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British Optical Science.

THE practice of optical science is largely concerned with the provision of means for aiding vision and increasing its effectiveness. Of the human senses, vision is the one on which, above all others, scientific work directly or indirectly depends for its successful prosecution. Thus, while optics may be regarded as the handmaiden of the other branches of science, the service rendered by it is essential and fundamental. It has provided science with—if we may quote the three classical examples—the microscope, without the aid of which medical science would have made little progress; the telescope, which has enabled astronomy to explore the heavens; and the spectroscope, which has played such a predominant part in modern physics and astrophysics.

With the increasing application of science and scientific methods to industrial processes, optical science has been brought more and more into the service of industry. It has efficiently fulfilled this service by reason of the fact that it has been able to provide not only delicate and powerful means of making observations, but also means of making accurate quantitative measurements in a simple and rapid manner. The use of the spectrometer in chemistry and the chemical industry, of the refractometer in biochemistry and in the preparation of foodstuffs, of the polarimeter in the evaluation of essential oils and in the sugar industry and of the interferometer in the examination of gases, and liquids, are a few examples of such applications, which are generally distinguished by simplicity of manipulation and by the rapidity with which results can be obtained.

As the study of absorption spectra has progressed, the measurement of selective absorption has become of great practical importance to the chemist, and spectrophotometers are now in regular use which enable quantitative measurements to be made, not only in the visible spectrum, but also in the infra-red and in the ultra-violet. The modern colorimeter has provided means by which the analysis and specification of colour can be recorded numerically, and thus permits of the accurate reproduction of any colour without recourse to the instrument on which the analysis was actually made. The position occupied by the microscope as an instrument of control is so thoroughly appreciated that it need scarcely be mentioned. A casual study of the many papers that have been read at the meetings of the Industrial Applications Section of the Royal Microscopical Society is sufficient to make one realise the difficulty of specifying any industry of real importance which has not materially benefited by the use of the microscope. The application also of the camera and of optical projection methods in routine testing

and in specific investigations in industry has now been definitely established.

A survey of the uses to which optical instruments have been put might be indefinitely extended. Not only in industry but also in astronomy and geodesy, in medicine and biology, in aviation and navigaton, in photometry and illumination, in education and entertainment, has optical science found wide and useful scope for the application of its products. Nor has it neglected the simpler appliances on which so many of us depend for overcoming the limitations of our unaided vision and enabling us to carry out our ordinary occupations with greater comfort and consequently with greater efficiency. There has been evidence of growing interest in the care and preservation of the eyesight, whether of the child, the adolescent, or the adult, and considerable attention has been directed to a study of the eye, more especially with regard to the mechanism and processes involved in the act of seeing. Improvements have been effected in the methods and apparatus for detecting and measuring errors of curvature and refraction of the eye, and, simultaneously, investigations have been conducted which have resulted in many important improvements in the form of the lenses applied to give the necessary correction.

The advances which have been made during recent years in the development and production of new types of optical instruments have been notable and far-reaching in their effects. On a previous occasion (NATURE, Aug. 22, 1925, pp. 265-267) we referred to the predominant share taken by British workers in aiding these advances and suggested that, in the interests of the optical industry, its achievements should be made more widely known. The forthcoming Optical Convention, which is to be held during the week April 12-17, should provide an opportunity for the technical and general public to obtain a comprehensive account of the important developments that have taken place in optical science and in the optical industry in Great Britain since the last Optical Convention in 1912.

At no time in the history of British optics has progress been more rapid than during this period, and evidence of this progress in the different branches of theoretical optics, in the varieties of optical instruments, and in the various applications of optical methods, should not be lacking. British optical products are of such variety that a thoroughly organised and descriptive exhibition of them should have a high educational as well as commercial value, and should prove of interest not only to the optical expert and to those engaged in scientific work in which optics is subservient to some other branch of science, but also to that large and ever-increasing body of regular users of optical instruments of various types who are yet uninstructed in the nature, construction, or origin of the instruments they use.

The invention of optical systems and the development and perfection of new instruments, during the period under review, have been accompanied by investigations into the fundamental scientific principles on which they are based, and results of considerable value have been published. Continuous investigations have been conducted, for example, in analytical geometrical optics, in refractometry, and in colour measurement at the National Physical Laboratory, Teddington, in physical optics and instrument design at the Imperial College of Science and Technology, London, and in ophthalmological optics at the Northampton Polytechnic Institute, London. Investigations of a fundamental nature, as well as those directed towards immediately practical ends, have also been conducted at the British Scientific Instrument Research Association, at various universities and colleges, and in the laboratories of several manufacturing firms in the optical industry. The full nature and extent of these investigations will no doubt be clearly indicated during the Convention, and also their influence, on one hand, on optical production, and, on the other, on the progress of related branches of science.

Papers dealing with the results of these investigations will be of interest mainly to those engaged professionally in optics or in the application of optics to some special science. The programme also includes, however, lectures addressed more particularly to the amateur, and discourses and demonstrations of such a character as to show the position of optics in the everyday life of the individual and of the nation. Thus, if the aims and objects of the Convention are even in part attained, there should result not only a much wider appreciation of the past achievements and current enterprise of the British optical industry and those associated with it, but also an appreciation of the part played by optical science in almost every sphere of human endeavour.

Agricultural Progress in the United States.

History of Agriculture in the Northern United States, 1620–1860. By Dr. Percy Wells Bidwell and Prof. John I. Falconer. (Publication No. 358.) Pp. xii + 512. (Washington: Carnegie Institution, 1925.)

FROM the time of the Pilgrim Fathers in 1620 until the Civil War and the abolition of slavery in the middle of the last century, agriculture in the northern United States developed steadily from the smallest beginnings, progress being intimately associated with increasing colonisation and extension of occupied lands westward. In the present volume the authors have

most ably presented the history of American agriculture up to the time that a radical change in the economic life of the nation was brought about by the Civil War. The account is one that will appeal to the general reader of history as well as to the agricultural worker; and, notwithstanding the wealth of detail, it captures the imagination and leaves a clear and forcible picture of the progress of agricultural development in the States.

The earliest settlers on the eastern seaboard found some land already cleared and abandoned by the Indians, and further rough clearance was made by burning woods and meadows. Maize was the chief grain crop from the beginning, and the primitive method of manuring was to insert two or three fishes in each hill of corn. Multiple cropping was practised with maize, peas, and pumpkins, and wheat did well when introduced until attacks of black stem rust, about 1860, caused spring wheat to be abandoned in favour of autumn wheat. Stock was very scarce at the beginning, the initial difficulty being shortage of forage, the native grasses not being sufficiently nutritious. The rapid spread of introduced English grasses and clovers improved matters, and islands were largely utilised for pasturage, as the common field system of agriculture precluded grazing for much of the year. The introduction of sheep was encouraged by legislation, especially in New England, and though horses were also brought in, oxen were preferred for most farm work for almost two hundred years longer. The earliest New England farms were very small, only about 13 to 38 acres, which was rather surprising considering the cheapness of land. Lack of capital was the difficulty, and this was reflected in the scarcity of livestock and food supplies and the poverty of farm tools and implements, even ploughs being missing at first, the work being done by mattocks and hoes. The first beginnings of trade in agricultural products were to relieve the food shortage, but eventually trade between the West Indies and New England was a central feature of economic life. New England supplied general agricultural necessities to specialised sugar-planting islands which could not afford time or labour for producing them. Export of horses and salted meat began about 1650, and continued until the end of the eighteenth century. Boston, Philadelphia, and New York became the chief centres for internal trade in farm products.

Various systems of land tenure and distribution were adopted by different colonies, but the fundamental economic condition behind them all was the abundance of cheap land, which made both large estates and tenancy impossible. New England adopted community settlements, and common fields survived in pastures long after tillage fields had been separately enclosed. The system in the middle colonies was that of settlement by the individual and payment by quitrents, which were practically unknown in New England.

During the eighteenth century two types of agriculture existed, that of pioneering in new settlements on the frontier, steadily advancing to the west, and that of the older agricultural communities on the seacoast. The continual grain cropping and general lack of manuring caused much land soon to become 'worn out,' and westward migration in search of more fertile areas became general. Nevertheless, the value of land in the eastern colonies rose rapidly, and land speculation became rife. As time went on the land systems put into force in the different States opened up affected the relative colonisation and, except in New York State, the settlement of back country was favoured. Emigration west was also partly influenced by a growing desire to escape from the puritanical social and ecclesiastical systems common in early settlements. The pioneers cleared land by girdling or burning, followed by two years' grain crops and then grass. The life was extremely hard, but resulted in great increase in the capital value of the holdings even when incomes were small. Lumbering, potash, and maple sugar-making were subsidiary industries in suitable districts.

About 1780 the poorness of the farming was noteworthy, rapid deterioration of land being caused by lack of rotation crops. Successive unmanured grain crops were taken until the land was exhausted, when it was allowed to become covered with grass and bushes for several years until it was considered sufficiently rested to produce more grain. This system of weed fallowing for renewal of fertility was gradually replaced by sowing down artificial meadows, as the stock increased beyond the capacity of natural pasturage. Some manures, as seaweed, gypsum, and limestone, came slowly into use after 1750, and rotations were introduced. Maize held its position as the chief grain crop, the total produce being more than all other cereals together. The association of wheat rust with the barberry was soon recognised, and legislation against the shrub was in force so early as 1726 in Connecticut.

The colonial farms, throughout the eighteenth century, were almost entirely self-contained, providing food, clothing, and housing for their occupiers; salt, molasses, rum, tea, and coffee being almost the only goods habitually bought. Farmers on the coast were often sailors or fishermen as well, and inland farmers were often artisans. The lack of a home market was the insuperable barrier to specialisation in farming and prevented progress, in inland towns especially. Export trade to Europe grew towards the close of the eighteenth century, but that to the West Indies remained the most important, 1½ million bushels of maize being exported

thereto in 1792, and more than 1 million bushels of wheat.

The first forty years of the nineteenth century marked a period of expansion and progress, as the population rapidly increased with a westward movement. The government federal land policy favoured settlement, giving liberal political privileges and freedom from tariff restrictions to new settlers. West of the Alleghanies the richer land gave better crops and pasturage, but all the early western settlements were extensive in nature, little labour and capital being expended over large areas, production being chiefly for home consumption until such time as markets were opened up. The gradual development of internal western trade with an eastern market for livestock was of great significance in American economic and political history. At the end of the eighteenth century definite interest in agricultural improvement was aroused, and the first agricultural society was founded in Philadelphia in 1785; others followed, and were pioneers in agricultural education.

In 1807 one Elkanah Watson exhibited two merino sheep at Pittsfield, Massachusetts, thus founding the cattle shows or fairs in the United States, making the direct appeal to farmers which the agricultural societies had failed to do. State aid was forthcoming, and a chair including agriculture was founded at Columbia University, while at Gardiner, Maine, the first institute for teaching farming only was opened in 1822. The Agricultural College, however, was founded considerably later, in 1857, at Michigan. During this period also many types of labour-saving machines were introduced, aiding progress still further. Wool growing on a commercial basis began to develop in a spectacular way in the eastern States, nineteen million sheep being grown in 1840, and general improvement and specialisation of livestock took place, with the introduction of special breeding stock from abroad. Throughout the colonies a gradual transition was taking place from self-sufficient economy to commercial agriculture, the chief hindrance being lack of working capital and imperfect organisation of markets. The most significant change was the decline in household industries, with the transfer of textile industries from farm-house to factory.

After 1840 a period of transformation set in, which is dealt with very fully by our authors. The development of prairie agriculture in the west, with rapid settlement and soil exploitation, the building of canals, roads, and railways, thus giving access to new markets, caused readjustment of eastern farming to meet western competition, while the advance in agricultural chemistry made possible the era of artificial fertilisers. By 1860 the increase in corn production and stock rearing had pushed steadily westwards, while hay was the leading crop in the east, where dairy farming had grown steadily in importance.

The situation at the close of the period under consideration may best be indicated by a quotation:

"Whenever a branch of agricultural production, such as wheat, wool, or beef, proved profitable in the west and poured its supplies into the eastern market, it became necessary for the eastern farmer to find some other line of development; and, fortunately for the eastern farmer, the development of an urban population made this possible. The uncertainty in the choice of farm enterprises was stimulating to thought. It tended to make the agriculture of the period rational rather than traditional. It stimulated the development of the agricultural press and paved the way for the establishment of agricultural education."

W. E. B.

Crystals and Chemistry.

Crystalline Form and Chemical Constitution. By Dr. A. E. H. Tutton. Pp. xii+252. (London: Macmillan and Co., Ltd., 1926.) 10*s.* 6*d.* net.

TIME was when the crystal was emblematic of the mysterious and the supernatural; the regularity and beauty of its outward form inspired the belief that it possessed properties which placed it on a different plane from ordinary matter. Science has discredited the superstition but has really emphasised the wonder and the mystery. That the regularity of form implied a corresponding regularity in elemental structure was early recognised, and many and varied have been the attempts to explain the nature of a crystal in terms of the properties of the chemical molecules of which it is composed. Of recent years the subject has received fresh attention chiefly because the discovery of X-rays has placed in the hands of the physicist a new tool which enables him to probe beneath the surface and actually to examine the arrangements and dispositions of the atoms or molecules in the small unit of pattern, the continued repetition of which finally results in the familiar crystal. The widespread and continually expanding applications of X-rays to the problems of crystallography have perhaps resulted in a tendency to ignore the results of previous work, and a book such as this will perhaps do something to emphasise the immense volume of results accumulated by the pure crystallographers, results which have perhaps not always had the recognition they merit.

The book contains the subject matter of a series of lectures and is, in a way, an abstract of some of the material dealt with more fully in the author's larger and well-known text-book. The title is a somewhat comprehensive one, and it is not to be expected that the whole of the field it implies can be covered in a

relatively small volume. Dr. Tutton's own researches form the bulk of the material on which the deductions are based. These are, for the greater part, concerned with some remarkable isomorphous series, the alkali sulphates and selenates and the corresponding double sulphates and selenates. For the satisfactory examination of the small variations in structure of the members of such series, the author was forced to devise new and more accurate methods of measurement, and one chapter is devoted to a description of some of the elaborate and ingenious instruments designed especially for this work.

In the succeeding chapters are given the results of these investigations, results which once more demonstrate that an increase of knowledge almost always results from an increased precision of measurement. The author emphasises the fact that, although there is a very close resemblance between the various members of these series, there are differences and these differences are subject to very definite laws. For example, when potassium is replaced successively by rubidium and cæsium, all the properties of the crystal show progressive changes; rubidium is always intermediate between potassium and cæsium, no matter whether it is the dimensions or angles of the crystal unit, the refractive indices, the heat expansion, or some other property which is being measured. In the same way, it is always found that the ammonium salt resembles extremely closely that of rubidium, implying that a replacement of the rubidium atom by the NH_4 group can be effected with practically no change in the crystal properties.

In the latter half of the book various interesting problems are discussed, problems which are for the most part suggested by the researches on isomorphous series. There Dr. Tutton describes the conditions which favour the growth of crystals of one substance on the surface of another and the formation and nature of mixed crystals. Further chapters are devoted to the questions of enantiomorphism and optical activity and to that interesting phenomenon, the liquid crystal.

A brief survey is given of Federov's methods of crystal classification and description, and in directing attention to this work the author has performed a real service. To one accustomed to the usual method of crystal description, Federov's papers make difficult reading, but the signs are not wanting that there is a real physical significance in the notation and that, in many cases, the description of a crystal in the way advocated by Federov gives a valuable clue to the molecular arrangements.

Throughout the volume the author frequently refers to the results of X-ray measurements, but has made no attempt to give a full account of this work. His aim has rather been to show how it has confirmed and extended the deductions made by the older methods. This does not mean that he does not appreciate the X-ray work; in fact, in his enthusiasm for it, he is apt at times to take as an established fact what the X-ray worker intended only as a speculative suggestion.

The book is admirably produced and profusely illustrated by excellent diagrams and plates, and is completed by a bibliography of the author's researches and a detailed index. It is perhaps a pity that no references are given to the many other researches described throughout the volume.

Osteology of the Reptiles.

The Osteology of the Reptiles. By Prof. Samuel Wendell Williston. Arranged and edited by Prof. William King Gregory. Pp. xiii + 300. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1925.) 18*s.* 6*d.* net.

IN no domain of zoological science have the contributions of American naturalists been more splendid than in that of vertebrate palæontology, and in the list of pioneer workers in this domain an honoured place will always be accorded to Samuel Wendell Williston, who, born and nurtured in obscurity, had by the time of his death in 1918 won his way to recognition as the chief authority upon the extinct amphibians and reptiles. Apart from his specialist papers upon fossil vertebrates and upon modern dipterous flies, Williston was well known to the general zoologist for his excellent book on "Water Reptiles of the Past and Present," published in 1914, and during the last year of his life he was busily engaged in the preparation of a second work of a general character on "The Reptiles of the World, Recent and Fossil." The volume now under review comprises the main part of this general work, so far as it had been completed at the time of the author's death, put into shape and edited at the competent hands of Prof. W. K. Gregory.

The book is one which will be of great use to the student and teacher of osteology, while to the general zoologist it will serve the useful purpose of providing a conspectus of contemporary knowledge regarding the bony skeleton of extinct reptiles, drawn up by a master of the subject.

Perhaps the most valuable part of the book consists of the series of illustrations, nearly two hundred in number. These are for the most part line drawings by the author, embodying the latest results of palæontological research whether by himself or by others, and of admirable clarity. While these drawings take up a large part of the whole volume, they are accompanied by clear and valuable letterpress—interrupted here

and there by gaps still unfilled when the author finally laid down his pen. The weakest parts of the book are to be found, as in many other palæontological works, where the author strays beyond the confines of osteology into the field of general evolutionary theory. Such old friends as "evolution is irreversible," "there has been a continuous loss of parts" (in the evolutionary history of the bones of the skull), "a race of small animals has never been evolved from a race of large animals," had better be omitted in the text-books of to-day. They are in conflict with one of the main canons of evolutionary philosophy—that its principles must be founded upon a broad basis in which are incorporated the available facts not of palæontology alone but of comparative anatomy, embryology, physiology, and field natural history as well.

In practice such statements do harm; for the student, his attention gripped in the first instance and his interest fired by such clearly and crisply enunciated 'laws,' is bound sooner or later—if he passes into territories other than those of fossil osteology—to come across facts which raise doubts in his mind as to whether there is anything in such so-called laws. He finds, for example, the facts of embryology assuring him that the early evolution of the Amniota has as one of its characteristic features the gradual increase in the size of the egg correlated with the provision of a larger and larger amount of hoarded-up food material or yolk, and that on the other hand the evolution of the modern mammal has involved a reversal of this evolutionary process—the supply of food yolk being gradually reduced and the egg reverting to a comparatively small size. He is assured again that the evolution of the modern fishes has involved the primitively symmetrical pointed tail passing through a period of gradually increasing asymmetry, but that at a later period the evolutionary history of various highly specialised modern teleosts has involved a reversion to the symmetrical pointed form of tail. He learns that in the evolutionary history of the cranial bones, reduction in number of elements by processes of fusion rather than of elimination are by no means to be ignored. He realises that although it is perfectly true that increase in size of body has been one of the principal features of animal evolution, there are yet very numerous cases where adaptation to a particular mode of life has involved great diminution of size.

However, such little aberrations, as I regard them, into unsound evolutionary philosophy must not be allowed to distract our attention from the main fact that this last book by Samuel Wendell Williston is, as regards what it purports to be—a text-book on the osteology of the reptiles—of admirable quality and great value.

J. GRAHAM KERR.

Enzyme Action.

Die Fermente und ihre Wirkungen. Von Prof. Dr. Carl Oppenheimer. Nebst einem Sonderkapitel: *Physikalische Chemie und Kinetik*, von Dr. Richard Kuhn. Fünfte völlig neu bearbeitete Auflage. Lief. 1-8. Pp. 1204. (Leipzig: Georg Thieme, 1925.)

PROBABLY all the important chemical actions operative in animal and vegetable systems take place through the agency of enzymes or ferments, the organised catalysts.

It is somewhat unfortunate that the difficulties attending the preparation and purification of enzymes are so great that the chemical composition of any one of a very numerous family is still unknown. Even Willstätter's preparations in a high state of purity contained both proteins and carbohydrates in variable quantities. Many attempts dating from the time of Liebig have been made to elucidate their mode of operation, and to obtain from an examination of the physical and chemical processes of enzyme action some idea of their chemical constitution and structure. The evidence in favour of the hypothesis that enzymes exert their catalytic properties by a process of adsorption, similar in some respects at least to the inorganic catalysts, appears to be complete, but the nature of the adsorption complexes is unknown. It is frequently argued that since enzyme action is even more selective in action than is the case with inorganic catalysts, the adsorbate-substrate union must be highly complex. We find the view fully expressed that enzymes may be regarded as proteins, globulin-like in character, the union to the adsorbate being effected by reactive groups which occur at definite space intervals along the complex molecule. The selective action of hydrolytic enzymes for optically active adsorbates lends support to the multipoint contact or 'key in lock' hypothesis, but, as in the case of simple inorganic hydrolysis, the effect of steric hindrance on one reactive group and on the reaction velocity is a factor which cannot be left out of consideration.

It is fully established that enzymes are very sensitive to a change in hydrogen ion concentration of their environment, supporting the view that they are amphoteric substances possessing diverse activities in their different ionic modifications. At the same time, the enzymes are colloidal in their nature and their activity is greatly dependent on the degree of dispersion, which in turn is affected by numerous factors such as alteration in the protein content of the solution which serves to support or protect the enzyme, the presence of electrolytes, alteration in temperature or intensity of incident radiation.

The fifth edition of Prof. Oppenheimer's "Die

Fermente und ihre Wirkungen" must be considered as the most authoritative work that has yet appeared on this subject. A casual glimpse of the various volumes, of which eight have now appeared, indicates that a veritable "Beilstein" of information has been collected together. A closer inspection reveals the fact that the vast mass of experimental data has been carefully assimilated and subjected to a critical examination. The alternative points of view of various investigators have been given without bias.

The book may be divided into three parts. In the first the chemical and physico-chemical characteristics of enzyme action are discussed in detail. Nearly three hundred pages of text, plentifully supplied with diagrams, experimental data, and references which appear completed up to and including the year 1924, have been written by Dr. Richard Kuhn on the physical chemistry of enzyme action, forming in itself a monograph which is not only a mine of information but also a model of condensation and clarity.

A short section is devoted to a discussion on the biology of ferments, whilst the remainder of the work includes a systematic classification of various types of ferment and enzyme action.

The production of this work is an achievement on which both Dr. Oppenheimer and Dr. Kuhn as well as the publishers, G. Thieme of Leipzig, are to be congratulated; for, if it accomplished no more than to serve as a digest of the enormous quantity of work that has appeared during the last decade alone, and published in the most diverse periodicals, on this complicated subject, it would have been of great value. Presenting in addition a careful formulation of the considered views of those who have made a detailed study of enzyme action, the volumes may well be considered indispensable to those interested in the subjects of chemistry and physics in their biological application. E. K. RIDEAL.

Our Bookshelf.

Dr. H. G. Bronn's Klassen und Ordnungen des Tierreichs wissenschaftlich dargestellt in Wort und Bild. Sechster Band, Abteilung 1: *Pisces* (*Fische*). Bearbeitet von Prof. Dr. M. Rauther. Lieferung 39. Pp. 583-710+v. 15 gold marks. Fünfter Band: *Arthropoda*. Abteilung 2: *Myriapoda*. Bearbeitet von Dr. K. W. Verhoeff. Lieferung 100. Pp. 539-666. 14·50 gold marks. Dritter Band: *Mollusca* (*Weichtiere*). Buch 2: *Pulmonata*. Bearbeitet von Dr. H. Simroth, fortgeführt von Dr. H. Hoffman. Lieferung 147. Pp. 737-832. 10·50 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1924–25.)

