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Museums and the British Empire.

IT was fitting that the Museums Association should hold its annual conference this year at Wembley, for the Exhibition is a great museum of Empire, a marvellous example of that education by the visual appeal of concrete objects which is the special characteristic of museum teaching. The inspiration it might afford to the large gathering of museum officials from these islands and from the Dominions overseas was well brought out in the presidential address of Dr. Herbert Bolton, of the Bristol Museum. Trained at the Manchester Museum, for many years director of one of our oldest and best provincial museums, personally acquainted with museum work in the Dominions and the United States, and one who has achieved scientific and academic distinction in the course of his professional labours, Dr. Bolton is eminently fitted to take advantage of the situation, and his constructive criticisms are worthy of respectful scrutiny.

That the museum method is of practical use to practical men is shown clearly enough by the British Empire Exhibition, and so successfully that the Prince of Wales has recently advocated the maintenance of the Exhibition throughout another year. What is still more important is that the impulse given should be guided into those permanent institutions which are intended for the same purpose. It would, indeed, be absurd to organise a vast temporary show of the Empire and to close down the galleries and collections of the Imperial Institute ; fortunately we are, as it seems, to be spared that threatened disgrace. But, as Dr. Bolton urged, the Imperial Institute should not stand alone ; existing museums all over the country should carry on the work, leading, it may be, to the establishment of independent commercial museums in the large industrial centres. Australia, ever advancing, has shown the way in the Technological Museum of Sydney ; Japan, seizing on that which is good in Western civilisation, has trade museums, not only at Osaka, but also scattered throughout the country. The most remarkable example doubtless is the Commercial Museum of Philadelphia, "which has done more to stimulate the trade and commerce of that city than all the other agencies put together." Not that Britain is so far behind : the museums of Sheffield, Halifax, and Hull, for example, have formed collections of metal-work, textiles, and shipping respectively, while for an example of the special museum of industry we need only recall that of the Potteries at Hanley.

Let us not, however, restrict our view to commerce. Public health, to take an activity so admirably illustrated by the tropical diseases exhibit in the Government Building at Wembley, is a subject that can and should be advanced by our ordinary museums. We cannot have forgotten how several of them rose to the occasion presented by the War, and Dr. Bolton reminded us of the valuable work then done at the Natural History Museum by research and exposition. But all this can be, and indeed is, pursued with profit in times of peace. The American Museum of Natural History in New York has even founded a separate health department.

Space forbids us to follow Dr. Bolton through the many fields in which museums can be of service to the community, from the highest ideals of art to the manurial depths of agriculture, but we must applaud the emphasis with which he once more urges that the prosecution of research is no less incumbent on museums than is the exposition of its results. Here, however, if not before, we are brought up against a formidable obstacle. While our museum officials either have, like Dr. Bolton, been raising themselves to the level of university investigators, or have been increasingly drawn from the higher classes of university graduates, while they have, in short, become skilled men of science no less than highly trained curators, their numbers have not kept pace with the growth of their collections or with the increased demands made on them by the public. Dr. Bolton takes as his example the British Museum (Natural History). As an interested onlooker he asserts that:

"The tasks with which each man has to deal are herculean, and can never be mastered by any one man. Every scientific man of note in the whole world interested in the sciences represented there visits it for study and inquiry, whilst general inquiries are legion. Collections pour in; the labours of Sisyphus were mild in comparison with those of the staff of this museum, for his labours never increased, whilst theirs are continuously mounting up. But this does not touch the question of research. These men do carry out research, but only by making the hours of life the hours of labour. I do not hesitate to say that in the interests of the nation and of the Empire the national museums call for a drastic reorganisation, in order that their hidden treasures may become available for an Empire's betterment and a people's welfare."

It is, indeed, deplorable that this can be said, and said with truth, of the central museum of the Empire, a museum that renders willing service to the whole world. Not all of Dr. Bolton's suggestions will be accepted without qualification, but on this at least we shall be agreed: that one of the best ways of helping the museums of Great Britain and of the Dominions would be an expansion of the staff of the Natural History Museum. If Dr. Bolton is, as we think, right in his belief that museums can do much to knit more closely the brotherhood of the British Empire, then there could be no more secure investment for such funds as may accrue from "The Great Advertisement" at Wembley.

Electrothermic Processes of Steel Manufacture.

The Manufacture of Electric Steel. By Frank T. Sisco. Pp. x + 304. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 15*s.*

UP to the present time several books have been written which deal with electric steel-making furnaces from the point of view of their electric, mechanical, and thermal efficiency. Not one of them, however, describes with any completeness the operation of the furnace and the making of a heat of steel. It has been evident for some time that this was greatly needed, for although the men directly connected with the manufacture of special steels are thoroughly conversant with the electric process and its advantages and disadvantages, those in the steel industry outside of this field have had very little opportunity of becoming familiar with it. In the present volume the author has endeavoured, with much success, to fill this need by discussing thoroughly the manufacture of electric steel, starting with the raw materials and ending with the teeming of the ingots. After the heat is poured and the ingots stripped, the furnaceman's duties are ended. If he has delivered a first-class ingot to the rolling mill or the forge, this represents his part of the effort necessary to the manufacture of a satisfactory product.

The electrothermic process of steel manufacture is the infant—a lusty one—of the iron and steel industry. Little more than twenty years ago the manufacture of steel by this process was still in the embryonic stage. To-day about 1200 electric furnaces are operating in America and Europe. The advance during the past ten years has been nothing short of astonishing, production having increased from 52,000 tons in 1910 to 502,000 tons in 1920. The recognised ability of this process to produce high quality alloy and tool steel ingots, and the superiority of the process over others in the manufacture of castings, is responsible for this advance. In view of the existing literature, the author has devoted comparatively little space to the description of the furnaces themselves. Even in the case of the Héroult furnace, which is the largest single producer of electric steel, manufacture and construction of the electrical details are only lightly touched on. In the United States of America, Héroult furnaces up to 30 tons capacity are in regular use, and are of a size comparable with open-hearth furnaces.

The electric furnace is unique in ferro-metallurgical processes in that it will produce a high-grade material in tonnage lots. The author claims that the same quantity of steel, say 30-50 tons, delivered by the open-hearth can be made in an electric furnace of a quality equal to the best product of the crucible pot. One of the great advantages of the electric process is flexibility and control. It can be operated with cold charges or hot metal. It can also be used for making pig-iron synthetically or for refining molten cupola iron. The temperature can be controlled within a few degrees. Deoxidation and reduction can be carried to any desired point and sulphur and phosphorus eliminated down to traces. Compared with steel made by the open-hearth or Bessemer process, electric steel has greater density and is much freer from slag and occluded or absorbed gases. It is stronger, tougher, and more ductile.

The outstanding disadvantage of the process is its cost. The author anticipates that this is destined to become a less serious handicap as power resources become more completely developed and economy of furnace operation is more thoroughly understood and practised. Another disadvantage is that furnaces are often operated by men unversed in deoxidation and thus a steel is produced which is not so good as it should be. A more thorough training is required for the furnace operators. Moreover, electric furnaces are frequently installed as adjuncts to open-hearth furnaces by companies interested primarily in the production of large tonnages. The electric furnace occupies a field of its own and may, with the greatest economy and best results, be operated in conjunction with another melting operation, but should never be used as a subsidiary to it. To quote the author: "Washing hot metal in an electric furnace and calling it electric steel has done much to give it a bad name."

The chapter on the chemistry of the basic electric process is one of the best in the whole book. The author discusses fully and fairly both the oxidation and deoxidation periods. After deoxidation is complete and the alloy additions have been made, the hot metal lies in the furnace covered by a very basic slag containing up to 65 per cent. of calcium as oxide with 13 per cent. of calcium carbide. Through the agency of these, iron oxides and manganese oxide are almost wholly eliminated from slag and bath, the addition of ferro-manganese and ferro-silicon completing the elimination. The fusible silicates of iron and manganese formed in small amounts have had time to separate from the steel. Carbon monoxide gas has been eliminated by silicon, leaving in its place silica, of which a very small amount remains dispersed in the metal. Sulphur is present in the form of manganese sulphide to the extent of one part in five thousand. It is practically impossible to get it out of the steel. Gases should be almost entirely absent. Except, therefore, for small amounts of manganese sulphide and still smaller amounts of silica, the steel should be free from non-metallic inclusions. In these respects it is markedly superior to even the best open-hearth steel.

The author devotes some attention to the Austrian practice of melting chrome-nickel steel for aeroplane shapes. The charge is melted and refined with the idea of producing a so-called fibrous structure which, according to Kothny, is necessary to meet the Austrian army specifications. He challenges the practice *toto caelo,* and gives very good reasons for concluding that the fibrous condition formerly considered so beneficial to steel is in reality harmful.

Mr. Sisco, who is an American metallurgist, has written a valuable book, and by his own work in this subject is making an important contribution to placing the manufacture of electrothermic steel on a scientific basis. His style is clear and his language apt, and he emphasises his main points so that he may be thoroughly understood by men who operate furnaces. The book will also be of service to college students and young metallurgists for the clear picture it gives of the essentials of the best accepted practice in both basic and acid processes.

H. C. H. C.

Tycho Brahe's Observations.

Tychonis Brahe Dani opera omnia. Edidit I. L. E. Dreyer. Tomus X. Pp. xxvii+434. (Hauniæ: In Libraria Gyldendaliana, 1923.) n.p.

THE Carlsberg Foundation and the president of the Royal Astronomical Society are to be thanked for presenting us with a most interesting, if not very readable book. The tenth volume of the works of Tycho Brahe is the first volume of his observations, and contains his observations down to the year 1585. The editor's prolegomena tell the history of the manuscripts in which these observations were recorded, of successive projects for their publication, and of the imperfect publications which have appeared. The obstacles to publication were not, it would appear, entirely material. We are quite accustomed to observations being made by one astronomer and theoretical deductions by another, and Ludwig Kepler's contention, thirty-six years after Tycho Brahe's death, that his observations should be reserved for the emperor alone and those to whom, as a special favour, he should grant the use of them, is what we should nowadays expect to find only in the case of discoveries of commercial value, not of astronomical observations. It will be noticed that the sole right to draw deductions seems to pass with the MS. observations after the observer's death. Happily, Kepler had been the owner, and these observations provided him with the material for his laws of planetary motion and his Rudolphine Tables.

