health in Moscow, has just been issued. The journal, which is of the type of *Pflüger's Archiv* and the *Zeitschrift für die gesamte experimentelle Medizin*, is devoted to experimental works in physiology, general pathology, bio-chemistry, bio-physics, microbiology and allied sciences. The editorial committee, under the directorship of Prof. B. Sbarsky, consists of the following: A. Bach, P. Diatropoff, N. Koltzoff, P. Lazareff, L. Tarassevitch and M. Schaternikoff, with Prof. I. P. Pavlov as one of the chief collaborators. The main object of the journal is to unite in one publication the original works appearing in Russia and hitherto scattered amongst the special biological and medical periodicals, which appeared very irregularly and were frequently inaccessible to workers in allied branches of science. From the editorial notice it is seen that the new journal will appear in 8-9 fascicules per annum, the regular publication of which is apparently ensured. All the papers will be provided with summaries in English, French or German. The first number of the *Journal de Biologie et de Médicine expérimentales* contains nine papers dealing with various questions of immunology, bio-chemistry, bio-physics, experimental pathology, physiology, bacteriology and comparative psychology.

IF the present vogue for noticing centenaries does nothing more than to lead to inquiries into the history of industries, it will have served a good purpose. In mechanical engineering a century ago, Matthew Murray of Leeds occupied a prominent position. Few details of his life are at present available, but the centenary of his death is sure to lead to additions being made to these. He was born in 1765 and died near Leeds on February 20, 1826. He had then been in business with two partners as a steam-engine builder for thirty years, and his firm in 1812 built the four locomotives for Blenkinsop which were the first commercially successful engines of this type. George Stephenson did not construct his first engine until 1814. Murray is also known among engineers as the inventor of the locomotive slide valve, as a pioneer in the use of machine tools, as one of the advocates of steam navigation, and also as a keen rival of the famous old firm of Boulton and Watt.

IT is announced in *Science* that the Nichols Medal in chemistry for 1925 has been awarded by the New York Section of the American Chemical Society to Dr. Samuel Colville Lind, associate director of the U.S. Fixed Nitrogen Research Laboratory, Washington, for his work on "The Chemical Activation of Alpha Particles."

THE following officers of the Royal Astronomical Society were elected at the annual general meeting on February 12: *President*, Dr. J. H. Jeans; *Vice-Presidents*, Dr. J. L. E. Dreyer, Sir Frank Dyson, Dr. J. W. L. Glaisher, and Rev. T. E. R. Phillips; *Treasurer*, Lieut.-Col. F. J. M. Stratton; *Secretaries*, Dr. Jackson, Royal Observatory, Greenwich, London, S.E.10, and Mr. H. Knox-Shaw, Radcliffe Observatory, Oxford.

AT the annual general meeting of the Optical Society, held at the Imperial College of Science on February 11, the following officers for the session 1926–1927 were appointed: *President*, Mr. T. Smith; *Vice-Presidents*, Inst.-Comdr. T. Y. Baker, Mr. F. F. S. Bryson, Dr. R. S. Clay, Mr. H. H. Emsley; *Treasurer*, Major E. O. Henrici; *Secretaries*, Prof. Alan Pollard, Imperial College of Science, South Kensington, S.W.7; Mr. F. F. S. Bryson, 12 Oppidans Road, N.W.3.

BY the will of the Right Hon. Stephen Ronan, lately Lord Justice of Appeal in Ireland, who died on October 3 last, and left personal estate in England and the Irish Free State valued for probate at 83,907*l.*, the Medical Research Council will receive considerable benefits. After private bequests amounting to nearly 9000*l.* and numerous legacies to Irish charities, the residue is left to the Medical Research Council to be applied in assisting and promoting scientific research as the Council may think best, "but without limiting their discretion, I would wish that special attention should be given to the relief, cure, and prevention of physical pain by physical means."

THE following awards of the Institution of Petroleum Technologists have been announced: The Boverton Redwood Medal for sessions 1923–24 and 1924–25 to Mr. C. H. McCarthy-Jones, for his paper entitled "Electricity applied to the Winning of Crude Petroleum, with Special Reference to the Yenangyaung Field, Burma"; the Students' Medal and Prize for 1925 to Mr. Ernest Clark, Royal School of Mines, Imperial College of Science and Technology, for his paper entitled "Organic Theories of Oil Origin." The Institution's Scholarships for 1925 have been awarded as follows: Royal School of Mines, Imperial College of Science and Technology, London, Mr. J. O. Tanner; University of Birmingham, Mr. C. J. Ward.

DR. HEM SINGH PRUTHI, in his letter on "Moulting of Insects" in NATURE of December 26, 1925, p. 938,

recorded some experiments carried out on the common mealworm (*Tenebrio molitor*) which afford further evidence that moulting is not necessarily correlated with growth. Mr. C. Macnamara, Arnprior, Ontario, Canada, writes pointing out that Folsom and Welles in 1906, working on the Collembola, concluded that moulting is connected with excretion. The suggestion that the moulting of insects has other functions than providing for growth is recorded in the standard works on insects.

THE "Lopulco" system of powdered fuel firing is making progress in Great Britain. The North Metropolitan Electric Supply Co. will have shortly its new station at Brimsdown working on this system. There are five boilers, each of which has a heating surface of 11,000 square feet. The equipment includes the latest design of pulverising mills each of 15 tons per hour capacity, the making of which, together with the feeders, bunkers, separators, water screens, exhausters, etc., provides employment to many workmen at Barrow and Derby, where the Lopulco works are situated. Capt. Donaldson, the electrical engineer, is satisfied that the system will assure him high thermal efficiency with minimum maintenance and operating charges even from the lowest grades of fuel. As this station when complete will be the largest in the London area operating entirely with pulverised fuel, engineers are awaiting the results with much interest.

WITH the December issue, the *Journal of the Franklin Institute* completes one hundred years of uninterrupted publication, during which it has come to occupy an important position as an organ of the scientific world. Its purpose, that "of reporting to the community the activities of the Institute, and of disseminating knowledge of science and the arts," has enabled it to serve a wide range of readers. Commenting on the increasing specialisation of modern research, which has of necessity been reflected in the pages of the journal, the editors refer to the importance of communicating the multitudinous results obtained by scientific workers in justification of the step they are taking in making the journal the agency for the publication of researches carried out at the Bartol Research Foundation. Thus even more than formerly, the *Journal of the Franklin Institute* will be an organ for the publication of research, though its traditional regard for invention and matters of wide interest in science will be maintained.

APPLICATIONS are invited for the following appointments, on or before the date mentioned:—An assistant lecturer in zoology in the University of Birmingham—The Secretary (March 1). A laboratory assistant in the physics department of the Liverpool Collegiate School for Boys—Director of Education, 14 Sir Thomas Street, Liverpool. A science mistress at the County School for Girls, Gravesend—The Head Mistress.

Our Astronomical Column.

RECENT SUNSPOT ACTIVITY.—The first half of February has offered only very occasional opportunities for observing the sun. A photograph taken on February 5 showed the disc comparatively free from spots, but another taken on February 13 recorded nine or ten groups, including one visible to the naked eye. This spot is the chief of a procession of spots of recent origin, extending for nearly 25° of solar longitude. Details of it are as follows:

No.	Date on Disc, 1926.	Central Meridian Passage.	Latitude.	Area.
3	Feb. 9-21	Feb. 15·0	18° S.	1/1200

(Area expresses the proportion covered of the sun's hemisphere.)

One of the other spots elsewhere on the disc is the large recurring spot, in latitude 21° S., seen previously on the central meridian on December 25 and January 22. It is of regular outline and of about half its original size.

The great spot No. 2 (NATURE, January 30) has returned to the sun's visible disc, but is so much diminished that it is a telescopic object only.

COMETS.—An observation of Blathwayt's Comet was obtained on Feb. 8 by M. Chofardet at Besançon, which led to the following corrected elements:

T	1926, Jan. 3·12 U.T.
ω	328° 30′
Ω	136 5
i	128 22
$\log q$	0·1293

EPHEMERIS FOR 0h.

	R.A.	N. Decl.		R.A.	N. Decl.
Feb. 20	6h 56m 9s	36° 36′	Mar. 4	5h 53m 14s	42° 53′
,, 24	6 29 18	39 36	,, 8	5 41 24	43 50
,, 28	6 8 52	41 33	,, 12	5 32 35	44 30

The comet has now passed its nearest point to the earth and may be expected to fade rapidly; but it is well placed for observation.

EPHEMERIS OF ENSOR'S COMET FOR 0h.

	R.A.	Decl.		R.A.	N. Decl.
Feb. 20	20h 51m 48s	3° 53′ S.	Mar. 4	21h 2m 48s	21° 4′
,, 24	20 52 0	3 47 N.	,, 8	21 13 24	30 33
,, 28	20 55 42	12 5 N.	,, 12	21 28 12	40 14

A HOMERIC ECLIPSE.—The suggestion has been made many times that the passage in the 20th book of the Odyssey, where the seer Theoclymenus describes the sudden gloom and the disappearance of the sun, seems to indicate a total solar eclipse. But until now no one has considered it worth while to carry the matter further.