BAND 6, Abteilung 1 contains accounts of the Leptocardii and the cyclostomes contributed by four successive authors—Drs. Lönnberg, Favaro, Mozejko, and Rauther, the last named being responsible for this Lieferung 39 which completes the Abteilung. He has contributed the last dozen pages of the description of the urinogenital organs of cyclostomes, a clear account of the development and organogeny of Lampetra and of Bdellostoma and of the biology of the principal species, and a scheme of classification in which the characters of the known genera and species are concisely stated. A short discussion on variation and similar matters, some general observations on geographical distribution, and an appendix on the origin and relationships of cyclostomes, form the concluding part of the text. There is an adequate systematic and subject index. Opportunity might have been taken to refer in the appendix to memoirs by Cole and others which have been issued since the earlier parts of the volume were published.

Lieferung 100 (Band 5, Abt. 2) opens with an account of the systematic characters of the Geophilomorpha, the families, subfamilies, genera, and subgenera being concisely defined and tabular keys provided where necessary. Supplements on the Scolopendromorpha, Lithobiomorpha, and Notostigmophora—two suborders and a subclass which were dealt with in preceding sections of the work—bring the information on these up-to-date. A concluding chapter is devoted to a detailed consideration of the geographical distribution of the Myriapoda, including the delimitation of the European and Mediterranean subregions, and a comparison of the chilopod fauna of the eastern and western parts of the latter.

Lieferungen 95-146 of Band 3, Buch 2, were written by the late Prof. H. Simroth and published in 1908–14. The first fifteen pages of the present Lieferung (147) are from his manuscript, and complete the account of the development of the reproductive organs of the Pulmonata, and summarise the records of natural and artificially produced developmental abnormalities. Dr. Hoffmann is the author of the rest of the Lieferung. He contributes a list of some 750 works published subsequent to 1908, which forms a continuation of the lists given in earlier parts of the book. A number of memoirs dealing with Indian and other species seem to have escaped attention and are not included in the list. The remaining pages contain appendices which embody the results of work published during the last twelve years. References are given to the earlier pages of the book to which these supplementary accounts relate; *e.g.* on the form of the body, shell, and operculum, on the integument, connective tissue, muscle, mantle, and on secretion of the shell.

Faune de France. Par L. Berland. 10: *Hyménoptères vespiformes, I.* (*Sphegidæ, Pompilidæ, Scoliidæ, Sapygidæ, Mutillidæ*). (Fédération française des Sociétés de Sciences naturelles: Office central de Faunistique.) Pp. viii + 364. (Paris: Paul Lechevalier, 1925.) 45 francs.

THE author of this volume includes in the Vespiformes all wasp-like Aculeates other than the Chrysididæ. The present contribution deals with the five families Sphegidæ, Pompilidæ, Scoliidæ, Sapygidæ, and Mutillidæ, or, in other words, the fossorial forms. Owing principally to insufficiency of reference material, the Bethylidæ are not included, and their treatment is postponed until the appearance of a second volume

which is in course of preparation. M. Berland has, for the first time, provided a comprehensive account of the 450 species of French fossorial wasps, and has accomplished his task with notable success. As in previous volumes of the series, full use is made of generic and specific keys, while each genus and species is also separately diagnosed. Under every species there is given a résumé of its distribution and of the chief facts relating to its biology. The biological notes are especially useful, since the author has sifted the literature of the subject with very evident care, and we know of no other work where similar information is available in an equally concise form. As M. Berland remarks, the study of the habits of Hymenoptera is more especially due to French observers, among whom the names of Latreille, Lepeletier, Dufour, Fabre, and Ferton are recalled. The author has wisely dispensed with long detailed lists of synonymy, and has left those who are curious on this subject to refer to the catalogue of Dalla Torre for all questions of nomenclature prior to 1897.

The book is profusely illustrated with 663 text figures, and, with the exception of Figs. 17-19 and 305, all are the original work of M. Berland. The various structural details which are thus represented add materially to the value of the book, and although many of these illustrations appear somewhat wooden in character, they nevertheless fulfil their purpose. We can recommend the book as one which should find a place on the shelves of English entomologists. A. D. I.

(1) *The Animals of New Zealand: an Account of the Dominion's Air-breathing Vertebrates.* By Capt. F. W. Hutton and James Drummond. Fourth edition, revised and enlarged. Pp. 434. (Auckland, Christchurch, Dunedin, Wellington, Melbourne and London: Whitcombe and Tombs, 1923.) 15*s*.

(2) *A Synopsis of the Vertebrate Animals of Tasmania.* By Clive E. Lord and H. H. Scott. Pp. v+340+41 plates. (Hobart: Oldham, Beddome and Meredith, 1924.) n.p.

(3) *Red Deer Stalking in New Zealand.* By T. E. Donne. Pp. xii+270+32 plates. (London, Bombay and Sydney: Constable and Co., Ltd., 1924.) 21*s*. net.

(1) IT is with pleasure that we welcome a new edition of Hutton and Drummond's "Animals of New Zealand." This is a well-written and well-illustrated account of a most interesting fauna, indispensable to all concerned with the vertebrate life of the southern hemisphere. It should do much to stimulate local interest and so help those who are endeavouring to preserve the fauna and flora of the Dominion.

(2) Mr. Lord and Mr. Scott are to be commended for their "Synopsis of the Vertebrate Animals of Tasmania." This work gives a concise account of all the vertebrates known to inhabit the island and the surrounding seas. Its illustrations are satisfactory and the volume contains a great deal of valuable information concerning the habits and distribution of many species. Some useful notes on mammalian osteology are incorporated in the text. Incidentally, here and there, the authors tell a good story, and that relating to the Hobart policeman who tried to arrest a sea-leopard, in the small hours, as 'a drunk and incapable,' is particularly pleasing.

(3) Though "Red Deer Stalking in New Zealand" is naturally a book for the sportsman rather than the zoologist, the latter will find in it a good deal of information relating to the present status of the red deer and of the many other species of deer that have now been introduced and acclimatised in New Zealand. Some very good photographs of heads from the Dominion, accompanied by measurements, add materially to the interest of the book.

A List of British Aphides (*including Notes on their Synonymy, their recorded Distribution and Food Plants in Britain, and a Food-Plant Index*). By Dr. J. Davidson. (The Rothamsted Monographs on Agricultural Science.) Pp. xi+176. (London: Longmans, Green and Co., 1925.) 12*s*. 6*d*. net.

THE volume under notice is the fourth of the recently instituted series of "Rothamsted Monographs on Agricultural Science," and is the first to treat of an entomological subject. The morphological characters separating allied species of aphides are often comparatively trivial, and this fact, coupled with polymorphism and a certain plasticity of host-selection, has led to much confusion in the identification of these insects. Their involved nomenclature has been badly in need of revision, and in many cases it has become a difficult task for the entomologist, who was not a professed aphidologist, to make certain of the genus or species to which a given name is strictly applicable.

Since the 'List' before us is a product of the activities of the Rothamsted Experimental Station, its object is more especially to facilitate the labours of workers in agricultural science. From this aspect only (even if there were no other) the accurate determination of species of aphides is of particular importance. This fact has in recent years acquired additional significance owing to the discovery that certain species of aphides, and apparently no others, are concerned with the transmission of mosaic disease in the case of the raspberry, tomato, potato, and sugar-cane. Dr. Davidson has done a useful service in providing synonymic lists of all the British species and genera of aphides in the light of recent taxonomic changes. The specific names are alphabetically arranged and amount to nearly 400, and the number of genera recognised is 87. The long list of plant genera and species, with the aphides recorded from them, should prove especially helpful. The first clue to the possible identity of a particular species of aphid is commonly obtained by noting, in the first instance, the plant upon which it is found. The book concludes with an extensive bibliography of all the more important papers on these insects.

Exercises in Practical Physics. By Sir Arthur Schuster and Prof. C. H. Lees. Fifth edition, revised. Pp. ix+373. (Cambridge: At the University Press, 1925.) 12*s*. 6*d*. net.

IT is some twenty-five years since the first edition of this book was reviewed in these columns. In several subsequent editions, including the present one, it has undergone some revision, chiefly necessitated by the steadily rising standard of the courses for which it was intended. It is a long life for any physics text-book, and such longevity is in itself the most eloquent of tributes to its many merits. Yet there may be some who will find lingering about it a suggestion of an old-

world atmosphere, as it were, which a modern interpolation or two (the thermionic valve, for example) merely emphasises instead of dispelling. Still, it is difficult to support such an accusation—if it be an accusation—by specific instances. What is indisputable, on the other hand, is the admirable soundness and thoroughness which characterise the book throughout. Of particular value is its insistence on the consideration of order of accuracy of measurements and results, for this is an aspect of laboratory instruction which is apt to suffer nowadays from the congested condition of practical syllabuses. Students who work conscientiously through this book, even without assistance from a teacher, will have laid a very secure foundation for more advanced experimental work in physics.

At the same time, one cannot but wish that the scope had been more comprehensive. It is true that there are sufficient experiments to constitute a satisfactory course, but no two teachers would be likely to select exactly the same experiments as being best suited to their special circumstances, and the book would therefore have been much more generally useful had it contained a wider range of experiments, from which selection could be made as required.

Zoologie im Grundriss. Von Prof. Dr. Walter Stempell. Erste Lieferung. Pp. xviii+160. 6·60 gold marks. Zweite Lieferung. Pp. 161-336. 6·90 gold marks. (Berlin: Gebrüder Borntraeger, 1925.)

THESE two parts are devoted to accounts of the morphology, structure, and classification of animals from Protozoa to Chordata, and the author has been faced with the problem of what to include and what to omit—as are all writers of text-books, and each author has his own views on the subject. But is seems difficult to justify the inclusion of even short accounts of relatively rare parasites of man, the affinities of some of which (*e.g.* Rhinosporidium, the Spirochætes, and the Chlamydozoa) with the Protozoa are more than doubtful. The brief description and single figure of the Mesozoa can be of little use, and the same may be said of the characterisations in two or three lines of many of the families of cœlenterates and other Metazoa. It is evident the author has carefully rationed himself in his descriptions of the more important organisms in regard to many of which further detail would have been helpful. The extent of the compression may be judged by citing as examples the Prototracheata, which are dealt with in 20 lines of text and 4 figures, the Scyphozoa in 30 lines and 5 figures, the rotifers in 26 lines and 2 figures, the Diptera in 15 lines and 4 figures; there are short descriptive legends to most of the figures.

The parts on the Mollusca and the Chordata are, on the whole, more satisfactory. The illustrations are usually well chosen and well reproduced, and many of them are original. It should have been possible to give better figures of Entamœba, the Spirochætes, the larva of Filaria and *Pulex irritans*.

The table of contents shows that the succeeding parts are to deal with physiology, development, biology, distribution, and phylogeny, on which there is room for a good text-book. We shall look forward with interest to the author's mode of treatment of these important subjects.

Ostwald-Luther Hand- und Hilfsbuch zur Ausführung physikochemischer Messungen. Herausgegeben von C. Drucker. Vierte neubearbeitete Auflage. Pp. xx+814+3 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 35 gold marks.

OSTWALD'S "Hand- und Hilfsbuch" has changed almost beyond recognition since it was first issued in 1893. It was then a comparatively small book, and the reviewer remembers vividly how as a student he used it as a text-book of scientific German. The second edition, issued in 1902, called for the services of a collaborator in the person of Prof. Luther; and now, fifteen years after the appearance of the third edition, the issue by Prof. Drucker of a fourth edition has only been possible with the aid of a long list of collaborators, who have contributed complete sections on optical measurements, X-ray measurements, radioactive measurements, etc. Including the indexes, the whole volume now covers more than 800 pages, and it would have been still larger but for the fact that, in the opinion of the responsible editor, the appearance of the "Kolloidchemische Praktikum" of Wo. Ostwald has rendered it no longer necessary to add a section on the technique of colloid chemistry. In the same way the revision of the "Physikalisch-Chemischen Tabellen" of Roth and Scheel has made it possible to omit most of the numerical data. The details of the practical course at Leipzig (which includes fourteen electrical exercises, but only one optical experiment, with a sodium lamp as the only light-source) have, however, been retained as an appendix.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 173. Abt. 9: *Methoden zur Erforschung der Leistung des tierischen Organismus*, Teil 2, 1 Hälfte, Heft 2. *Methoden der Süsswasserbiologie.* Pp. 285-542. (Berlin und Wien: Urban und Schwarzenberg, 1925.) 10·80 gold marks.

THE second part of the "Methoden der Süsswasserbiologie" is a further instalment of that indispensable work "Handbuch der biologischen Arbeitsmethoden," edited by Prof. Emil Abderhalden, and continues the description of freshwater biological methods begun in Part 115. The present portion begins with the rearing of freshwater insects of all groups, followed by other invertebrates. In such experimental work, the knowledge of the food required by the animals in question is essential, and a large amount of exact information is given as to the feeding at every stage. The culture of certain invertebrates as fish food has now become a matter of extreme importance, and special prominence is given to the small crustacea such as the Cladocera, a separate chapter being given to *Daphnia magna* Straus. Then follow a long treatise on the rearing of freshwater fishes, more especially carp and trout, although others are also mentioned; a most interesting account of the methods of investigating the history of lake bottoms by means of samples taken by boring tubes and tube sounding leads; and finally chapters on boats for scientific work in inland lakes and a description of the working of the biological station at Lunz in the Austrian Alps. As each section is by an expert in his own line, we have an up-to-date account of all recent research methods which is of inestimable value to all freshwater biologists.

Letters to the Editor.

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

The Motion of the Spinning Electron.

IN a letter published in NATURE of February 20, p. 264, Messrs. Uhlenbeck and Goudsmit have shown how great difficulties which atomic theory had met in the attempt to explain spectral structure and Zeeman effects, can be avoided by using the idea of the spinning electron. Although their theory is in complete qualitative agreement with observation, it involved an apparent quantitative discrepancy. The value of the precession of the spin axis in an external magnetic field required to account for Zeeman effects seemed to lead to doublet separations twice those which are observed. This discrepancy, however, disappears when the kinematical problem concerned is examined more closely from the point of view of the theory of relativity.

As usual, letters in heavy type will denote vectors. The anomalous Zeeman effect seems to require that the spin axis of the electron precesses about an external magnetic field **H** with angular velocity

$$\frac{e}{mc}\mathbf{H}, \quad . \quad . \quad . \quad . \quad . \quad (A)$$

where c is the velocity of light and $-e$, m are the electronic charge and mass. Suppose such a spinning electron moves with velocity **v** through electric field **E**. At first sight it would seem that, being subject to magnetic field

$$\mathbf{H} = \frac{1}{c}[\mathbf{E} \times \mathbf{v}],$$

the spin axis will precess about the instantaneous normal to the orbital plane with angular velocity

$$\frac{e}{mc^2}[\mathbf{E} \times \mathbf{v}]. \quad . \quad . \quad . \quad . \quad (B)$$

As the mean value of this expression is just twice the angular velocity with which the perihelion of the orbit rotates on account of the variation of mass of the electron, this would lead to twice the observed doublet separation.

There is, however, an error in the above reasoning; the precession of the spin axis so calculated is its precession in a system of co-ordinates (2) in which the centre of the electron is momentarily at rest. System (2) is obtained from system (1), in which the electron is moving and the nucleus at rest, by a Lorentz transformation with velocity **v**. If the acceleration of the electron is **f**, and system (3) is obtained from system (1) by a Lorentz transformation with velocity $\mathbf{v} + \mathbf{f}dt$, then the precession which an observer at rest with respect to the nucleus would observe, and which should be summed to give the secular precession, is that precession which would turn the direction of the spin axis at time t in (2) into its direction at time $t + dt$ in (3) if both directions were regarded as directions in (1). To a first approximation system (3) is obtained from system (2) by a Lorentz transformation with velocity $\mathbf{f}dt$ together with a rotation $(1/2c^2)[\mathbf{v} \times \mathbf{f}]dt$. Thus the observed rate of precession will be, to a first approximation,

$$\frac{e}{mc^2}[\mathbf{E} \times \mathbf{v}] - \frac{1}{2c^2}[\mathbf{v} \times \mathbf{f}].$$

To a first approximation

$$\mathbf{f} = -\frac{e}{m}\mathbf{E},$$

so the rate of precession is

$$\frac{e}{2mc^2}[\mathbf{E} \times \mathbf{v}], \quad . \quad . \quad . \quad . \quad (C)$$

just half the expression (B).

The interpretation of the fine structure of the hydrogen lines proposed by Messrs. Uhlenbeck and Goudsmit now no longer involves any discrepancy. In fact, as Dr. Pauli and Dr. Heisenberg have kindly communicated in letters to Prof. Bohr, it seems possible to treat the doublet separation as well as the anomalous Zeeman effect rigorously on the basis of the new quantum mechanics. The result seems to be full agreement with experiment when the calculation is based on formulæ (A) and (C).

I hope in a later paper to develop the above kinematical argument in greater detail.

In conclusion, I wish to express my appreciation of the encouragement and help of Prof. Bohr and Dr. Kramers.

L. H. THOMAS.
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Copenhagen, February 20.

Genes and Linkage Groups in Genetics.

Now that Prof. MacBride has delivered himself of his final reply to Prof. Huxley on the subject of linkage and genes, I should like to offer a few comments on a point from which further confusion might easily arise in the future. It concerns the use of the word 'linkage.' This term was originally proposed by Prof. Morgan, and the first evidence of its appearance in print that I have been able to find is in the title of a paper published in the *Biological Bulletin* for August 1912 by T. H. Morgan and Clara S. Lynch on "The linkage of two factors in Drosophila that are not sex-linked." In the previous year Mr. Bateson and I had shown that what we had hitherto termed 'coupling' and 'repulsion' were in reality phases of the same phenomenon, and we subsequently adopted Morgan's term as a convenient one for the phenomenon as a whole. In this matter the United States and Europe saw eye to eye, and henceforward the term 'linkage' in this definite and precise sense has been in use by geneticists all the world over.

Before a case of association between characters in the hereditary process can be assigned to the category of linkage, it must be shown (1) that each character, followed separately, shows normal segregation in the Mendelian sense, and (2) that the relative distribution of the characters in a given generation differs in orderly fashion according as their gametic representatives entered the parental zygote together or apart. Only when these conditions are observed are we entitled to speak of a case as exhibiting the phenomenon of linkage.

Here it seems to me that Prof. MacBride becomes definitely misleading. In his letter of March 6, p. 340, he cites as a case of linkage the effects produced in the developing vertebrate embryo by alterations in amniotic pressure. No doubt such alterations produce simultaneous and definite effects in various organs. Such a statement, coming from such an authority on matters embryological, I do not dream of questioning. But when Prof. MacBride cites this as an example of linkage, I assert that he has no right to do so until he, or some one else, has proved that it fulfils the conditions necessary to bring it under the heading of this phenomenon. Until this has been done, the case, interesting as it may be in other

connexions, is here worthless. For it is quite likely that it has nothing whatever to do with linkage.

Mr. Tate Regan, too (NATURE, Jan. 16, p. 86), has fallen into the same error when, in flat fishes, he describes ambicoloration, monomorphic scales, and delayed migration of the eye as a linkage group. That these variations tend to occur together is well recognised, but here again we know nothing of their hereditary behaviour; and until we have some knowledge of this it is beside the mark to bring them forward. As Prof. Huxley suggests in his letter of February 20, p. 268, they may quite well be all dependent upon the operation of the same genetical factor. In the white sweet pea the colourless flower is always associated with a green axil and a pale brown seed coat, and these three associated characters can all be referred to the absence of one of the ingredients necessary to the production of anthocyan pigment. These associated characters, as experimental evidence has clearly shown, do *not* constitute a linkage group, and I suspect that this is more likely than not to be true also of Mr. Tate Regan's example. Further, in view of Mr. Tate Regan's later note of March 6, p. 341, I would add that the simultaneous appearance of mutations is, in so far as we know, quite unconnected with linkage. That such simultaneous mutations may show linkage is of course possible, but in all probability it is more likely that they will not.

In conclusion, I would lay further stress upon what Prof. Huxley has already clearly pointed out, namely, that the recognition of the orderly series of phenomena to which the term linkage has been applied does not necessarily entail acceptance of the chromosomal theory of heredity. That this theory at present offers the most plausible interpretation of linkage is admitted by the great majority of those who are best qualified to judge. Yet if the chromosomal theory were to be swept away to-morrow, the precise and clear-cut phenomenon of linkage would remain untouched.

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The So-called Dielectric Constant.

IN NATURE of March 6, p. 361, an abstract of an address by Prof. Compton, entitled "Dielectric Constant and Molecular Structure," is given.

So early as 1889 it was known that dielectrics conduct electricity (see Curie, *Annales de Chimie et de Physique*, 1889), and that the so-called constant depends upon the time of charging, and when measured by the alternating method, upon the frequency (J. J. Thomson, *Roy. Soc. Proc.*, 1889).

I have shown (*Roy. Soc. Proc.*, 1915 and 1925) that when a potential v is applied to one surface of a condenser, the other surface being connected to the earth, the relation between the charging, polarising, and conduction currents is represented by

$$\gamma = \frac{dQ}{dT} + \frac{v - P}{R}, \quad . \quad . \quad . \quad . \quad (1)$$

where γ = the charging current,

$\frac{dQ}{dT}$ = the polarising current (*i.e.*, the rate at which the charge is accumulating in the dielectric),

P = the electromotive force of polarisation of the dielectric,

and R = the true electrical resistance of the dielectric in the given circumstances.

After the current has been flowing for some time, $\frac{dQ}{dT}$ becomes negligible and the equation reduces to

$$\gamma = \frac{v - P}{R}. \quad . \quad . \quad . \quad . \quad (2)$$

For the discharge the equation reduces to

$$-\frac{dQ}{Td} = -\frac{P}{R}. \quad . \quad . \quad . \quad . \quad (3)$$

Röntgen and Joffé (*Annalen der Physik*, vol. 72, 1923) have experimented on numerous substances (including pure crystals) in widely varying circumstances as to voltage and temperature, and their results confirm both (2) and (3).

I, myself, having performed many experiments (at constant temperature) on quartz along and across the optical axis, fused quartz, Iceland spar, rock-salt, glass, paraffin, ebonite, and xylol, have come to the conclusion that if one surface of a condenser be connected to the earth and the other surface be maintained at a potential v for a time T, the total charge accumulated in the condenser can be represented by

$$(K + K'_\tau)Cv,$$

where C = a constant depending on the size and arrangement of the conducting surfaces,

K = the specific inductive *instantaneous* capacity of the dielectric,

K'_τ = the *maximum* value of the specific inductive *residual* capacity,

and τ = the time taken for the potential of the surface originally at potential v (when connected to the earth) to fall to zero.

At any subsequent time, t (greater than τ), the charge remaining in the condenser, can be represented by

$$K'_t Cv,$$

where $$K'_t = nK'_\tau \epsilon^{x - \alpha(t-\tau)}$$

and n = a constant for the given *specimen* of dielectric,

α = a function of T (the time of charging),

x = a function of both T and t.

When the discharge has taken place for some time this expression reduces to

$$K'_t = nK'_\tau \epsilon^{-\alpha t}.$$

The general behaviour of dielectrics is, however, at present little understood and cannot, I think, be represented adequately by any kind of simple model.

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The Relation of Weight to Height during Adolescence.

AMONG the well-known anthropometric formulæ due to Prof. Dreyer of Oxford (see *Lancet*, August 9, 1919, and NATURE, August 26, 1920), there is one connecting weight, W, with stem-length, or height of trunk alone, λ, namely, $W = 0{\cdot}380^{\sqrt[0{\cdot}319]{\lambda}}$. This gives a ratio of the type $W^n/\lambda = K$, and is of special interest because, when dealing with averages of large numbers, it seems to show surprisingly little variation with age during the important adolescent period of life. To test it I used data relating to Manchester Grammar School boys, for which I am indebted to Dr. Mumford, Medical Officer of the School. The school measurements of height and weight have been taken on a uniform basis for about forty years; measurements of stem-length were taken in addition in 1921 and 1923. If the stem-length is replaced by the full height (H), and if 0·319 (n) is replaced by the approximate value $\frac{1}{3}$ in Dreyer's formula, I find that the ratio is even less variable. Table 1 shows the values of $W^{\frac{1}{3}}/H$, calculated from the mean values of W and H, for groups of boys varying in age from 9 to 19 years at three different periods of time. In

the same table are shown, for comparison, calculations of the same ratio for Schuster's observations of undergraduates, and of $W^{0\cdot319}/\lambda$ for the Grammar School boys in 1921, 1923. Measurements were expressed in C.G.S. units, but significant figures only are printed.