There are two great MS. collections of Tycho's observations, both made under his own direction and both containing notes in his own hand. One, now preserved at Copenhagen, contains the daily or nightly record; the other, now at Vienna, arranges the observations of each year according to the bodies observed. Neither is quite complete. Dr. Dreyer has, where possible, followed the text of the Copenhagen and the arrangement of the Vienna MSS.

The one previous edition of any degree of fulness was that of Albert Curtz, which appeared in 1657–66, but it is defaced by many grave defects. It was based on what is now the Vienna MS. The numerous subsequent projects were based mainly on the Copenhagen MSS. or on Curtz corrected from those MSS. After an abortive project of the Royal Society in 1707, proposals for a complete edition practically died away, the one exception being Hvass's project to include the observations in a complete edition of Tycho's works in 1778. This was inevitable. The observations had for the most part come to belong to the history of astronomy. They had lost their living value. Pingré used for his "Cométographie" in 1783 a copy which Bartholin had prepared for printing and never printed, and the observations of comets were published in full by Friis in 1867. These observations at least could not be superseded.

The present most scholarly edition is probably to be classed as a work of piety rather than as a contribution to the progress of science. But without investigation it is impossible to say how far back observations are useful. A sign of the editor's extreme pains is that where there has appeared to be an error in the record of observations, he has attempted to discover its cause by means of computations.

The student of Tycho will find mixed with the observations mathematical constructions and discussions of the quantities dependent on the observations. These increase the interest of the book to any one who studies the history of astronomy. It would be useful to have in some later volume a glossary of star-names.

J. K. F.

A New Natural History.

The Animal and its Environment: a Text-Book of the Natural History of Animals. By Dr. L. A. Borradaile. Pp. vii+399+4 plates. (London: Henry Frowde and Hodder and Stoughton, 1923.) 18*s*. net.

EVERY zoologist will grant that animals should be studied in relation to their surroundings. Physiologically, as Huxley said, they are whirlpools in the river; morphologically, they are, in part at least, bundles of adaptations, definitely related to environmental conditions. Embryologically considered, they develop in a particular "nurture," and they may develop differently when the circumstances are altered. Etiologically, they must be considered in relation to environmental stimuli and environmental sifting; isolation is often an environmental affair; the pulse of evolution changes its throbs with the climate. Then there is the behaviour of the creature, so largely concerned with thrust and parry between organism and environment. In certain cases we are most impressed with the grip of the environment on the organism; in other cases, what strikes us is the dominance of the organism over its environment. As Prof. Patrick Geddes has neatly put it, life is a balancing between Organism→function→environment and Environment→function→organism: $\frac{\text{Ofe}}{\text{Efo}}$. All zoologists recognise theoretically the inseparability of the animal and its surroundings, but the truism has not always been evident in their books and lectures. Therefore one gives a hearty welcome to Dr. Borradaile's new natural history which definitely considers animals in relation to their environment. It may be regarded as a continuation of Semper's unsurpassed "Natural Conditions of Existence as they affect Animal Life" (1881).

The book begins by envisaging animals in their natural setting. The organism runs the gauntlet of physical influences and animate influences. There are relations between animals and plants, between animals and their kindred, between animals and other species, and between the sexes. It does not seem easy, if desirable, to separate the animate from the non-living environment; yet one feels that, just as with mankind, there is a difference between mutual relations among living creatures and the relations between living creatures and their *milieu*, or, let us say, climate. Anyhow, what we should call the more distinctive environmental note is sounded emphatically in the subsequent chapters dealing with the faunas of the sea, of fresh waters, and of the land. Then follow chapters on the evolution of faunas, migration, and internal parasites. The concluding chapter deals with the influence of surroundings upon the animal organism, a consideration of which lands the author in an unnecessary scepticism as to the organism's power of "real initiative."

Dr. Borradaile gives many familiar facts a new setting, but he has also a wealth of fresh material. All is presented clearly and educatively, with a generous supply of interesting figures. There are four very beautiful coloured plates. The book is to be strongly recommended in itself and as a supplement to other modes of treatment. There are very few words in it that could be dispensed with, and we do not know that the author could have used his space to better effect, but we venture to suggest for a new edition that more space should be given to the inter-relations between plants and animals and to the seasonal changes of environment. Dr. Borradaile has deliberately refrained from discussing theories of evolution (as to the steps and factors in the historic process), but we cannot agree with his view that "these subjects are but remotely connected with that of the relation between the individual and its surroundings, which is best studied for its own sake." This seems like a reaction to biological statics, quite inconsistent with the temper of a very dynamic book. The existing relations between organisms and their environments must, of course, be described and analysed, but sooner or later they must also be studied as historically determined results. And in this inquiry the changes of environment from age to age must be appreciated. Prof. Huntington, thinking chiefly of the climatic factor in man's history, writes on "The Pulse of Asia"; the zoologist cannot afford to lose hold of this clue. There is a pulse in evolution.

In regard to the chapter on parasitism, where the author shrewdly recognises the heterogeneity of the phenomena, we think that he misses an opportunity of striking out from an outworn conventional concept. "Parasitism" is a too convenient label and it has been badly strained; there are (see Borradaile) at the very least half-a-dozen different kinds of parasitism. That seems to us to indicate the one-sidedness of the environmental grouping in general. Just as we have plankton and nekton in the open sea, illustrating one of the great organic dichotomies, so there is a sharp contrast between a tapeworm and a trypanosome. But we are not blaming Dr. Borradaile for the intricacy of Nature; we are rather, in our hyper-criticism, paying our best compliment to a notable new departure in natural histories. We hope it will have the great success it deserves.

Chemistry of Colloids.

Colloid Chemistry: Wisconsin Lectures. By The. Svedberg. (American Chemical Society Monograph Series.) Pp. 265. (New York: The Chemical Catalog Co., Inc., 1924.) 3 dollars.

COLLOIDAL solutions of the suspensoid type, although not always of immediate technical importance, have many advantages as material for the investigation of the quantitative factors in disperse systems. Sols can be prepared with particles of known and regular size, and, provided conditions of formation are carefully regulated, the systems can often be reproduced within quite narrow limits. The stability of these colloidal solutions does not depend to any great extent on the hydration of the particles, and is therefore not affected by the previous treatment of the solution to the same degree as in sols of the emulsoid type. Indeed, the suspensoids approximate most closely to the purely physical conception of a colloidal system as particles of small size dispersed in a pure continuous medium.

The numerous and fundamental researches of Prof. The. Svedberg have mostly been concerned with colloids of this type, and in the present volume, which embodies a course of lectures delivered at the University of Wisconsin in 1923, this work is summarised with copious references to the related discoveries of other investigators. The title "Colloid Chemistry" is thus misleading unless read with some emphasis on the subtitle. For example, only fifteen pages of the whole book are devoted to gels, and emulsions are scarcely mentioned at all. The author apologises for his bias in the preface, but it should have been indicated in the title of the book.

When, however, the restricted scope of the volume is realised, its value becomes greater than it would be if it were a more general treatise. The author is naturally impatient and distrustful of the merely qualitative or at best empirical experiments which are common in colloid chemistry, and so tends to confine his summary to accurate work on well-defined systems. The methods of formation are first considered and include an interesting account of the work of the author on the electrical dispersion process first worked out by Bredig. In this section the usual methods of purifying colloidal solutions are discussed, including several types of apparatus for electro-dialysis developed in the last few years. In the second part the colloidal particle is considered as a molecular kinetic unit, and the determination of Avogadro's number from the rate of sedimentation of these particles, giving values in remarkable agreement with those obtained by other methods, is described in detail. Among the methods by which the size of colloidal particles can be found is mentioned the calculation from the width of the lines in the X-ray diagram, which should prove a serviceable approach to this difficult determination in the future.

In the third section, under the title of "The Colloid Particle as a Micell," such subjects as adsorption, electrophoresis, coagulation and gel formation are introduced. This portion of the book is worked out in much less detail than the first two sections, and the author wisely refrains from dealing with the tangled mass of results which makes up our knowledge of the coagulation of colloids by electrolytes, and confines his remarks to fairly general statements. Peptisation, again, with the mass of empirical information which represents practically all we know of that phenomenon, is dismissed in a single paragraph; and protection, of such great importance in technical work, is treated in an equally cursory manner.

It is, perhaps, unreasonable to expect a new branch of science to develop evenly in all directions, but in reading this book one is struck by the extent to which investigators in colloid chemistry have been occupied with systems in which water is the continuous medium. The extreme sensitiveness of aqueous suspensoids to slight traces of impurities, and the variation in properties of emulsoids with minute changes in the concentration of hydrogen and other ions, make the most heroic precautions necessary to avoid complete vitiation of results. The detailed study of non-aqueous and in particular of non-ionising liquids as the dispersion medium is now imperative, if only to clear up some of the results obtained with water. Prof. Svedberg's book indicates what can be done with fairly simple systems with specially designed apparatus, but we can look forward to results even more astonishing and important in the near future.

The author must be congratulated on writing so clearly in a language which is not his native tongue, and also on amplifying his narrative with more than a hundred excellent illustrations, most of which are original. The formal diagrams of the apparatus are frequently supplemented by photographs taken in the laboratory. It is a pity that the printing of the mathematical expressions is so amateurish, so that at times, as for example on pp. 94 and 151, the result is more decorative than intelligible. The value of the book to the scientific worker is increased by the selection of key references which is so constant a feature of the author's publications. For those without the time or opportunity to read the papers in the original, the volume provides an excellent summary of important work in the field with which it deals.

P. C. L. Thorne.

Our Bookshelf.

The Peaks, Lochs, and Coasts of the Western Highlands; Penned and Pictured with One Hundred Photographs. By Arthur Gardner. Pp. xi + 169 + 100 plates. (London: H. F. and G. Witherby, 1924.) 15*s*. net.

The value of this work rests on its collection of photographs, most of which are excellent in quality and well illustrate the structure and character of the Scottish Highlands. The most beautiful are those of the western coast to the south of Skye. Those of the mountains in the interior have a certain monotony which is, however, instructive, as it represents the frequent recurrence of the same physiographic types. The text consists of an account of the author's journeys with hints to other photographers. The information is too indefinite to serve as a guide, and includes little as to the history, natural history, or geology of the country. The author expresses interested ignorance as to the nature of some of the rocks illustrated by his photographs, which might have been easily removed by reference to a geological map. He deplores the extent of the country devoted to deer forests, both on economic grounds and because they render much of it inaccessible during the usual holiday season. He laments the closing of inns which has rendered impracticable to most pedestrians some of the most beautiful routes across the country. The author also regrets the inconsiderateness of the landlords in planting the clumsy Austrian instead of the picturesque Scottish pine, from which it may be inferred that the author is a better photographer than forester. The book, as a useful collection of geographical photographs, will be of most interest to those who wish for a picturesque souvenir of the western Highlands.