Dr. C. Schoch, in the *Observatory* for January, describes a research he has made, using Oppolzer's "Syzygien-tafeln" corrected by his own and Dr. Fotheringham's researches on ancient eclipses and occultations. He has examined all the eclipses of the twelfth century B.C., and finds that the only one total in Ithaca was that of April 16, 1178 B.C., total there at 11h 41m A.M. local time. This is five years earlier than the traditional date of the return of Odysseus, a very small discordance. The deduced date of the siege of Troy is 1198 to 1188 B.C. It would be unsafe to lay any great stress on this eclipse, since the poem is much later than the event; but it is extremely interesting to find that calculation supports the narrative, which makes it likely that the tradition used by Homer was not wholly mythical but had a substratum of fact. Dr. Schoch gives the dates in astronomical reckoning, but they are corrected here into civil reckoning.

Research Items.

MAORI AGRICULTURE.—Mr. Elsdon Best's valuable study of Maori cultivated plants and native methods of agriculture and attendant rituals and ceremonies has been published as *Dominion Museum Bulletin* No. 9 (Wellington, N.Z.). The Maori appear to have introduced at least five (and possibly six) food plants into New Zealand. These were not introduced by the first settlers; and it was the lack of the food plants of their earlier home as well as the greater difficulty in cultivating those which they did succeed in acclimatising that led them to the utilisation of the so-called fern-root, and exalted it to such an important position in their food supply that it was assigned a special mythical origin. Their principal food plant, however, was the *kumara* or sweet potato. Special ceremonials were attached to every stage of its cultivation from planting to harvest. Some of these, such as the ritual observed when a tuber of special size was found, recall the corn goddess customs of other countries. A tradition, it is conjectured largely on philological grounds, suggests that the Polynesians may at one time have inhabited a country in which rice was the staple diet. It is a curious fact that there is a double tradition of the origin of the *kumara*, one associating it with the deity Rongi, the other with the goddess Pani, who brought forth sweet potatoes *in the water*. In other elements in the Pani traditions, *kumara* is also connected with water, although it is a dry land plant. A transference of a rice tradition therefore appears not impossible.

ARCHÆOLOGY OF THE ALEUTIAN ISLANDS.—A valuable monograph on the Aleutian Islands by Waldemar Jochelson has been published by the Carnegie Institution of Washington. It embodies the results of the archæological investigations on these Islands of the Riaboushinsky Expedition of 1909–10, on which the author was the leader of the anthropological section. The object of these investigations was to supplement the results of the Jesup Expedition of 1902 and endeavour to clear up the question of the ethnological affinities and origin of the Aleutians, upon which various views, none of them entirely satisfactory, were held. The anthropological division excavated a number of kitchen middens and house sites, finding many skeletal remains (about fifty were in a sufficiently good state of preservation to be available for measurement), and a large quantity of implements, in stone and bone, utensils, etc. Both geological and cultural conditions appear to preclude the hypothesis that the Aleutians represent a migration from the Asiatic continent. Their boats at the present day are not such as could have faced the lengthy and difficult sea voyage to which the geological conditions point. On the other hand, their language presents close affinities with that of the Eskimo. Their culture, which at the time they were first visited by the Russians still belonged to the Neolithic stage, contains some elements which are to be attributed to their environment, but with certain variations presents a close resemblance to that of the Eskimo; but it also includes elements which are related to the culture of the north-west coast of America. Cranial measurements of the dead and living alike show a very high degree of brachycephaly —average 84, which suggests an Athapascan strain. The conclusion is that on the whole the evidence points to the Islands having been peopled from the American rather than the Asiatic continent.

A MISTAKEN ATTRIBUTION IN SOUTH AMERICAN LINGUISTICS.—We owe to the researches of Dr. Paul Rivet the correction of a mistake in American linguistics which has endured for nearly seventy years. In 1858 Ludewig in his "Study of American Aboriginal Languages" referred to a text in the Arda language which had been printed at Madrid in 1658. No ethnographical data are available relating to the Arda tribe, and the only fact known concerning it is that it lived between the upper waters of the Nanay, a tributary of the Amazon, and the Mazan, a tributary of the Napo. It was surrounded by the Yameo people on three sides and bounded on the north by the Zaparo tribe. Dr. Rivet, who had devoted attention to this text, of which a copy is in the Library of San Isidro at Madrid, at intervals over a period of years, at last became suspicious as to its provenance, and submitted it to M. Maurice Delafosse, the well-known African authority. The result of M. Delafosse's examination is given by Dr. Rivet in the *Proceedings* of the twenty-first International Congress of Americanists held at Göteborg in 1924. The verdict is that the text in question is in pure Dahomean, and, except for a few phonetic variations possibly due to transcription, might well be contemporary. Portions of the text and the modern language printed in parallel columns place this conclusion beyond question. Further study has revealed that it belongs to the Popo dialect, and it is interesting to note that in date it is a hundred years earlier than any hitherto known specimen of the language of this part of Africa. It is clear, therefore, that the language of the Arda tribe can no longer be regarded as independent, as has been done on the evidence of this document; and the statement of Velasco that it belongs to the extinct dialects of Yameo, which had been abandoned as incorrect, must be reinstated.

TWO ADDITIONS TO THE BRITISH AVIFAUNA.—In two recent issues of the *Scottish Naturalist*, Admiral J. H. Stenhouse describes two species of birds recorded for the first time from Britain. Both arrived at Fair Isle, between the Orkney and Shetland Isles, during the autumn migration season of 1925, and this in spite of the fact that, during the period of the recorder's visit, weather favouring prolonged east to west migration was absent. The Petchora pipit, *Anthus gustavi* (Fair Isle, September 24), breeds in N.E. Russia and widely across northern Asia to Kamchatka, whence it generally moves south-east to China during the winter. It has not before been noted in Europe beyond Russia. Jerdon's reed-warbler, *Acrocephalus agricola* (Fair Isle, October 1), is a more southern bird, breeding in the Ural region and across Asia to the Himalayas. In winter it is found in India and north-west Africa. Apart from one record from Heligoland, it has not previously been found in western Europe. Both birds were far out of the normal migration track of their species.

THE MEDUSÆ OF NORWAY.—Dr. P. L. Kramp and Prof. D. Damas have published (*Vidensk. Medd. fra Dansk. naturh. Foren.*, Bd. 80, 1925) an account of the medusæ of Norway. The specimens on which the account is based have been collected from 1900 onwards, chiefly during cruises of the *Michael Sars*. When the cruises of this vessel began, there were known with certainty only 17 species of medusæ in Norwegian waters, to which 10 were afterwards added through the work of E. T. Browne, and 7 more by Hj. Broch. It was realised that with such an extended coast-line and numerous islands with deep water adjacent, providing a great variety of conditions, careful investigation would probably result in a considerable addition to the list of species; and so it has proved, for 57 species are now known, 19 of

which are recorded from the area for the first time. The present account deals with the Hydrozoa—the Scyphozoa being reserved for a future part. Under each species is given a list of the stations at which examples were collected, notes on systematic characters, and in many cases on the geographical and bathymetrical distribution. Excellent figures are given of the new genus and of two new species, of some of the rarer species, and of aberrant examples.

HERRING.—Mr. W. C. Hodgson gives us his second report on the work he has done in connexion with the herrings of the southern North Sea (Ministry of Agriculture and Fisheries, Fish. Invest., Ser. ii. Vol. 8, No. 5, 1925. 6*s.* 6*d.*). From samples taken by the *George Bligh* and from records previously published by Bjerkan, immature herrings with one winter ring on their scales may be taken about the Dogger Bank, the Firth of Forth, and the Skagerak. Fish in their third year make their appearance in the commercial shoals, but, whilst some of these may become mature, it is not until the fish are a year older that they form the greater part of the catches made off the north-east coast, Northumberland to the Spurn, and high numbers come to maturity. With this and the statement that the younger fish are followed by older fish into the great fishery of the Southern Bight, and the finding of a considerable amount of spawning now on these grounds, Mr. Hodgson confirms a great deal of evidence which has been accumulated and interpreted by other workers. The presence in the shoals off the Northumberland coast in 1923 of large numbers of herrings with three growth zones on their scales and having a small first-year growth may be regarded as exceptional, and so may be the high percentage of fish of this age found in the catches from north-east of the Spurn in 1924. Negative evidence has been found for a migration of spents into the Channel from the Southern Bight, but a sample from north-west of Skagen indicates the possibility of a movement towards the Skagerak. The mixing of mature fish with first-year growths of 8 cm. and 9-11 cm. inclines Mr. Hodgson to agree with Storrow as to the impossibility of the occurrence of separate races of herring in the North Sea, so far as the southern half is concerned.

THE HYOMANDIBULA OF FISHES.—In an important paper on this subject (*Jour. Anat.* 60, pp. 173-93, January 1926) Prof. F. H. Edgeworth, as an adherent to the theory of Gegenbaur that the hyomandibula in the Teleostomi is homologous with that in the Selachii, reviews the recent theories of Allis, Schmalhausen, and de Beer and, after critical examination, rejects them in favour of the Gegenbaur hypothesis. In support of this view he advances the following facts: (1) In both groups of fishes the hyoid bar is at first a continuous one, its upper end at first not reaching the auditory capsule, though afterwards doing so; (2) the hyomandibular is the segmented-off upper part of this bar; (3) it comes into relationship with the auditory capsule in both groups; (4) the relations of that portion of the hyoid constrictor muscle which forms a levator hyomandibulæ are similar in the Chondrostei and Selachii. The curious condition found in Ceratodus he concludes is almost certainly secondary.