In order to get a more precise measure of the variability, the standard deviations of the 1921, 1923 values of $W^{\frac{1}{3}}/H$ and $W^{0\cdot319}/\lambda$ at different ages were also determined, being measured from the weighted means of all the observations in each case. To render them comparable, these standard deviations were expressed as percentages of the corresponding weighted means; the resulting coefficient of variation for $W^{0\cdot319}/\lambda$ was 0·66 per cent and for $W^{\frac{1}{3}}/H$ was 0·37 per cent. This is a further corroboration of the conclusion to which Mumford and Young came (*Biometrika*, August 1923): "Despite the definite tendency shown in recent work on the inter-relationships of the physical measurements to replace the full-length by the stem-length, the latter does not possess the many advantages over the former that have been frequently claimed or asserted. It would almost appear to be a matter of indifference as to which measurement of length is used."

TABLE 1.

Variability of $W^{\frac{1}{3}}/H$ and $W^{0\cdot319}/\lambda$ at Different Periods and Ages.

Age.	Number of Boys Observed.			$W^{\frac{1}{3}}/H$.			$W^{0\cdot319}/\lambda$.	Schuster's Undergraduates.		
	1881–86.	1905–10.	1921, 3.	1881–86.	1905–10.	1921, '23.	1921, '23.	Age.	Number.	$W^{\frac{1}{3}}/H$.
9-	38	17	..	228	230	..	..			
10-	124	85	..	229	230	..	..	18-	129	229
11-	356	256	60	228	229	228	421	19-	330	229
12-	353	340	204	227·5	227	226·5	420	20-	209	229
13-	672	470	339	227	226·5	228	424			
14-	704	473	496	227	226	227	422	21-	137	229·5
15-	668	340	551	227	226	226	419	22-	95	230
16-	347	432	388	227	227	226	417			
17-	115	187	165	226	227	227	415	23-	59	229
18-	32	88	68	227	229	228	415			

TABLE 2.

ELEMENTARY SCHOOL-BOYS IN LIVERPOOL (1923).

Comparison of Values of $W^{\frac{1}{3}}/H$ at Different Ages according to Class of District.

Age.	Class of District. (Number of Observations.)			Class of District. ($W^{\frac{1}{3}}/H$).		
	Poor.	Fair.	Good.	Poor.	Fair.	Good.
5½	222	363	236	254	249	245
6½	147	195	209	249	246	242
8½	413	539	412	242	240	234
12½	420	461	317	234	232	235
13½	175	124	94	233	232	230

It may be stated that the ratio $W^{\frac{1}{3}}/H$ was also worked out individually for a random sample of 50 boys in the same school in the summer of 1924. The boys varied in age from 13 to 19 years. There were two exceptional boys in the group for whom the ratio was so high as 244 and 260 respectively; for the rest, it varied between the limits 216 and 238. For the whole group the lower and upper quartites were 224 and 233; the arithmetic mean was 229; the standard deviation, 74·7; and the coefficient of variation, 3·3 per cent.

The formula $W^{\frac{1}{3}}/H = K$ is a well-established one. Quetelet himself said that the weight of the human body, if it were symmetrical, would vary as the cube of the height, though his observations led him to the opinion that "in general, we do not err much when we assume that, during development, the squares of the weight at different ages are as the fifth powers of the heights." Hutchinson, later, decided that W varied as the 2·75th power of H. Livi had introduced the ratio $W^{\frac{1}{3}}/H$ into general and comparative anthropometry under the name "ponderal index," and it has been used on the Continent for many years as an index of nutrition among school children.

Table 2 may be of interest as bearing on the nutrition question. It analyses the values of $W^{\frac{1}{3}}/H$, calculated upon the mean values of W and H, for elementary school-boys in Liverpool, at different ages from 5 to 14 years, according to the class of district where each school is located. (Data from the Report of the Medical Officer, Liverpool, 1923.) Note that the index during these early years falls as the age increases and, if we may assume that the boys from the better districts are the better nourished, the index also falls as the nutrition increases. To this there is only one exception, namely, in the 'good' district at age 12½ years.

It is doubtful, however, whether the claim to treat $W^{\frac{1}{3}}/H$ as a trustworthy index of nutrition has ever been properly established. Other factors certainly affect the index besides nutrition, for example, muscular activity, hours of sleep, and home conditions generally; exercise under healthy conditions promotes growth in height and weight, but absolute rest with a nourishing diet likewise promotes growth; some illnesses seem to have a stimulating effect on the growth of the skeleton, perhaps by removing the muscular tension which acts on bone. But apart from its possible value as a nutrition index, more especially in dealing with children somewhere near the poverty line, the ratio $W^{\frac{1}{3}}/H$ might serve a useful purpose as the basis of a table, like the Dreyer tables, connecting weight, stem-length, vital capacity, and chest girth, providing a gauge of the approximate weight to be expected in a normal boy of given height and given class.

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University of Liverpool,
January 30.

References and Re-paging of Reprints.

AGAINST the re-paging of reprints, the British Association Committee on Zoological Bibliography and Publication has protested since its foundation in 1895, and it has always taken the view that this and similar matters are in the control of editors, to whom accordingly its recommendations have been addressed. It is therefore refreshing at last to find an editor, in the person of Dr. Rastall, associating himself so whole-heartedly with the protest (NATURE, March 20, 1926, p. 418). *Experientia docet.*

In the same number of NATURE (p. 425), in allusion to the work of the Bureau of Chemical Abstracts in "endeavouring to secure uniformity in the method of referring to original papers," you justly say that "on questions common to all sciences the views of other bodies . . . must be considered." Here again the above-mentioned British Association Committee has for many years past urged the general adoption of a method already widely in use among biologists, especially in the United States. Here the order is:

author, date, title, journal, series, volume, page. The committee advocates giving the year number in full, since zoology at any rate neither began nor ended with the nineteenth century. If this be done and a logical order followed, both 1825, 10, 6, and 6, 10, 1825 are equally intelligible, though personally I prefer 'Oct.' to '10' or 'X.' The intercalation of the date between volume and page-numbers is illogical and often misleading.

F. A. BATHER,
Sec. B.A. Committee Zool. Bibl.

March 20.

I THOUGHT that this pernicious custom had long ago disappeared for ever. Any one who has occasion to refer to the long series of papers on the Nomenclature of the Foraminifera in the *Am. Mag. Nat. Hist.*, 1859–72, will cordially endorse Dr. Rastall (NATURE, March 20, p. 418). References to these in synonymies are made indifferently to the journal and its reprints, and it is never safe to rely upon them.

There exists, however, a far more ghastly crime than the mere re-pagination of reprints. One looks with suspicion on a page reference (say 1-20), but one is tempted to accept as 'original' page references (say) 100 *et seq.* But the late Charles Schlumberger used to have his reprints paged consecutively—*and left out his own pagination when he was not allowed to do so*, and took it up again when he was. The awful result was as follows. His first paper was re-paged 1-3; his second was not re-paged, and he allowed for this in his third, which was re-paged 10-19 with a second part paged 20-23, *and he allowed for his new title wrappers*, so his next was re-paged 27-34, the next 35-37, the next 39-89, and so it went on until 1894, when he had reached pp. 237-243, an unre-paged reprint, which had its original pagination 118-123, coming between pp. 222 and 237. After this, probably yielding to infuriated pressure, he abandoned the system, but the mischief was done, and no page reference to any of his twenty-one papers (up to 1894) is to be accepted without reference to the original journal.

It would be interesting to know whether any other writer ever committed this outrage upon posterity.

EDWARD HERON-ALLEN.

The Evolution of Rosa.

THE recently published paper of Dr. C. C. Hurst ("Experiments in Genetics," 38, 1925) on the chromosomes and characters in Rosa may well mark a new epoch in biology. We must await the appearance of his monograph for full details, but as he suggests, we may in the meanwhile try to apply the 'Rosa principles' to other plants and animals. It is suggested that the common ancestor of all roses was a northern decaploid species, at present unknown. The various forms could have arisen by the dropping out of sets of chromosomes, the existing five diploid types being the end-products of this process. We are told, however, that "certain cultivated triploid and tetraploid forms are obviously duplicated forms which have arisen . . . by duplication of the septets of chromosomes." These maintain the essential specific characters of the original diploid species, instead of showing a complex of the characters of diverse septets. Is it not possible to suppose that this duplication may have been the first step in the production of polyploid species, the latter acquiring the diverse septet characters by successive mutations? The Drosophila work has shown that mutations are likely to be lethal or unfavourable. In a diploid species such mutations should apparently work more havoc than in a polyploid one. Polyploidy might then be a condition favouring the survival and accumulation of mutated genes, resulting after very long periods of time in diversity of the septets. Such diversity might come to have its advantages, as Dr. Hurst indicates, in specific cases. On the other hand, in some cases the shedding of a septet might be advantageous, getting rid of some undesirable features, and producing a more uniform or consistent type. Thus the diploid *R. rugosa*, which I found to be a strictly sea-coast plant in Siberia, is a well-defined type specially adapted to its peculiar habitats but not extending even a few miles inland. Yet it is not to be expected that the diploids will all be successful, and close field study combined with cytological research may be expected to reveal a variety of forms with reduced chromosome numbers, coming into existence only to perish at once or in a few years. Many, probably, may not even be capable of development.

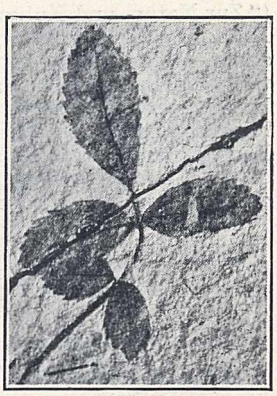

FIG. 1.—Fossil *Rosa Wilmattæ* Cockerell, from the Miocene of Florissant, Colorado.

Possibly, then, there is a double process going on, and it may not appear certain that the original rose was decaploid, though the existing diploids may all be derived from polyploid ancestors. There has been time for much to happen, for we know from the Miocene of Florissant several species of roses extraordinarily like those of the present day (cf. Fig. 1).

T. D. A. COCKERELL.

University of Colorado,
March 4.

The Banana in America.

As a student of culture-history I must protest against the inferences drawn by Dr. E. W. Berry from the finding of fossil banana seeds in Tertiary beds in Colombia which were referred to in NATURE, February 6, 1926, p. 209.

The moot-problem resolves itself into two questions. What is the value of the early references to the banana as a plant cultivated by the natives prior to the possible introduction of the cultivated banana? And, what follows from the indigenousness of the wild banana as to its cultivation by the aborigines? The 'historical evidence' for the pre-Colombian cultivation of the banana is considered quite unconvincing by such authorities as Baron Erland Nordenskiöld, who writes: "It may be regarded as proved by De Candolle and Karl v. d. Steinen that the banana was introduced into America by the whites" ("Comparative Ethnographical Studies," vol. 5, 1922, 64 *sq.*). On the other hand, the conclusion that *if* the banana was indigenous in America it must have been cultivated by the natives is a monstrous *non sequitur* that might be labelled a typical 'botanist's fallacy,' were the sobriquet not unjust to many botanists keenly alive to the historical questions involved in the history of cultivation. This methodological question has been so adequately treated in Dr. B. Laufer's "Sino-Iranica" (Chicago, 1919), that I will here content myself with a reference to that treasure-trove of information. It no more follows that, say, the Peruvians would cultivate a wild plant

found in their territory than that the Eskimo would domesticate the caribou. As Laufer has shown, the Chinese had the wild walnut and a wild vine, but it never occurred to them to cultivate either.

Though the botanical aspects of the question are beyond the sphere of my competence, I should like to refer the reader to E. Werth's paper on the banana ("Zur Natur- und Kulturgeschichte der Banana," in *Festschrift Eduard Hahn*, 1917, 22-50). The author shows—satisfactorily, so far as a layman can judge—that the African wild species, *Musa ensete*, could not by any possibility have given rise to the cultivated banana. So far as I remember the report of Dr. Berry's paper in *Science*, his Colombian banana is of the African type and must accordingly be ruled out as a possible ancestor of the cultivated forms.

ROBERT H. LOWIE.

University of California,
Berkeley, California.

Phyllody in the Primrose Flower.

THROUGH the medium of the columns of NATURE, may I record the occurrence in this neighbourhood of a pair of plants of *Primula Vulgaris* (Huds.), both of which illustrate the phenomenon of phyllody of the sepals.

The calyx is the whorl of floral leaves chiefly involved. The teeth of the calyx, normally narrow and sharply pointed, have become revolute, acuminate, miniature leaves above the tubular portion, while this latter part has—but for slight increase in size—retained the normal tubular form, the veins being rather more obvious. Tracing this increase in foliar characters in the sepals through several flowers, it was noticed that the increase is accompanied by a decrease in the size of the individuals of the corolla.

The stamens (the flowers in every case in both plants were 'thrum-eyed') and pistil were in all cases normal in appearance, but the more the reversion characters were developed in individual flowers the shorter was their duration. Normal flowers on normal plants are still flowering while the diminutive corollas and staminate parts of the retrogressive flowers withered within four days of opening.

The measurements of the foliar sepals are: 1·45 cm. from top of calyx tube to acuminate point; 1·20 cm. broad at the greatest breadth. These figures represent the average for the five sepals of the flower exhibiting the greatest reversion. The average diameter of the most abnormal flower is 3·2 cm., measuring across the sepal expansion.

The plants are being maintained in the laboratory here, and will be watched through subsequent seasons. The seeds of the abnormal flowers will be sown.

F. R. BROWNING.

Bedales School, Petersfield,
March 13.

The Crystalline Style and Anaerobic Respiration.

THE review of the *Journal of the Marine Biological Association* (vol. 13, No. 4) in NATURE of January 2, p. 31, has directed my attention to the very interesting paper by Dr. Yonge on the hydrogen ion concentration in the gut of certain lamellibranchs and gastropods. In the course of this paper Dr. Yonge criticises my suggestion (*J. of Exp. Zool.*, vol. 37, p. 477) that the disappearance of the crystalline style from certain marine molluscs when they are kept under anaerobic conditions may be, in part, a direct response to the lack of oxygen. Dr. Yonge holds that the disappearance of the style is "probably due to a lowering of the vital activities" of the animals, amongst which the secretion of the style-forming material is one, and that in the case of an animal the vital activity of which is thus reduced, the secretion cannot keep pace with the consumption of the style substance for digestive purposes. The style consequently disappears.

The evidence which Dr. Yonge and others have brought forward seems to leave it beyond doubt that the crystalline style plays an important part in digestion, but this does not exclude the possibility that it may also be connected with, and affected by, anaerobic respiration. Dr. Yonge's experiments do not seem to have been designed to differentiate the two possible functions, since the only methods employed by him to lower the vital activity of the animals with which he worked involved keeping them under anaerobic conditions. May not the resulting dissolution of the style be an expression of an effort on the part of the animal to offset the strain on its vital activity induced by anaerobiosis as well as by the necessity to maintain the acid condition of the gut for the purpose of digestion? The facts that the style disappears under anaerobic conditions and is regenerated by aeration *in the total absence of food material to digest* seems rather to point in that direction.

It seems to me that the matter must be considered *sub judice* until a series of experiments can be designed to follow the possibly manifold functions of the style independently of one another. C. BERKELEY.

The Biological Station,
Nanaimo, B.C., Canada,
February 4.

Renewed Activity of Cameroon Mountain.

CAMEROON Mountain, which has been more or less dormant since the last eruption in 1922, has recently been showing signs of renewed activity. The following extract from a letter by Mr. E. J. Arnett, Senior Resident, Cameroons Province, dated November 30, 1925, may be of interest to readers of NATURE:

"You may be interested to know that the summit of the mountain is showing more signs of activity than for some time past. There is a large old crater on the west side of the summit about 400 yards in diameter and 150 feet deep. From its western and southern lip the ground falls rapidly away, and this face of it is visible from the 12,000-foot ridge as the mountain is ascended from Buea. This south-west face was seen to be white with fresh ash and steaming when I ascended the mountain on 29th instant accompanied by Mr. J. C. Drummond-Hay and Mr. C. W. Seed, Auditor.

"On reaching the top we found the whole circumference of this crater was white and steaming and the ground hot to the tread for some way back, with many small fissures giving out steam. The bottom of the crater was evidently cold, as the lichen-covered rocks which appeared to have fallen from the lip were fresh and green.

"Beyond the summit, *i.e.* north-west of it, between it and an almost equally high peak, there is a long valley or crater in which are a number of recently formed circular pits varying in diameter from 3 to 20 feet. These, it appears, have been formed during the past three months, but are now quite cold and black. There are about a dozen of these holes in a rough line running south-east and north-west."

J. D. FALCONER.

Geological Survey, Nigeria,
February 8.

Diatoms and Flocculent Matter.

IN old microscopical journals, one frequently finds the query "How can I get rid of flocculent matter in preparing diatoms for mounting?" and as a rule there is no answer to the question.

The desired result can be attained by pouring the water containing the cleared diatoms into a glass bowl and letting it stand until the diatoms have settled and all eddies have died out in the liquid. By inclining the bowl sideways and giving it a gentle rocking motion a quantity of flocculent matter will be detached and can easily be made to roll up into small lumps and drawn away from the diatoms, when the lumps can be sucked up with a glass syringe. The process can be repeated over and over again till nothing but pure diatoms are left. The necessary rolling action is caused by viscosity, and except at the surface of the bowl the small oscillations of the fluid are practically irrotational. The diatoms mostly collect at the edge of the receding liquid, but it is important that the operation should be performed in the shade, as otherwise "greasiness" is produced by the evolution of air, and the diatoms float and stick on the surface of the water.

When all the flocculent matter is removed the fluid is stirred up by the syringe and then sucked up and deposited on the cover-glass, when the diatoms will be found to be perfectly evenly distributed, and the cover-glass must be left untouched and protected from dust until the water has dried. It is almost impossible to avoid impurities being deposited round the edge of the cover-glass, and it is my practice to wipe off a narrow margin, the central part being clean. The method of cleaning answers equally well for the desmids found in the sphagnum pools in North Wales.

I have collected diatoms from very unpromising localities by washing a quantity of seaweed in a large basin and emptying the basin by suddenly reversing it and immediately restoring it. The tiny pool of water left in the basin is usually full of diatoms, and if slowly drained off sand will be left behind.

G. H. BRYAN.

Plâs Gwyn, Bangor,
Carnarvonshire.

American Official Publications.

I BEG leave to direct attention to the lack of facility for obtaining the official scientific publications of the various departments of the United States Government. If it is desired to obtain a copy of one of these, it is necessary to write to Washington, enclosing the anticipated and approximate sum for payment, and in due course the publication arrives. Such a procedure necessitates a delay of about a fortnight at the very least, and the accredited agents of the U.S.A. Government in this country inform me that more than a month may elapse before the information is received.

It is obvious that such delay is annoying and undesirable, the more so because many of these publications are of real value for the careful work they contain. Consultation at a library is not always satisfactory, as the various series may not be complete and are not invariably in a condition suitable for quick reference: in any case, personal possession is usually more satisfactory and is often imperative.

Some time ago I brought this matter before my friend Dr. George M'Lean, who was on a visit from the United States in order to report to his government on the British universities, and afterwards became so valuable as a link between American students and British and French centres of learning. I do not know whether or not he took any action, but, so far as I am aware, the situation remains the same as it always has been.

It would, I consider, be of considerable value for arrangements to be made so that all the U.S.A. official publications could be purchased in Great Britain as soon as they can arrive here after their issue in America. There can be no doubt as to the practical and educational value of such an arrangement, which might include a somewhat widespread distribution, at a nominal fee, of periodic lists of the various Bureaux and Departments.

PERCY E. SPIELMANN.

The Athenæum,
Pall Mall, London, S.W.1,
March 24.

The Use of an Artificial Horizon in Photographic Measurements of Buildings or other Structures.

IN a letter in NATURE for March 6, p. 338, Mr. Mallock records his method of using an artificial horizon in photographic measurements of buildings. The method, as described, would of course give a permanent and easily studied record, but it appears to the present writer as needlessly complex. No mention is made by Mr. Mallock of a modern phototheodolite which, set up and in adjustment, would give, without the need for an artificial horizon, all the information required. The setting up, usually by means of an attached bubble, introduces into the instrument the desired vertical. The correlation of this vertical with the image on the photographic plate is a practical matter of 'check' or 'adjustment' on the instrument itself. This 'setting up' or levelling of the camera is essential in the case of any photographic recording instrument for such a purpose. Having thus obtained a true vertical, it appears unnecessary again to secure it by means of an artificial horizon. The method of indicating fundamental directions on the plate would be a matter of choice. It might be a series of fiducial vertical lines or simple marks in the photograph to indicate vertical and horizontal planes. Unless the artificial horizon has merits not fully appreciated by me, it would appear better to carry out such work with a simpler and practically standard equipment.

Mr. Mallock's very interesting letter does, however, suggest the question as to whether periodic photo surveys of our more important public buildings might not be part of upkeep routine. The survey need not be expensive and the records could be studied at leisure. Photographic surveys at ten-yearly periods, or as required, would be a safeguard against unsuspected subsidence or other changes. T. F. CONNOLLY.

India Store Dept.,
London, S.E.1.

Did Davy melt Ice by Friction in a Vacuum?

QUITE firmly entrenched in scientific literature, including some very recent English histories of science, is the statement that Sir Humphry Davy contrived a clockwork by which two pieces of ice were rubbed together and made to melt under the exhausted receiver of an air-pump. This is incorrect. A reference to Davy's works (Davy, "Collected Works," vol. 2, 1839, p. 11, 12, "Experiment II." and "Experiment III.") indicates that in one experiment he melted ice at 29° F., by friction, *in the open*, and that in another experiment he caused *wax* to melt by friction of two metals (wheel and plate) *in a vacuum*. Davy did not melt ice by rubbing together pieces of ice in a vacuum. FLORIAN CAJORI.

University of California.

Tests of Relativity Theory.[1]

By Prof. A. S. EVE, C.B.E., F.R.S., McGill University, Montreal.

"They say miracles are past; and we have our philosophical persons, to make modern and familiar, things supernatural and causeless. Hence it is that we make trifles of terrors, ensconcing ourselves into seeming knowledge, when we should submit ourselves to an unknown fear."—SHAKESPEARE ("All's Well that Ends Well").

THOSE who were fortunate enough to attend the meeting of the American Physical Society at Kansas City in January, found ample food for reflection on the strange but interesting position into which the experimental tests of the consequences of the theory of relativity have now passed.

This theory, first received with reluctance, is now held with extreme tenacity. In some form or other, it has come to stay. It can be modified, but not annihilated. It may, indeed, fall into line with evolution which every one believes, few can define, and no one can "explain." Its disproof has become a far more formidable task than its proof.

Those, however, who carry relativistic ideas beyond their proper sphere of mathematical physics will do well to ponder the intensive limerick of Father Ronald Knox—

> "There was a young man who said God
> Must think it excessively odd
> That the sycamore tree
> Just ceases to be
> When there's no one about in the Quad."

But surely we are wandering from Kansas!

What then are the experimental tests to which the theory or theories of relativity may be subjected? Mainly five:

(1) The gradual shift of the perihelion of Mercury stated to be 41″ per century and found by Einstein to be 43″. Here, as elsewhere, no sooner is the calculated found to agree with the observed value, than the latter becomes elusive and fresh calculation gives widely differing numbers, 38″ or even 29″, so that Einstein has to build not on a rock but on a quicksand.

(2) The bending of the rays of light passing near the sun's surface, verifiable only at time of total eclipse. This story is too well known to be retold. British and also, especially, American astronomers are well satisfied that the verification is amply complete; but there are many astronomers and physicists who are well aware that this verified effect may be assigned to a number of other causes, particularly to refraction.