The Hampshire Gate. By H. G. Dent. Pp. 179 + 14 plates. (London: Ernest Benn, Ltd., 1924.) 8*s*. 6*d*. net.

Of the southern inlets into England, physical circumstances have made the Solent and Spithead, with the valleys that give access to them, one of the most important. This may be termed the Hampshire Gate. Its value was very marked when Winchester enjoyed the full significance of its site as a focus of routes in southern England. The importance of Southampton dwindled with the Portuguese discovery of the Cape route to India, which involved the diversion of much Mediterranean trade, but eventually it revived with expansion of Empire and the growth of American trade. Miss Dent's book treats of the Itchen basin, and is mainly a study in historical geography. The relation between physical conditions and trade routes is clearly shown. A considerable part of the book is naturally devoted to the port of Southampton: Winchester gets relatively little notice. The study, so far as it goes, is a useful piece of work, and is a good example of regional treatment in geography. The maps are small but clear.

History of the Great War, based on Official Documents. Medical Services: General History. Vol. 3: *Medical Services during the Operations on the Western Front in 1916, 1917, and 1918; in Italy; and in Egypt and Palestine.* By Maj.-Gen. Sir W. G. Macpherson. Pp. viii + 556. (London: H.M. Stationery Office, 1924.) 21*s*. net.

This volume deals with the medical arrangements of the War in France, Belgium, Italy, Sinai Peninsula, Egypt, Palestine, and the Senussi Expedition. Particularly detailed were the arrangements in the Somme battles of 1916, the advance to the Hindenburg Line (1917), Vimy Ridge (1917), Messines (1917), Ypres (1917), Hill "70" (1917), the German offensive of 1918, the Lys region, and the final advance to victory, ending with the occupation of Mons on November 11, 1918. Apologies are offered that the volume could not be made more attractive to general readers. It is hoped that omissions may be made good by a study of the maps and charts which are in profusion.

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 Pressure in the Reversing Layer of Stars and Origin of Continuous Radiation from the Sun.

THERE seems to be at present a wide divergence of views regarding the magnitude of pressure in the "reversing layers" of stars. While earlier investigators assigned to it a pressure of one to ten atmospheres, on the basis of pressure shift of lines to the red, these experiments do not appear to carry much weight at present. Fowler and Milne (Monthly Notices R.A.S., vol. 83, p. 415, 1923) actually assign to it a pressure of the order of 10^{-3} to 10^{-4} atmospheres.

The following speculations will show that probably an accurate method of determining the pressure may be developed from the limit of series absorption of elements in the Fraunhofer spectrum. To introduce the subject, let us start with the well-known fact that in the Fraunhofer spectrum of the sun the Balmer series of H absorption lines abruptly terminate at H_ζ, while in the flash spectrum no less than 35 Balmer lines are found. Here the ionisation theory does not help us, for all Balmer lines require the same H atom (in the diquantic state) for absorption. We are therefore confronted with the fact that as continuous radiation pours through the H(2) atoms, pulses which lift the electron up to the 8th quantum orbit are freely absorbed, but pulses which would lift the electron to the higher orbits somehow fail to be absorbed in spite of the presence of suitable absorption centres. Something prevents the development of the H-orbits beyond certain limits.

The next step is naturally to identify this agency with the congestion in the reversing layer due to high concentration of particles. In order that the *n*th-orbit may be developed, the electron should be capable of passing to an average distance of $0\cdot532 \times 10^{-8} \times n^2$ cm. from the nucleus. But if within this distance it comes under the influence of a second nucleus, or another electron, there can be no free development of the orbit: the electron will become either free, or attach itself to another nucleus. Hence for rays shorter than H_ζ, the H(2) atoms in the particular layers treated will lose their power of picking up the pulses corresponding to the Balmer series, but will exercise a sort of general, though much enfeebled, absorption on all radiation beyond H_ζ, somewhat after the manner of X-ray absorption. This part will be freely emitted only by higher layers, where the pressure has fallen to sufficiently low values; in other words, if the solar atmosphere were composed of H(2) atoms only, part of the continuous spectrum beyond H_ζ would originate from somewhat higher levels than the redder part of the spectrum.

The idea helps us to get a clearer view of the origin of continuous radiation from the sun. For what has been said of H(2), absorption is a general phenomenon, and can be extended to all other elements. In fact a scrutiny of the Fraunhofer spectrum shows that quantum orbits higher than the 5th or the 6th (total quantum number) are rarely developed. The following examples illustrate the point:[1]

Element.	Last Series-line in the Fraunhofer Spectrum.	Corresponding Wave Number of final Orbit.
H	$H_\epsilon,\ \nu = N\left\{\frac{1}{2^2} - \frac{1}{7^2}\right\}$	2238
	$H_\zeta,\ \nu = N\left\{\frac{1}{2^2} - \frac{1}{8^2}\right\}$	1714
Na	$2p_1 - 6d,\ \lambda = 4668\cdot60$	3062 }
	$2p_1 - 6s,\ \lambda = 4751\cdot89$	3437 }
Mg	$2P - 6D,\ \lambda = 4351\cdot94$	3649
Ca	$2P - 4D,\ \lambda = 5188\cdot85$	6385 }
	$2P - 5S,\ \lambda = 4847\cdot29$	5028 }

For every one of these elements conclusions similar to that in the case of hydrogen hold. Thus, since the higher members of the series lines are in the ultra-violet, there will be cumulative continuous absorption on the short wave-length side. Hence, as a rule long waves will come from deeper layers, short waves from higher layers. How satisfactorily this view accounts for the distribution of energy in the solar spectrum will be evident from the following passage: "Both the observed curves of distribution of energy in the solar spectrum (by Wilsing and Abbot) agree in having a much more pronounced peak than the black body curve, in being depressed below the latter in the violet (*the drop of intensity on the violet side of the maximum being very sudden*), and in coinciding with the black body in the extreme infra-red" (Milne, Phil. Trans., A, vol. 223, p. 218).

Thus for different rays we have different photospheres, but the distances separating the extreme photospheres probably do not differ by so much as 100 km. The photospheres and the reversing layers thus get very much mixed up. Owing to the rapid density gradient of luminous matter (except probably in the case of such atoms as are maintained by selective radiation pressure) the luminosity of the concentric layers round the sun decreases very rapidly. For example, it is well known that if, when obtaining the Fraunhofer spectrum, exposures of longer duration than 1/100 sec. are given, there is no contrast, all dark lines becoming bright. But to obtain the spectrum of layers about 100 km. from the disc during total solar eclipses, exposures of 4 to 10 sec. are required. This shows that the so-called dark lines of the Fraunhofer spectrum are intrinsically 100-1000 times more luminous than the bright lines of the flash. Hence when we expose for the Fraunhofer spectrum, the time of exposure is too short for the chromosphere, which does not, therefore, contribute anything to the resulting photograph. In other words, Fraunhofer absorption is caused by layers close to the disc, the higher chromosphere contributing nothing to the process.

These ideas may be extended to stars. According to a rough calculation, if n is the quantum number corresponding to the last absorption line of the Balmer series in a star, $n \propto \left(\frac{T}{P}\right)^{\frac{1}{6}}$. I have been able to collect the data for three A-type stars, α Cygni (ab. mag. $-4\cdot5$), α Lyræ (ab. mag. $+0\cdot6$), α Canis Majoris (ab. mag. $+0\cdot9$). In α Cygni, 24 Balmer lines are developed, in Vega 17 (up to H_ρ), and in Sirius 13. Now α Cygni is a typical giant star, Sirius is a typical dwarf, and Vega lies between them. It is generally admitted that the pressure in the reversing layer of giants is much lower than in dwarfs, and hence the great development of Balmer lines in α Cygnus can be easily understood. Sirius also shows more Balmer lines than the sun, and this is to be ascribed to the joint action of higher temperature and lower pressure in its atmosphere.

For an exact estimation of the pressure from such

[1] See Russell, *Astrophysical Journal*, vol. 55, p. 130. According to some authors, H_ϵ is the last absorption-line of the Balmer series. It is always difficult to trace the last line, as it is usually very faint.

data we must wait for further theoretical and experimental work. Much of the idea contained in this communication is to be found in papers by Fowler (*Phil. Mag.*, vol. 45, p. 20), Urey (*Astro. Journ.*, Jan. 1924), Wright (NATURE, vol. 109), Becker (*Zs. f. Physik*, vol. 18, p. 335).

MEGH NAD SAHA.

The Indian Institute of Science.

IN the first column of his article on chemical research in India, in NATURE of June 28, Prof. Thorpe makes reference to the past history of the Indian Institute of Science. I held the office of director for the first half of the period since it was created; and I am glad to have an opportunity of relating the facts with regard to the Institute, now that it is "under the new regime."

In the first place, the term "original purpose" requires some explanation. The proposal to establish a "university of research for India," by the late Mr. J. N. Tata, goes back to the opening of Lord Curzon's viceroyalty, when the matter was first brought to the notice of Government. After much discussion between Mr. Tata and the Government of India, matters took a practical turn when, in the cold weather of the year 1899–1900, Sir William Ramsay went out to India, on the invitation and at the expense of Mr. Tata, to advise on a scheme. Sir William advised in favour of establishing an institution with nuclear departments of chemistry, engineering, and applied bacteriology, but suggested that the main work of the organisation should be to develop industries directly, and that projects should be taken up, developed until they arrived at a paying stage, and then handed over to commercial concerns. The Government of India rejected this suggestion as altogether unsound, and I entirely agree with their conclusions.

Professor (now Sir Orme) Masson and Col. Clibborn, principal of Rurki Engineering College, were then asked to report upon Mr. Tata's scheme, and to make recommendations as to carrying it out. They drew up an eminently practical report, recommending the establishment of nuclear departments, a library, etc., much on the lines of Sir William Ramsay's report, but pointing out that the function of the Institute should be restricted to the provision for advanced study and research. The only section of the report with which I am in disagreement is the building proposals, which, as Col. Clibborn afterwards told me, were drawn up rapidly, and were not checked. The report was accepted by the Government of India and by Mr. Tata.