PELVIC AND THIGH MUSCLES IN ORNITHORHYNCHUS.—Miss Helga S. Pearson (*Jour. Anat.* 60, pp. 152-63, January 1926) has made a detailed study of these muscles in Ornithorhynchus with the view of interpreting their homologies in the light of recent work on the homologies of the muscles of the Vertebrata based on a study of fossil forms, especially the work of Romer on the locomotor apparatus of amphibia, reptiles, and mammals. Romer had not dissected any monotreme himself, but relied on earlier descriptions for the conditions obtaining in this group. Miss Pearson's work, therefore, supplements Romer's in this respect. She rejects the views of the earlier workers, especially Westerling, on the homologies of the muscles in this group, and finds that, so far as the pelvic and thigh muscles are concerned, they can be readily brought into line with Romer's ideas. They are essentially mammalian in their arrangement, but sometimes still suggest a reptilian origin. Miss Pearson has carefully described each muscle and indicated its reptilian homologue in Romer's scheme. The paper is well illustrated by a series of carefully constructed and very clear figures.

ARTIFICIAL CELLS.—Year Book No. 24, issued by the Carnegie Institution, Washington, contains brief progress reports on a number of interesting investigations. Under the director, Dr. D. T. MacDougal, the laboratories for plant physiology at Tucson, Arizona, and Carmel, California, continue the attempt to parallel the phenomena of absorption by the plant cell, by the properties exhibited by artificially constructed cells. One definite success is recorded, in that the artificial cell, if agar, pectin, and gelatin are used in appropriate proportions and method in its construction, shows the same sort of anomalous behaviour, in removing potassium ions selectively from solution containing both sodium and potassium ions, as is shown by the living plant cell. Beverly L. Clarke reports upon this investigation, as also upon some interesting experiments on the condition governing the swelling of agar gels.

ANTENNÆ OF TRILOBITES.—Hitherto the antennæ have been found in only four species of trilobites belonging to the genera Neolenus, Triarthrus, Trinucleus, and Calymene, which range in age from Middle Cambrian to Upper Ordovician. In a large collection of trilobites from the Lower Cambrian of Lancaster County, Pennsylvania, which has been received by the Peabody Museum, Yale University, C. O. Dunbar (*American Journ. Sci.* 9, 1925, p. 303) has discovered the antennæ in one specimen of Olenellus. They appear to have been about half as long as the body. The species of Olenellus is regarded as new, but closely resembles *Olenellus Thompsoni*.

AUSTRALIAN WIND STORMS.—A discussion on Australian hurricanes and related storms, with an appendix on hurricanes in the South Pacific, prepared by Mr. Stephen S. Fisher of Chicago and Mr. D. Hodge of the Bureau of Meteorology, Melbourne, has been issued under the direction of Mr. H. A. Hunt, Commonwealth Meteorologist (Bull. No. 16, Bureau of Meteorology, Melbourne). The publication has been undertaken that all recorded data regarding the occurrence of hurricanes in Australia and the surrounding tropical waters might be available for the information of mariners and shipping interests generally. In Australia the Queensland coast is most often affected by hurricanes. In the thirty-four years 1890–1923 they averaged one or two a year, coupled annually with two or three storms of less severity. Four-fifths of the storms occur in the five months December to April, and two-thirds of the storms occur in January, February, and March. Most of the hurricanes which affect Queensland come from the east; many recurve near the coast and pass southward, frequently so far as Brisbane. Western Australia has, on the average, rather more than one hurricane a year. In the fifty-two years 1872–1923, 74 severe tropical cyclones were recorded; some years had as many as three, and one year, 1917, had five.

Of the less severe types of storm, Western Australia has fewer than Queensland. The portion of Western Australia which is most often damaged by hurricanes lies far north of Perth. The hurricanes are most frequent in the hotter months. The Northern Territory has fewer cyclones than Queensland or Western Australia. Attempts have been made to issue long-previous predictions of hurricanes but no satisfactory result has been attained. Maps are given showing the hurricane season in different parts of Australia and the movement of the hurricanes at different seasons of the year.

MEASUREMENT OF AIR-FLOW.—Methods of air-flow measurement are of importance in many industries and in factories where fans are utilised for ventilation. The Pitot-static tube is the instrument most commonly used for accurate determination of air-flow velocity, but little detailed information is available regarding its characteristics. It consists of an open-ended tube facing the wind, with holes situated in a concentric tube aft of the open end. Both openings are normally connected to the ends of a water-gauge and the pressure difference gives a reading proportional to the square of the air-flow velocity. Experience with the National Physical Laboratory standard instrument has shown that, although accurate under certain conditions, it is defective in many respects. Investigations described by Messrs. E. Ower and F. C. Johansen (Aeronautical Research Committee, R. and M. 981, "The Design of Pitot-static Tubes." London: H.M. Stationery Office, 1925. Price 9*d*. net) have now indicated that these defects may be eliminated by the following precautions: The static holes in the concentric tube should be at least six diameters back from the base of the head, and the supporting stem at least fifteen diameters downward from the holes. The calibration will then be practically independent of the shape of head used, and therefore insensitive to relatively large variations in the form of the nose, so that considerable latitude in the manufacture of duplicates will be permissible without entailing special calibration. From both aerodynamic and mechanical considerations a hemispherical nose is most suitable. The instrument is then markedly less sensitive than the standard Pitot-static tube to angular deviations of the wind, an important feature.

RIVER SOUNDING EXPERIMENTS.—The determination of submerged contours by the process known as sounding has always been subject to the difficulty of ensuring perfect verticality in the sounding chain, or wire. In most cases, the divergence from the perpendicular has not been of serious moment, but it can readily be understood that, in taking measurements in order to compute the discharge of a river in flood, as close an approximation as possible to the actual depth is of the utmost importance. The matter forms the subject of a monograph prepared by Dr. Phillips of the Egyptian Hydrological Service ("An Experiment to Determine Corrections to Sounding in River Gauging," Government Publications Office, Ministry of Finance, Darawin P.O., Cairo; price P.T. 5). He states that the practice at discharge sites in Egypt has been to sound with a heavy conical lead weight of about 48 kgm. suspended by a piano wire of 1·6 mm. diameter. A stay wire is fixed to the weight and pulled, from some point well forward in the boat, until the part of the suspension wire which can be seen above the water is vertical, and it has been assumed, with a certain amount of latitude, that in this position the sounding measured is a true sounding. Dr. Phillips proceeds to describe the experiments he made with the view of ascertaining the correction necessary to be introduced in order to rectify the deviation of the sounding wire caused by the flow of the current. The problem was attacked by suspending the sounding weight from the side of a launch and dragging it through still water at various speeds and with various lengths of sounding wire. By this means the curvature of the sounding wire for the respective speeds and lengths was experimentally determined. After detailing his experiments and recording the results, Dr. Phillips concludes that the corrections have been established with sufficient accuracy.

NEW USES FOR METALLIC TANTALUM.—It is stated in the *Chemiker-Zeitung* that Messrs. Siemens, Halske and Co. have succeeded in solving the problem of producing pure metallic tantalum in the form of large blocks and sheets of foil, which will be likely to provide most useful material for the manufacture of scientific apparatus. At ordinary temperatures the metal remains untarnished in air, and it resembles the noble metals in its resistance to the attack of chemical reagents. In particular, it is said to be unaffected by all acids except hydrofluoric acid. When first prepared by the same firm in 1903 it was used for making the filaments of incandescent electric lamps, but for this purpose it has been superseded by tungsten, which melts at a higher temperature. It is claimed, however, that it is still superior to all other metals for the manufacture of the electrodes of high-vacuum tubes, and it has also been used extensively for making small surgical and dental instruments. Basins of platinum may now be replaced by basins of tantalum, since the latter metal resists chemical action satisfactorily, and it can also be heated to redness for long periods without deterioration. Moreover, it is claimed that electrodes of tantalum are superior to platinum electrodes in the electrolysis of metallic salts. Thus in the electrolysis of common salt the electrodes are not attacked; in the case of zinc salts the cathode forms no alloy with the zinc, so that no coating with copper or silver is necessary. When used as anodes, the metal usually protects itself from attack with a layer of oxide. By means of the new process the firm has been able to reduce the cost of the metal to about one-twelfth of that of a similar *weight* of platinum.

SEPARATION OF THE ISOTOPES OF CHLORINE.—Further experiments on the separation of the isotopes of chlorine by diffusion and the determination of the atomic weight of the light fraction are described by W. D. Harkins and F. A. Jenkins in the January number of the *Journal of the American Chemical Society*. It will be remembered that previous experiments reported in NATURE dealt with the heavier fraction, and that chlorine of atomic weight 35·515, about 0·058 higher than ordinary chlorine, was obtained by diffusion methods. The present paper deals with the results of a series of diffusions of hydrogen chloride through the stems of Scotch clay churchwarden pipes at atmospheric pressure. The aim was to produce chlorine of atomic weight lower than that of ordinary chlorine, and in the final product the atomic weight was found to be 35·418, or 0·039 less than that of ordinary chlorine. The extreme separation of chlorine into light and heavy fractions thus represents a change of atomic weight of 0·097 unit, or 1 part in 365. It is pointed out that this is the greatest relative difference of atomic weight obtained by artificial means for any element. The atomic weights were obtained by determining in quartz flasks the ratio of the weights of highly purified silver to extremely pure silver chloride, with no transfer of silver or silver chloride from one vessel to another.

The Kansas City Meeting of the American Association.

THE annual meeting of the American Association for the Advancement of Science was held at Kansas City, Missouri, December 28, 1925–January 2, 1926. This gathering was the eighty-second meeting of the Association. With it met twenty-nine scientific societies. The total registered attendance was 1931. The total number of papers read was 985.