(3) At Kansas City, Dr. St. John gave a most complete account of his exhaustive inquiry into the shift towards the red in the spectrum of the sun, a shift to which Einstein attached so much importance that he is reported to have said that if the shift did not exist, then his theory of relativity was wrong. This statement is not upheld by Silberstein, who in his exquisite treatise on "The Theory of Relativity" (p. 392) points out that the period of an atom on the sun need not necessarily be the same as the corresponding period of a similar atom on the earth, as is commonly assumed. The full relation is

$$\lambda_{sun}/\lambda_{earth} = \left(1 + \frac{M}{c^2 R}\right)\tau_{sun}/\tau_{earth},$$

where λ is the wave-length corresponding to period τ ($\lambda = c\tau$, of course), M is the mass, R the radius of the sun, and c as usual the velocity of light. Einstein assumes $\tau_{sun} = \tau_{earth}$ (but it need not be so),[2] and in that case $\lambda_{sun}/\lambda_{earth} = 1 + \frac{1{\cdot}75}{8 \times 10^5}$, so that $d\lambda/\lambda = 2{\cdot}11 \times 10^{-6}$, amounting to 0·008 of an Ångström unit in the blue.

This shift is certified by St. John and by Evershed to be true for the sun. Incidentally the testing of this relation has stimulated an enormous amount of research into the character and motion of the sun's atmosphere. In addition to the horizontal motions due to the sun's rotation and other causes, there are vertical motions varying with elevation, each producing its baffling Doppler effect overlapping the Einstein shift. Strangely enough, the pressure shift can be ignored, for it is estimated, even at the very base near the photosphere, that the pressure of this flaming atmosphere fourteen thousand kilometres thick is but one-tenth of our atmosphere!

Where calcium is first ionised the pressure is but one ten-thousandth, and passing upwards through the regions of the sodium D lines on to the H_α and H_β, we arrive near the top to a pressure of 10^{-13} earth's atmosphere where Ca^+ exists, and the calcium atom enjoys the privilege of losing a second electron.

The full evidence, standing by itself, would testify as much to the skill of the astronomers as to the accuracy of the theory, without any reflection on their transcendent honesty of purpose.

But the real treat of the meeting was yet to come. St. John threw on the screen a photograph of the spectra of Sirius and of its illustrious companion, the White Dwarf. The consequent applause of a large audience told its own tale. The spectrum of the companion was bordered on each side by the scattered light of Sirius. On the right at the red end the companion's spectrum was conspicuously clear; at the other end the blue of Sirius largely overwhelmed it. The predicted shift in this case is 34 times that in the sun, amounting to 21 km./sec., while the measured shift gave for H_β, 26 km./sec.; for H_γ, 21 km./sec.; for other lines, 22 km./sec.—mean, 23 km./sec. Here was indeed an unmistakable and emphatic triumph for Einstein of undoubted and overwhelming importance. Shall we not also pay a tribute to the genius of Eddington, who foresaw the possibility of a gaseous star of atoms completely stripped, and therefore giving rise to little

[1] From a lecture given to the Physical Society of McGill University, Montreal, January 1926.

[2] This is the answer to Sir Oliver Lodge's recent letter to NATURE (December 26, 1925, p. 938).

radiation pressure, resulting in a compactness hitherto unconceived, amounting to a density fifty thousand times that of water?

(4) At a joint meeting with the American Association for the Advancement of Science (a close relative of the British Association in type and design), the American Physical Society had the pleasure at Kansas of hearing their illustrious president, D. C. Miller, give a clear and interesting account of his latest results on the famous Michelson-Morley-Miller experiment as carried out by him on Mount Wilson. He has, in 1925, carried out a long series of continuous experiments which exceed in quantity and weight all previous experiments of this type. He has taken every precaution of which the most careful of physicists is capable; he has listened and given heed to the suggestions of critical friends, for he is a man without enemies. He has kept aloof from preconceptions and refused to be dragged into controversy. *He proclaims definitely a positive result indicating an earth motion through space of 10 km./sec.* The direction of motion is 6° from the south pole of the solar system, as if our system was like a falling leaf moving broadside on to its proper motion. It will be recollected that in 1887 Michelson and Morley obtained a displacement of 0·02 of an interference fringe, whereas the stagnant ether theory indicated that $2v^2L/c^2\lambda$ should give 0·4 of the said fringe. This was *assumed* to be a null effect.

In 1905 Morley and Miller at Cleveland obtained 0·0075 out of 1·5. Then followed the Rayleigh and Bruce double refraction experiment, the Trouton and Noble capacity experiment, the Fitzgerald and Lorentz shortening theory, and ultimately the special and generalised theories of relativity of Einstein.

Now, mixing metaphors, we see the very experiment, which first started the ball a-rolling, turning round to bite the hand which fed it. Yet we seek intuitively, and therefore possibly wrongfully, for some explanation of Miller's result other than the abandonment of the theory of relativity. Why? Because other experiments are in favour of it? Partly, no doubt. Chiefly, I think, because the space contraction and time elongation of Einstein make the Maxwell equations transformable, and because the change of mass with speed, well verified for β-rays, agree with a rational outlook on a universe where we find only electrical phenomena exhibited as energy in a metrical space-time. Minkowski's work is as persuasive as a great experiment. But the matter will not rest here, for already American physicists are contemplating more experiments at different levels and localities. Rumour has it that Millikan has in hand a portable apparatus. Critics have pointed out that 10 km./sec. a second on Mount Wilson and zero at sea-level would perturb the agreement of astronomical data from various observatories. But Miller has never suggested zero at sea-level, and observatories do have 'personal equations' no less than individual observers. The situation is one requiring patience and experiment rather than speculation at present.

Miller has, however, taken a further step which is quite independent of the positive result of 10 km./sec. above stated, and no less of his deduced direction of motion. He finds that he can get a satisfactory explanation of all his results if he assumes that the solar system is moving with a velocity of 200 kilometres a second (*or more, not less*), relative to the ether. If that is so, then the earth must *drag* 95 per cent. of the ether with it and 5 per cent. must *slip* past the earth. Here we have a revival of the ideas of Stokes, with possibly Planck's addition of immense compressibility due possibly to gravitation. To the writer this idea suggests profound difficulty. For example, the ether would have a vastly larger condensation round the sun than round the earth. However that may be, it appears true that if Miller's results are confirmed at different places, then all our theories go into the melting-pot, relativity and all, and a patient resurvey must commence to unravel afresh order from chaos. The only grave mistake which we can make at present is to treat Miller's main results otherwise than seriously.

(5) It is a relief to pass from the profound difficulties of the second-order experiments to the conspicuous success of the great first-order effect devised by Michelson, advocated strenuously by Silberstein, and carried out so efficiently by Gale and his co-workers. The results of the famous Chicago rotation experiment are equally explainable by the old view of a stagnant ether, or by the Einstein relativity theory. It is no less opposed to the Stokes drag theory, or to Miller's suggestion of 10 km./sec. slip and 190, or more, km./sec. drag. The compromise of Silberstein that in rotation there is full drag, and that in translation there is a partial drag, will suit the experimental evidence in hand, but no one seriously supposes that such will be the ultimate result of further experiments.

At the meeting at Kansas, in the unavoidable absence of Gale, a graphic account of the Chicago experiment was given by Watson, who was himself engaged in the work. His description dealt with the body rather than the soul of it.

If two runners start back to back and run with equal speeds in opposite directions round a circular track, they will pass each other again at the starting-point. If one runs faster than the other, there will be a difference. So if light is sent round in opposite ways a many-sided polygon approximating to a circle of radius r, say at the north pole, there will be a time difference

$$\frac{2\pi r}{c-v}-\frac{2\pi r}{c+v} \text{ or } \frac{4\pi rv}{c^2},$$

and this becomes

$$\frac{4\pi r^2\omega}{c^2},$$

or

$$\text{the area} \times 4\omega/c^2;$$

where r is the radius of the track; v, or ωr, the velocity due to earth's rotation. This circulation of light in opposite ways still depends upon the *area*, whatever the shape of the track round which the divided beams circulate. In latitude l there is a factor $\sin l$ to be introduced, and there results a lag in wave-length of $4 \times \text{area} \times \omega \sin l/c^2\lambda$, with an observed value 0·230, as against a calculated value of 0·236, or a verification within three per cent. In place of the crude proof above, there is the relativity proof in Silberstein's "Theory of Relativity" (p. 382), and other proofs may readily be

derived, for it is hard to arrive at any other result by any first-order principle. The result of the experiment is equally gratifying to the relativist and to the classicist. It was pointed out to the writer by K. T. Compton that this uncertainty of 3 per cent. might cover the failure to detect the 5 per cent. slip (20 out of 200 km./sec. or more) which Miller's result might suggest.

As Watson described this heroic experiment, a feeling of disappointment arose that such glorious apparatus had to be dismantled. The pipes (14 in.) were well and truly laid over a large area, and it was necessary to make good joints to get a vacuum, but winter was coming on and frost would have displaced the pipes, so that it is a greater matter for congratulation that this fine experiment should have been carried out, than that the apparatus should have been dismantled and removed.

It is possible to summarise the situation:

For Relativity.	*Against Relativity, but for drag and slip.*
Mercury perihelion (?). Eclipse results. Spectrum shift.	Miller's experiments on Mount Wilson.

For Relativity or for Stagnant Ether, but against drag and slip.

Michelson-Gale-Silberstein.
Chicago rotation experiment.

This brief and imperfect record of a difficult subject is written for those who are interested in the situation as it appeared to one who attended the meetings at Kansas City.

Some Properties of the Vitamins.

THE reality of the existence of the three well-known vitamins having been confirmed by numerous careful investigations, attention was directed to their isolation in a pure state, with the ultimate aim of discovering their chemical constitution. At first the work was largely qualitative, but with improvement in the technique of the necessary animal experiments, quantitative investigations became possible, and have led not only to a great increase in our knowledge of these elusive substances, but also to the probable discovery of further members of the series. Whilst undue multiplication of the number of unknown accessory food factors must be deprecated, yet it must be admitted that recent work suggests that there exist besides the orthodox trinity, an antirachitic factor D and an antisterility vitamin E: at the same time, our knowledge of their chemical properties has advanced so considerably, especially in the case of the fat-soluble vitamins A and D, that some of them may soon be justifiably transferred to a place amongst compounds of a similar chemical constitution. Thus the multiplication of vitamins resolves itself into the problem of the identification of substances which are required in metabolism only in minute amounts, and the discovery of which has been delayed until recently owing to difficulties of chemical analysis, and to the fact that they are usually present in the natural food of animals in adequate amount. Similar problems can be found in other branches of biochemistry and metabolism: thus all the amino-acids which make up the protein molecule have not yet probably been isolated, and vitamins are not the only substances which are required in minute quantities—for example, certain elements such as iodine.

Recent investigation has made it clear that the fat-soluble vitamins are present in the unsaponifiable portion of the fat, and that cholesterol can be removed from this fraction without impairing its efficacy. Takahashi and his co-workers have now carried our knowledge a stage further in an elaborate investigation (K. Takahashi, Z. Nakamiya, K. Kawakami, and T. Kitasato, *Scient. Papers, Inst. Phys. and Chem. Res., Tokyo*, 1925, vol. 3, p. 81). Starting with cod-liver oil or green leaves, the unsaponifiable fraction was obtained in a fairly pure condition and the cholesterol removed; some further purification of the product isolated from the former source was attempted by crystallisation from acetone at $-60°$ to $-70°$ C., followed by distillation at 147°-150° C. under 0·02-0·03 mm. pressure. These drastic treatments did not appear to destroy the vitamin, but did not effect any great purification: the products obtained from the two sources are somewhat different in composition, that from the oil being the more unsaturated. The yields of the crude material were of the order of 0·1 per cent of the oil and 0·025 per cent of the dried leaves. Tested on animals (rats), about 0·04 mgm. of the crude material or 0·005 mgm. of the purified product sufficed, when given daily to each animal, to promote growth on a diet deficient only in vitamin A.

The Japanese investigators have made a lengthy investigation into the physical and chemical properties of their refined product, which they have labelled 'Biosterin.' It has an absorption band in the ultra-violet, it is soluble in the organic solvents, but is unstable in ether and chloroform, and it is adsorbed by fuller's earth and animal charcoal. It also produces a photo-chemical action upon photographic plates, which the authors suggest, as the result of a series of experiments, is due to the formation of active oxygen from the oxygen of the air over the material: a similar effect was found to be produced, though less markedly, by the cod-liver oil itself, and also, but very feebly, by olive oil. As mentioned above, the vitamin is also stable to heat, in the absence of air. O. Rosenheim and J. C. Drummond (*Biochem. Journ.*, 1925, vol. 19, p. 753) have also shown that the cholesterol free unsaponifiable fraction of cod-liver oil containing the vitamin can be distilled in superheated steam in an atmosphere of nitrogen or in a high vacuum without loss of activity. On the other hand, H. W. Southgate (*ibid.*, p. 733) has found that when the cod-liver oil itself is heated to 200° C. in an atmosphere of carbon dioxide, and maintained at this temperature for varying lengths of time, a slow destruction of both the growth-promoting and the antirachitic factors takes place: the author was unable to show that this destruction was due to the liberation of fatty acids by hydrolysis at the high temperature used.

The stability to heat of these vitamins is of considerable practical importance: thus they are likely to be

found in certain foods, such as milk, which has been dried by means of heat. Gladys A. Hartwell (*Brit. Med. Journ.*, 1925, vol. 1, p. 1073) has shown that both dried and evaporated milks form, together with white bread, diets adequate for growth and reproduction in rats: the former was as good as, or better than, fresh cow's milk, whilst the latter was distinctly inferior, this inferiority showing itself more especially when the animals reached adult size. It is possible that this difference is due to a relative deficiency of vitamin B in the evaporated milk. It must be pointed out that these results do not imply an adequate supply of vitamin C, since the rat requires extremely little of this vitamin compared to the guinea-pig or man: moreover, vitamin C is the most sensitive to the ordinary destructive agents. Katharine H. Coward (*Biochem. Journ.*, 1925, vol. 19, p. 500) has found also that drying green leaves need not destroy vitamin A, though it appears to vanish in leaves which are allowed to wither. The importance of the vitamin content of milk appears again in some recent experiments by H. Pringle (*Sci. Proc. Roy. Dub. Soc.*, 1925, vol. 18, p. 93). Human milk was found to be less efficient in promoting the growth of young rats than cow's milk, probably owing to a deficiency in vitamin B content. Thus again is the importance of the mother's diet during pregnancy and lactation emphasised.

Takahashi and his co-workers have carried out a number of analyses of the purified products obtained from cod-liver oil and green leaves, and suggest that their formulæ should be $C_{27}H_{44}O_2$ and $C_{27}H_{46}O_2$ respectively: for comparison, that of cholesterol, $C_{27}H_{46}O$, may also be given. A large series of chemical derivatives have been prepared, from which the authors have deduced that the oxygen atoms are present as OH groups, one a tertiary, and the other a primary or secondary alcohol, and that the products are unsaturated, containing three double bonds: they are also capable of reduction, and form a digitonide but less readily than cholesterol: on standing they slowly take up oxygen. In general, it may be stated that any change in the molecule results in a loss of the growth-promoting property. Cholesterol and its oxy derivative, which has the same formula as the product obtained from green leaves, are also inactive.

At the present time the most useful chemical property of vitamin A is probably that of producing a blue colour in the presence of certain reagents. Takahashi has investigated this side of the subject, using a number of different reagents, such as sulphuric acid and fuller's earth: inactive allied products give a reddish colour under similar conditions. Rosenheim and Drummond have utilised arsenic chloride, trichloracetic acid, dimethylsulphate, etc., for a similar purpose, and have found that the intensity of the blue colour runs parallel with the product's potency when tested on animals, in the case of both butter and cod-liver oil. Incidentally it may be mentioned that the antirachitic factor, in the form of cholesterol activated by exposure to ultraviolet light, does not give any colour with these reagents, a further confirmation of the distinctness of vitamins A and D. The test is very delicate, the cholesterol free unsaponifiable fraction giving it in a dilution of one in two million. The colour is discharged by a number of substances, including alcohol and ether.

One point may be referred to before leaving the work of the Japanese investigators, and that is that they have found their products toxic to rats in doses of about 10 mgm. a day. The possibility that this might be due to some poisonous impurity, perhaps introduced during the requisite chemical manipulations, does not appear to have been considered. It is obvious that the value of their conclusions will be considerably enhanced when the work has been repeated—and confirmed—by independent observers.

The relation of light to the fat-soluble vitamins has not yet been completely elucidated, but it appears from the evidence available that it produces synthesis of both the growth-promoting and antirachitic factors in plants, but in animals only influences the latter. Plants grown in the dark produce no vitamin A, but even one day's exposure to light is sufficient to cause its appearance: at the same time the lipochrome pigments are developed (K. H. Coward, *ibid.*). The relation of ultra-violet light to the antirachitic factor in plants has been little studied, since both factors usually appear to occur together: in animals, light does not cause any synthesis of vitamin A, but may influence the production of the antirachitic factor, for example, by activating the cholesterol in the skin. Whether this is the case or not, the improvement in calcification in rickets is probably in part due to an increased calcium absorption; since in other conditions in which there is a drain on the calcium of the body, for example, in lactation, exposure of the animal to ultra-violet light results in increased calcium absorption and retention (see the experiments on goats by J. B. Orr, H. E. Magee, and J. M. Henderson, *Biochem. Journ.*, 1925, vol. 19, p. 569).

A further factor to be considered in this increased retention of calcium is the influence of small quantities of iodine in the diet. F. C. Kelly (*ibid.*, p. 559) has shown that this addition to the diet of the growing pig produces an increased retention of nitrogen, phosphorus, and calcium, and points out that cod-liver oil is a rich source of this element. Iodine is necessary for the production of the thyroid hormone, which is itself essential for growth, but the relation, if any, between this secretion and the growth vitamins is at present unknown.

Whether light has any influence on the other vitamins is at present doubtful. In fact, so far as vitamin C is concerned, P. Eggleton and L. T. Harris (*Brit. Med. Journ.*, 1925, vol. 2, p. 989) have recently shown that oats germinated in the dark produce the vitamin in proportion to the amount of growth occurring; moreover, ultra-violet light cannot prevent or cure experimental scurvy in guinea-pigs on a scorbutic diet. Hence it cannot replace an adequate supply of this vitamin in the food.

Less is known of the chemical nature of the water-soluble vitamins than of that of the fat-soluble. S. S. Zilva (*Biochem. Journ.*, 1925, vol. 19, p. 589) has obtained vitamin C in a concentrated condition from orange and swede juice. The nitrogen content of this fraction was only 1-2 mgm. per cent., of which about half was amino and amide nitrogen; the latter could be destroyed without interference with the potency of the preparation. R. A. Peters (*ibid.*, 1924, vol. 18, p. 858) has obtained a somewhat similar result with a

concentrated solution of vitamin B extracted from yeast; nitrous acid does not destroy it, as is the case with primary and many secondary amines. Working with H. W. Kinnersley, he has succeeded in purifying the yeast extract still further, until only 0·084 mgm. is necessary to cure symptoms of polyneuritis in a pigeon (*ibid.*, 1925, vol. 19, p. 820). Regular doses given to a bird on a polished rice diet are capable of preventing the appearance of symptoms without, however, maintaining its weight. Now vitamin B is essential for growth and maintenance of weight in rats, so that the authors are led by their results to suggest that the factor which cures and prevents polyneuritis in pigeons may be different from the one which is necessary for growth and maintenance of weight. It is possible, however, that the continued loss of weight without symptoms may be due to the deficiency of the polished rice diet in some other material.

It has been known for some time that excessive amounts of carbohydrate food hasten the onset of symptoms in pigeons. In examining the relationship between vitamin B and carbohydrate metabolism, P. Eggleton and L. Gross (*ibid.*, 1925, vol. 19, p. 633) have found that deprivation of vitamin B in rats leads in about a month to a fall in the blood-sugar, together with a gradual disappearance of glycogen from the liver; at the same time Kinnersley and Peters noticed that the convulsions of polyneuritic pigeons occurred at low temperatures, whilst removal of the birds to the warmth of the laboratory produced a temporary improvement. Now it is known that in mice the convulsions produced by insulin only occur regularly if the animals are kept at an external temperature so high as 37° C. At first sight the two observations appear opposed; but the condition of the experimental animals is fundamentally different: the mice have glycogen in their livers, whilst the pigeons probably do not. Hence cold in the former, stimulating glycogenolysis, acts against the insulin injected by producing a flow of sugar into the blood and thus prevents hypoglycæmic symptoms, whilst in the latter this cannot occur owing to the paucity of glycogen in the liver. At the same time, the cold increases the metabolism of the muscles, leading to withdrawal of sugar from the blood, which cannot be replaced, thus producing convulsions: warmth would diminish the demand for sugar and allow the blood-sugar to be restored to a more normal level. Some such hypothesis may be useful in correlating the various observations which have been recorded.

In conclusion, attention may be directed to some recent work in connexion with vitamin E, first described by Evans and Bishop a few years ago. It was observed that rats on certain synthetic diets, chiefly those in which the protein was supplied by casein, became sterile in course of time: any offspring of these rats obtained before sterility occurred were sterile from birth. In the female the ovaries are normal, the sterility being shown by absorption of the embryos late in gestation. In the male, on the other hand, the sterility is produced by degeneration of the testes themselves: a full description of the histological changes involved has been given by K. E. Mason (*Proc. Nat. Acad. Sci., U.S.A.*, 1925, vol. 11, p. 377). Degeneration begins about two months after the commencement of the diet, and recovery only occurs when the vitamin is given if some normal testicular tissue is still in existence.

The distribution of the vitamin E and its properties are considered in more detail by H. M. Evans and G. O. Burr (*ibid.*, 1925, vol. 11, pp. 334 and 378). It is fat soluble, and its richest source is the oil expressed from the germ of wheat: it occurs also in oats, corn, lettuce, alfalfa, etc.; in small amounts in animal tissues including milk, and also in moderate amount in the vegetable oils. Cod-liver oil contains little. It is very stable and can be distilled in superheated steam; it occurs in the unsaponifiable fraction of the oil, but is not precipitated by digitonin: it does not contain nitrogen, sulphur, phosphorus, or the halogens. A single dose of 5 mgm. of the concentrated product by mouth or subcutaneously to a female rat suffices for the production of a normal litter, whilst 0·3 mgm. daily prevents male sterility. It appears to be stored in the body to a considerable extent, but is used up in the ordinary processes of metabolism quite apart from pregnancy. In some of its properties, therefore, it resembles the other fat soluble vitamins, but in its distribution, and in the fact that normal growth occurs in its absence, it is sharply differentiated from them.

News and Views.

AT a conference on March 25, held by the principal broadcasting organisations, representatives from twenty European countries took part. A new scheme for the redistribution of wave-lengths in Europe was submitted and provisionally approved. The details of the scheme will now be considered by the various interested organisations from the point of view of local difficulties. Suggested amendments will be considered by the Committee of the Office International of Radiophonie, and a final scheme will be drawn up for the approval of the various Governments concerned. The scheme divides broadcasting stations into two classes. The first class consists of those capable of guaranteeing good reception at long ranges. They receive an 'exclusive' wave-length, but every country receives at least one exclusive wave-length. The other class consists of low-power stations for the use of local listeners only. All this class will work on a common wave-length. Experiments have shown that each of these small stations can work without practical interference from the other stations using the same wave-length. To ensure satisfactory results it is absolutely necessary that the same standard type of wave-metre should be used by all the stations. This problem is being considered by a technical committee at Brussels under M. Raymond Braillard. No wave-lengths less than 200 metres have been allotted, and great pains have been taken to avoid unnecessary changes in wave-lengths already in use. It will be seen that the proposed solution is, perhaps unavoidably, not a perfect one. The ideal solution would be one in which every listener with a good valve set would be able to listen in to many of the small stations in Europe. If they all have a common

wave-length this would be impossible. In the course of other meetings held at Geneva, committees were formed to consider pressing international broadcasting problems with the object of finding practical solutions.