In August 1906 I was offered the appointment of director, being informed by letter by the Secretary of State for India that "in accordance with the will of the late Mr. J. N. Tata" it was proposed to found an institution for advanced study and research, particularly in applied science; and, on accepting the appointment, I was given copies of printed minutes of the Government of India, setting forth the whole story of the Institute, and confirming the idea that the report of Masson and Clibborn had been definitely accepted and must be considered the basis of the organisation which I had to develop.

I did not know until I arrived in India a few months later that Mr. Tata's heirs held a view of the matter different from that which had been communicated to the home Government. They held, in spite of the opinion of the Advocate-General, Bombay, that they were not bound by the will to carry out the scheme agreed upon by Mr. Tata and the Government of India, and they had informed the Government of India that they were only prepared to proceed with a scheme which left in their hands a measure of control far beyond that claimed by Mr. J. N. Tata at any time. In a note on their proposals, Lord Curzon had pointed out that they wished to establish a private institution financed out of the public funds.

Though working compromises were arrived at from time to time, it was not until 1910 that the matter was settled, and then settled on unsatisfactory lines; for to the constitution, as finally adopted, Lord Curzon's criticism might well apply. Further, all agreements prior to Mr. Tata's death were cancelled, and the representatives of Mr. Tata's heirs declared their intention to use every effort to divert part of the funds of the Institute, and the whole of the accumulated balances, which alone were available for properly equipping laboratories, to the establishment of departments dealing with "social and economic studies." Actual and definite proposals for the creation of departments of social and political history, and of certain medical studies, were put forward, and I have masses of documents dealing with these matters. Thanks to the support which I received from the then Resident in Mysore, and to the then Dewan of Mysore, I succeeded in resisting these proposals; but this gave rise to resentment, and before the end of 1909 I well knew that I should have my work cut out to hold on to my post for the eight years of active service in India for which I was appointed.

On the basis of compromise we had begun building operations in May 1908, and a provisional committee was appointed on which the Tata family was represented. The committee did not, however, support the idea of establishing departments of social studies, and was wrecked before the end of the year. Since, however, small contracts which the committee had entered into were still running, Government requested me to carry on. In the autumn of 1909 a provisional council came into existence. I laid before this body proposals based upon the Masson and Clibborn scheme, which had been agreed to in Mr. J. N. Tata's lifetime. An attempt was made to modify it with the view of including social studies, but the majority was against the proposal. The provisional council then entered into contracts for building, etc., amounting to more than 100,000*l.*, and all appeared to go well. However, the political element were not to be beaten. They found a flaw in the constitution of the council, and in May 1910 I was informed by Government that I must spend no more money until certain legal formalities had been completed.

I believe that I should have been well advised if I had cancelled all contracts, dismissed my office staff, etc., and shut down. Such a course would have been officially correct, but contrary, at least, to civilian tradition in India. It was clear that Government dare not help me. The Bank of Madras did, however, come to the rescue, and I was prepared to risk accepting loans on my own account. I carried on for five months; but I knew that the resolution of thanks passed by the reappointed council was not an unanimous resolution of good-will.

By July 1911 the laboratories, etc., were sufficiently advanced to allow of students being admitted, and the Institute actually opened. For a moment the future looked promising, but not for long, for difficulties arose in which the later failures, now to be corrected by "the new regime," found their origin. In their report, to which I have already referred, Masson and Clibborn pointed out that trouble would undoubtedly result if members of local educational and scientific services were elected to the governing body, as interests were certain to come into conflict. Were the Institute to develop on the lines they (Masson and Clibborn) laid down, and provide facilities for study and research in pure and applied science, it must necessarily come into conflict with the interests of the University of Madras. On the other hand, the departments of industries of Madras and Mysore might find in its staff and laboratories the means of developing their industrial projects. Actually, before I left for home on leave in April 1912, I found that the political opposition had added to itself a service opposition, opposed to carrying out the policy of the Masson and Clibborn report, and supporting the idea of developing the Institute on industrial lines. The position was fairly hopeless, and before leaving for home I laid the whole matter before the Education Department.

During my absence from India an unexpected development took place. In the month of September I received a communication embodying what was said to be a resolution of the council, asking for an explanation on certain matters connected with the building operations, but couched in such language that I could only return to India by the next mail, and proceed directly to Simla, where I asked that a full inquiry into my administration of the Institute should be held with as little delay as possible. I was received most sympathetically, and I was informed that notes on the matter were in my favour, as it was obvious to the authorities that an attack on me had been organised by my staff. I doubted it, but returned to Bangalore to find out. I then learned the following facts. The resolution had been compiled by the official members of the council. It had been read through, or had been said to have been read through, at a council meeting, and passed; but a legal member of the council, on receiving a copy of it, stated in writing that he did not recognise it, and that it prejudged every issue that it raised. I further learned that the officials would oppose an inquiry; and later, when the Viceroy, as our Patron, ordered that an inquiry should be held, and that in the meantime I should return no explanation in answer to the resolution, they flouted his authority, demanding an explanation of me, and when I refused to comply, they addressed a communication to the Education Department recommending that I should be removed from my office without any inquiry being held.

The inquiry was held in May and June of the following year (1913). It was a lengthy business. Every one who had ever been connected with the Institute was asked to come to Bangalore, and to give evidence, but not on oath. I was not asked to be present, and I heard none of the evidence, and yet the terms of reference were "to inquire into the conduct of the director." Towards the end of June I was invited to meet the committee, and to tell the story of the Institute down to the year 1911, but not later. Before the committee broke up I was sent for, and told that it proposed to give me the substance of its report to the Viceroy. What this amounted to was this,—that on two occasions I had failed to circulate papers to the Council, and that I should cultivate better relations with the political element. The matter about the papers had come out in evidence, but I pointed out that the records would show that it was untrue. The second item involved acceptance of the scheme for political studies, which would have brought me into direct conflict with Government. I had been warned to this effect the day I landed in India.

It did not need the assurance of the Indian official who acted as secretary to the committee—I can mention the matter at this distance of time—to make it perfectly clear to me that the attack which the official members of the council had led against me had failed completely; but I knew perfectly well that as a non-official I could not win in this conflict. That the Education Department was in a dilemma was obvious, and contrary to the hopes of my official opponents they made no move until, in the month of September, they wrote me about a further money grant for the completion of certain buildings. It was clear that they wished the matter to be dropped; but a fresh outburst on the part of the official members of the council, who complained that the result of the inquiry had not been issued, resulted in a telegraphic summons to me to go to Simla. When I arrived there I was informed verbally that the situation could only be solved by my resignation, and it was suggested that I should retire on my pension at the end of the following March. The prospect of release was inviting; but on my return to Bangalore a document came into my hands, practically by accident, which put an entirely new complexion on the matter. It was a copy of a printed minute of Government, dealing with the inquiry, and containing all that Government dared say about it, and a great deal more than it dared publish. With reference to myself, it was the finest testimonial I ever received, and if I ever destroy the rest of the vast accumulation of papers relating to this business, I shall keep it as such. However, it showed that, following my resignation, it was proposed to dispense with the services of two members of my staff, who were not, knowingly, the subjects of the inquiry, and a third was to be removed to Madras to avoid competition between his department and a somewhat similar but inferior department in a Madras institution. I at once informed Government that I would not resign upon any terms.

However, my position was an intolerable one, and it was clear that if I stayed on I should have to carry out a policy which I believed to be wrong. Even the stimulus of fighting against it would be lacking. I therefore intimated my willingness to resign, provided that my colleagues were satisfied. Two years' furlough, followed by pension, were actually due to me, and I only asked that the circumstances of my resignation should be made clear in a *communiqué*. This was agreed to, but the *communiqué* was never issued. The late Prof. Rudolf, professor of applied chemistry, agreed to accept six thousand pounds by way of compensation, and he was appointed honorary technical adviser to the Institute, and the other proposed removals were cancelled. Prof. Rudolf left India in March (1914), but I did not get away till the end of June, exactly two years after the passing of the resolution which gave rise to the trouble.

Within a few months an official ex-member of the council was appointed to the vacant post of director. The new day dawned, but the afternoon seems to have clouded up rather badly.

The "new regime" will have found buildings, equipment, and organisation much as I left them at the end of eight somewhat strenuous years, and for which I had to beg most of the money. It will have found a policy against which I fought, losing the battle and also my appointment at the same time. Had I been contented to adopt a policy of *laissez-faire* I should have had an easier time. I might even have earned the commendation of the powers, at the expense of my own self-respect. It now remains for the "new regime" to sweep away the rubbish and carry on from where I left off. If this is done I shall have nothing to regret. MORRIS W. TRAVERS.

23 Stafford Terrace, Campden Hill, W.,
June 28.

DR. M. W. TRAVERS knows better than any one else the inner history of the events he describes. The report of my committee dealt with conditions as we found them, and the recommendations were made with the sole object of indicating a remedy for the very unsatisfactory industrial condition in which

India now finds herself. No one who has visited Bangalore can have failed to recognise the great pioneering work which Dr. Travers did there; but the fact that he was unable to carry through does not necessarily mean that, under different conditions, possibly determined by past experience, the outcome might not be different. JOCELYN THORPE.

Imperial College of Science and Technology,
South Kensington, London, S.W.7.

Some Poetic Allusions to Phenomena of Plant Biology.

IT is with a peculiar pleasure that one finds observations, ordinarily recorded in the precise words of scientific usage, appearing in the beautiful and fanciful diction of the poets. The following examples may be familiar to many, but I have not seen them mentioned elsewhere in this connexion.

It has been shown by A. R. C. Haas that the soluble pigments in many flowers act as indicators, and give a measure of the hydrogen ion concentration of the sap, which in some flowers becomes less as the petals age and wither. This colour change has been noted by Edmund Spenser, and in recent times by A. E. as follows:

Astrophel.
Transformed them, there lying on the field
Into one floure that is both red and blew;
It first grows red, and then to blew doth fade,
Like Astrophel, which thereinto was made.

The Great Breath.
Its edges foamed with amethyst and rose,
Withers once more the old blue flower of day:
There where the ether like a diamond glows
Its petals fade away.

The first is the imagery of mythology, the second uses the same illustration to contrast the brief life of a flower with the unending procession of days.

Again Tennyson gives us a description of the yew tree in stanza 2 of "In Memoriam," which contains these lines:

O not for thee the glow, the bloom,
Who changest not in any gale,
Nor branding summer suns avail
To touch thy thousand years of gloom.