The policy of the American Association differs from that of the British Association in encouraging the reading in sectional meetings of large numbers of communications, especially many by younger scientific workers. In another respect, however, the practice of the British Association was followed to advantage at Kansas City, namely, in that there were a number of evening and afternoon lectures specially arranged for the general public, seven in all. All sessions of sections, and the various society meetings, were open to the public. Several radio talks were arranged, and popular accounts of a large number of the papers were prepared for wire and mail service to the daily press by a local publicity committee and by Science Service, of Washington.

The address of the retiring president of the American Association, Dr. J. McKeen Cattell, editor of *Science* and the *Scientific Monthly*, was delivered on the evening of the opening day. Dr. Cattell spoke on "Some Psychological Experiments," emphasising the application of methods of psychological measurement to modern industrial and social problems.

The paper selected by the award committee for the annual 1000 dollar prize of the American Association, as an outstanding contribution to science presented at the meeting, was by Prof. Dayton C. Miller, of the Case School of Applied Science, Cleveland, Ohio, and was entitled "The Michelson-Morley Ether-Drift Experiment, its History and Significance." This paper was read on the Tuesday afternoon, as the presidential address of the American Physical Society.

A paper on a related subject was presented on the following day by Prof. James Pierpont, of Yale University. Prof. Pierpont's address was delivered under the auspices of the American Mathematical Society, as the third annual Josiah Willard Gibbs lecture. His title was "A History of Man's Effort to Solve the Problem of Space, and the Effect of Relativity on Our Views."

Two symposia were led by Prof. Michael I. Pupin, president of the Association. The first was held by the Engineering Section on the Wednesday evening, with a discussion of the relation of engineering to the fundamental sciences. On Thursday afternoon the Committee of One Hundred on Scientific Research discussed the problem of the encouragement of research workers and of securing co-operation among them. The same question was attacked by Dr. Vernon Kellogg, secretary of the National Research Council, whose address before the Entomological Society of America was entitled "Co-operation or Isolation in Science?"

President F. D. Farrell, of Kansas State Agricultural College, chose as the topic of the fourth annual Sigma Xi. lecture "The Desert Becomes a Garden," telling how the region between the Missouri River and the Rocky Mountains, once marked on the maps as the "Great American Desert," has become one of the most productive agricultural areas in the world. The whole of Wednesday afternoon was devoted to a symposium on prairie ecology, participated in by the botanical and zoological groups.

The newly elected president of the Association is Dr. Liberty Hyde Bailey, formerly dean and director of the New York State Agricultural College at Cornell University, Ithaca, N.Y., well known as the writer and editor of many works on botany and on various aspects of horticulture and agriculture, as well as on rural life in general. Dr. Bailey was also chosen president of the Botanical Society of America.

The next annual meeting of the Association will be held in Philadelphia, and later annual meetings are planned for Nashville, Tennessee; New York City; Des Moines, Iowa; Cleveland, Ohio; and New Orleans, in order. This series of meetings will complete the first of the twelve-year cycles contemplated in the plan inaugurated at the Chicago meeting in 1920. According to that plan, the Association is to meet in Chicago, Washington, and New York in rotation once each quadrennium, meetings during the interim years being held in other cities, alternating between larger and smaller places, and between locations in the eastern States and in the west and south.

FRANK THONE.

The Standardisation of Insulin.

THE position which insulin holds in clinical medicine in the treatment of diabetes would never have become so firmly established if the manufacture of the product had not been controlled. The appearance on the market of preparations of varying potency, perhaps even inactive, would have led to a great delay in the recognition of the usefulness of this compound, perhaps even to a certain amount of scepticism as to its actuality. To control production adequately, then, meant the discovery of a method by which the activity of different samples could be accurately compared and expressed in terms of some known standard. The latter was, and is still, defined in terms of the blood-sugar reducing power of insulin, after injection subcutaneously into normal rabbits. Thus one rabbit unit is that amount of insulin which will reduce the blood-sugar of a 2 kilo. rabbit, starved for twenty-four hours, to the convulsive level of 0·045 per cent.: a clinical unit is one-third of this amount and is the unit which is now generally used. The problem of putting on the market samples of insulin of known and unvarying potency has been simplified by the issue, to those manufacturing the product, of a solid powder (the hydrochloride of insulin), the activity of which has been determined by the authorities controlling the manufacture: this standard powder is now in use in different countries, so that all samples produced should be of the same activity. But this, of course, depends upon the accuracy of the assay of the sample against the standard.

Methods of estimating the activity of insulin preparations have been developed utilising both the blood-sugar reducing property and also a secondary result of this property, the production of convulsions on doses which reduce the blood-sugar to levels of 0·045 per cent. or lower. Owing to the fact that the occurrence of convulsions in a group of animals is much less regular than a fall in the blood-sugar after a dose of insulin, to obtain consistent results very large numbers of animals must be used, either rabbits or, perhaps more conveniently, mice. But even utilising the first method, complications arise from the fact that different animals react very

differently to the same dose of insulin on the same day, and the same animal shows definite variations to the same dose on different days. A method, therefore, which tends to eliminate such variations increases the accuracy of the assay; the "crossover" test described by H. P. Marks (*Brit. Med. Journ.*, 1925, vol. 2, p. 1102) appears to a great extent to fulfil this condition. Rabbits of about 2-3 kilo. in weight are used, those which convulse on one unit per kilo. or are abnormally insensitive having been previously eliminated from the stock. The principle of the method is to divide the rabbits into two groups, of which one is given a dose of standard and the other a dose of the sample, and then to repeat the test a few days later, reversing the doses given to the two groups. In this way variations affecting the whole of the rabbits, the bulk daily variations in sensitiveness, are eliminated entirely, or almost entirely, since different rabbits may respond somewhat differently to these bulk variations; moreover, by using a large enough number of animals, it is possible to eliminate to a great extent the individual variations, which may be in the direction of either increased or decreased sensitiveness, since these variations may be supposed to cancel out.

The details of the actual test are as follows: the rabbits, at least six, preferably twelve or even more, are starved for the twenty-four hours preceding the test. On the morning of the test, blood is drawn from an ear vein of each rabbit, and then half are given a dose of standard corresponding to 0·5 unit per kilo. subcutaneously, and the other half a dose of the sample, which is assumed to be of about the same value. Blood is drawn from the ear every hour after the injection for five hours, by which time the blood-sugar has usually returned to its initial level. A little more than 1·0 c.c. of blood is drawn at each bleeding, the blood-sugar being estimated by the Shaffer-Hartmann method. The average value for the blood-sugar over the five hours after the injection is found and subtracted from the initial value: the result, expressed as a percentage, is known as the "percentage reduction" of the blood-sugar. After at least three days the test is repeated on the same group of rabbits, starved for the preceding twenty-four hours, but the rabbits which previously had a dose of the standard are now given a dose of the sample, and vice versa. The sum of all the percentage reductions on the sample is now compared with the sum of those obtained on the standard, the result being expressed as a percentage of the latter. When the sample has a strength of about 100 per cent. compared with the standard, the standard error is about 2·5; trial of the method with known doses of standard tested against 100 per cent. standard showed that the effect produced tended to be closer to the 100 per cent. than the actual dose given: thus a dose of standard 110 per cent. against standard 100 per cent. gave a result of 106 per cent., whilst a dose of 80 per cent. appeared to be 83 per cent.; moreover, the standard errors with these two doses were 3·7 and 6·3 respectively. From the figures given it is possible to calculate the actual strength of a solution of insulin with a fair degree of accuracy, to make the appropriate change in its strength to bring it to 100 per cent. and, on retesting, to feel fairly confident that the result obtained will agree, within about 5 per cent., with the result expected.

Do insulin solutions of somewhat varying potency, assayed in the laboratory on *normal* rabbits, show parallel variations in potency when used clinically on *diabetic* patients? According to G. A. Harrison and R. D. Lawrence, in a continuation of the same paper (p. 1104), this is now the case. Although in the early days of insulin testing variations in the activity of different samples of insulin could be detected clinically, and clinical results did not agree always with those obtained in the laboratory, during last year the laboratory tests agreed very closely with the clinical tests, so that the authors conclude that the method of assay above described gives results which are perfectly satisfactory for determining the potency of solutions to be used clinically. In the performance of the clinical tests strict adherence to diet and daily routine is essential: the two samples of insulin are given on successive days and the resultant falls in the blood-sugar plotted as superimposed graphs: if the curves show a reasonable coincidence, the samples are considered to be of the same strength; if one appears stronger than the other, the test is repeated later, using doses which are more nearly comparable. It should be emphasised that small differences in the strength of different batches will not be detected clinically unless the patient's whole daily routine is kept absolutely constant. The authors consider that variations of 10 per cent. from the standard will not be inconvenient clinically: as has been seen above, the method of assay worked out by Marks is capable of determining even smaller differences.

The Lines of the Solar Spectrum.