THE Czeckoslovak Academy of Agriculture, of comparatively recent formation, is seeking to establish and consolidate international relations for the benefit of agriculture in its country. The latest number of the *Věstnik* (Ročnik I., Čislo 9-10) gives reports of papers read at the general meeting of the Academy, with summaries in French, German or English. The address of Dr. Julian Stoklasa on the nitrogen problem in the Czeckoslovak republic is given in four languages, rendering it accessible to a wide circle of readers. The problem is acute, but is receiving much careful attention. The yearly consumption of nitrogen is only 2·5 kilogm. per hectare compared with 20 kilogm. per hectare in Germany, and it is calculated that very heavy losses have been incurred during the last seven years owing to this deficiency, as the yearly harvest is held to abstract 40 kilogm. nitrogen from each hectare of soil, on an average. The production of synthetic nitrogenous manures on a large scale is under careful consideration. Since 1923 the work has been under the direction of the Ministries of National Defence, Public Works and Agriculture, which created the Inter-ministerial Nitrogen Committee. It is recognised that the country is too dependent on imported food stuffs owing to the failure of agriculture to attain the necessary economic intensity. The chief causes of failure are the high costs and the scarcity of certain means of production, nitrogenous fertilisers being a prominent example, more than 60,000,000 kilogm. having recently been imported yearly, chiefly as Chile saltpetre. As a further means for improving the knowledge and status of agriculture in Czeckoslovakia, the Academy has set up commissions for publishing an agricultural encyclopædia and a bibliography, and for the establishment of a central library and reading-room in which would be concentrated all Czeckoslovak and Slavonic agricultural literature, together with the most important world literature on the subject.

ONE cannot imagine a more eloquent series of tributes than those which, lead by M. Painlevé, were pronounced over the grave of the late Camille Flammarion, which have now been issued in permanent form, admirably reprinted on art paper, from *L'Astronomie*, the bulletin of the Astronomical Society of France, of which Flammarion was the founder. The book also contains an account of the funeral ceremonies, and a selection from thousands of letters received from astronomical observatories and scientific institutions at home and abroad, and from public and private individuals. A lengthy and complete discourse on the life and work of Flammarion is included from the facile pen of M. Emile Touchet, who was long associated with the dead "maître" in the administration of the largest of all astronomical societies. Several portraits of Flammarion at various periods of his life are included, the last of which, taken shortly before death, is a characteristic picture. For an authentic pronouncement on the life and work of an inspiring French astronomer, one need not go past this little publication, coming as it does from the fount of his astronomical activity. The book can be obtained from the headquarters of the Society at 28 Rue Serpente, Paris. Flammarion was a great admirer and user of British scientific publications, particularly NATURE, and it is interesting to learn on the authority of his widow that the last piece of literary work he accomplished, actually on the day of his death, was the translation of a note on "Ancient Clepsydræ" from our issue of October 25, 1924. This he intended for reproduction in *L'Astronomie*. Shortly after this was completed he walked to the window, commented upon the beautiful day and the loveliness of his garden, and collapsed into the arms of Madame Flammarion. The last prospect he beheld was the extensive view over the Seine which he asked the writer of this paragraph to photograph for him one magnificent summer Sunday afternoon many years ago. Flammarion was proud of that view.

AT a meeting of the Scientific, Technical, and Trade Circle of the Institute of Journalists, held on March 30, a summary of the aims and objects of the Optical Convention was given by Mr. F. Twyman (chairman of the Executive Committee), Sir Richard Paget (Hon. Treasurer), and Prof. Cheshire. In thus inviting the co-operation of the members of the Circle the precedent set in connexion with the British Empire Exhibition a couple of years ago was followed. Mr. Twyman enumerated some of the very wide range of instruments and apparatus in which optical lenses and prisms are necessary, and Prof. Cheshire, who gave an account of some of his experiences when acting as Director of Optical Munitions during the War, directed attention to the vital importance of an adequate home supply of optical glass in modern warfare, and the necessity of encouraging and developing the British optical industry in time of peace. Sir Richard Paget gave an entertaining account of the various optical illusions and exhibits at the Convention likely to be of popular interest. These include many ingenious and novel devices as well as demonstrations of lantern projection in natural colours and other processes of great practical importance. In this respect the organisers are following the lead of early pioneers in science who did not disdain to kindle public interest by the exhibition of odd contrivances and striking effects. In early scientific entertainments 'optical illusions' often played a considerable part.

"CAPE to Cairo," Major C. Court Treatt's kinematograph film of a journey by motor car through Africa from south to north, now showing at the Regent Street Polytechnic, is a record of a remarkable feat of organisation and endurance. The expedition, with Major Treatt as leader, consisted of Mrs. Treatt, Mr. F. C. Law, Mr. Errol Hinds, and Mr. T. A. Glover, the photographer who accompanied Major Angus Buchanan in his journey across the Sahara. A

distance of 13,000 miles was covered in sixteen months; but a mere statement of time and distance can convey no adequate conception of what the journey involved. In the early stages, while traversing Rhodesia, they were caught by the rains. The cars were constantly bogged in the deep mud of the roads, while the rivers were so swollen as to be almost impassable. Throughout, the rivers were the most serious obstacle. When they reached the Nile, it was only by towing the cars across the river under water that the expedition was saved from failure. The film records some native dances—a war dance in a Uganda village and a Dinka dance being particularly interesting—and gives a good idea of the varying types of African scenery. Special mention must be made of the pictures of a herd of buffaloes and a really remarkable and exceptional series of the Zambesi falls. The part played by Mrs. Treatt in securing friendly relations with the natives is an object lesson of the valuable work which can be accomplished by a woman, and in some matters by a woman only, in anthropological and geographical exploration.

IN the course of an account of recent excavations at Beisan in Palestine, contributed to the *Times* of April 4 by Mr. Allan Rowe, Field Director of the Philadelphia University Museum Expedition, reference is made to an interesting find, and a suggestion made as to its meaning and use, which will appeal to all readers of Sir James Frazer's "Golden Bough." The object in question is a hollow circular ring of clay, to the top of which are attached several jars and animal heads. The jars have holes in the base which connect with the hollow inside the ring. Another example such as this was found some years ago at Megiddol and a derivative, much later in date, was found at Naukratis in the temple of Aphrodite. It is suggested that these objects are the flower stands known to have been in use in Syrian temples, and that they may be the actual "Gardens of Adonis," the baskets or pots in which various kinds of seeds or grain were planted and tended by women for a period of eight days, when they were thrown into a river or stream with an image of the god. It will be remembered that Sir James Frazer, in his "Adonis, Attis and Osiris," suggests that the rite was intended as a charm to secure abundance of rain or water for the crops, and adduces a number of analogous customs from various parts of the world to support his view.

FOR several years past an annual inter-university conference of metallurgical students has been held, attended by delegates from the principal universities and technical colleges in Great Britain, for the purpose of discussing questions concerning the training and prospects of professional metallurgists. At the conference held in Birmingham on February 19 and 20 last, the subject for discussion was the place of the metallurgical student in industry. There was general agreement among the speakers as to the necessity of combining works training with the academic course, for which purpose the vacations could be partly utilised. Graduates on entering a works should at once be given a self-supporting wage, the system of apprenticeship being undesirable. On the other hand, the graduate should enter on his duties with a due sense of his inexperience and a proper respect for the practical knowledge of the technical man. It was considered that a trained metallurgist should not become a routine chemist, but should be regarded as having a special function. Some speakers urged the giving of more attention to the commercial side of industry, and to such subjects as works organisation and management, instruction in those subjects being given preferably by industrialists. Copies of the report may be obtained free on application to Mr. W. L. Kent, Metallurgical Society of the University, Birmingham.

THE Association of Special Libraries and Information Bureaux, which held a conference at Oxford last autumn (NATURE, October 10 and November 14), has now decided to proceed with a formal constitution and the enrolment of members. The inaugural meeting was held at the Institution of Mechanical Engineers on March 29 and was well attended. Mr. J. G. Pearce, director of the British Cast Iron Research Association, presided. The Association has planned a third conference, to be held at Balliol College, Oxford, on September 24-27, at which the draft constitution will be submitted to the members. The first work of the Association, which is one of some magnitude, is the preparation of a Directory of Special Libraries and Information Bureaux in the United Kingdom, which should contain in a suitably classified form a guide to existing sources of reference. The Carnegie United Kingdom Trust, which has already generously supported the Association, has promised to finance the preparation of the Directory at an estimated cost of 2000*l.*, and with the wide interest already taken in the Association by delegates from learned societies and large industrial corporations, it is hoped that the difficulties of editing such a volume can be overcome.

THE King has approved that the Royal Commission on Agriculture in India should be composed of the following: The Most Hon. the Marquess of Linlithgow (chairman); Mr. H. Calvert; Prof. N. Gangulee, professor of agriculture and rural economy, University of Calcutta; Dr. L. K. Hyder, professor of economics, University of Aligarh; Mr. B. S. Kamat; Sir Henry Staveley Lawrence; Sir James MacKenna; Sir Thomas Middleton; The Rajah of Parlakimedi; Sir Ganga Ram. The appointment of a Royal Commission, "generally to examine and report on the present conditions of agricultural and rural economy in British India," was announced by Lord Reading at the opening of the Indian Legislature on January 20. The terms of reference go on to point out particular directions in which investigations are to be pursued. The scope of the inquiry was discussed in these columns in our issue of January 30, p. 166.

AMONG the gifts for scientific purposes made by the late Prince Albert of Monaco in his will was a sum of a million francs to the Paris Academy of Sciences for the provision of a biennial prize (NATURE,

October 14, 1922, p. 524). The first award of this prize has been made to Dr. Charcot, who will thus be enabled to improve the scientific equipment of his vessel, the *Pourquoi Pas* ! It is appropriate that the first to benefit under the bequest should be Dr. Charcot, for Prince Albert, himself a keen scientific worker, carried out many notable investigations in physical and biological oceanography.

DR. P. CHALMERS MITCHELL, secretary of the Zoological Society of London, will deliver the Huxley Memorial Lecture at the Imperial College of Science and Technology on May 4 at 5 P.M., taking as his subject " Logic and Law in Biology."

THE proceeds of the Daniel-Pidgeon Fund of the Geological Society of London for 1926 have been awarded to Dr. David Williams, who proposes to investigate the geology of the country between Snowdon and the Carnedds.

WE are asked to state that the meeting of the Chemical Society which had been arranged for Thursday, April 15, has been postponed until the usual hour on Thursday, April 22.

THE fifth Hurter and Driffield memorial lecture of the Royal Photographic Society of Great Britain will be delivered on Tuesday, April 20, at 7 o'clock, by M. Charles Fabry. The subject will be " The Photographic Plate as a Measuring Instrument for Visible and Invisible Radiations."

A MEETING of firms interested in the formation of a research association for the paint, colour, and varnish industries will be held at the London Chamber of Commerce, Cannon Street, E.C., on Wednesday, April 14, at 11 A.M. An invitation to be present is given to members of companies interested in these industries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned : A resident tutor in economics in the University of Bristol—The Registrar (April 20). A lecturer in the department of electrical engineering of Bradford Technical College—The Principal (April 21). A lecturer in botany in the University of Bristol—The Registrar (April 30). An assistant plant breeder under the Department of Agriculture and Forests of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (May 7). A professor of physiology at St. Bartholomew's Hospital Medical College — The Academic Registrar, University of London, South Kensington, S.W.7 (May 20). A laboratory assistant in the Biochemical Department of the Wellcome Physiological Research Laboratories, Beckenham—The Director. A chief physics master at Shrewsbury School—The Headmaster's Secretary, The School House, Shrewsbury.

Our Astronomical Column.

THE DISTRIBUTION OF O-STARS.—An article by B. Gerasimovic, of Charkow Observatory, in *Astr. Nach.* 5420, deals with the galactic distribution of these stars. As is well known, they lie in very low galactic latitude and afford one of the best methods of obtaining the co-ordinates of the galactic plane, and the linear distance of the sun from it. The 144 O-stars in the Draper Catalogue (excluding those in the Magellanic Clouds) give for the galactic pole R.A. 189° 13′, N. Decl. 27° 22′ (equinox not stated, but presumably 1900), while the 78 planetary nebulæ in Curtis's Catalogue give R.A. 192° 13′, N. Decl. 28° 28′. The latter show a greater dispersion than the O-stars, which is shown to arise from wider scattering in space, not from greater proximity to us. The mean distance of the O-stars is taken as 770 parsecs after Wilson (Plaskett increases the distance to 900 parsecs), and the distance of the sun to the north of their mean plane is found to be 31 parsecs.

Further, it is shown that the angular width of the zone of O-stars is greatest in the direction of the anti-centre of the star-system (according to Kapteyn, R.A. 23^h 10^m, N. Decl. 57°), where it amounts to 11°, being only 3° in the opposite direction. This is ascribed to the greater proximity of the zone in the former direction.

THE DISTRIBUTION OF RADIANT ENERGY OVER THE SUN'S DISC.—Bulletin No. 91 of the Aeronautical Institution of the Netherlands is devoted to a communication from the Heliophysical Institute at Utrecht, " The Distribution of the Energy over the Sun's Disc," by W. J. H. Moll, H. C. Burger, and J. van der Bilt. To avoid the disturbing effects of the lower atmosphere the authors set up their apparatus on the Gornergrat near Zermatt. They had the good luck to find next to the hotel a small house with brick walls, admirably suited for an observatory. The ' monochromator ' with which the energy of any assigned wave-length was determined was provided with a linear vacuum-thermoelement, and was therefore more sensitive than the apparatus used by previous investigators. The slit of the monochromator was only 0·1 mm. wide. It was found that a sufficiently regular movement of the sun's image, 3 cm. in diameter, past the slit could not be obtained with a cœlostat. Regularity was achieved by using fixed mirrors and giving a steady motion to the lens by which the image was formed.

Final results are not yet available, but the authors claim that they were able to get trustworthy values of the distribution of the energy along about 99 per cent. of the sun's radius against Abbot's 95 per cent. Their values of the ratio of the energy to that at the centre of the disc are greater than Abbot's. The differences attain a maximum amount of about 2·5 per cent. at a distance from the sun's limb of about 8-hundredths of the radius. The discrepancy is attributed to the quicker response of the new apparatus. The general result, that the radiation in all parts of the spectrum falls off rapidly near the limb, is of course confirmed. The effect is most conspicuous in the shorter wave-lengths, so that the sun is yellowish towards the edge. At 5-hundredths of a radius from the limb the blue rays have only half their intensity at the centre and at 2-hundredths less than a quarter. The curves are in fact consistent with the hypothesis that the radiation falls to zero at the limb. It is to be hoped that further use will be made of the observatory on the Gornergrat. Independent measurements of the ' solar constant ' might well be made there, for comparison with the determinations at the stations of the Smithsonian Institution in America.

Research Items.

A TAHITIAN BREAST ORNAMENT FROM ALASKA.—Dr. H. U. Hall discusses in the issue of the *Museum Journal* dated September last, the provenance of an object of exceptional interest recently acquired by the University Museum, Philadelphia. Although it was collected in an Indian village on Admiralty Island, Alaska, it is beyond question a feather breast ornament from Tahiti. Only seven of these are known to be in existence, three being in the British Museum. That they belonged to the highest chiefs is clear, since their adornments include red feathers, sacred to Oro the war god, which could be worn only by persons of this class. They are described by Cook under date September 8, 1777, and possibly, under missionary influence, had ceased to be used so early as 1825, or at any rate not much later. It is therefore improbable that this specimen was carried north by one of the whalers, who did not begin their voyages to the Arctic through Bering Strait until the late 'forties. It would seem most probable that it was taken to Alaska either by Cook or Vancouver, the probabilities favouring the latter. Among the Chilkat it was a clan object and regarded as very precious. It was known as 'raven cape.' The late owner said that the old leaders of her house had boasted of it as a possession which was uncommon. It was regarded as the work of the people of another world. Fragmentary traditions of its origin connect it with the coming of the white man, and refer it to a strange party who made a visit to the land "in company with the first man of the sun."

AN ARCHÆOLOGICAL COLLECTION FROM FLAGSTAFF, ARIZONA.—A number of archæological objects from graves found in Young's Cañon, near Flagstaff in Arizona, has recently been added to the U.S. National Museum, Washington. It is of special significance for the archæology of the south-western United States, partly because some of the objects are unique; partly because few antiquities have been obtained from this area. The collection was made by Mr. J. C. Clarke in the course of road-making operations, and consists principally of pottery, red, gray, dark, and painted ware, shell bracelets, armlets, and finger rings, a few bone objects, needles, bodkins, and the like. Two rare specimens of polished bone with incised decoration were evidently ornaments for the hair as they were found on a cranium. Cremation was practised and calcined human bones were found in mortuary vessels or burial urns. Mr. J. W. Fewkes, who describes the collection in *Smithsonian Miscellaneous Collections*, Vol. 77, No. 10, directs attention in particular to the pottery, of which the decorative designs are purely geometric, none showing naturalistic forms of men or animals. None is perforated or ceremonially 'killed.' One object is exceptional, a black and white ware ladle, of which the sides and end of the handle are pinched up to form a cradle. This contains a small clay figurine. Similar figurines have been found higher up the Little Colorado, suggesting that the cradle-handled ladle, though rare, was known in Pueblo households. The pottery as a whole resembles the pre-puebloan of the region north of the Hopi Pueblos—a culture which probably at one time spread over the whole of what is now Arizona and is now best represented on the Lower San Juan in the region called Takonabi.

THE ATMOSPHERE AND HUMAN COMFORT.—The *Monthly Weather Review* for October last has an article on "The Relation of the Atmosphere to Human Comfort," by Dr. C. F. Brooks of Clark University. The journal also contains other articles on the same subject, treating different branches, but all have general reference to America. The work is allied to that undertaken by Prof. Leonard Hill in Great Britain, but an attempt is made to push the study further and to reduce it to mathematical form in order to find a basis by which weather might be classified according to its relation to human comfort. With data of heat emission, heat production, and comfort, Dr. Brooks considers it possible to construct tables which will show for any weather conditions approximately the rate at which a man will cool. We need tables showing for any kind of weather the feeling of cooling which a man will experience under any degree of activity and in any kind of clothing. More calorimetric observations of the actual cooling and heating of man are required. The author hopes that the discussion will be helpful as a pioneering effort.

ASYMMETRY IN MICROSCOPIC ORGANISMS.—In his presidential address to the Quekett Microscopical Club (*Journ. Quekett Micr. Club*, Nov. 1925), Mr. D. J. Scourfield directs attention to asymmetry in microscopic organisms and to the need for observations on the functioning of asymmetrical structures in order to throw light on the vexed question of adaptations. Among the rotifers, the Rattulidæ present a twisting of the body so that practically every part is involved in the asymmetry. Among the Bdelloid rotifers the jaws occasionally show slight differences, and in this group there are two ovaries which function alternately, while in other rotifers there is only one ovary. Mr. Scourfield recalls examples of asymmetry in some Crustacea and refers to the occurrence of androgynous individuals of Daphnia, rightly urging the desirability for carefully recording the condition of such examples. He enters a plea for experimental research in the cultivation of microscopic organisms under varied conditions, and we may suggest to the keen amateur that the tracing of the subsequent history of such androgynous specimens which, *e.g.*, exhibit a male antenna on one side and a female antenna on the other, would form an interesting study.

BEATING OF THE EARLY EMBRYONIC HEART.—The Report of the Department of Embryology of the Carnegie Institution of Washington (from Year Book No. 24), which is located in Baltimore, shows the wide range of investigations in progress, *e.g.* on cleavage stages in the pig, the origin of the notochord, the development of the blood-cells, and a re-analysis of the different types of cells by the aid of staining living blood smears, the study of early human embryos—a well-preserved 7-somite embryo has been carefully investigated—and a number of other lines. Of interest to all biologists is P. N. Johnstone's work on the heart of living chick embryos. In addition to making observations on the morphology of the living embryonic heart he has studied the origin of the first pulsations, and finds they first appear at the 10-somite stage in the primitive ventricle. Starting at a definite spot on the right border of the ventricle, the beating area spreads until the entire ventricle is engaged in rhythmic contractions. It is some time later that the pulsations begin in the primitive sinus venosus, so that at the outset the sinus venosus does not serve as a "pacemaker" for the ventricle. The author further confirmed this by placing a ligature between them which did not alter the rhythm of the ventricle, but later, by the fourth day of development, such a ligature produces heart block, showing that the rôle of

pacemaker or rhythm control has then shifted to the sinus venosus. Mr. Johnstone devised a method for stimulating these small hearts electrically, and found that the earliest period at which the chick's heart can be influenced by electrical stimulation is the middle of the third day: that is, long after the atrium, permanent ventricle and bulbus arteriosus have become functionally active.

THE CLASSIFICATION OF INSECTS.—*Bull. 162, Agri. Research Inst., Pusa* (1926), is a publication of 101 pages devoted to "Tentative Keys to the Orders and Families of Indian Insects." Its author, Mr. T. Bainbrigge Fletcher, has compiled this synopsis in order to meet a long-standing want for a modern guide to the detailed classification of Indian insects. Present-day tendencies are towards the recognition of an increasing number of orders and families among insects, and it has become progressively difficult for isolated workers, in a country so extensive as India, to keep in touch with recent changes. Mr. Fletcher has, to a large extent, followed the classification of Brues and Melander (whose system is based upon that of Handlirsch), and recognises thirty-two separate orders. In many cases it is still largely a matter of opinion as to what criteria are to be accepted as being of ordinal value. We note that the author has wisely united the Mallophaga and Pediculina (Siphunculata) into the single order Anoplura; but, on the other hand, the Zoraptera and Psocina, which are closely related to each other, are retained as separate orders. The increasing number of families of the larger orders is the outcome of specialisation and intensive study; and, in India alone, there are 86 families in the Coleoptera, 75 in Hymenoptera, and 73 in Lepidoptera. The fact that only a small number of families do not find a place in these keys (since they are unrepresented in India) is a feature commending the Bulletin to workers in other lands besides those in the country for which it is written.

WINSCONSIN ALGÆ.—Of great interest to algologists is the publication of the second part of Prof. G. M. Smith's "Phytoplankton of the Inland Lakes of Winsconsin" (*Bull. Univ. Winsconsin, Serial No. 1270*, pp. 227, 1924). This volume deals with the Desmidiaceæ. It quite reaches the high standard set by the earlier publication, and it is a necessary work of reference to all interested in this subject. Four new species and seventeen new varieties are described, most of them belonging to the genus Staurastrum. Among a small number of new combinations is the transfer of *Dictyocystis Hitchcockii* (Wolle) Lagerheim to Cosmocladium. The work of European authorities, notably West and Borge, has been thoroughly assimilated and collated.

THE SWAMP CYPRESS OF CHINA.—At a meeting of the Royal Irish Academy on March 16, a paper was read by Prof. A. Henry, giving a detailed account with photographs and drawings of the Chinese swamp cypress, known to science as *Glyptostrobus pensilis*. This species has died out in the wild state, and is only known in cultivation in two restricted localities around Canton and Foochow. It has been preserved from extinction by the superstitious beliefs of the peasants, who plant it on the north side of villages to bring luck, and amidst rice-fields to increase the crop. Adapted to wet, marshy situations, it develops peculiar curved "knees," which are woody growths from the roots, projecting above the ground. The function of the knees is to enable the roots to breathe, whenever the soil happens to be inundated. The genus is a very ancient type, and its fossil remains have been found throughout the Tertiary era, widely spread over the northern hemisphere in North America, Europe and Asia, extending as far north as Spitsbergen, Greenland and Alaska. Its twigs and leaves have been gathered in the Eocene beds at Ardtun in the Isle of Mull, in company with similar remains of two other genera, Ginkgo and Cryptomeria, all three being now represented in China by three living species, which can scarcely be distinguished from those that flourished at the beginning of the Tertiary era. Ginkgo is also unknown at the present time in the wild state, and owes its preservation to the Buddhist priests who plant it around their temples. Prof. A. Henry, who was assisted in the microscopical work and drawings by Mrs Marion McIntyre, gave in addition a comparative account of the American swamp cypress Taxodium, which is much better known to science than Glyptostrobus. The photographs of the latter, obtained recently from China, are the first to be published of this interesting tree.