Beyond this stanza the early edition makes no further detailed reference to the yew. Later editions, however, provide one additional stanza, a new thirty-ninth being intercalated.

Old warder of these buried bones,
And answering now my random stroke
With fruitful cloud and living smoke,
Dark yew, that graspest at the stones

And dippest toward the dreamless head,
To thee too comes the golden hour
When flower is feeling after flower;
But Sorrow—fixt upon the dead,

And darkening the dark graves of men,—
What whisper'd from her lying lips?
Thy gloom is kindled at the tips,
And passes into gloom again.

Here Tennyson guards against the too literal interpretation of "who changest not in any gale," and gives a wonderful description of the liberation of the pollen and its result of many months later, the formation of the red berry, red as a glowing tip on a piece of wood kindled by fire. The berry falls, the glow is quenched, and gloom follows. This natural sequence of pollen and berry, coupled with the use of the word "kindled," so suggestive of a fiery hue, makes it seem impossible that Tennyson can have intended to allude to the lighter green of the young leaves—an explanation which, I believe, has been put forward.

To A. E. again we are indebted for the description of the recovery of turgor in plants wilted by the heat of day, which is contained in "A Summer Night":

The falling of innumerable dew,
Lifts with grey fingers all the leaves that lay
Burned in the heat of the consuming day.

We have all seen the "grey fingers," but it takes a poet to stamp the picture in an untarnishable phrase.

Finally, in "Prometheus Unbound," Shelley alludes to the liberation of oxygen in photosynthesis, imagining that the spirits "Which make such delicate music in the woods" dwell in bubbles, thus:

The bubbles, which the enchantment of the sun
Sucks from the pale faint water-flowers that pave
The oozy bottom of clear lakes and pools,
Are the pavilions where such dwell and float
Under the green and golden atmosphere
Which noon-tide kindles thro' the woven leaves;
And when these burst, and the thin fiery air, . . .

Have we as yet got so very far beyond "the enchantment of the sun" as an explanation?

W. R. G. ATKINS.

Antony, Cornwall,
July 17.

Electrical Properties of Thin Films.

THE mechanical properties of thin films on the surface of water have been the subject of many investigations; yet little is known of their electrical properties. Whilst the electrical properties of those films which are formed on the surface of soluble capillary active substances can be readily investigated, using a method elaborated by Kenrick (*Zeitschr. f. physik. Chem.*, xix. 625), no method, so far as I know, has yet been described which can be applied to

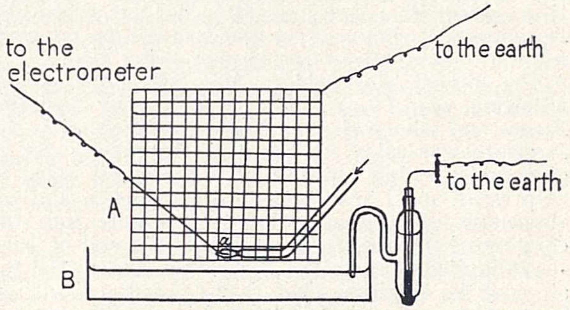

FIG. 1.

films formed by insoluble substances. The following simple arrangement has been designed which has given quite satisfactory results in this case.

A thin platinum wire *a* was heated to white-heat by a minute gas flame in an earthed Faraday cage *A* hung over the surface of water in the vessel *B* (Fig. 1). The platinum wire was connected with a quadrant electrometer, and the water in the vessel with the earth through a decinormal calomel electrode. Between the earth and the electrode, a variable electromotive force could be inserted. The experiments have shown that the potential of the wire follows closely the variations of the potential of the water surface when the distance between the platinum wire and the water surface does not exceed 7-8 mm.

If we put now a droplet of oil on the water surface, the electrometer shows instantly a change of the potential of the wire. In order to compensate this change a definite electromotive force has to be inserted between the calomel electrode and the earth. In this way it can easily be shown that a monomolecular layer of oleic acid makes the water surface more positive by 0·22 volt, whereas the same effect for lauric acid amounts to 0·27 volt and for olive oil to 0·33 volt. On replacing the water in the vessel by a solution of a capillary active substance, data are obtained which can be compared with those given by the Kenrick method. In this way I have found a positive effect equal to 0·27 volt for 50 per cent. acetic acid and a negative one equal to 0·38 volt for a molar solution of chloral hydrate, whereas the Kenrick method gave for the same solutions in a fair agreement +0·285 and −0·365 volt respectively (*Zeitschr. f. physik. Chem.*, in press).

The experiments are to be continued, and a detailed account will be published in the *Zeitschr. f. physik. Chem.* A. FRUMKIN.

Karpow Chemical Institute,
Moscow, July 3.

The Oogenesis of Lithobius.

MISS S. D. KING in her note on the oogenesis of Lithobius published in NATURE of July 12, p. 52, says:

"Yolk formation is from nucleolar extrusion, of which two phases can be distinguished; first, an early extrusion of particles budded off from the large central nucleolus, which retains its individuality, and, secondly, an extrusion of particles derived from the fragmentation of this nucleolus."

In a paper on the oogenesis of Lithobius now in the press (Proceedings Cambridge Philosophical Society), I have shown that there is no fragmentation of the nucleolus. It can be seen in the most highly developed oocytes obtainable from the ovary as a completely acidophil structure with prominent vacuoles. The nucleus at this stage lies just below the chorion. As to budding of the nucleolus, there are two kinds of nucleolar extrusions: small circular bodies, which generally form the secondary nucleoli, and large irregular bodies, which are first plastered round the nuclear membrane, where they may bud off smaller pieces, and are later detached and lie in the cytoplasm.

Nor is there any direct evidence for the statement that "the later extrusions enlarge after proliferation to form the definitive yolk spheres." All that can be said with certainty is that the nucleolar extrusions precede yolk formation, although a few may exist side by side with yolk spheres.

With regard to the Golgi apparatus, I have definitely established that during fragmentation it undergoes fatty degeneration, and gives rise to fatty yolk, which forms the uppermost area in the centrifuged egg, whereas the true vitelline yolk is thrown down. Both direct and indirect evidence has been adduced in favour of this statement. The fatty yolk is intensely blackened by chrome-osmium alone; with Da Fano it turns brownish. The mitochondria, the nucleus, and a few unchanged Golgi elements form the central area of the centrifuged egg.

In view of the remarkable transformation of the Golgi elements in the oocytes of Lithobius, which is paralleled only in Saccocirrus (Gatenby), and also in view of the egg-like giant spermatocytes of Lithobius, it was considered desirable to extend the investigations to the Golgi apparatus in the male germ cells. No fatty degeneration of the apparatus takes place in these cells. In the spermatogonia the apparatus consists of at least one circular element, in the centre of which is a definite archoplasm. During the remarkable growth phase the circular element proliferates profusely, so that the spermatocytes are full of such elements. Each circular element may also divide in such a manner as to form two very regular crescents, each with an archoplasm. During meiosis the distribution of the Golgi elements is quite haphazard. During spermateleosis all the mitochondria and the majority of the Golgi elements form the tail sheath, but a few Golgi elements are plastered round the anterior face of the nucleus, and probably give rise to the acrosome. VISHWA NATH.

Zoological Laboratory,
Cambridge, July 14.

Approximate Rectification of the Parabola.

RECENTLY I had to ascertain with some precision the length of the curved path of a shot in air at elevations up to 40° as compared with the horizontal range.

The material available was a quantity of trajectories worked out in full detail by "small arcs." The error in summing these small arcs and considering the result to be the length of the curved path was within ±0·10 per cent. The greatest heights were also contained in the calculations.

Assuming the parabola of equal angle of projection and of equal height as standard and comparing the actual length, the length of a similar circular arc and the "fudge" formula L = R sec E to this standard, the result is surprising, and is as follows in parts *per thousand*:

Elevation in Degrees.	10	20	30	35	40
Parabolic error	0	0	0	0	0
Actual length	+1·0	+4·5	+7·0	+ 8·5	+ 8·5
R sec E . .	0	0	0	+ 0·8	+ 4·5
Circular arc .	0	+2·0	+10·0	+18·0	+31·0

On comparing notes with professional ballisticians, I cannot find that the "fudge" R sec E was known to Tartaglia, Galileo, Newton, or Benjamin Robins, nor has it yet been found in any modern book on ballistics or geometry. I hit on it myself by pure chance. Can any reader of NATURE supply a reference?

J. H. HARDCASTLE.

13 Charlton Road,
Blackheath, S.E.3.

Electric Charges by Friction.

THE following quotations from a book printed nearly one hundred years ago (Murray's "Elements of Chemistry." Sixth edition, Edinburgh, 1828) bear on the observations of an anomaly in frictional electricity referred to recently in NATURE (June 21, p. 914). "A white silk ribbon rubbed against a black one becomes positively electrified; but if the black ribbon be worn so that the colour is faded, and if the white ribbon be heated, the latter will be found to be negative, and the black positive."

As a result of consideration of a large number of such experiments, M. Coulomb inferred "that where the particles suffered a transient compression, they would be more disposed to become positive; where they suffered dilatation, the tendency would be to the reverse state."

This inference seems to receive support in the recent experiments with rough and smooth ebonite rods. H. E. GOODSON.

38 Chapel Lane, Armley, Leeds,
July 4.

The Radioactivity of the Rocks.[1]

By Prof. JOHN JOLY, D.Sc., F.R.S.

THE subject of the radioactivity of the rocks is one whch offers to the geologist considerations of the first importance respecting the history of the surface features of the globe. To the chemist it offers considerations even more fundamental in character, for it appears to throw a certain amount of light on the past history of the chemical elements during geological ages—knowledge attainable in no other way at the present time.

The fact that the radioactive elements of the uranium family are widely, indeed universally, distributed in the rocks was determined, in the first instance, by the present Lord Rayleigh, who in 1906 published an extensive research on rocks of various kinds. Later it was found that elements of the thorium family are just as widely distributed; and further, it was found that there appears to be a certain well-sustained relation between the amounts of these elements present in igneous rocks when the uranium and the thorium content of the same chemical division of the rocks are compared.

Lord Rayleigh in his earliest paper came to the conclusion that the acid rocks contained more radium than the basic rocks. This result has been confirmed by subsequent work. He found that the mean content of the igneous rocks was considerably greater than that of the sediments. This result, which has also been confirmed, throws light on the high radioactivity of the more slowly collecting oceanic deposits—the red clay and the radiolarian ooze. Similar results have been arrived at for the thorium content of rocks.