AN important paper by K. Burns and W. F. Meggers, dealing with the wave-lengths of lines in the solar spectrum, appears in Vol. 6, No. 7, of *Publications of the Allegheny Observatory*. In order to investigate a number of problems connected therewith, the Allegheny Observatory co-operated with the Bureau of Standards, Washington, the observations being made at the former institution and the measurements jointly. The problems dealt with in the present paper are the errors in Rowland's measurements of solar wave-lengths over a limited range of spectrum, and a preliminary study of the relative wave-lengths of lines in the solar and terrestrial spectra. An image of the sun was formed in a Fabry-Perot interferometer by a lens of 40 cm. focal length. The issuing light was focussed by a quartz-fluorite achromatic lens on the slit of a spectrograph containing a Michelson grating having 500 lines per mm. and giving a dispersion of 3·65 Å.U. per mm. in the first order. The resulting spectrum therefore appeared as a number of line images of the slit, each crossed by segments of the interference ring system, the centre of which coincided with the centre of the spectrum line. Special attention was given to a disturbing interference effect which disappeared when the slit width was properly adjusted, and the paper contains a useful discussion of the interference phenomena associated with a continuous spectrum.

The wave-lengths were measured by comparison with those of standard lines of neon. Light from a neon lamp was reflected through the same apparatus by means of a half-silvered diaphragm placed before the interferometer, and the neon lines, crossed by rings, were photographed in an auxiliary camera of shorter focus. The thickness of the interferometer (ranging, in separate experiments, from 3·75 mm. to 10 mm.) was computed from the neon lines, and the solar wave-lengths were thereby calculated. A table gives the wave-lengths of 201 lines in the region $\lambda 4754 - \lambda 4073$ and the corrections to be applied to

Rowland's values at frequent intervals throughout this region.

In order to compare solar and terrestrial wave-lengths a vacuum iron arc was used, the comparison being made either by simultaneous exposures to sun and arc or by successive exposures and independent comparison with neon. A systematic shift of the solar lines to the red was revealed, which increased with both intensity and wave-length, within the region above quoted. It is stated that the dependence on wave-length might be merely an indirect effect of the dependence on intensity, arising from the difficulty in comparing intensities in different regions of the spectrum. Owing to the need for more extended investigation, no attempt is made to form a judgment concerning the nature of the red shift, but the shift itself and its variation with intensity are regarded as real, and as making it impossible to say at present whether or not the Einstein displacement exists in the solar spectrum.

University and Educational Intelligence.

ABERDEEN.—The University Court has appointed Dr. A. W. Borthwick, senior research officer to the Forestry Commission, to the chair of forestry; and Dr. J. Cruickshank, reader in bacteriology in the university, to the chair of bacteriology. Both are first appointments to recently founded chairs.

Sir David Prain has been appointed to deliver a university lecture in the science faculty.

CAMBRIDGE.—Mr. S. Lees, fellow of St. John's College, has been reappointed as Hopkinson lecturer in thermodynamics. Mr. F. Debenham, fellow and tutor of Gonville and Caius College, has been appointed Director of the newly formed Polar Research Institute.

The Pinsent-Darwin Studentship has been allotted to Dr. R. D. Gillespie, of the Cassel Hospital for Functional Nervous Disorders, for the period of three years.

A Scientific Research Fellowship at Girton College of the value of 300*l.* a year is offered for research in mathematical, physical, and natural sciences. Women who are graduates or have taken honours in a final degree examination of any university, and members of the Girton College Roll, are eligible. The appointment will be for three years in the first instance. Applications must reach the Secretary of the College on or before April 12. The proposed course of research, and a dissertation or published work, and other evidence of fitness to undertake the research, are required.

LONDON.—A course of three public lectures on "The Constitution and Evolution of the Stars" will be given by Prof. A. S. Eddington at King's College, at 5.30, on February 22, 24 and March 1. A similar course, on "Some Principles of Therapeutics," will be given at St. Thomas's Hospital Medical School at 5.30, on February 22, 23, and 24, by Prof. D. Murray Lyon. No tickets are required in either case.

Three further courses of free public lectures are announced, namely: "The Morphology of the Vascular Cryptogams in the light of Pre-carboniferous Plants," by Prof. W. H. Lang, at University College, on March 1, 3 and 5, at 5.30; "Active and Passive Immunity," by Dr. R. A. O'Brien, at University College Hospital Medical School, on March 1, 5, 8 and 12, at 5, and "Atomistic Physics," by Prof. A. Sommerfeld, at the Imperial College of Science, on March 3, 9 and 10, at 5.30.

BRITISH Dyestuffs Corporation is again granting facilities to a limited number of university students taking honours schools in chemistry, to enable them to gain an insight into chemical works practice. The students must be of British birth, have no direct connexion with the dyestuffs industry or industries competing with the Corporation, and they must be recommended by their professor of chemistry. Application forms should be returned to the Corporation at 70 Spring Gardens, Manchester, marked "Vacation Course," not later than May 1. If sufficient applications are received, courses are proposed for the periods July 1-28 and September 1-30 only.

THE Ramsay Memorial Fellowship Trustees in their report for 1924–25 give particulars of the eighteen fellowships (including five temporarily vacant) which they are administering. These fellowships are for research in chemistry and are, ordinarily, worth 300*l.* a year for two years. Those awarded in 1924–25 were held at University College, London (5), King's College, London, the Imperial College of Science and Technology, London, Oxford (2), Cambridge (2), Bristol, Manchester, Sheffield, and the Davy-Faraday Laboratories of the Royal Institution, London. Eleven of them were held by fellows from other countries: a Canadian at Cambridge under the direction of Sir Ernest Rutherford, a Dane under Prof. M'Bain at Bristol, a Dutchman under Prof. Robert Robinson at Manchester, a Frenchman under Sir William Bragg at the Royal Institution, a Greek under Prof. E. C. Williams in the Ramsay Laboratory of Chemical Engineering at University College, London, an Italian at Cambridge under Prof. Lowry, a Japanese and a Spaniard under Prof. F. G. Donnan at University College, London, a Norwegian at Sheffield in the Department of Metallurgy, a Swede at King's College, London, under Prof. Richardson, and a Swiss at the Royal School of Mines, Imperial College, under Prof. H. C. H. Carpenter.

THE Commonwealth Fund Fellowships were established a year ago by the Commonwealth Fund of New York, a philanthropic foundation existing since 1918 and supported by gifts from Mrs. Stephen V. Harkness. They are tenable by British graduate students at American universities and are worth about 600*l.* a year for two or, in exceptional cases, three years. A report of the working of the scheme in its first year, issued last November and recently received, shows that every university and university college in Great Britain and Ireland, with one exception, sent in candidates, and that on the final list Cambridge, Durham, Edinburgh, Leeds, London, Manchester, Oxford, Belfast, St. Andrews, and Wales were represented. The chosen subjects of study of the twenty successful candidates are: Agriculture, architecture, botany, chemistry (3), classics, economics (2), English (2), geology (2), history, law, mathematics, medicine (2), and physics (2). The fellowships will be held in the first instance at the following universities: Harvard (3), Yale (2), University of California (2), Cornell (2), University of Wisconsin (2), Johns Hopkins (2), University of Chicago (2), Columbia (2), University of Illinois, Princeton, University of Minnesota. One of the conditions of tenure is that fellows are required to travel for three months in the United States at the end of the first year. Each fellow is asked to submit by the middle of the academic year a plan for travel in connexion with his work, for example, to visit libraries, laboratories, or universities. Advice regarding the plan is offered by the New York office of the Fund, and letters of introduction when possible, and sufficient allowance is made for comfortable travel.

Contemporary Birthdays.

February 19, 1858. The Duke of Bedford, K.G., F.R.S.
February 19, 1859. Prof. S. Arrhenius, For.Mem.R.S.
February 19, 1871. Dr. W. Diller Matthew, F.R.S.
February 19, 1865. Sir Sven Anders Hedin, Hon. K.C.I.E.
February 22, 1856. Prof. M. J. M. Hill, F.R.S.
February 23, 1856. Viscount Cave, G.C.M.G.
February 25, 1869. Prof. Arthur W. Crossley, F.R.S.
February 26, 1864. Mr. John Evershed, F.R.S.

The DUKE OF BEDFORD, who was born in London, graduated at Balliol College. His Grace is a trustee of the British Museum and president of the Zoological Society of London.

Prof. ARRHENIUS was born at Wiljk, near Upsala. He is the originator of the theory of electrolytic dissociation, and was Nobel laureate in 1903. In the previous year he was awarded the Davy medal of the Royal Society for his application of the theory of dissociation to the explanation of chemical phenomena. In 1914 the Chemical Society allotted him its Faraday medal, and Prof. Arrhenius received it in person. On that occasion Sir William Crookes said, "The world is deeply in need of researchers both of the type of those whose genius is characterised by that fertility of resource in experimental investigation exhibited by Faraday and the type of Arrhenius. Both are revolutionaries and founders of new kingdoms. The world's debt to them is incalculable."

Dr. MATTHEW, palæontologist, was born at St. John, New Brunswick. He is curator of fossil vertebrates in the American Museum of Natural History, New York.

Sir SVEN ANDERS HEDIN, explorer and geographer, was born at Stockholm and educated there and in various foreign cities. In 1902 he was ennobled by the King of Sweden. He is Hon. D.Sc. (Oxon., Camb.). The Founder's medal of the Royal Geographical Society was awarded him in 1902. Sir Sven published "My Life as an Explorer" in 1925.

Dr. M. J. M. HILL, formerly professor of mathematics in the University of London, was born at Berhampore, Bengal. Educated at Blackheath, University College, London, and Peterhouse, Cambridge, he was 4th wrangler and Smith's prizeman (1879).

Viscount CAVE was born in London. Educated at Merchant Taylors' School, he graduated at St. John's College, Cambridge. Lord Cave is chairman of the Grand Council of the British Empire Cancer Campaign.