COTTON IN TANGANYIKA.—The report of the Department of Agriculture of the Tanganyika Territory for 1924–25 shows, among other developments, a remarkable extension of cotton-growing among the natives. The Department is the only legal source of cotton-seed supply to natives and the chief source to non-native planters. Figures show an increase in seed distribution to natives from 481 tons in 1923 to 1594 tons in 1925. The lint production has increased by 64 per cent. in the last year. Furthermore, it is of interest to note the general superiority, as judged from brokers' reports, of the native-grown cotton over that raised on non-native estates. Extensive experiments are being carried out on the time of sowing in relation to rainfall and on the spacing that gives the best results. Studies of the pink bollworm of cotton, which has apparently been known in Tanganyika since the Germans imported seed in 1898, leads to the probability that it is not indigenous but was introduced from India through Egypt. With the strict control on the movements of seed, it is hoped that this pest may be kept in hand.

SURVEYS IN SOMALILAND.—In the January-February number of the *Bolletino* of the Royal Italian Geographical Society, Messrs. G. Stefanini and N. Puccioni give a long account of the expedition to Italian Somaliland in 1924, undertaken by Mr. Stefanini under the auspices of the Italian Government and the Italian Geographical Society. A map on a scale of 1 to 1,500,000 accompanies the paper and covers the south-western part of the country as far as the Juba river. A number of short papers dealing with the general scientific results of the expedition, in particular anthropology, are appended.

HISTORICAL RUSSIAN DIAMONDS.—The jewels of the "Russian Diamond Treasure" have recently been thoroughly examined by the distinguished mineralogist Dr. A. Fersman, and in a series of papers of historical as well as scientific interest, many of the legends and misconceptions that have crept into the descriptive literature of these stones are corrected (*Bull. de l'Acad. des Sciences de l'U.S.S.R.*, 1922, 1925 and 1926). The "Shah" diamond is a remarkable elongated octahedron of Indian origin, which bears engraved inscriptions of three different dates. Soon after the first engraving in 1591 it passed into the possession of the Great Moguls, and in 1665 it was seen by Tavernier in the palace of Aureng-Zeb. In 1739 it was seized by the Shah Nadir and carried from Delhi to Persia. In 1829 a Russian diplomatic agent was murdered in Teheran, and to conciliate the Tsar the famous gem was presented to Russia. The "Orlov" diamond is the largest of all the old

stones of Golconda, and it is now identified by Fersman as the "Great Mogul," also seen by Tavernier in 1665. The Shah Nadir possessed this beautiful gem for some time after the conquest of Delhi, and with the "Koh-i-noor" it was mounted in the Persian throne. The "Orlov" was stolen and passed through various adventures until 1773, when it was purchased by Prince Orlov and presented to Catherine II. Since then it has held pride of place in the sceptre of the late Tsars. The "Koh-i-noor," which has often been described as the "Great Mogul," lost its historical Hindu form in 1862, when it was re-cut, after having been presented by the East India Company to Queen Victoria in 1850.

PLATINUM DEPOSITS IN SOUTH AFRICA.—In the *Trans. Geol. Soc. S. Africa*, vol. 28, 1925, pp. 83-133, Dr. P. A. Wagner describes the platinum occurrences in the norite zone of the Bushveld complex. Taken as a whole, they constitute the world's greatest primary concentration of that metal, the localities of the deposits being scattered along the norite periphery for nearly 400 miles. The distribution indicates that extreme magnetic differentiation was essential for platinum concentration. It is shown that in dunite, unusual basicity of the residual fractions, together with the presence of fluorine, were the most probable conditions essential to the formation of rich deposits. The metal also occurs with magmatic nickel-copper-iron sulphides which are indigenous to the rocks in which they occur. The sheets of sulphidic rocks are invariably floored and roofed by anorthosite, suggesting a preliminary necessity for the separation of calcic felspar, and indicating a type of differentiation dependent not on gravity alone, but more particularly on gas pressure. Here sulphurous gases were presumably responsible both for the peculiar rock differentiation and for the extraction and concentration of the platinum. Where the sulphidic magmas were brought into contact with dolomites or sheared banded ironstones, contact deposits of platinum-bearing sulphides were formed. The paper is a most valuable contribution both to economic geology and to the theoretical aspects (which still remain confused) of ore-genesis and magmatic differentiation. The views of W. H. Goodchild and J. E. Spurr on these topics are here supported by much of the newly recorded evidence.

THE JAPANESE EARTHQUAKE OF 1923.—Continuing his investigation of the great Kwanto earthquake, Prof. T. Ogawa now presents evidence in favour of the hypothesis of magmatic injection, and adverse to the alternative tectonic theory (*Jap. Journ. of Geol. and Geog.*, vol. 3, No. 3). Omori determined the mean depth of the hypocentra of shocks in the Kwanto region as 34·5 km., and Ogawa combines this result with Shida's conclusion that the 1923 earthquake began as a deep-seated fracture. The depth of fracture is so great that an injection of magma seems to be implied as the underlying cause, particularly as the depth is also that deduced from other evidence as the upper boundary of the magmatic zone. On plotting the epicentra of all the great shocks of the region since the twelfth century, they are found to coincide with a zone of eruptive rocks. It is suggested that the association of volcanic eruptions with great earthquakes—recognised in South America long ago by Humboldt and Darwin—is a genetic one. The extraordinary 'depressions' and 'upheavals' of Sagami Bay revealed after the 1923 earthquake provided evidence for the tectonic theory, but Ogawa shows that this is not conclusive He interprets the changes of level as due to the shifting of sediments of mobile consistency by a process of submarine gliding initiated by the earthquake and intensified by the long waves of the *Tsunami*. The new explanation further accounts for the fact that the alleged crustal movements are limited to the floor of Sagami Bay and do not extend to the surrounding land.

THE LAW OF FORCE WITHIN THE ATOM.—In two papers which were communicated to the Vienna Academy of Sciences in 1924 and have now been issued as parts 9 and 10 of volume 133 of the *Sitzungsberichte*, Dr. Hans Pettersson describes his observations of the number and ranges of the H-particles ejected from carbon, aluminium, magnesium, nickel, and copper at angles exceeding 150° from the paths of the α-particles used in bombarding the atoms. He finds that the numbers are less than would be expected on the current theory, and concludes that some of the bombarding particles are retained by the nucleus. He also shows that the change from repulsion of like charges by each other to attraction at atomic distances, which observations have rendered probable, may be explained by the displacement of the negative charges of the nucleus towards, and of the positive away from, the approaching α-particle without departing from Coulomb's law. On this theory the surface of zero force has a radius for carbon of 1·34, for aluminium of 1·22, and for gold of 1·09 times the radius of the nucleus.

THE SULPHUR COMPOUNDS OF KIMMERIDGE SHALE OIL.—Technical literature contains numerous references to the sulphur content of Kimmeridge shale oil, and numerous unsuccessful attempts have been made to eliminate this undesirable constituent. Most of these trials have proceeded, however, without any knowledge of the form in which the sulphur occurs. It was left to Messrs. F. Challenger, J. Haslam, R. J. Bramhall, and J. Walkden to determine the problem, and the results of their work were presented to the Institution of Petroleum Technologists on February 9 last. So far back as 1885 Victor Meyer established the presence of thiophen and its homologues in coal tar, a factor having direct bearing on the sulphur condition in shale oil; subsequent researches of Mabery on American petroleum, Thierry on Persian crude oil, and Scheibler on shale oil from the Tyrol and south of France, led to the recognition of thiophen derivatives in these oils. In their investigation the authors paid special attention to that portion of the Kimmeridge oil volatile in steam, representing an average of 30 per cent., and successive fractions of the oil were examined independently. The fractions tested were—(i.) 93°, (ii.) 109°-117°, (iii.) 117°-126°, (iv.) 132°-140°, (v.) 158°-167°, (vi.) 105-115/27 mm., (vii.) 115-140/27 mm. From (i.) a small amount of thiophenmercurichloride was obtained on treating part of the fraction with alcohol, mercuric chloride, and sodium acetate. In the case of (ii.) a large amount of 2-methylthiophen was isolated; the presence of 2-ethylthiophen and 2 : 3-dimethylthiophen (2 : 3-thioxen) was established for (iv.). Fraction (v.) yielded a complex derivative, not yet definitely identified, approximating to the propyl-, methyl-ethyl-, or trimethylthiophen. From the fraction (vi.) naphthalene and thionaphthem were obtained by use of picric acid and mercuric acetate; the compound thiophthen is also suspected in this portion of the oil. As will be noted, these products are all derivatives of thiophen, but the authors have also succeeded in establishing the presence of tetramethylene sulphide and similar derivatives. These results may lead to the formulation of a successful desulphurisation process.

Dutch Pendulum Observations in a Submarine with a New Apparatus.

AT the request of the Dutch Geodetic Committee, the Minister of Marine has once more allowed Dr. Vening Meinesz to make pendulum observations on board a submarine of the Royal Navy, bound for Java, on the voyage from Helder to Alexandria.[1] He left Helder on October 15 on board H.M. Submarine K XI, and arrived at Alexandria on November 12, after having touched at Sevilla and Tunis. On November 23 he embarked at Port Said on board the Dutch mail-steamer *Koningin der Nederlanden* and disembarked on December 5 at Amsterdam.

The main object of the voyage was the trial of a new pendulum apparatus constructed on the lines described by Dr. Vening Meinesz in No. 5, Janvier/Mars 1925, of the *Bulletin Géodésique*, the organ of the geodetic section of the Geodetic and Geophysic Union. With the consent of the Minister of "Waterstaat" and the director in chief of the Royal Meteorological Institute at de Bilt, Prof. Dr. E. van Everdingen, the apparatus was constructed in the mechanical workshop of this Institute by the chief instrument-maker, Mr. L. L. M. van Rest, with the co-operation of the assistant director, Dr. C. Schoute.[2]

A detailed description of the apparatus with the necessary illustrations will appear in a publication of the Geodetic Committee; for the time being the following cursory description may suffice.

The whole apparatus consists of three parts: the support with the pendulums, the suspension apparatus and the recording apparatus.

The support contains three quarter-metre pendulums of the common Von Sterneck model, the same as were used on the first voyage. These are of brass, not of bronze as was stated erroneously in my former communication.

The three pendulums are rendered as near as possible isochronous. They oscillate in the same plane and can be set going simultaneously with an exactly adjustable amplitude. The oscillations are recorded on a moving photographic film by the light reflected by a mirror fixed to the pendulum, but not, as with the former apparatus, for each of these separately. The light-ray reaches first the mirror of the first pendulum; next that of the second. It records in this way the difference of the elongation angles. The result is that the film gives the curve of a hypothetical pendulum, of which the revolving vector is the difference of the vectors of the constituent pendulums. As the disturbances of those, caused by the horizontal accelerations due to the movement of the vessel, are the same, their effect is eliminated from the hypothetical pendulum.

In the same way, a second hypothetical pendulum is recorded by the third pendulum in combination with the second. The two curves give two independent results, which control one another and increase the accuracy.

For the amplitude reductions of the observations, the movement of the second pendulum must be recorded separately; the ray which performs this is on its way reflected by a small, highly damped pendulum, of a construction devised by Dr. Vening Meinesz, the plane of oscillation of which is parallel to that of the other pendulum. In this way the movement of the middle pendulum is recorded with respect to the vertical.

A second highly damped pendulum of the same construction, the plane of oscillation of which is perpendicular to the plane of the others, serves to record the inclination of this plane during the observations. It was controlled by a small undamped pendulum, but the results proved that this control is not necessary.

The changes of temperature within the apparatus during the observations are recorded by means of a metallic thermometer.

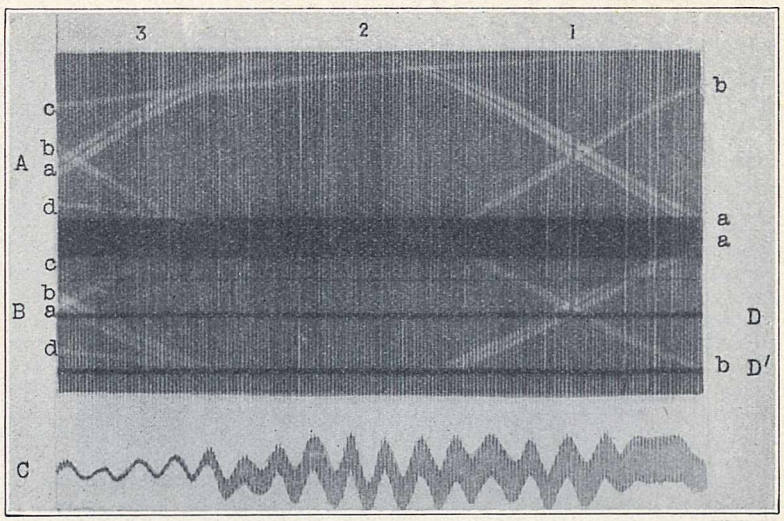

FIG. 1.—November 12, Tunis Harbour. A and B, curves of hypothetical pendulums (overlapping). Time gaps showing four curves: *a* and *b*, sidereal time (short period); *c* and *d*, mean time (long period). C, curve of middle pendulum. Inclination of plane of oscillation: D, damped pendulum; D′, undamped pendulum.

Before the rays of light enter the support, they pass a lens that makes them parallel. When leaving it they pass a second lens that collects on the film the constituents of every bundle of rays. Within the apparatus each bundle is compelled to follow its path by a number of mirrors or prisms. In every path there is one adjustable prism by which the distribution of the curves on the film can be regulated.

Between the observations the pendulums are not to be removed; they can remain in the apparatus, even when the motion of the vessel is most violent. By turning a small handle the knives of the pendulums are lifted from the agate planes on which they oscillate during the observations. By moving a second handle the double cone at the lower end of each pendulum is fixed between four arms. The fastening is strong, but elastic, in order to avoid the effect of shocks on the pendulums. The disposition is such, that when the pendulums are free it is impossible for any one to turn the handle that commands the arms below before the pendulums are lifted; or when the pendulums are fastened, to turn the handle that lowers them before the arms are removed.

The brass top and base plates of the support are connected by strong vertical slabs; the top plate

[1] Particulars of the voyage on board H.M. Submarine K II from Helder to Batavia in 1923 are given in NATURE of September 15 and December 1, 1923, and March 1 and May 3, 1924.

[2] If geodetic offices in other countries should wish to purchase a similar apparatus, the "Nederlandsche Seintoestellenfabriek" at Hilversum will undertake the construction.

carries the pendulums, the fixed mirrors and prisms and the two lenses. The three agate planes on which the knife-edges of the pendulums rest lie in exactly the same plane; they have been ground and adjusted by the firm Hahn in Cassel (Germany). The base plate rests on three foot screws; parallel to the plane of oscillation of the pendulums a small level is affixed; the bubble is, during the observations, in constant movement owing to the rolling of the vessel; the pendulums must be set free the moment that the bubble is at zero, in order to begin the oscillations with the desired amplitude. Between the top and the base plate are placed a dummy pendulum with thermometer and a hair hygrometer.

The support is encased in a metallic cover with double walls, resting on the base plate; the interstice is filled with a bad conductor of heat. A receiver is not needed. The time of an observation being about thirty-five minutes, it is not necessary to operate in a vacuum, which would cause a great complication. In the cover are three windows: one for each of the two lenses and one for reading the thermometer and the hygrometer.

The whole is placed in the suspension apparatus, the plane of oscillation of the pendulums perpendicular to the suspension axis. The latter must be parallel to the keel of the vessel; in this way the effect of the rolling is neutralised. Originally the apparatus was suspended from pivots, but as the friction caused sudden jerks, these were replaced during the stay at Sevilla by knives, which proved most satisfactory.

The recording apparatus contains two compartments: the small light box and the larger film box.

Behind the light box is placed a Wolfram arc-lamp; the rays of this enter the box through a hole in the back. In the front wall is the small horizontal light-slit, 0·2 mm. wide and 5·0 mm. long, through which the rays leave the box. The interior contains the apparatus for the electromagnetic movement of two shutters, governed by a pair of chronometers, each of which every half second prevents for a moment the light-rays from passing the slit.

The film box contains two vertical cylinders, one bearing the film, which by a clockwork is gradually wound round the other. By the displacement of a lever the velocity with which the film moves can be made 1·0 or 0·33 mm. per second; the first is used at the beginning and the end of the observations, the latter in the intermediate time. Between the cylinders the film moves past a vertical slit in the front wall of the box, 9 mm. wide and 12 cm. high; through this pass the rays coming from the support. The lenses form images of the light-slit on the film, but by a cylindrical lens placed before the recording-slit they are reduced to points. The distance between the optical centres of the lenses is the same as that between the light-slit and the recording-slit. As both slits and both lenses are placed symmetrically with regard to the suspension axis, the place of an image of the light-slit on the film is not changed by the relative movements of the free hanging support and the steady recording apparatus which are caused by the rolling of the vessel.

By the movement of the film the bundles of rays describe the different curves, which, owing to the periodical movements of the shutters, show small gaps that indicate the time elapsed.

The distance between the support and the recording apparatus is 1·03 metre; a tube of blackened cardboard joins the second lens and the vertical slit, and prevents undesired light striking the film.

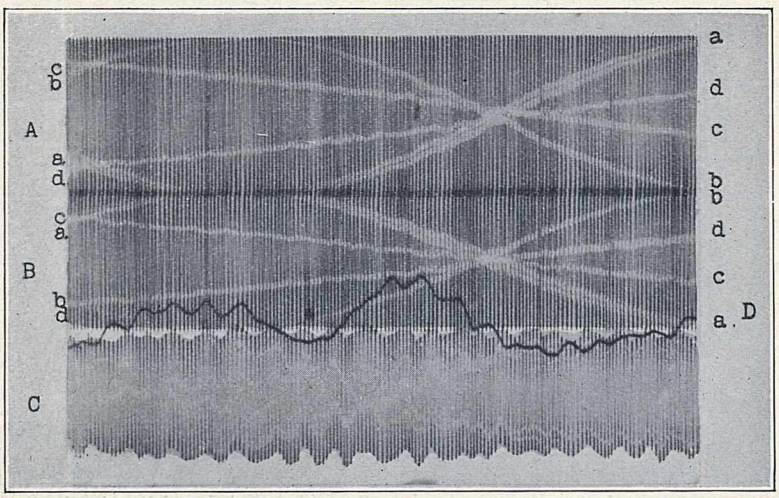

FIG. 2.—November 10, Mediterranean Sea, submerged. Curves as on November 2. Undamped pendulum D′ absent.

The two chronometers, constructed by Nardin at Locle, Switzerland, are excellent time-keepers; the irregularities of the daily rate do not exceed 0·1 sec. One, giving sidereal time, has been in use since 1903, the other, giving mean time, is new. It was judged useful to have two chronometers for the purpose of checking each other.

It may be said that in practice the apparatus has surpassed our expectations. The curves recorded on the film are perfectly clear and distinct; their appearance is wholly different from that shown by the films obtained in 1923. This may appear from the accompanying specimens (Figs. 1 and 2) when compared with those given in the *Geographical Journal* for June 1925. The amplitudes of the hypothetical pendulums are entirely regular, which proves that the influence of the horizontal accelerations is wholly eliminated. Letting alone the slow decrease caused by the damping, the amplitudes do not vary more than 0·1 mm., that is 2 to 3 per cent. of the whole amplitude. The vertical accelerations are only perceptible in the track of the half-second gaps, which show slight fluctuations; by tracing a straight line through a number of them the influence is easily eliminated.

Sliding of the pendulums is only to be feared in peculiar circumstances. Thanks to the suspension apparatus, the rolling has no influence, but when the pitching exceeds a few degrees, sliding is noticeable, and the images may even altogether disappear from the film. By the use of the horizontal rudder the pitching of a submerged submarine can generally be greatly reduced, if necessary, after submerging to a greater depth.

Observations with the suspending apparatus hanging free or fastened, executed in quiet water, proved that there is no systematic influence caused by this apparatus.

The advantages of the new apparatus over the old one may be summarised as follows:

1. The exertion required from the observer is a great deal less; he is not compelled during the observations to keep the body in a cramped posture under a black cloth, such as covered the old apparatus.

2. The measurement of the films is very easy, thanks to the clearness and regularity of the recorded curves.

3. The computations are simplified; as the films directly give the movement of the hypothetical pendulums, these have not to be derived by computation from the curves for each separate pendulum.

4. The accuracy of the observations is greater; it is not inferior to that of observations on land.

5. The apparatus may still be used in circumstances where the old one would be useless.

As to the accuracy of the results, it may be remarked that two circumstances unconnected with the apparatus make it somewhat less than that obtainable on land. The first is the varying rate of the chronometers, which may differ during the observations from the mean value, deduced from the time-signals. If scientific radio time-signals of very high precision could be obtained every hour, this would meet the difficulty. The influence is lessened by the use of two chronometers.

The second circumstance is the displacement of the vessel during the observations by the sea currents and the resulting contribution to the Eötvös effect. This cannot be determined with accuracy and an average value must be used. I think it improbable that this difficulty will be easily removed.

On board, the apparatus was placed in the central compartment, near the metacentrum, between the two periscopes, one of which was lifted to enable the light-rays to pass.

At the beginning of an observation the first and the third pendulum were set in motion with the desired amplitude. The middle pendulum, hanging free, began to oscillate through the horizontal accelerations caused by the movement of the vessel.

The depth of the sea was found by applying the echo method by means of the underwater clock-signals. The lapse of time between the giving of the signal and the perception of the echo was determined by a stop-watch.

The time-signals used to determine the rates of the chronometers were generally those of the Eiffel Tower, Bordeaux or Nauen. The relative rate of the chronometers during the observations could be deduced with very great accuracy from the half-second gaps on the films. So far as the computations have been executed, they agree fairly well with the mean relative rates deduced from the time-signals.

During the voyage the following observations were made:

October 17. Mouth of the Channel, near the French coast.
,, 18. Bay of Biscay, not far from the Spanish coast.
,, 26. Sevilla, on the Guadalquivir.
,, 28, 29, 30. Mediterranean Sea, between Gibraltar and Tunis.
November 2. Harbour of Tunis.
,, 8, 9, 10. Mediterranean Sea, between Malta and Alexandria.
,, 12. Harbour of Alexandria.

Some of the observations have been provisionally computed; the results for the harbours of Tunis and Alexandria differ respectively by 0·001 and 0·007 cm./sec.$^{-2}$ from the values obtained in 1923.

The weather was generally very fine and the sea smooth; but on November 27, after the vessel left the harbour of Tunis, a heavy gale was blowing, which prevented the making of observations. The small number of observations in the Atlantic Ocean must be imputed to the circumstance that the time fixed for the track from Helder to Sevilla allowed but small delay. The observations in the Mediterranean Sea constitute a valuable complement to that executed in 1923.

November 26, on board the mail-steamer *Koningin der Nederlanden*, between Crete and Sicily, Dr. Vening Meinesz made a series of observations. The sea was very smooth and the movements of the ship slight. The apparatus was placed in a state-room; practical difficulties prevented the use of the suspension apparatus. Some of the observations had to be repeated because of the sliding of the pendulums. The films show the influence of the vibrations caused by the engines, but the amplitudes are very regular. The weather during the rest of the voyage prevented further experiments being made, but it appears from the results that in favourable circumstances it is possible to use the apparatus on board a mail-steamer.

I think that Dr. Vening Meinesz may be heartily congratulated on the success he has achieved with his apparatus. The Geodetic Committee cherishes a strong hope that he will be enabled in the course of 1926 to use it on a second voyage to Java, but this time through the Panama Canal, in this manner concluding a series of determinations of gravity at sea all around the world. J. J. A. MULLER.

Life in the Bed of the Sea.

IN recent years many attempts have been made to obtain more definite information than the older naturalists had about the composition and the *constitution* of the collections of animals living in the bed especially of the European shallow seas. It was known in a vague way that certain animals were to be found, for example, in a muddy and others in a sandy bottom at certain depths; hence the challenge to modern naturalists to clarify the condition of our knowledge.