I have already referred to the fairly constant ratio which exists in the quantities of uranium and thorium in igneous rocks. When we estimate the uranium from the radium, using the equilibrium factor $3{\cdot}4 \times 10^{-7}$, we find in basalts about $0{\cdot}44 \times 10^{-5}$ gm. of uranium and $0{\cdot}9 \times 10^{-5}$ gm. of thorium. In intermediate rocks the corresponding ratio is 0·76 : 1·64. In the acid rocks (granites) the ratio is 0·8 : 2·0. For acid intrusives it is 1·1 : 2·3. The mean of all acid rocks affords 0·9 : 2·0. In short, we find a ratio which does not vary much from 1 : 2. In individual rock specimens this ratio is often seen to hold; but exceptions are found. It is best revealed in the general means, as, under the conditions, might be expected. To what may this fairly constant ratio be ascribed?

The rate of decay of uranium is nearly three times as fast as that of thorium. Obviously the precise numerical value of the ratio referred to must have been changing throughout geological time and must continue to change. The uranium will have dwindled to insensible amounts long before the thorium. But the fact that there appears to be a numerical ratio which is preserved through the chemical divisions of the rocks, although the actual amounts involved may differ largely, must be significant of some controlling condition.

Now if all rock families derive their origin from some world-magma by certain processes of differentiation which do not select between the parent radioactive substances, uranium and thorium, then we can account for the observed constancy of ratio. For if granites, for example, take from the parent magma a certain quantity of both the parent radioactive elements without disturbing their primal ratio, and if diorites and syenites take a different quantity, but still without disturbing the original ratio, then in subsequent ages the ratio of uranium to thorium, varying in the same manner both in granites, diorites, syenites, and the mother magma, will continue to be alike in all.

This subject naturally leads us to the interesting conclusion reached by Lord Rayleigh that the first formed silicate in rocks—zircon—is most exceptionally rich in radium. We seem to know little about mineral genesis in rocks. Hence we find here a tempting field for speculation. The oxide of zirconium is isomorphous with the oxides of uranium and thorium. It seems probable that herein is some explanation of the accretion by zircon of radioactive elements from the magma. The radioactive centre thus originating becomes the centre of a minute field of intense ionisation. These conditions may be supposed to be favourable to the crystalline growth of molecules around it. The radioactive nuclei are small and their field of influence is restricted, but the surrounding chaos is trembling on the verge of equilibrium and there is unlimited time. Of the chemical effects of radioactivity Soddy says: "The great chemical reactivity of otherwise inert substances in presence of the radioactive materials must always be remembered in the interpretation of their action." In fact it has been supposed by workers on this subject that there is first a dissociation of molecular aggregates and temporary formation of free atoms under the influence of the radiations, rendering the substance highly reactive, as in the nascent state. Much experimental evidence for this statement might be quoted. In some such way the growth of mica or hornblende around zircons may originate.

This concentration of radioactive elements gives rise to the radioactive haloes found in certain rock-forming minerals of early consolidation—notably the brown micas. These very beautiful manifestations of radioactivity in the rocks raise many questions. It is remarkable that the earlier observers regarded these minute objects as organic in origin. The only basis for this view appears to have been their behaviour when the containing mineral was heated to a high temperature. The halo then vanished or lost all definition.

Far-fetched as such an explanation may appear, we must remember that the real history of these objects was at that period absolutely undecipherable. It required a generation of scientific discovery and the brilliant advances which brought to light radioactivity, the transforming atom, and the phenomena of material radiation, before the real explanation was possible. Sollas, before the period of these discoveries, suggested that they were in some way caused by the presence of rare elements in the nuclear zircon which is in most cases to be found in the halo. To go any nearer to the truth was then impossible. The

[1] Hugo Müller lecture (slightly abridged), delivered before the Chemical Society on February 28.

wonderful similarity of dimensions and structure revealed by these objects seems to have escaped notice.

With the advent of radioactivity the explanation is simple. In this new domain, which borders at once upon radioactivity, chemistry, petrology, and geology, many curious facts have come to light. For the first time we can determine by direct visual observation the presence of radioactive elements in the rocks, and, given the halo, a single measurement of its radius tells us at once whether it was generated by uranium or by thorium. Some haloes there are which are generated in a curious way from the passage of the gaseous emanation of the uranium family which has wandered from the radium whence it originated and has become occluded in certain nuclei. These then have become centres of development of haloes possessing characteristic dimensions telling of their exotic origin. These are the only three sorts of haloes reconcilable with the known sources of radioactivity.

It is desirable to recall here the foundations upon which our knowledge of haloes is built. The fundamental assumption is that the α-ray is the all-sufficient source of the halo. For example, the atomic *débâcle* from uranium to lead takes place in fifteen stages. Of these, eight are attended by the expulsion of a helium atom as an α-ray carrying a charge of two units of positive electricity. The range in air of these rays varies from 2·7 cm. (in the case of the ray from uranium-1) to 6·97 cm. (in the case of radium-C_1). If the atomic disintegration occurs within a mica flake, these ranges are reduced some two thousand times.

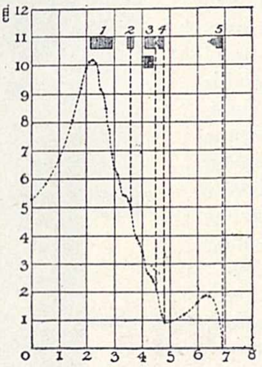

FIG. 1.—Ionisation curve for uranium haloes.

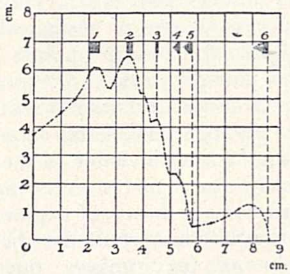

FIG. 2.—Ionisation curve for thorium haloes.

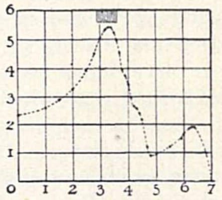

FIG. 3.—Ionisation curve for emanation haloes.

We know something about what happens along the track of the ray in gases. The particles of the gas are ionised. Bragg plotted the curve of ionisation. He found that the curve was alike in form for α-rays of long range and of short range, and that the ionisation rapidly increased just before the ray lost so much of its kinetic energy as to be no longer effective. The range of the ray is measured to the point where—effectively—it comes to rest.

Suppose now that in the brown micas the ionisation is attended with certain chemical changes—for example, affecting the iron present—so that the mica is darkened in colour. Then this darkening intensifies along the path of the ray and is darkest just at the approaching end of its trajectory. If uranium is contained in a minute particle—a crystal of zircon most generally—the eight rays will all act upon the surrounding mica within a certain spherical volume which has the zircon at its centre and the outermost boundary of which is defined by the path of the helium atom discharged from radium-C_1, the most penetrating of the rays. The radius of the uranium halo will therefore be about the two-thousandth part of 6·97 cm.—or, say, 0·035 mm. In the case of an emanation halo the outer dimension will be the same, for the penetrating ray of radium-C_1 decides its boundary, but the effects of the four least penetrating rays of the uranium family will be absent. If thorium be in the nucleus, then seven rays operate on the mica and the outer dimension is determined by the range of thorium-C_1, which is 8·62 cm. in air and becomes 0·041 mm. in biotite. Uranium and thorium haloes are thus readily distinguishable.

To determine the inner features, we lay out the ionisation curves of the eight rays of the uranium family, or the seven rays of the thorium family, or the four rays which generate the emanation halo and add the ordinates at sufficiently close distances. This gives us the integral curves of ionisation, and these curves we find bear close comparison with the actual halo. The apices of the curves correspond to the rings of darkened mica which lie around the nucleus. The depressions of the integral curve are depicted in the mica as annular areas of feeble darkening. But here a difficulty arises. Our method of arriving at these curves assumes that the rays affect the mica as if they travelled in parallel lines. But in fact they diverge, and when we plot the integral curve so as to allow for this divergence, we get a curve not at all accordant with the halo.

In order to explain why the halo does not exhibit the effects of the divergence of the rays, we may assume that something like photographic reversal or solarisation occurs when one ray traverses the path followed by a preceding ray. This weakens the density of the inner parts more than it affects the outer parts of the halo, and it follows that the ultimate effect is much the same as if the rays had been parallel. This view also explains the early appearance of the outermost ring of all; for a minimum of reversal affects this. It is not at all an improbable assumption that reversal plays an important part in the generation of the halo as we see it.

We see, then, that we can foretell the appearance and dimensions of the inner parts of a halo according as it originates from uranium, thorium, or radium emanation. If we find haloes not in accordance with these dimensions, we must conclude that we are dealing with new radioactive elements, unless some means of reconcilement be forthcoming. Herein we find an important application of the radioactivity of the rocks to the advance of chemical science.

When we look at the integral curves of uranium, thorium, and emanation haloes, we see that in the case of uranium and emanation (Figs. 1, 2, and 3) a single conspicuous crest occurs which must appear in the halo as an inner ring of small radius. In the case of thorium, two such crests appear close together. Those early rings are the first appearance we find. Their measurement will tell us what elements we are dealing with, although the halo is only in an incipient stage of development. Such rings are found well developed and easily measurable around nuclei of extreme minuteness.

We possess in haloes a means of identifying the presence of radioactive substances in rocks which much transcends in sensitiveness any other known method. The electroscope transcends in sensitiveness chemical gravimetric methods of detection many thousands of times. The billionth of a gram of radium per gram of rock may be detected by the electroscope. But we may have a zircon nucleus of the five-thousandth of a millimetre in diameter. We may suppose it endowed with a radium richness twenty-five times as great as obtained in the richest zircons measured by Lord Rayleigh. Then the mass of radium involved is only 3×10^{-18} gm. or the millionth of the billionth of a gram. Such nuclei may show a perfectly measurable and identifiable ring.

The reason for this extraordinary sensitivity is obvious. The halo is always old—often very old, and through all the successive ages of geological time the ionisation effect is slowly adding up. It is, in fact, not found in the younger rocks. We perceive the final effects of such feeble radiation exactly as we may detect on the photographic plate, after long exposure, stars which are for ever invisible to the eye.