Prof. CROSSLEY is a Lancashire man. He went to Mill Hill School, and afterwards he graduated at the University of Manchester. He is also Ph.D. (Würzburg). Formerly Daniell professor of chemistry in the University of London (King's College), he is now director of the Cotton Industry Research Association, Didsbury. Prof. Crossley is an Officer of the Legion of Honour.

Mr. EVERSHED, until lately director of the Kodaikanal and Madras Observatories, is distinguished for his work in astrophysics. In 1918 he was awarded the gold medal of the Royal Astronomical Society for his investigations of the radial motion in sunspots, and more recently he has detected the shift of the lines of the solar spectrum required by the theory of relativity.

Societies and Academies.

LONDON.

Royal Society, February 11.—H. G. **Thornton** and N. **Gangulee**: The life-cycle of the nodule organism *Bacillus Radicicola* (Beij.) in soil, and its relation to the infection of the host plant. A regular cycle of changes was found, unbanded rods, cocci, and banded rods successively predominating in the soil. Increase in the percentage of cocci was associated with increased bacterial numbers and with the appearance of motile forms. When soil and sand is inoculated with a suspension of the bacteria, the latter commence, after a lag period, to spread radially at an approximate rate of 1 inch in 24 hours. The lag is apparently related to the time taken for cocci to predominate in the soil, and is decreased by using milk and 0·1 per cent. of calcium phosphate as the inoculating fluid. The bacteria multiply rapidly in the soil into which they have recently spread. Lucerne plants grown from seed inoculated with a suspension of bacteria in milk + 0·1 per cent. calcium phosphate showed a considerable increase in nodule numbers and in yield compared with plants from seed inoculated with a suspension in milk alone.—C. E. **Walker**: The meiotic phase in certain mammals. The daughter chromosomes of the last somatic division before the first meiotic split longitudinally. The semivalent half-chromosomes lengthen out, until the whole nucleus is filled with fine semivalent threads. This is the end of the telophase. These semivalent threads join together again in pairs to form univalent filaments, which join laterally in pairs to form bivalent loops. The filaments, after forming these loops, separate except at their ends. These are the meiotic bivalent chromosomes. At the first meiotic division, the pairs of whole somatic chromosomes, joined by their ends, separate and are distributed, half to each daughter cell. The longitudinal split in the daughter chromosomes of the somatic division which reappears in the telophase of the first meiotic division, is not consummated until the second meiotic division. The term "exeilesis" is suggested for the process by which each of the daughter chromosomes becomes converted into two semivalent threads.—J. **Needham** and Dorothy **Needham**: Further micro-injection studies on the oxidation-reduction potential of the cell interior. The results of the micro-injection of *p*H and *r*H indicators into living cells have been investigated. Oxidation-reduction potential indicators exhibit no anomalies when injected into *Amœba proteus*. It appears, therefore, that all the dyes on the scale may be used with biological material. The amœba is capable of oxidising the leucoform of indicators of lower oxidation-reduction potential, and the latter is probably independent of the percentage of oxygen in the external atmosphere. *Nyctotherus cordiformis* (an anaerobic protozoon) possesses an internal *p*H of 7·1 and an internal *r*H of 19·0-20·0 under aerobic conditions, while under anaerobic conditions, the latter changes to 9·5-10·5.—J. W. H. **Harrison** and F. C. **Garrett**: The induction of melanism in the Lepidoptera and its subsequent inheritance. Both in the British Isles and on the Continent in large manufacturing and urban areas, melanic forms have arisen. The conditions point immediately to the smoke in the atmosphere of large towns as responsible for the melanism and, moreover, indicate that it influences insects in the larval state by means of their food-plants. Thus it should be possible to induce melanism by (1) feeding up non-melanic strains of Lepidoptera in melanic districts, and (2) feeding them in non-melanic areas on food-plants artificially charged with impurities known to exist in

or on the foliage of plants found in manufacturing centres. Both methods were employed on *Selenia bilunaria*, *Tephrosia crepuscularia*, and *T. bistortata*. Melanic examples appeared in all the experimental broods, and in numbers diverging widely from Mendelian expectation. The melanism so induced in *Selenia bilunaria* and *Tephrosia bistortata* behaved as a Mendelian recessive, while in *T. crepuscularia* it acts as a dominant.—J. **Gray**: The mechanism of ciliary movement.—(v.) The effect of ions on the duration of beat.—N. H. W. **Maclaren**: The early development of Cavia: Note on associated remains of previous placentation.

Linnean Society, January 21.—H. B. **Fantham** and Annie **Porter**: On two protozoan parasites found in the latex of *Ficus edulis* and *Euphorbia striata*. Two species of herpetemonads were found respectively in the latex of *Euphorbia striata* and *Ficus edulis* in Johannesburg, South Africa; the former is probably a strain of *Herpetemonas* (*Leptomonas*) *davidi*, and the latter is regarded as a new species. The plants parasitised do not show any marked pathological symptoms, the infection being localised. The number of infected plants was very small in each case. The possible source of the herpetemonads is of interest. They are best known as parasites of the alimentary tract of insects, both blood-sucking and non-blood-sucking. Marks of punctures, very probably made by the proboscides of plant-feeding Hemiptera, were seen on the Euphorbia, while green flies, Lucilia sp., were found on the fig-leaves, which may have inoculated the flagellates into the latex of the plants. They occur in man and dogs under the name of *Leishmania kala-azar*, and skin-sores are caused by them. It is interesting to find the latex of certain plants forming a natural reserve of herpetemonads.—H. H. **Thomas**: Discussion: The relation between the Caytoniales and modern flowering plants. The recently described Caytoniales are of some interest because they were Angiosperms without flowers, their reproductive structures being megasporophylls bearing carpels and microsporophylls bearing anthers. A single carpel and a single anther of this fossil type can be compared somewhat closely with the corresponding structures in the modern flower. It is unlikely that the Caytoniales represent the direct ancestors of the flowering plants, but they may be derived from the same stock which gave rise to that group. Assuming some relationship, the structure of Caytonia points to the carpels of the primitive Angiosperms having double rows of ovules produced in a dorsal median position near the vascular strands, rather than to the occurrence of marginal ovules produced on the sides farthest away from the vascular strands. Caytonia and Gristhorpia were undoubtedly wind-pollinated, and contained many ovules in each carpel. They can therefore be cited in opposition to the views (Robertson) that the primitive Angiosperms were insect-pollinated. The seeds of the Caytoniales are small in size and do not agree with the view that the primitive Angiosperm seeds were large like those of Cycas. The comparison of the microsporophylls (*Antholitus Arberi*) with the modern stamens may indicate that the primitive anther had four equal pollen-sacs arranged longitudinally, and was inserted by its base on the filament. A group of plants resembling both the Caytoniales and the Bennettitales, and also derived from the Pteridosperms, is suggested as the origin of many flowering plants. Recent discoveries tend to show that the Angiosperms originated at a much earlier period than was formerly supposed, and that at least one group of early Angiosperms achieved a very wide distribution in early Mesozoic times.

PARIS.

Academy of Sciences, January 11.—Pierre **Weiss**: Paramagnetism independent of the temperature. Solutions of luteocobaltic chloride and of potassium bichromate possess a magnetisation coefficient independent of the temperature. This fact is of importance in the theories of paramagnetism. A discussion of the possible hypotheses leads to the conclusion that constant paramagnetism should be an intra-atomic phenomenon.—Ph. Le **Corbeiller**: The substitutions of the complex modular group.—Ladislas **Nikliborc**: Hyperharmonic functions.—J. Kampé de **Fériet**: The uniformisation of a class of functions defined by integral series with meromorph coefficients.—Constant **Lurquin**: Binary covariation.— — **Kiveliovitch**: The conditions of a binary shock in the problem of three bodies.—Emile **Belot**: Remarks on the dense internal nucleus of the sun and on the movement of sunspots in latitude.— — **Pauthenier**: The photographic measurement of the electrostriction in the case of carbon tetrachloride. The experiments described are in good agreement with theory for the case of carbon tetrachloride.—H. **Pélabon**: Detection and the stability of certain detectors. Any imperfect contact metal-dielectric-metal may be used as a detector of wireless waves. If the dielectric interposed is gaseous the detector obtained is unusable on account of its extreme instability due to temperature changes. Powdered, badly conducting solids form stable detectors.— — **Andrieux**: The electrolysis at a high temperature of oxides dissolved in boric acid or in borates. Details of a method by which sodium can be obtained by the electrolysis of borax.— — **Baykoff**: The theory of hardening of hydraulic cements. The author considers that three stages can be traced in the hardening of cement. The first stage is one of solution during which the liquid becomes saturated with the various soluble constituents. In the second stage all the products of the chemical reaction enter into the colloidal state. This corresponds to the commencement of the setting. In the final stage the gels are transformed into crystalline aggregates and this is the period of hardening.—A. **Kling** and A. **Lassieur**: The stability of solutions of carbonic acid. In a previous communication the authors have shown that water, purified as completely as possible, possesses an acid reaction, corresponding to $p\mathrm{H} = 5{\cdot}8$. One plausible explanation of this would be that it is due to retained carbon dioxide. Direct experiment proved that a solution of carbon dioxide in highly purified water lost the whole of its carbon dioxide on exposure to air and gave the same acidity (5·8) as water purified without access to carbon dioxide.—Georges **Delbart**: Study of the fragility of cold drawn steel.—T. **Karantassis**: Researches on stannous chloro-iodide, bromo-iodide, and chloro-bromide. Data are given in support of the existence of the definite compounds SnICl, SnIBr, and SnClBr.—J. **Bougault**: An example of ether-oxide of a hydrated ketone.—M. **Faillebin**: The hydrogenation of ketones in the presence of pure and impure platinum black. It has been shown in earlier communications that the reduction products of ketones and aldehydes by hydrogen in the presence of platinum black are affected by the purity of the platinum. In the present paper an attempt is made to study the mechanism of the phenomenon. A platinum-iron catalyst was treated with a mixture of acetic acid and acetylacetone to remove the iron. The catalyst thus obtained functions as pure platinum black in the reduction of ethyl acetoacetate.—Raymond **Delaby**: The catalytic oxidation of vinylalkyl-carbinols into vinylalkylketones in the presence of