The first serious attempt was made by Allen on the grounds off Plymouth, and it was proved clearly that certain forms were definitely associated in that locality with a certain type of bottom which was defined in terms of the percentage composition *in size* of the particles composing the ground soil. Later, Petersen, employing an approximately accurate instrument, the grab, for taking a definite area of the sea-bottom, obtained figures which showed which animals were really dominant and characteristic in the different areas examined, but that worker failed to follow up Allen's precise work on the physical composition of the soil, and therefore failed to obtain critical information on the problem attacked. Other workers—notably Ford, who attempted to combine the methods of Allen and Petersen—followed, and have in the main always found communities of animals, but communities also in the main in their own particular locality of silty, muddy, sandy, gravelly or stony soil.

It has remained, however, for Davis in a recent publication[1] to combine to some extent the methods of the two chief investigators. Petersen had found different groups of animals living together in different localities and suggested that such animals lived in *communities*, which, however, might vary in different geographical but equivalent localities by the dropping out or addition of certain members. The later

[1] Ministry of Agriculture and Fisheries. Fishery Investigations, Series 2, Vol. 8, No. 4, 1925: "Quantitative Studies on the Fauna of the Sea Bottom." No. 2: "Results of the Investigations in the Southern North Sea, 1921–24." By F. M. Davis. Pp. 50. (London: H.M. Stationery Office, 1925.) 5s. net.

worker went further than this and tried to predict the 'communities' which might be expected to occur in (quantitatively) unknown faunas off the European coast.

By his use of the term 'community' Petersen seems to imply more than Hjort does, for example, in referring to 'societies' or communities of plankton forms in the different hydrographical regions of the Atlantic, or than botanists do in referring to ecological groups of plants, and by his relative neglect of soil analysis gives more importance to the mere association of animals than to the relation of the animals to the nature of the soil. In this attitude Petersen has in part followed Mobius, who long ago (1877) stated that the animals living on an oyster bed form a community, and goes on to say that "Science possesses, as yet, no word by which such a community of living beings may be designated . . . where the sum of species and individuals, being mutually limited and selected under the average external conditions of life, have, by means of transmission, continued in possession of a certain definite territory. I propose the word *Biocœnosis* (from *bios*, life, and *koinoein*, to have something in common) for such a community."

Obviously all these are the beginnings of attempts in marine zoœcology or *zoocönosis*, and we are witnessing the early stages in the evolution of a nomenclature and, indeed, of method. Davis adopts, but unfortunately, we think, in a modified way, the Allen-Borley method of soil analysis, and pays insufficient attention to the hydrographical and topographical variants, which both Petersen and Borley noted. Thus in no case are all the correlated observations to date marshalled in such a way as to indicate an enduring natural classification of such associations or groups as do undoubtedly occur, although Petersen's broad method of treatment alone has certainly carried the problem beyond its initial stages. In his paper, Davis gives a remarkable table showing soil-analyses correlated with the animals inhabiting particular soils and clearly shows that a large number of animals prefer a particular soil in the North Sea, though some are more catholic in habitat. The author concludes that animal associations were found, but that in detail those groups (communities) which Petersen found are not homogeneous in nature when regarded in relation to the soil analyses, nor strictly comparable with one another in the areas investigated.

We hold, however, that there is not enough information available for the latter part of the conclusion, since (1) Petersen gives no analysis of soils to define his communities, (2) the fauna in relation to known soils has not been adequately investigated at stations linking Petersen's scene of work with the North Sea stations, (3) Davis has himself grouped together animals only in relation to soils without consideration of other biological factors—despite Borley's warning—and (4) what is more important, the biological significance of the soil and medium for the animals inhabiting them has scarcely yet been considered, and a close study of individual species will be required to give the information needed on this point.

The trend of modern work is indeed to delimit and to come to grips with the problem of the relation of any animal to its habitat. The essence of the work on marine animal communities is the provision of a complete description of the factors of the habitat and the inter-relationships of the members, and the results should be stated so as to be capable of comparison or contrast with one another in all parts of the world. J. H. O.

Applied Psychology.

PROF. J. MCKEEN CATTELL, the retiring president of the American Association for the Advancement of Science, gave in his address at Kansas City on "Some Psychological Experiments," a portion of which was published in NATURE of January 16, an illuminating account of the development of the experimental study of individual differences. Starting with a description of the measurement of a simple sense reaction time, he proceeded to show, step by step, how the same type of objective measurement can be used in such a complicated action as the selection of a career.

Although no striking new experiments were described, Prof. Cattell's account of the recent applications of psychology was both original and stimulating. "Daily, weekly and seasonal curves," he says; "the optimum periods for definite tasks and for a day's work; industrial fatigue; temperature, ventilation and humidity; the most desirable sexual relations, food, amount and distribution of sleep; rest, play and physical exercise; the use and misuse of emotional excitement and of drugs as sedatives and stimuli: these have been the subjects of many investigations. . . ."

An interesting point discussed by Prof. Cattell is the variation of the curve of ease of learning with age. It is well known that a young child can learn to pronounce a foreign language more easily than can his father and mother. Three years is found to be the optimum age for acquiring pronunciation, and after the age of twelve years it can but rarely be learnt correctly. In the same way other abilities—both physical and mental—have their optimum learning curve at various ages. It is an important task for the educational psychologist to examine the practice curves of the ordinary school subjects at different age levels, so that he can suggest at what stage they should be commenced. Mathematical relations, Prof. Cattell finds, are generally taught a couple of years before the child's age allows him to respond to them with the least effort.

Reference is made to the work that is being done in England by the National Institute of Industrial Psychology to reduce industrial fatigue. Psychologists have found that by arranging for suitable alternative periods of rest and exercise, and by supplying training in the use of the most physiologically economical movements, it is possible to increase the output of the worker—be he miner, mill-hand, or typist—and simultaneously reduce his fatigue. Prof. Cattell outlines the enormous economic importance of this work and describes how in America a Psychological Corporation has been formed to advance this new science, to allow of research, and to protect the interest of psychologists. "The Father of American Psychology," as Prof. Cattell is well named, is the president of this Corporation, and its establishment has already been amply justified. W. J. G. S.

University and Educational Intelligence.

BIRMINGHAM.—Dr. Daniel Hanson, principal assistant in the Metallurgy Department of the National Physical Laboratory, Teddington, has been appointed to the Feeney chair of metallurgy, which will be vacated by Prof. T. Turner at the end of the current session.

Mr. J. Armitage Robertson has been appointed assistant lecturer in zoology.

LONDON.—The following doctorates have been conferred: *D.Sc.* (*Chemistry*): Mr. H. T. S. Britton (King's College and Imperial College—Royal College

of Science), for a thesis entitled "Part I. Some Electrometric Studies of Reactions, with special reference to the Precipitation of Basic Salts; Part II. Some Studies of Salts of Rarer Metals"; Mr. H. D. K. Drew (Birkbeck College), for a thesis entitled "Heterocyclic Systems containing Tellurium in the Ring"; and Mr. M. A. Matthews (East London College and the Sir John Cass Technical Institute), for a thesis entitled "The Reactions of the meso-Hydroxy Anthrones and their Bearing on the Mechanism of certain Reactions"; *D.Sc.* (*Statistics*): Mr. E. S. Pearson (University College), for a thesis entitled "Bayes' Theorem examined in the Light of Experimental Sampling"; *D.Sc.* (*Geology*): Mr. George Slater, for a thesis entitled "Glacial Tectonics as reflected in Disturbed Drift Deposits," and other papers; *D.Sc.* (*Horticulture*): Mr. H. R. Briton-Jones, for a thesis entitled "On the Diseases known as 'Bark Canker' and 'Die-back' in Fruit Trees," and other papers; *D.Sc.* (*Physics*): Mr. L. F. Richardson, for a thesis entitled "Collected Works on Meteorology, Differential Equations, etc."

DR. H. R. BRITON-JONES, lecturer in mycology in the Department of Agriculture of the University of Bristol, has been appointed professor of mycology to the Imperial College of Tropical Agriculture, Trinidad.

MR. FRANK BALFOUR-BROWNE, formerly lecturer in zoology (entomology) in the University of Cambridge, has been appointed professor of entomology in the Imperial College of Science and Technology, South Kensington, in succession to the late Prof. H. Maxwell Lefroy.

APPLICATIONS are invited for two scholarships in connexion with the Manchester Royal Infirmary, namely, the Dickinson research travelling scholarship in medicine, value 300*l* for one year, and the Dickinson pathology scholarship, value 75*l* for one year. Particulars are obtainable from the Secretary to the Trustees, The Royal Infirmary, Manchester. The latest date for the receipt of applications for the scholarships is May 1.

A CENSUS of graduate research students in chemistry in the United States in 1925 shows that of 1763 such students in 121 universities, colleges, schools of engineering and agriculture, medical schools, and schools of pharmacy, 544 were engaged on work in the physico-chemical group of subjects: general, colloid, catalysis, subatomic, electro-chemistry, and photo-chemistry. Organic chemistry comes next with 430 students of whom 44 per cent. were working on the aliphatic series. The remainder are classified under the groups, medicine (333), agricultural, industrial, and engineering chemistry (237), inorganic chemistry (86), analytical and metallurgical (72), sanitary and food (61).

IN connexion with the celebration of the fiftieth anniversary of the Johns Hopkins University, it is proposed to establish a Brooks Research Fund in memory of the late Prof. William Keith Brooks. The income of this Fund is to be used to give to some advanced student in zoology or in botany aid in carrying out his work in direct contact with Nature, as at a tropical marine laboratory, or under other stimulating conditions of environment for growth and widening of experiences. The hope would be that from time to time some man thoroughly devoted to zoology or to botany might receive in this way needed aid at a critical point in his career. An offer of five hundred dollars has been received if a further ten thousand is raised. The Fund will be distinct from that now being raised to celebrate the jubilee of Johns Hopkins. Prof. E. A. Andrews, Johns Hopkins University, is chairman of the appeal committee.

"WHAT every woman's college course ought to include" is a question which has been much discussed of late by the Faculty of Barnard College, Columbia University. The conclusions arrived at as a result of these discussions are described in an article by the Dean of the College, Virginia C. Gildersleeve, in the December number of *School Life*. While recognising that in many fields of work it is almost impossible to say that one subject is for all students more valuable than another and a wide range of choice must be permitted, the College prescribes for all the mastery of certain fundamental tools useful for successful work in any field. These are: "A command of written and spoken English, the ability to read at sight with ease at least one foreign language, a healthy body, and a knowledge of hygiene." To ensure the acquisition of these tools, courses in English composition, spoken English (chiefly for remedying defects of the voice), personal hygiene, and human biology are made compulsory—the three first-mentioned being taken during the first of the four years of college life. All students are also obliged to take, during their four years, appropriate physical exercise. As regards the selection of the remainder of the curriculum, two general rules are laid down. On one hand every candidate for a degree must pursue in some one subject a course, carefully planned and supervised by the department concerned, on lines designed to ensure a fairly thorough knowledge of it. On the other hand, in order to avoid too much concentration, every student is required to reach a certain minimum standard in at least one subject chosen from each of the three groups—languages, literatures, and fine arts; mathematics and natural sciences (including some laboratory work); and social sciences.

A REVIEW of Education in India in 1923-24 by the acting Educational Commissioner, which the Government of India has recently published, shows that in the field of higher education the year was in several respects one of disillusion and reaction. In the University of Allahabad, for example, the new constitution was found to keep the minds of the teachers so engaged in the technicalities of meetings of university bodies that they had insufficient time left for teaching duties. In Bengal a widespread dissatisfaction with the existing university system found expression in a reaction against literary education and a preference for science courses. From Assam came reports that graduates and undergraduates seek employment in vain and create discontent with the system which has brought them to such a plight. The University of the Punjab was reported to be "becoming more and more on the major side of its activities an examining body." The policy of separating the intermediate classes from the university course of study has been found in the United Provinces, where it was tentatively adopted, to be unworkable for the present in the colleges which prepare degree candidates. In Bombay the school-leaving certificate examination does not altogether fulfil the hopes with which it was instituted, and it was decided that the University should resume the conduct of its matriculation examination. The Dacca Vocational Education Committee presented a report in which doubt is thrown on the belief of the Calcutta University Commission that at the intermediate stage vocational education can be so combined with general education as to produce a worker competent to earn his living with the training which he has undergone at the close of that stage. There was also disillusion of a beneficent kind on the part of some political enthusiasts and the effect of the non-co-operation movement on attendance in schools became negligible. The University of the Punjab embarked on a new venture in the opening of its first science laboratory—that of chemistry.

Contemporary Birthdays.

April 11, 1862. Prof. W. Wallace Campbell, For.Mem.R.S.
April 11, 1863. Mr. Henry Balfour, F.R.S.
April 11, 1890. Dr. Eric K. Rideal.
April 12, 1851. Mr. Edward Walter Maunder.
April 14, 1867. Prof. J. C. M'Lennan, F.R.S.

Prof. W. W. CAMPBELL, the distinguished director of the Lick Observatory, Mount Hamilton, California, and president (since 1923) of the University of California, was born at Hancock Co., Ohio. The development of astronomical knowledge owes much indeed to him during the past thirty-five years, not only for practical issues, but also for valuable contributions to the journals recording theoretical progress in the science of astronomy. He has had charge of many eclipse expeditions, and those who were privileged to act with him have testified to his enthusiasm, powers of organisation, and resourcefulness. Prof. Campbell was among those who were successful in adopting the method of employing a moving photographic plate to record the succession of phenomena during a solar eclipse. The Royal Astronomical Society awarded him its gold medal in 1906 for his spectroscopic researches on stellar objects, and work respecting stellar motions in the line of sight. The Paris Academy of Sciences allotted Prof. Campbell the Lalande medal in 1903, and the Janssen medal in 1910, for researches and discoveries in stellar spectroscopy.

Mr. HENRY BALFOUR was educated at Charterhouse and Trinity College, Oxford. Since 1891 he has been curator of the extensive ethnological and archæological collections acquired by the late General Pitt Rivers, F.R.S., and presented by him to the University of Oxford in 1884. Huxley medallist of the Royal Anthropological Institute, and a past president of the Folk-lore Society, Mr. Balfour is the author of many noteworthy memoirs.

Dr. E. K. RIDEAL is an old pupil of Oundle; from thence he graduated at Trinity Hall, Cambridge. He is Owen Jones lecturer in physical chemistry in the University of Cambridge. For a year (1919–20) Dr. Rideal was visiting professor of physical chemistry in the University of Illinois, U.S.A.

Mr. E. W. MAUNDER, astronomer, entered the service of the Royal Observatory, Greenwich, as an assistant in 1873, and from that date until 1913 he was Superintendent of the Solar Department. Mr. Maunder was educated at University College School, London, and King's College. He has taken part in many eclipse expeditions. Author of a number of useful works on practical and popular astronomy, he has in several of these had the happy advantage of Mrs. Maunder's collaboration. He founded the British Astronomical Association in 1890.

Prof. J. C. M'LENNAN, Director of the Physical Laboratory in the University of Toronto, though born at Ontario, is of Scottish descent. He received his education at the Universities of Toronto and Cambridge. His attachment to the former began in 1892, and has never been severed. Prof. M'Lennan was president of the Royal Society of Canada, 1924–25. In 1923 he was president of Section A (Mathematics and Physics) at the Liverpool meeting of the British Association; the subject of his discourse was, "On the Origin of Spectra." The Royal Society of Arts allotted him a medal in 1919, for his paper "Science and Industry in Canada." He is D.Sc., Manchester and Liverpool.

Societies and Academies.

LONDON.

Royal Microscopical Society, February 17.—A. **Piney**: The principles of hæmatological differentiation. An attempt to classify the normal leucocytes of human blood on purely morphological grounds. The characters of the nuclei must be regarded as the determining feature, particularly the distribution of the two forms of chromatin. Cells with sharp distinction of the chromatin into two types were derived from the bone marrow (myeloid cells), while those with incomplete separation of the two substances in the nucleus were of lymphatic origin. The technical details of preparing the films were discussed.

Royal Microscopical Society (Industrial Applications Section), February 24.—C. A. **Klein**: The application of the microscope to the examination of pigments and paints. More precise information is required as to the size of pigment particles in view of the important relationship known to exist between particle size and the subsequent behaviour of paints, in respect to ease of application and also wearing properties. The methods of sieving and subsidence frequently used to indicate the fineness of division of pigments have limitations, and microscopical examination is recommended after grading of the material by elutriation, in order to obtain fields of more even-sized particles. The removal of even small proportions of over-sized particles in paint materials is an expensive process. Many problems in connexion with the behaviour of paint films on drying and subsequent exposure could be solved by the proper application of microscopical methods as in the United States of America, where they have been applied to a considerable extent.

Royal Anthropological Institute, March 2.—Mrs. Janet B. Montgomery **McGovern**: The head-hunters of Formosa. The Chinese-Formosans of the towns do not differ materially from the Chinese of the mother country; it is among the pseudo-aboriginals of the almost inaccessible mountain ranges that curious customs are observed. Of these tribes the most interesting are the Taiyal, the head-hunting tattooed tribe of the northernmost mountains. A feature of their culture is the government of the tribe by women. Their power is both spiritual and temporal. The chieftainess of each sub-tribe is also the priestess of that sub-tribe. She is assisted by other priestesses, mostly widows. They officiate at marriage and funeral ceremonies, and act as physicians in case of illness, effecting some marvellous cures. The chief priestess also performs the ceremonial tattooing. All the children have their foreheads tattooed in a series of horizontal marks at the age of five years. At marriage, elaborate markings are tattooed on the cheeks of the bride, and on attainment of the rank of priestess further elaborate markings are added. The warriors are also tattooed by the priestess. One function of the priestess is the ceremonial kindling of new fire once a year. From this all fires are re-lighted. The priestess also decides when head-hunting expeditions are to be carried out, and in what direction. No warrior may marry unless he has at least one head to his credit. For each head that is taken, a horizontal mark is tattooed on the chin. An essential part of the marriage ceremony is that bride and groom should drink millet wine from a cup made of a skull taken by the latter. A communal system prevails among the Taiyal, the millet, the principal food of the people, being distributed by the high priestess from the communal

granaries. A very high standard of personal morality exists among them, and untruths, theft, and unchastity are almost unknown where the people have not come into contact with civilisation.

March 16.—G. **Landtman**: Some agricultural rites of the Kiwai Papuans. The gardening of the Kiwais, like all their occupations, is interwoven with all kinds of observances purporting to promote the work. When clearing timbered bush the people avoid felling certain large trees which are thought to be inhabited by the *étengena*, a group of sylvan beings. These appear by day as snakes or birds, at night in human form, and are guardians of the plantations. The people give them part of the first-fruits and invoke them in the *karéa*-rite, sprinkling of *gámoda* (*káva*) in the direction of the garden. Most of the fertility rites are first performed in the garden by an old man and an old woman, whose example is followed by the rest of the people. In several of the rites the sexual act plays a part, and one of the principal "medicines" is secretion from the female genitalia, for sago palms the male semen. The people also resort to various methods for depriving an enemy of his luck in gardening, or for summoning pigs to destroy his crop. The old couple generally lead the way in every stage of garden work with their preparatory rites. Each of the principal garden plants is attended by observances of its own. Bullroarers are particularly used for yams. The first few yam stalks are usually tied up with strings which have been employed for cat's cradles. "Skipping-rope" is a game which causes the yam roots to grow large. Certain rites at the first cropping of a garden purport to make the food last a long time and prevent the people from being taken ill when eating it. A series of rites referring to the banana gardens are performed by a number of small boys, each with a little "play-wife." These small couples bear resemblance to the various descriptions of "May-brides," etc. The principal feature of the *gaera*, the great agricultural ceremony, is a tree erected on the festal ground with much solemnity, overhung with garden produce and beautifully decorated. A long serial song is sung during the ceremony, describing a journey from Adiri, the land of the dead, in an easterly direction right through the part of the country known to the Kiwais. One cannot forbear recognising one of the many instances of the fertility tree or the tree of life.

Mineralogical Society, March 16.—A. F. **Hallimond**: On molecular volume relations in the mica group. The 'observed' molecular volume is obtained from the density and silica-percentage, on the assumption that the mica molecule contains the same number of silicon atoms for all members of the group. It is shown that the molecular volumes so obtained are of similar dimensions throughout, but that each of the non-miscible sections, muscovite, lepidolite, etc., has a distinctive molecular volume, in agreement with the chemical classification proposed in earlier papers. The volume is an additive property, and can be expressed as the sum of the volumes of the oxides present. The corresponding absolute molecular volumes for the oxides are in general agreement with those derived from X-ray measurements. Micas deficient in potash do not show a corresponding diminution of volume. Titanium is usually present as TiO_2, but two titanium-rich biotites only give normal molecular volumes when represented as compounds of Ti_2O_3.—E. D. **Mountain**: (1) Smithsonite from the Rhodesia Broken Hill Mines. Colourless crystals 7 mm. in size, in the British Museum (Natural History), are of the form f(1$\bar{1}$1), striated parallel to longer diagonal; cleavage angle $rr' = 72° 21'$; $H = 4 - 4\frac{1}{2}$; $G = 4{\cdot}398$; contains 97·34 per cent. $ZnCO_3$. Refractive indices measured on oriented prisms gave for Na-light $\epsilon = 1{\cdot}6212$, $\omega = 1{\cdot}8485$. (2) The identity of the Cobija and Lampa meteoric stones. A complete quantitative analysis of Cobija and a partial analysis of Lampa confirm Dr. Prior's suggestion of their identity; $f = 14$, $n = 10\frac{1}{2}$, $m = 5$ (Prior's nomenclature); specific gravity, 3·58. Further evidence suggests that they are two stones of the Cobija fall.—C. E. **Tilley**: On garnet in pelitic contact zones. In the normal pelitic contact zone, garnet is inconstant in its occurrence, and from many aureoles is entirely absent. The instability of almandine in normal thermal metamorphism is attested by the destruction of this mineral when crystalline schists containing it are involved in the aureoles of the Caledonian granites of Scotland. Aureoles especially conspicuous for the presence of garnet are those of New Galloway, Co. Wicklow, and Skiddaw. Analyses of garnets from these show considerable spessartine percentages, varying from forty to fourteen. The occurrence of garnet in pelitic contact zones (stress zones excluded) appears to be conditioned by the presence of a considerable MnO content, promoting the formation of spessartine bearing types. Almandine proper is characteristically a stress or high-pressure mineral; the physical conditions for its formation are not realised in normal thermal aureoles.

Royal Meteorological Society, March 17.—Sydney **Chapman**: Some recent advances in atmospheric physics (Symons Memorial lecture). The existence of a strongly ionised layer in the upper atmosphere, required by theories of the daily variations of the earth's magnetism, and also required to explain the long-distance transmission of wireless waves, has recently been strikingly demonstrated by observations of high-angle reflection of short-wave wireless signals at night. The wireless and magnetic data for the ionised layer are in fair qualitative and also quantitative accord where they overlap. It appears possible to explain the production of the ionisation by ultra-violet radiation absorbed in the atmosphere by day, certain quantitative difficulties proposed by Swann being found invalid. Additional ionisation occurs, by night as well as by day, in higher latitudes, in association with auroræ. The nature of the ionising agent in this case is somewhat obscure, but a stream of charged corpuscles of opposite signs, but with a slight residual charge, seems the most likely hypothesis. The auroral spectrum suggests that nitrogen is the principal ionised gas in the auroral regions.

Royal Microscopical Society, March 17.—Mohammed **Ali**: Studies on *B. ægypticus*, Pt. I. The appearance and structure of colonies of this organism upon artificial media and its morphological characters were described. Variations in the H-ion concentration of the medium transforms the minute rod of 1 μ into a filament often thirty times that length, which latter could be restored at will to the type form, thus demonstrating that heritable tendencies are not involved. In this respect *B. ægypticus* behaves in a precisely comparable manner to *B. influenzæ* (Pfeiffer). There is a lack of morphological, tinctorial and cultural difference between these two members of the hæmophilic group of bacilli; the only differentiating point so far observed has been the longer vitality upon artificial media of *B. influenzæ*.

EDINBURGH.