On this account, also, the halo is important to chemical science. It gives us a means of exploration, almost uncanny, into the past history of the chemical elements. By its help we may answer questions which may not be approached in any other way. We can tell if the known radioactive elements formerly differed in their mode of disintegration or if other radioactive elements existed in the remote past. The important question as to whether during geological time radioactivity has been a diminishing phenomenon may be answered by the halo. For the halo is, in fact, a sort of hieroglyphic, a writing in the rocks, which admits of interpretation based on to-day's experience of what radioactivity involves. All this is equally important to the geologist. For he wants to know, as vital to the past history of the surface changes of the earth, whether the known radioactive elements evolved thermal energy as they do to-day, or whether in the past notably more or notably less energy from this source affected the earth.

That halo-reversal is an actual and definite phenomenon seems certain. We cannot, indeed, be sure that it is quite similar in character to photographic reversal; but it acts much in the same manner and there is considerable probability that the two phenomena are very much the same in character.

The theory of photographic reversal may be stated in a few words. The action of light on the photographic plate is photo-electric in nature. Electrons are released from the silver halide each bearing a certain quantum of energy derived from the absorbed luminous vibratory energy. These electrons penetrate a certain distance from the illuminated point, which remains positively electrified, and create around it a negative electrostatic field. This ionised system constitutes the latent image. It may persist for months or years. If we apply a developer, the energy, potential in the latent image, is expended in promoting chemical interaction between the ionised silver halide and the developer. In this process the silver is liberated and is built up in the ionised region to form the visible image. Such is the typical course of events in the case of normal exposure.

Suppose, however, we prolong the exposure or use a very powerful source of illumination. The electrostatic field around the illuminated point grows stronger and stronger until finally the insulation breaks down. There is then re-combination of positive and negative ions and the plate is restored to its original state. At this stage development gives no visible image. The image has, in fact, been reversed, the former latent image having disappeared. This is the first

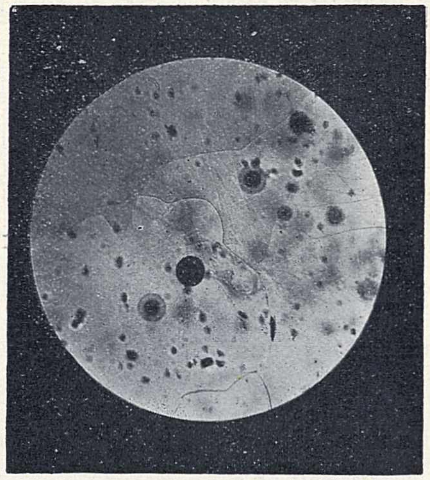

FIG. 4.—Uranium haloes in various stages of development. ×76. From Leinster Granite (Devonian).

reversal. If exposure be continued beyond the point of reversal, the original phenomena are repeated and a new latent image is formed like the first one, and so with continuous exposure the events in the film are repeated. The successive reversals may be demonstrated by exposing for increasing periods consecutive areas of a photographic plate.

The α-ray carries a certain quantum of energy according to its initial velocity when it leaves the transforming atom. The ray consists of a helium atom carrying two unit positive charges. In its passage through the mica it does work of ionisation. The original chemical bonding is disturbed, and under the influence of the ionisation, atomic systems are built up which are stable just as the latent image is stable. But it is conceivable that a second ray traversing the same or a nearly adjacent region may destroy this equilibrium and cause a reversion to the original equilibrium or to some new state of atomic equilibrium. The former case would result in the restoration of the original state of the mica: the latter may involve a new chemical bonding. As a matter of observation the new bonding appears, at least in some cases, to result in bleaching of the mica. Possibly successive "images" and reversals may occur. In experiments on the age of haloes, Rutherford produced very intense coloration in biotite by exposing it to strong α-ray radiation. It might be possible to obtain some definite knowledge as to what actually happens by continuing such intense α-radiation for long intervals of time.

In the oldest rocks we certainly find plentiful evidence of bleaching around radioactive nuclei. If these particles happen to be sufficiently isolated, we get a

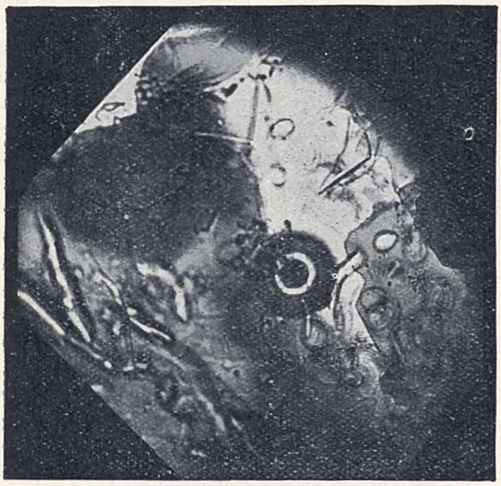

FIG. 5.—*X*-halo. ×256. Radius = 0·0294 mm. Ytterby mica. (Archæan.)

halo which may show some of its circular bands not as darkened areas but as colourless areas. If the particles are arranged in line and are sufficiently close together we get a bleached band, in the axis of which the particles are distributed. Outside the bleached band we see the effect of normal exposure in the darkening of the mica. Sometimes we find a halo very beautifully reversed or bleached where normally there would be successive dark rings.

In the study of haloes we have to bear other conditions in mind besides these changes brought about by reversal. Side by side in the oldest mica, embryonic haloes and "over-exposed" haloes are to be found, the former merely as a delicate ring of small radius surrounding a very minute nucleus, and the latter as a disc sometimes of almost impenetrable blackness (Fig. 4). Why is this? The answer is simple. The stage of development attained depends on two conditions: the age of the rock and the radioactive richness of the nucleus. These conditions correspond to duration of exposure and strength of illumination in the case of photography. Another obvious fact must also be borne in mind. The halo presented to us in the flake of mica may be a section off the centre of the halo-sphere, for serial sections of haloes in mica demonstrate that they are spherical. Rock sections revealing haloes contained in sections crossing the cleavage support this conclusion.

The phenomena attending bleaching have also to be held in view when studying these radiographs in very ancient rocks; for it may happen that certain outer or inner features may be obliterated thereby. In drawing the conclusion that a halo cannot be reconciled with known varieties, further evidence than the external dimensions of a few examples is required.

In the micas of Ytterby, which are of mid-Archæan age (pre-Huronian), I have found haloes which cannot be reconciled with haloes originating from known radioactive elements. These haloes I have called *X*-haloes (Fig. 5). There appear to be two varieties. I distinguish them as X_1- and X_2-haloes. They are fairly numerous. Sometimes, while free from any sign of bleaching, they look pale and washed-out. This is due possibly to some effect of over-exposure, just as an over-exposed plate lacks strength. Or, possibly, it is due to the remarkable metamorphic effects which this mica has generally experienced. In places such faded haloes may crowd together so as to overlap. They vary somewhat in dimensions, both externally and internally. But this effect may be due merely to different stages of development. Generally they consist of a central dark disc surrounded by two or three consecutive wide bands, the innermost one of which may be reversed. I do not think it is possible to ascribe *X*-haloes to thorium. Moreover, the thorium haloes which occur in this mica are always easily identifiable.

Here, then, is an example of the peculiar use we may make of these radiographs. If my conclusions are correct, we here find evidence either for an unknown element which has radioactively vanished off the earth, or for an undiscovered radioactive element.

In this same mica of Ytterby—but of extreme rarity—certain haloes of minute dimensions and all completely reversed or bleached also occur. I have called these "hibernium" haloes (Fig. 6). The majority are very uniform in dimensions, the radius being 0·0052 mm. A larger size—less abundant—seems present. These are closely 0·0086 mm. in radius. Now the earliest inner ring of a thorium halo is 0·011

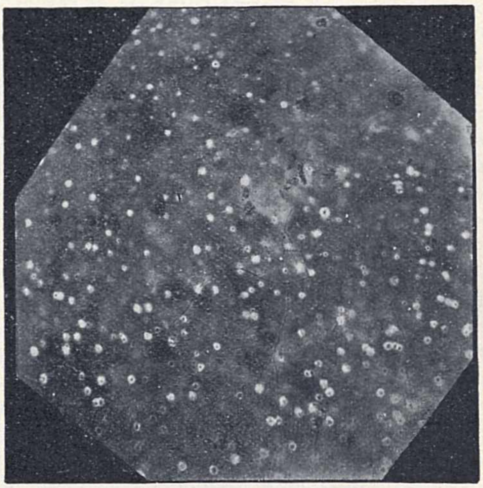

FIG. 6.—"Hibernium" haloes. Radii, 0·0052 mm. and 0·0086 mm. ×106·4. Ytterby mica. (Archæan.)

and of a uranium halo 0·014. If the conversion factor in this mica be taken as roughly 2000, the range in air of the rays responsible for the smaller hibernium halo would be a little more than 1 cm.

Each of these minute halospheres contains a nucleus accurately centred. If two such nuclei are sufficiently adjacent, the resulting halo is of the form of intersecting spheres. Three adjacent nuclei may give rise to a pear-shaped halo. There seems no doubt that their development is controlled by the nucleus in every case. As the bleaching is no objection to their radioactive origin, but in fact supports it, I see no alternative to the view that they are true haloes but of remarkably small dimensions. A prolonged search for other swarms of these haloes has proved unavailing.

It is of interest to notice that these haloes may be—not impossibly—generated by one of the known elements, for they must originate from a substance so feebly radioactive that no known method of observation would detect its radioactivity. This follows from the extremely small trajectory of the responsible α-rays. It will be remembered that Rutherford long ago pointed out that there existed a connexion between the initial velocity with which an α-ray was expelled and the period of the element giving rise to it. Geiger and Nuttall showed that a definite relation was deducible, most simply shown by plotting the logarithm of the constant of transformation against the logarithm of the range of the α-particle. Thus treated, the elements of each radioactive family are distributed approximately along a specific right line, and the lines for the uranium, thorium, and actinium series are sensibly parallel. From this investigation Geiger inferred that elements emitting α-particles of very small ranges would possess so slow a rate of transformation that no known instrumental method would reveal the fact that they were radioactive.

The age-long integration effected in the halo, however, can reveal radioactive phenomena far beyond the power of instrumental measurement. It is, therefore, not impossible that in these haloes we detect the radioactivity of some of those rare elements which this mica first revealed to science.