palladium black. The oxidation of unsaturated secondary alcohols can only be carried out in a gaseous system at low pressures, but the yields are not good.—André **Cornillot**: The bis-phthalide carboxylic esters.—P. **Gaubert**: Detection (in wireless telephony) and the facies of crystals of galena and pyrites.—Conrad **Kilian**: The proportion in which the Silurian period is represented by its formation of the Tessilian enclosure, and on the presence of the Ordovician in the Sahara.—G. **Georgalas** and N. **Liatsikas**: The spectrum analysis of the flames from the Santorin volcano (eruption of 1925). From the lines recorded in the spectrograph, the gaseous mixture issuing from the central dome of the volcano contained hydrogen, vapour of sodium chloride, oxygen, nitrogen, and probably ferric chloride.—F. X. **Skupiénski**: The evolutive cycle in *Didymium difforme*.—A. **Hée**: The influence of temperature on the intensity of respiration of submerged plants. The plants studied were *Elodea canadensis*, *Myriophyllum spicatum*, and Cladophora, and the temperatures varied between 10° C. and 39°·5 C. The respiration increased with rise of temperature and there was no optimum temperature.—P. P. **Stanescu**: The quantitative variations of the carbohydrates in the leaves of green plants in the course of a day.—M. **Bridel** and C. **Béguin**: The application of the biochemical method of research to the glucosides undergoing hydrolysis by rhamnodiastase to the study of the fresh roots of *Polygonum cuspidatum*. The production of a new glucoside, polydatoside. The results of the action of rhamnodiastase on the root extract indicated the presence of a new glucoside. Details of the mode of extraction and purification of this substance are given, together with its physical and chemical properties.—L. **Mercier**: The orthogenesis of the longitudinal vibrator muscles of flight in the Diptera.—Jean **Piveteau**: The importance of structural characters in the interpretation of certain fossils classed with the reptiles.—Maurice **Aubertot**: The contractility of the excretory apparatus in the larvæ of *Rhabditis pellio*.—L. M. **Bétancès**: The genesis of the hæmatopoietic organs and of the blood cells in the invertebrates.—A. **Policard**: The movements of sarcomatous cells cultivated *in vitro*. The most marked characteristic of the sarcomatous cells is incessant and rapid amœboid movement.— —**Raymond-Hamet**: The action of yohimbine and the active alkaloids of ergot on the sympathetic vasomotor innervation of the kidney.—J. **Risler** and Foveau de **Courmelles**: The physiological action of the ultra-violet rays transmitted by the thin glass in ordinary use. It is generally held that ultra-violet rays emitted by a source of light in the interior of a glass apparatus are not harmful. Four cases of accident resulting from the use of apparatus constructed of light glass are described which show that injurious effects on the skin can be produced by the absorption of rays in the region between $\lambda = 2960$ Å.U. and $\lambda = 3120$ Å.U.—Daniel **Berthelot**: Remarks on the preceding communication. Additional data confirming the results.—R. **Fosse**: The formation, by heating plant juices, of urea and of a substance giving the same hydrazine colour reaction as formol. The simultaneous formation, by heating plant juices, of urea and of a substance giving the colour reaction of formol, results from the hydrolysis of a ureide.—G. **Delamare** and Saïd **Djémil**: Abnormal forms of *Plasmodium vivax*.—A. **Paillot**: A new disease of the nucleus or *grasserie* of the larvæ of *Pieris brassicæ* and a new group of micro-organisms.—Mme. **Phisalix**: The natural immunity of the eel against the virus of hydrophobia and the rabicidal action of its serum. The eel is naturally refractory to hydrophobia and its serum destroys the virus of hydrophobia *in vitro*. The serum can also be used to protect animals against hydrophobia.—B. **Issatchenko**: Nitrification in the sea.—X. **Debedat**: Ulcerated Röntgen epitheliomas cured by high frequency treatment (diathermo-coagulation). After giving details of his own cure by this treatment, the author concludes that radiologists need not die of cancer brought on by their work.

Official Publications Received.

Board of Trade. Catalogue of the British Industries Fair 1926, The White City, Shepherds Bush, London, W.12, February 15th–26th. Organised by the Department of Overseas Trade. Pp. xxx+176+112. (London: Department of Overseas Trade.) 1*s*.

Memoirs of the Asiatic Society of Bengal. Vol. 6: Zoological Results of a Tour in the Far East. Edited by Dr. N. Annandale. Part 10: The Amphipoda of Talé Sap. By Dr. Chas. Chilton. Pp. 531-558. 1.2 rupees. Vol. 9, No. 2: Geographic and Oceanographic Research in Indian Waters. By Major R. B. Seymour Sewell. Part 2: A Study of the Nature of the Sea-Bed and of the Deep-Sea Deposits of the Andaman Sea and Bay of Bengal. Pp. 27-50+plates 6-7. 2.4 rupees. (Calcutta.)

Meddelelser fra Kommissionen for Havundersøgelser. Serie Fiskeri, Bind 8, Nr. 1: On the Age and Growth of the Haddock (*Gadus æglefinus* L.) and the Whiting (*Gadus merlangus* L.) in Icelandic Waters. By Bjarni Sæmundsson. Pp. 33. Serie Fiskeri, Bind 8, Nr. 2: On the Diurnal Vertical Movements of Young of some Fishes in Danish Waters. By Dr. A. C. Johansen. Pp. 27. (København: C. A. Reitzel.)

Proceedings of the Royal Irish Academy. Vol. 37, Section A, No. 2: A Quaternion Substitute for the Theory of Tensors. By W. J. Johnston. Pp. 13-27. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

Union of South Africa. Department of Mines and Industries: Geological Survey. Geological Map of the Union of South Africa. On the Scale of One to a Million. In 4 Sheets, 40 in. × 30 in. The Geological Structure of the Union: an Explanation of the Geological Map of the Union of South Africa. By Dr. A. W. Rogers. Pp. 34. 6*d*. Map, with Explanation, 26*s*. (Pretoria: Government Printing and Stationery Office.)

Diary of Societies.

SATURDAY, FEBRUARY 20.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology, 329 High Holborn), at 11.30.—Prof. Pear: What is meant by Skill in Industry.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. G. Macdonald: Roman Britain (1).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.), at 3.—G. Avenell: A Glance at Richard Jefferies (Lecture).

PHYSIOLOGICAL SOCIETY (at King's College).

MONDAY, FEBRUARY 22.

ROYAL IRISH ACADEMY (Dublin), at 4.15.

ROYAL SOCIETY, EDINBURGH, at 4.30.—Rev. T. C. Gordon: The Finding of the Galilee Skull.—Prof. A. Robinson: A Scientific Description of a Neanderthal Skull found in Galilee, from a Cast.

INSTITUTE OF ACTUARIES, at 5.—C. R. V. Coutts: On the Distribution of Life Office Profits.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Fossil Remains of Ape and Man (1): The Taungs Anthropoid: its Zoological and Geological Position.

FARADAY SOCIETY (at Chemical Society), at 5.30.—Prof. A. J. Allmand and R. H. D. Barklie: The Influence of Alternating Currents on the Electrolytic Corrosion of Iron.—A. N. Campbell: The Direct Oxidation of Manganous Ion to Permanganate.—H. J. Poole: The Elasticity of Jellies of Cellulose Acetate in Relation to their Physical Structure and Chemical Equilibria.—F. G. Tryhorn and W. F. Wyatt: Adsorption II. The Adsorption by a Coconut Charcoal of Saturated Vapours of some Pure Liquids. Adsorption III. Stages in the Adsorption by a Coconut Charcoal from the Saturated Vapour over Liquid Mixtures of Alcohol and Benzene and of Acetone and Benzene.—I. R. McHaffie: A Device for Circulating Fluids under High Pressure.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Bedford College for Women), at 5.30.—Prof. J. Johnstone: The Organism and its Environment (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. F. Harmer and others: Discussion on Some Changing Characteristics in the Application of Electricity to Public Supply.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—J. L. Thompson and H. Walmsley: Notes on the Testing of Static Transformers.

INSTITUTION OF STRUCTURAL ENGINEERS (Midland Counties Branch) (at Birmingham), at 7.30.—H. F. Lea: Arterial Road Construction.

ROYAL SOCIETY OF ARTS, at 8.—Dr. G. W. C. Kaye: The Production and Measurement of High Vacua (Cantor Lectures) (2).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Sir Frank Colyer: Abnormal Teeth from the Region of the Premaxilla.

RAILWAY CLUB (at 65 Belgrave Road), at 8.15.—B. M. Bazley: Development of the Railway Carriage.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.

TUESDAY, FEBRUARY 23.