Royal Society, March 8.—N. B. **Eales**: The anatomy of the head of a fœtal African elephant. The muscles, blood-vessels, nerves and skeleton are described. Despite its youth, the skull possesses the features of a modern elephant, and the flattening of the facial region at the root of the proboscis has already taken place. No traces of the first premolar or of the lower incisor teeth are present. All the teeth of a young elephant are represented and no others. The fœtal mandible exhibits the *longirostris* condition and is turned downward at the symphysis. Its vertical measurement is relatively shorter and its horizontal measurement relatively greater than in the adult. The shape resembles that of the fœtal elephant's ancestors rather than that of its own parents.—C. M. **Yonge**: The digestive diverticula in the lamellibranchs. The so-called liver or hepato-pancreas of the lamellibranchs consists of a great number of ramifying blind tubes, the epithelium of which is composed of one kind of cell only. There is no evidence that the cells secrete or perform any of the functions of a liver or a pancreas; the whole structure is an organ of absorption and intercellular digestion, small particles being directly ingested and acted upon by digestive enzymes within the cells. The only extracellular enzymes in the gut of lamellibranchs are those elaborated in the crystalline style.—W. **Peddie**: Present problems in colour vision: the laws of visual fatigue, and of resultant sensation. The paper deals specially with the form of the relation which expresses the threshold value, that is, the least perceptible value, of an external stimulus, in terms of the external stimulus itself. This expression is then generalised so as to take account of interrelation of effects, and of the influence of any given fatiguing light to which the eye may have been previously exposed. This generalisation furnishes an explanation of the peculiar effect of strong precedent fatigue upon the sensitiveness of the eye to spectrum colours, which has been investigated in detail by Prof. Frank Allen.—F. A. E. **Crew**: On fertility in the domestic fowl. Fertile eggs are to be expected about 48 hours after the introduction of the male into a pen of virginal laying females; the onset of fertility varies slightly in different matings. The maximum fertility is attained by the end of the first week. Although fertile eggs are laid so long as 21 days after removal of the male, yet should the male be replaced by another, then the influence of the previous sire is removed by the end of the first week. This competitive action of the sperm is probably to be explained in terms of their relative staleness.—H. W. **Turnbull**: The invariant theory of forms in six variables relating to the line complex. A symbolic algebraic basis is given for the treatment of quaternary complex forms which occur in line geometry as forms in six variables, as suggested by Klein. The most general case including point, line and plane co-ordinates is considered. The transformation is reversible.—Pierre **Humbert**: Some hyperspace harmonic analysis problems introducing extensions of Mathieu's equation. Mathieu's differential equation, specially studied by Prof. E. T. Whittaker, is of great importance in harmonic analysis; two other equations, similar to it, are here connected with some new problems in four-dimensional space.—W. **Saddler**: A geometry associated with the double binary (2·2) form. The vanishing of the form as the incidence condition of a point on one conic with a tangent to a second, both represented parametrically, is treated. Canonical forms and the covariants are readily obtained and interpreted, while applications, using two (2·2) forms, are given to the geometry of three conics.

PARIS.

Academy of Sciences, February 15.—Paul **Appell**: A principle of statics.—V. **Grignard** and J. **Savard**: The existence of isopulegone in the natural state. The isolation of the α- (iso) pulegones and β- (ordinary) pulegone and their enols in the pure state. The separation is based on the fact that pulegone combines with sodium bisulphite, whilst isopulegone is not attacked by this reagent.—G. **Friedel**: Concerning fatty acids and smectic bodies.—Axel **Egnell**: A property of curvature of certain Riemann spaces.—Charles **Jordan**: The inversion of the theorem of Bernoulli.—Rod. **Fueter**: Improperly discontinuous groups.—Michel **Petrovitch**: Definite integrals bearing on the generalised series of Lambert.— — **Mandelbrojt**: The effective determination of the singular points of an analytical function given by its development in series of powers.—J. **Sudria**: A theorem of the vectorial calculus.—R. **Swyngedauw**: An experimental method for the study of the working of belts.—M. **Girault**: The intrinsic equations of the plane parallel motion of incompressible fluids in a permanent régime.—Y. **Rocard**: Conditions at the surface in problems of aerodynamics furnished by the kinetic theory of gases.—V. **Bjerknes**: The temperature of sunspots. The assumption of vortex movements can explain the existence of parts of the sun's surface either locally cooled or heated.—H. **Pélabon**: The mechanism of detection (in wireless telegraphy).—Léon **Bloch**, Eugène **Bloch**, and Georges **Déjardin**: A second spark spectrum of neon. A description of a new spark spectrum of the second order, the lines of which are wholly situated in the ultra-violet.—Georges **Déjardin**: The excitation of the second spectrum of neon by electronic shock.—E. **Darmois**: The mutarotation of mixtures of molybdates and ethyl malate. The probable constitution of the molybdomalic derivatives.—Albert **Nodon**: An electrometer designed for the study of weak radio-active manifestations. The instrument described has a small electrostatic capacity, and indicates variations of 2 volts.—J. **d'Espine**: The slowing down of the β-rays by matter.—Max **Morand**: The direct determination of the relative proportion of the isotopes of lithium. Making use of an improved apparatus for the production of positive rays, the currents transported by the positive rays of the two isotopes of lithium have been measured, receiving the isotopes on two separated plates, each connected with a galvanometer. The numbers obtained give a ratio of intensity between 14 and 15, corresponding to an atomic weight of between 6·93 and 6·94. The chemical determination of the atomic weight, 6·935, is in good agreement.— — **Herrera**: New experiments simulating living organisms.—Victor **Lombard**: The permeability of nickel to hydrogen. The influence of pressure. The permeability of nickel to hydrogen, within the limits of the experiments described, is proportional to a^{-h}, where h is the thickness of the nickel plate. It is an exponential function of the temperature, and varies proportionally to the square root of the pressure of the gas.—J. **Laissus**: The cementation of ferrous alloys by tungsten.—R. **Cazaud**: Researches on the auto-magnetisation of steels by torsion. The study of the auto-magnetisation of steels by torsion gives a rapid method of identification, capable of furnishing indications of their composition and thermal treatment.—B. **Bogitch**: The composition of copper mattes.—P. **Billon**: The reduction of oximes by sodium and absolute alcohol. Splitting up the racemic amines

thus obtained by means of dextrorotatory tartaric acid.—Louis **Longchambon**: The tartaric acids. Study of the preparation and properties of anti-tartaric acid (inactive).—André **Duparque**: The microscopic structure of coals.—Mlle. Yvonne **Wahl**: Tectonic and stratigraphic observations in the region of the lake of Allos (Basses-Alpes).—J. **Savornin**: The discovery of native gold at Djebel Mekam, near Berguent (Eastern Morocco).—Maxime **Coutin**: A layer of molybdenite in Morocco.—R. **Cerighelli**: The influence of light and temperature on the germination of seeds in the absence of calcium. In the germination of the pea, in the absence of lime, light exerts no influence on the growth of the root and stem, but the temperature has a marked action on each of these organs.—A. **Guilliermond**: The relations of the vacuolar system with the reticular apparatus of Golgi in plants.—Marcel **Brandza**: The influence of heat and of rapid evaporation on calcareous myxomycetes living in full sunlight.—Pierre **Georgévitch**: *Armillaria mellea*, the cause of the drying up of the oak forests of Jugoslavia.—A. **Quidor** and Marcel A. **Hérubel**: The monocular perception of relief by direct observation.—H. **Simonnet** and G. **Tanret**: The action of ergotinine on the uterus of the guinea-pig.—Pierre **Lesne**: A coleopterologic Pliocene fauna in the north of England.—Émile **André** and Mlle. Th. **François**: Contribution to the study of the oils of marine animals. Researches on cachalot and spermaceti oils.—Mme. **Phisalix**: The vaccination of the rabbit against intracerebral inoculation of fixed rabies virus, by subcutaneous inoculation of virus-serum mixtures from the viper, the adder, or the hedgehog, with excess of virus.—**Loubat** and **Duférié**: The influence of vascular ligatures on experimental gas gangrene.

ROME.

Royal Academy of the Lincei, January 17.—Umberto **Cisotti**: Mechanical actions of a plane current investing two circular profiles separated by a convenient distance.—Secondo **Franchi**: Discoveries of Priabonian foraminifera in the Taveyannaz arenaria, confirming the Eocene age demonstrated for the Annot arenaria in 1916.—Harry **Levy**: Canonical form of the ds^2 for which Riemann's symbols with five indices are annulled.—Alfredo **Rosenblatt**: The case of general collision in the problem of three bodies.—A. **Pontremoli**: New investigations on the accidental double refraction of colloids in motion.—Elena **Freda**: Propagation of stationary electric currents under the action of a magnetic field.—A. **Carrelli**: The compound photo-electric effect.—Giulio **Bemporad**: The principle of the arithmetic mean.—G. R. **Levi** and R. **Haardt**: The catalytic action of metals of the platinum group and their degree of subdivision (1). Measurement of the dimensions of the granules of a number of preparations of platinum black and spongy platinum shows that it is possible to alter the magnitude of these granules by varying the method of preparation. Reduction of cold chloroplatinic acid by means of aluminium yields granules only five times as large as the elementary cell.—P. **Pasquini**: The structure of pecten and its morphological and functional significance in the eye of the bird.

Pontificia Accademia delle Scienze (Nuovi Lincei), February 21.—**Tonietti**: Telluric movement of Amiata at Montalcino.—**Luigioni**: Specific validity of *Anoxia sicula* Motsch, a beetle of the scarab family.—**Gianfranceschi**: The law of distribution of energy in the spectrum of the black body.—**Scatizzi**: A type of derivative of variable index capable of summing its index with another derivative of the first type.—**Silvestri**: Invariable radiophonic receiver.

VIENNA.

Academy of Sciences, January 22.—K. **Höfler**: The iron content and local iron concentration in the cell walls of Desmidaceæ.—A. **Kailan** and J. **Schroth**: The electric conductivity of mixtures of hydrochloric and sulphuric acids with orthophosphoric acids prepared in various ways.—A. **Kailan** and J. **Schroth**: The esterification of malonic acid by hydrochloric acid in glycerin.—R. **Dworzak**: Ester-condensation in relation to the exchange of functional groups under the influence of aluminium ethylate.—B. P. **Wiesner**: The sexual cycle of the rat. (1) The œstrous rhythm and the œstrous cycle; (2) phases of the sexual cycle; (3) castration and extirpation of the suprarenals; (4) periodicity in the secretory function of the ovary and the œstrous rhythm.—O. **Lehmann**: Devastation in the Sandling group in the early autumn, 1920.—L. **Hofmann**: The axonometric theorems of Kruppa and Pohlk in non-Euclidean space. It relates to descriptive geometry and projections and curves of the second degree.—A. M. **Hugetz**: The influence of the alcoholic components on the velocity of saponification of acetic ester.—M. **Skrabal** and M. **Zlatewa**: The velocity of saponification of tetra-acetyl-penta-erytrit.—M. **Glässner**: New Emyden discoveries in the Vienna basin and fossil species of Clemmys in the Mediterranean region.—A. **Kieslinger**: Geology and petrography of the Kor Alps.

Official Publications Received.

Comité International des Poids et Mesures. Procès-verbaux des Séances. Deuxième série, Tome 11, Session de 1925. Pp. v + 105. (Paris: Gauthier-Villars et Cie.)

Catalogue of Indian Insects. Part 10: Stephanidae. By G. R. Dutt. Pp. iii+14. (Calcutta: Government of India Central Publication Branch.) 5 annas; 6*d*.

Commonwealth of Australia: Bureau of Meteorology, Melbourne. Paper 1, Extract from Bulletin No. 17: Some Periods in Australian Weather. By Dr. Edward Kidson. Pp. 33. (Melbourne: H. J. Green.)

Ministry of Public Works, Egypt: Physical Department. The Climate of Helwan. By L. J. Sutton. (Physical Department Paper No. 20.) Pp. iv + 82 + 17 plates. (Cairo: Government Publications Office.) 10 P.T.

The National Benzole Association. Third Report of the Joint Benzole Research Committee of the National Benzole Association and the University of Leeds. Pp. 20 + 7 plates. (London: National Benzole Association.)

Sixteenth Report on the Sarawak Museum, 1925. By E. Banks. Pp. ii+21. (Kuching, Sarawak.)

Thirteenth Report of the Research Sub-Committee of the Gas Investigation Committee of the Institution of Gas Engineers. 1: Aeration of Lighting Burners; 2: Determination of Specific Gravity of Gases. Pp. 102-167. Fourteenth Report of the Research Sub-Committee of the Gas Investigation Committee of the Institution of Gas Engineers. The Experimental Gas Plant at Leeds University. Sir Corbet Woodall Memorial. Pp. 168-195. (London: Institution of Gas Engineers.)

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1925. (No. 74.) Pp. 130+13 plates. (Marlborough.) 5*s*.

Suomen Geodeettisen Laitoksen Julkaisuja: Veröffentlichungen des Finnischen Geodätischen Institutes. No. 5: Schwerkraft und isostatische Kompensation in Norwegen. Von W. Heiskanen. Pp. 33. No. 6: Die Erddimensionen nach den europäischen Gradmessungen. Von W. Heiskanen. Pp. 26. (Helsinki.)

Aeronautical Research Committee. Reports and Memoranda, No. 986 (Ae. 198): On the System of Vortices generated by a Circular Cylinder in Steady Motion through a Fluid. By C. N. H. Lock. (A.1.a. Dynamical Similarity, etc., 58—T. 2044.) Pp. 6+1 plate. 4*d*. net. Reports and Memoranda, No. 993 (Ae. 204): Note on the Minimum Speed from which the Direction of a Gliding Aeroplane can be changed to a Horizontal Path for Landing. By F. W. Meredith. (A.2.a. Calculations and Model Experiments, 96—T. 2103.) Pp. 5+1 plate. 4*d*. net. (London: H.M. Stationery Office.)

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 2, No. 7: The Scottish Kames and their Evidence on the Glaciation of Scotland. By Prof. J. W. Gregory. Pp. 395-432. 5*s*. Vol. 54, Part 2, No. 9: The Geology of Videy, S.W. Iceland; a Record of Igneous Action in Glacial Times. By Dr. Martin A. Peacock. Pp. 441-465+1 plate. 3*s*. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The National Physical Laboratory. Report for the Year 1925. Pp. 242+23 plates. (London: H.M. Stationery Office.) 8*s*. 6*d*. net.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 37, Part 1. Pp. 115. (London: Edward Stanford, Ltd.) 5*s*.

Diary of Societies.

SATURDAY, APRIL 10.

MINING INSTITUTE OF SCOTLAND (Annual General Meeting) (at Royal Technical College, Glasgow), at 3.—J. B. Sneddon: Some Findings of the Royal Commission on the Coal Industry (Presidential Address).—Dr. F. Fergus: Miners' Nystagmus; and Discussions on: The Report of the Institution Committee on Ventilation of Mines; Coal Cutting by Machinery and Conveyors in Scottish Mines, G. L. Kerr; The Adjustment of Ropes on Bi-Cylindro-Conical Drums, Dr. J. Parker; The Problem of In-bye Transport, D. C. Gemmell.

MONDAY, APRIL 12.

ROYAL IRISH ACADEMY, at 4.15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—H. B. Creswell: An Inquiry into the Ugliness of Engineering Structures.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Exeter), at 6.—R. B. Matthews: Electro-Farming; or the Application of Electricity to Agriculture.

INSTITUTION OF STRUCTURAL ENGINEERS (Students' Meeting), at 6.—E. S. Andrews and others: Discussion on Theory *versus* Practice.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Birmingham and Midland Institute), at 7.—G. Rushton: The L.G.O.C. Methods of Omnibus Repair (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—Capt. P. P. Eckersley and others: Discussion on the Linking together of Wireless and Wire Communication Systems.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—C. Vernier: Some Impressions of Chicago and U.S.A. (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—F. C. Johansen: Some Factors affecting the Speed of Passenger Trains.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Rev. E. Hanson: The Problem of History.

SURVEYORS' INSTITUTION at 8.—Discussion of Paper by H. E. Sherwin, On the Various Statutes which comprise the New Law of Property.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—H. F. Lambart: The Ascent of Mount Logan.

SOCIETY OF CHEMICAL INDUSTRY (London Section).

TUESDAY, APRIL 13.

MANCHESTER GEOLOGICAL AND MINING SOCIETY, at 4.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section) (Annual General Meeting), at 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: Organs of Multiple Function (1): The Salivary Glands.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—C. M. Hunter: The Oil Fields of the Maracaibo Basin.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. K. Kuiper: On a Black Variety of the Malay Tapir (*Tapirus indicus*).—B. S. Vinogradov: Some External and Osteological Characters of *Prometheomys schaposchinikovi* Satun (Rodentia).—Dr. P. R. Lowe: On the Callosities of the Ostrich (and other Palæognathæ) in connection with the Inheritance of Acquired Characters.—W. S. Bristowe and G. H. Locket: The Courtship of British Lycosid Spiders and its Probable Significance.—Dr. J. Beattie: On the Ileocæcal Region of the Reptiles.—I. *Tupinambis teguexin*.—J. H. Power: Note on the Tadpoles of *Cassina senegalensis*.

INSTITUTION OF CIVIL ENGINEERS, at 6.—J. N. Reeson: The Influence of Electric Welding in the Design and Fabrication of Plant and Structures.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—W. S. Burn: Double-Acting Oil Engines.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—S. O. Rawling: Thiocarbamide Fog and a Suggested Explanation of Waterhouse Reversal.—A. Montigny: Demonstration of the Hilo and Montix Apparatus.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Section) (at Royal Technical College, Glasgow), at 7.30.—Ordinary and Annual General Meeting.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—A. Healey: Dunlop Tyres and their Uses.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—J. Ramsbottom: Fairy Rings and Allied Growths.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—J. Stuart: The Zulus in Peace and War.

WEDNESDAY, APRIL 14.

ROYAL INSTITUTE OF BRITISH ARCHITECTS (at 9 Conduit Street, W.), at 5.—F. Inigo Thomas: Gardens (Lecture).

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—G. W. Tripp: The Young Engineer: His Training and Prospects.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—E. H. Shaughnessy: The Rugby Radio Station of the British Post Office.

RADIO SOCIETY OF GREAT BRITAIN (Informal Meeting) (at Institution of Electrical Engineers), at 6.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—Discussion on Government Electricity Bill.

ROYAL SOCIETY OF ARTS, at 8.—Principal R. A. Dawson: Art Training for Industry, and the Royal Society of Art's Competitions.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Institution of Chemical Engineers) (at Burlington House, Piccadilly), at 8.—J. Kwantes: The Beet Sugar Industry.

LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 8.—R. Waddell: The Properties and Engineering Uses of Stainless Steel.

EUGENICS EDUCATION SOCIETY (at Royal Society), at 8.30.—G. C. Robson: Observations of the Selective Death-rate in Nature (Lecture).

INSTITUTION OF STRUCTURAL ENGINEERS (Lancashire and Cheshire Branch), Annual Meeting.

THURSDAY, APRIL 15.

LINNEAN SOCIETY OF LONDON, at 5.—Prof. C. Schröter: The Swiss National Park and Scientific Researches into its Nature (Hooker Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. O. H. P. Prior: French Rhythm and English Poets in Norman and Modern Times.

INSTITUTION OF MINING AND METALLURGY (Annual General Meeting) (at Geological Society), at 5.30.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. J. N. Glaister: The Educational Value of the Order of Woodcraft Chivalry.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.

FRIDAY, APRIL 16.

ROYAL SOCIETY OF ARTS (Joint Meeting of the Indian and Dominions and Colonies Sections), at 4.30.—Lieut.-Gen. Sir W. T. Furse: The Work of the Imperial Institute.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—W. Worby Beaumont and L. N. Burt: Modern Development of Paper Mill Plant.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—R. T. Gibbon: Some Limitations of Photography.

PHOTOMICROGRAPHIC SOCIETY (at 4 Fetter Lane), at 7.—Prof. R. T. Hewlett: Neurotropic Viruses.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—T. L. Allison: Automobile Lighting, Starting, and Ignition.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. A. W. Hill: The Quest for Economic Plants.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section).—F. M. Rowe, E. Levin, A. C. Burns, J. S. H. Davies, and W. Tepper: A New Reaction of certain Diazo-sulphonates derived from *b*-naphthol-*l*-sulphonic acid.

SATURDAY, APRIL 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. T. Calman: The Shipworm (1).

CONFERENCE.

APRIL 17 AND 18.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Marine Biological Laboratory, The Hoe, Plymouth):—Saturday, April 17.—10 A.M. to 1—W. H. Pearsall, J. T. Saunders, B. W. Keen: Symposium: The Regulation of the Environment and its Effect on Plants and Animals; 2.15 to 3.45—E. M. Delf: Some Aspects of the Ecology of Marine Algæ.—A. D. Cotton: Ulva and the Assimilation of Nitrogen.—M. Knight: An Analysis of the Algal Vegetation of the Port St. Mary Coast, I.O.M. (Demonstration); 3.45 to 4.45, Exhibits—C. M. Yonge: Digestive Mechanisms in Mollusca.—G. P. Wells: Contractile Tissues of *Holothuria nigra*.—O. D. Hunt: Studies on Bottom Deposits of the Sea.—F. S. Russell: Plankton Distribution.—H. W. Harvey: Nitrates in Sea Water.—A. Westbrook: Tetraspore Formation in Red Algæ.—M. Knight: Ecological Photographs of Algæ; 4.45 to 6.15—F. S. Russell: Factors affecting the Vertical Distribution of Plankton.—H. P. Hacker: The Grouping of Species into Faunæ.—Sunday, April 18.—4 to 7.—C. M. Yonge: The Crystalline Style in the Mollusca.—G. S. Carter: On the Control of the Velar Cilia of the Nudibranch Veliger.—L. E. Bayliss: Contractility in Plain Muscle.—A. S. Parkes: The Mechanism of the Œstrus Cycle.

CONVENTION.

APRIL 12 TO APRIL 17.

OPTICAL CONVENTION (at Imperial College of Science and Technology):—Monday, April 12.—At 12.—The Right Hon. Stanley Baldwin: Opening of the Convention; at 8.30—Sir Frank Dyson: Presidential Address.—Tuesday, April 13.—At 10 to 1 and 2.30 to 5.—Reading and Discussion of Papers.—Wednesday, April 14.—At 10 to 1 and 2.30 to 5.—Reading and Discussion of Papers; at 5.30—C. R. Darling: The Optical Lantern as an aid to Teaching (Lecture); at 8.30—Prof. G. Elliot Smith: The Eye and its Functions (Address).—Thursday, April 15.—At 10 to 1 and 2.30 to 5.—Reading and Discussion of Papers; at 5.30—W. Taylor: The Manufacture of Optical Elements (Lecture); at 8.30—J. R. Wharton: Lighthouses and the Optical Apparatus used in them (Lecture).—Friday, April 16.—At 10 to 1 and 2.30 to 5.—General Meeting for the Reading and Discussion of Papers; at 4.30—Dr. E. E. Fournier d'Albe: The Optophone (Lecture); at 8.30—Prof. A. S. Eddington: The Largest and Smallest Stars (Address).—Saturday, April 17.—At 10 to 12.—Reading and Discussion of Papers; at 12—Concluding General Meeting.

CONGRESS.

FRIDAY, APRIL 16.

CONGRESS OF THE INCORPORATED ASSOCIATION OF HOSPITAL OFFICERS (at Central Hall, Westminster).—Miss R. E. Derbyshire: The Nursing Requirements of a Modern Hospital.—E. W. Morris: The Geographical Distribution of Hospitals in Relation to Community Requirements.

EXHIBITION.

APRIL 12 TO APRIL 27.

INTERNATIONAL FORESTRY EXHIBITION (at Milan).

INTERNATIONAL MEETING.

APRIL 16 TO APRIL 20.

INTERNATIONAL SOCIETY OF MEDICAL HYDROLOGY (Annual Meeting will be held in Czecho-Slovakia). (Particulars from Dr. E. P. Poulton, at 36 Devonshire Place, W.1.)