ROYAL DUBLIN SOCIETY (at Balls Bridge, Dublin), at 4.15.—Prof. W. E. Adeney and Miss B. B. Dawson: The Estimation of Organic Matter in Water by means of Potassium Bichromate and Sulphuric Acid.—T. G. Mason and C. J. Lewin: On the Rate of Carbohydrate Transport in the Greater Yam, *Dioscores alata*, Linn.—Prof. J. Reilly: The Production of Lavender Oil from Irish Grown Plants.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: The Egg (2): The Shell.

LINNEAN SOCIETY, at 5.30.

ROYAL SOCIETY OF MEDICINE (Medicine, Electro-Therapeutics, Surgery, and Laryngology Sections), at 5.30.—Dr. L. S. T. Burrell, Dr. S. Melville, J. E. H Roberts, S. Hastings, Dr. W. Gordon, E. M. Woodman, Dr. R. Knox, Dr. D. Forrest, Sir Charlton Briscoe, and others: Discussion on The Diagnosis and Treatment of Intra-thoracic New Growths.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Bedford College for Women), at 5.30.—Prof. L. J. Russell: The Philosophical Problems within Science (Lecture).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. H. H. Scott: Report on the Deaths occurring in the Society's Gardens during the Year 1925.—W. E. Le Gros Clark and the late Dr. C. F. Sonntag: A Monograph of *Orycteropus afer*. III. The Skull, Skeleton of the Trunk and Limbs, and General Summary.—Dr. Marie V. Lebour: The Young of *Stylocheiron suhmii* G. O. Sars and *Stylocheiron abbreviatum* G. O. Sars (Crustacea), from Mediterranean Plankton collected by Mr. F. S. Russell in the Neighbourhood of Alexandria, Egypt.—Oldfield Thomas: On Mammals from Ovamboland and the Cunene River, obtained during Capt. Shortridge's Third Percy Sladen and Kaffrarian Museum Expedition into South-West Africa.—Helen M. England: Development of Gonophores of the Stylasteridæ.

INSTITUTION OF CIVIL ENGINEERS, at 6.—V. Bayley: The Khyber Railway.—Col. G. R. Hearn: The Survey and Constructiion of the Khyber Railway.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—F. S. Clifford: The Principles and Practice of Automatic Steering.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—A. Keighley: Palestine (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—H. Parodi: The Electrification of the Paris-Orleans Railway.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7.15.—A. A. Perks: The Heat Reactions occurring during the Vulcanisation of Rubber.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.

ROYAL ANTHROPOLOGICAL INSTITUTE (Indian Section), at 8.15.—R. E. Enthoven: Ethnographic Research in India.

WEDNESDAY, FEBRUARY 24.

INSTITUTE OF HYGIENE, at 3.30.—Dr. L. R. Lempiere: Diet in Schools.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Fossil Remains of Ape and Man (2): Fossil Anthropoids of Europe and of Asia.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. G. L. Elles: The Geological Structure of Ben Lawers and Meall Corranaich (Perthshire).

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at the Science Museum, South Kensington), at 5.30.—G. F. Tyas: Matthew Murray—A Centenary Appreciation.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at University of London Club), at 5.30.—Hon. Bertrand Russell: The Structure of the World (Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Neville Hall, Newcastle-upon-Tyne), at 7.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—S. R. Trotman and Dr. E. R. Trotman: Further Experiments on the Chlorination of Wool.—Dr. E. R. Trotman: The Determination of Dissolved Oxygen in Effluents.

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7.30.—Kodak, Ltd.: Practical Demonstration of the Eastman Colorimeter.—C. A. Klein: The Application of the Microscope to the Examination of Pigments and Paints.

ROYAL SOCIETY OF ARTS, at 8.—Dr. Mary Fishenden: Domestic Heating.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Royal Society of Medicine), at 8.30.—Dr. J. T. MacCurdy: A Hypothetical Mental Constitution of Compulsive Thinkers.

MEDICAL SOCIETY OF LONDON, at 9.—Dr. F. Buzzard: The Principles of Treatment in relation to Diseases of the Nervous System (Lettsomian Lectures) (2).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section—Newcastle) (at Armstrong College).—Prof. C. J. Hawkes: The New Engineering Laboratories at Armstrong College.

THURSDAY, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—O. R. Baldwin and Prof. G. B. Jeffery: (*a*) The Relativity Theory of Plane Waves; (*b*) Electronic Orbits on the Relativity Theory.—Margaret Stimson and Prof. G. B. Jeffery: The Motion of Two Spheres in a Viscous Fluid.—A. L. McAulay and F. P. Bowden: Evidence for a Film Theory of Hydrogen Overpotential from Surface Tension Measurements.—*To be read in title only*:—J. H. Wolfenden: Critical Potentials of Hydrogen in the Presence of Catalytic Nickel and Copper.—J. P. McHutchison: Adsorption Experiments with Radium D and Radium E.—J. S. Dunn: (1) High Temperature Oxidation of Metals. (2) The Low Temperature Oxidation of Copper.—Prof. J. Heyrovský: A Note on The Significance of the Electrode Potential.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. D. Ellis: The Atom of Light and the Atom of Electricity (1).

INSTITUTION OF MINING AND METALLURGY (at Geological Society of London), at 5.30.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Anthropological Institute), at 5.30.—H. J. Laski: Politics in Literature. H. G. Wells (Lecture).

ROYAL AERONAUTICAL SOCIETY, at 6.30.—A. J. Cobham: Long Distance Aeroplane Flights.

BRITISH ASTRONOMICAL ASSOCIATION (West of Scotland Section) (at Royal Technical College, Glasgow), at 7.30.—J. J. Ross: The Moon's Motions and Ocean Tides.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—O. Aves: Notes on the Significance and Detection of Low Errors of Refraction.—W. H. A. Fincham: Vertex Power and its Measurement.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre (Dublin)) (at Trinity College, Dublin), at 7.45.—Prof. S. P. Smith: An All-Electric House.

INSTITUTE OF CHEMISTRY STUDENTS' ASSOCIATION (London), at 8.—F. H. Carr: The Transference of Chemical Processes to the Large Scale.

FRIDAY, FEBRUARY 26.

ROYAL SANITARY INSTITUTE (in Municipal Buildings, Middlesbrough), at 4.—Dr. Grace Dundas, Dr. C. V. Dingle, and others: Discussions on the Malthriving Infant, the Present Type of Smallpox, Organic Salvage, and Housing and Main Drainage.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section) (at Paddington Green Children's Hospital, W.2), at 4.30.—Clinical Meeting.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—J. E. Calthrop: The Effects of Torsion upon the Thermal and Electrical Conductivities of Aluminium, with special reference to Single Crystals.—T. H. Harrison: A Study of the Concurrent Variations in the Thermionic and Photo-Electric Emission from Platinum and Tungsten with the State of the Surfaces of these Metals.—C. R. Darling and E. Edser: Demonstrations illustrating Surface Tension and Capillary Phenomena.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Fossil Remains of Ape and Man (3): The Kivu Gorilla and its Bearing on the Problems of Human Evolution.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Anthropological Institute), at 5.30.—Prof. T. H. Pear: The Gestalt Theory (Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institute of Chemistry) (at 39 Elmbank Crescent, Glasgow), at 7.—Prof. R. A. Berry: Soil Nitrogen.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Swansea Technical College), at 7.30.—E. A. Tyler: Some Notes on Pure Chemicals: An Inquiry into the Purity of Available Supplies.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 7.30.—J. Richardson: Hydro-Mechanical Gearing.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. F. Petree: Seven Thousand Years of Shipping.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. C. Hagberg Wright: Nicolas de Peiresc and his Circle: The Story of a 17th Century Patron of Learning.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

INSTITUTION OF MECHANICAL ENGINEERS (Sheffield Branch).—Informal Discussion.

SATURDAY, FEBRUARY 27.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne), at 3.—F. J. Johnston: The Use of Breathing Apparatus in Mines.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. G. Macdonald: Roman Britain (2).

PUBLIC LECTURES.

SATURDAY, FEBRUARY 20.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Gordon V. Childe: Ancient Crete and the Myths of the Greeks.

MONDAY, FEBRUARY 22.

KING'S COLLEGE, at 5.30.—Prof. A. S. Eddington: The Constitution and Evolution of the Stars. (Succeeding Lectures on February 24 and March 1.)

ST. THOMAS'S HOSPITAL MEDICAL SCHOOL, at 5.30.—Prof. D. Murray Lyon: Some Principles of Therapeutics. (Succeeding Lectures on February 23 and 24.)

TUESDAY, FEBRUARY 23.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomy. (Succeeding Lectures on February 24, 25, and 26.)

WEDNESDAY, FEBRUARY 24.

SCHOOL OF ORIENTAL STUDIES, at 5.15.—Prof. E. Herzfeld: Persian Archæology (James G. R. Forlong Lectures). (Succeeding Lectures on March 3, 8, and 12.)

FRIDAY, FEBRUARY 26.

MUNICIPAL TECHNICAL SCHOOL, BIRMINGHAM, at 7.15.—Dr. J. Newton Friend: Historical Chemistry: Phlogistic Period and Joseph Priestley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Dr. H. T. Calvert: The Activated Sludge Process of Sewage Treatment (Chadwick Lecture).

SATURDAY, FEBRUARY 27.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—G. C. Robson: Squids, Cuttlefishes, and their Allies.

CONFERENCE.

FRIDAY, FEBRUARY 19, AND *SATURDAY*, FEBRUARY 20.

UNIVERSITY, BIRMINGHAM.—Inter-University Metallurgical Conference.—The Metallurgical Student: His Place in Industry.