Lastly, one conspicuous fact is everywhere forced upon us in our studies of haloes—the scarcity of visible radioactivity in the rocks and the immense antiquity of that which we observe. In the absence of this mode of tracing radioactivity into the past, we might quite reasonably have argued that in former geological times many of the known elements were in process of radioactive genesis. The study of haloes rules out this view. Again, what radioactivity we are acquainted with has not originated in recent times. It dates back into the oldest rocks. The appearances which I have endeavoured to describe show this clearly. The reversed or blackened-up haloes of the Archæan are entirely different in appearance from those of Lower Palæozoic age. Indeed the geologist may by these appearances derive strong evidence as to the relative antiquity of the rocks he deals with. We arise from halo-study more than ever impressed with the immense age of the elements, and yet we know that some of them are to-day perishing off the earth and that a definite period is placed to their existence. What the halo ultimately shows is the remoteness of those past ages which probably witnessed the evolution of the elements.

The Malarial Treatment of General Paralysis.

FOR many years it has been realised that the intercurrence of an acute specific fever, such as erysipelas, in cases of general paralysis of the insane, is frequently followed by marked improvement in the general condition, and attempts have been made to procure remissions by the induction of an artificial pyrexia. In 1917, von Jauregg introduced the method of inoculation with malaria. About 5 c.c. of blood are taken from the vein of a patient suffering from benign tertian malaria and immediately injected subcutaneously, intravenously, or intramuscularly into the general paralytic. The average incubation period is about ten days, after which typical malarial attacks appear. When the patient has passed through ten or twelve attacks, the malaria is arrested by the administration of quinine and a course of neosalvarsan is given. Improvement is observed soon after the cure of the malaria, and in early cases of general paralysis the patient may become as capable as before the onset of the disease. Von Jauregg obtained prolonged remissions in more than fifty per cent. of his cases, the most noticeable features being the cessation of fits, better articulation, and general improvement in the mental and physical conditions. Other European observers have reported equally good results; in a series of 296 cases, Gerstmann found remissions in sixty-eight per cent.; Weigandt obtained improvement in forty-four out of fifty patients. In Great Britain the number of patients hitherto treated is small; Worster-Drought found improvement in all except one of twelve early cases; in a series of asylum patients, in whom the disease would be more advanced, improvement has been reported in six out of nine cases.

In dealing with syphilis of the central nervous system, the cerebro-spinal fluid affords an indicator of the inflammatory changes taking place in the brain and spinal cord, and the efficiency of treatment may be estimated by the resultant alterations in the fluid. So long as a positive Wassermann or any other abnormal reaction is given by the fluid, it cannot be considered that the disease has been eradicated. In cases of general paralysis, treatment by drugs has very little influence on these reactions; neither has it been found that inoculation with malaria, although producing remissions, has any effect in diminishing the intensity of the Wassermann and colloidal gold reactions. No patients have been observed for sufficient length of time to determine what period of improvement may be anticipated, but it must be remembered that spontaneous remissions are common during the course of general paralysis, and that relapses invariably follow. In view of the persistence in the cerebro-spinal fluid of the evidence of active syphilis, it cannot be expected that remissions following malarial inoculation will differ from those which arise spontaneously.

In our present state of knowledge, only speculation is possible concerning the mode of action of artificial pyrexia. Drugs, and probably specific antibodies, penetrate with great difficulty into the central nervous system; it may be that pyrexia with leucocytosis in some way increases the accessibility of the actual nervous tissue to the passage of substances from the blood-stream. Purves-Stewart suggests that the remissions are due to the destruction in the febrile reaction of some of the toxins affecting the cerebral cells, the specific organism of the disease being unaffected. He has published descriptions of two cases of general paralysis treated by malarial inoculation, followed by a course of intra-cisternal injections of salvarsanised serum. In the resulting remissions the cerebro-spinal fluid became completely normal in one case, and the pleocytosis was markedly diminished in the other. This result is of great importance in indicating that malarial inoculation, combined with a specific anti-syphilitic treatment which can reach the cerebral cortex, may prove to be a means of completely arresting the disease.

Inoculation with malaria is not entirely without drawbacks; there is a definite risk of the parasite being conveyed to other persons by the mosquito; the Board of Control has issued a letter to asylum superintendents recommending a number of precautions to be adopted against this risk. In advanced cases the attack of malaria may hasten the fatal termination, but, in view of the hopeless prognosis of general paralysis, this mortality cannot be considered as a contra-indication to a treatment which in early cases produces such marked remissions. The serious nature of the disease, and the complete failure of anti-syphilitic treatment to have any effect on its course, demand that every endeavour should be made to investigate and perfect a method which offers some hope of improvement.

Obituary.

SIR WILLIAM A. HERDMAN, F.R.S.

THE sudden death of Sir William Abbot Herdman on July 21 will be deeply regretted by naturalists in many parts of the world. For several years his general health had been bad. His only son, George, was killed in the battle of the Somme, and this calamity accentuated an illness from rheumatism which left him partially crippled and with serious heart weakness. He had begun to shake off the rheumatism when his wife died after two days' illness from pneumonia, and since then his health continued to be bad. He had gone to London on the day that he died to be present at the wedding of his daughter, and had arranged to leave Liverpool three days later for the British Association Meeting at Toronto.

Herdman was born at Edinburgh in 1858, and was educated at the High School and University in that city. He graduated in science in 1879, and was for a short time assistant to Sir Wyville Thomson. Then he went to the *Challenger* office, where he worked under Sir John Murray, and began the description of the Tunicate collections, a work which he finished at Liverpool. He went to the latter city in 1881, when the University College was established, as the Derby professor of natural history. In 1919 he retired from his chair (then that of zoology), and became professor of oceanography, a post which he held for a year, when he retired as Emeritus Professor. His connexion with the University of Liverpool did not, however, cease in 1921: he was a member of council and of various committees, and during the Lent term of 1924 he was acting vice-chancellor in the absence, on sick leave, of Dr. Adami. He had a room in the Department of Zoology, and he was there almost daily. At the time of his death he was engaged in a research on the morphology of Ramulina.

During the latter part of his life Herdman was a comparatively wealthy man, and (with his wife) was a generous donor to the University. He endowed the chair of geology in 1916, and that of oceanography in 1919. In 1923 he gave the University a sum of 20,000*l.* to assist in the building of a new department of geology. He endowed an exhibition, and he bought and furnished a building at Port Erin as an institute and club for fishermen. For the last dozen years of his life he had become greatly attached to Port Erin, where he owned a house at which he resided during a considerable part of each year. His interest in Manx affairs was strong, and he was practically responsible for the foundation of the new Government Museum at Douglas.

Herdman's life-work was, of course, marine biology: that he began by a series of dredging expeditions in the Firth of Forth; developed in the *Challenger* office, and continued when he went to Liverpool. There he found a small group of amateur naturalists whom he organised as the Liverpool Marine Biology Committee; he outlived nearly all these original workers. They prosecuted active, systematic, biological investigations in the Irish Sea region, at first hiring steam tugs for their dredging and trawling expeditions. Then they fitted out a biological station at Puffin Island, in Anglesey, and later built two stations at Port Erin, in the Isle of Man. In 1892 Herdman organised the scientific work of the Lancashire Sea Fisheries Committee, and persuaded the latter body to found the Fisheries Laboratories at the University of Liverpool, and at Piel in Barrow. The result of these activities has been a very satisfactory biological survey of the Irish Sea, summarised in five volumes of a "Fauna and Flora," and a long series of papers on fishery subjects written by Herdman and his colleagues, and published by the Fisheries Committee. This work was, at first, financed locally, but, later, it was supported by government grants with results that have not been satisfactory. The local contributions have tended to decrease; there has been an unnecessary control over expenditure, and an insecurity of tenure of post for the scientific men employed.

In 1901–2 Herdman went to Ceylon for the greater part of a year, at the request of the Colonial Office, to study the pearl-oyster fisheries. He went out again a year or two later at the request of the syndicate of pearl fishers, which had in the meantime leased the fishery rights from the Government. The results of these expeditions was a very complete biological survey of the pearl banks, published in five volumes by the Royal Society, and an hypothesis of pearl formation which has given rise to much controversy. He was, in 1892, elected a fellow of the Royal Society, and was its foreign secretary in 1916–20. He was president of the Linnean Society in 1904, president of Section D of the British Association in 1895, and president of the Association at the Cardiff meeting in 1920. During the war years he was chairman of the Grain Pests (War) Committee of the Royal Society. He was a member of various official commissions and advisory committees, and gave expert testimony before other similar bodies. He received many honours during his lifetime: he was a D.Sc. and LL.D. of the University of Edinburgh, and a D.Sc. of the Universities of Harvard, Durham, Sydney, and West Australia. He was made a C.B.E. in 1920, and was knighted in 1922.

Herdman was, above all, a field naturalist and systematist of the type which seems now to be passing away. His knowledge of species of animals was extraordinarily good: helpful (and at times embarrassing) to his colleagues and assistants. This fine zoological knowledge was of immense value to him in his fishery investigations. He was adventurous, very active, and inclined to "rough it" until middle age: he and his friend Isaac Thompson for a time went regularly to Port Erin Bay to swim during the Christmas vacations. He was a keen traveller and yachtsman, and had visited most countries in the world. For many years he owned small steam vessels which he worked himself up the west coast of Scotland, round St. Kilda, and through the Orkneys and Shetlands on his trawling and plankton expeditions. He always had strong interest in archæological investigation, and with his friend P. C. Kermode did a good deal of excavation in the Isle of Man, while at one time or another he had visited most of the places of anthropological interest in the continent of Europe. In his own home he was at his best: an accomplished talker, most hospitable and good-humoured. On his fiftieth birthday his family presented him with a pipe, and after that he became an inveterate smoker. While his interests were thus very wide, he was first and last a marine biologist, both as an investigator and an expositor, and it is in this direction that his influence was most widely manifested, and will be most sadly missed.

J. J.

Mr. Edwin Thompson, who was one of the local honorary secretaries for the Liverpool meeting of the British Association last year, sends the following tribute:

Sir William Herdman was known throughout the world as a great oceanographer. There are thousands who, in addition, knew him as a delightful personality, and there are others who had the privilege of knowing him as the kindest, most cheery, most breezy and sympathetic of men. To have known Sir William Herdman personally was an education in the highest sense of the word; he knew and could teach others how to work and how to play, but he never knew what it was to waste time. The short memoir he wrote about his son, George, who was killed in the War, was, I think, an inspiration to every boy who read it, and I always wished that it had been made public, and I feel that Sir William Herdman's life, if it is ever written, will be an inspiration to every man whether he be interested in science or not.

When Sir William Herdman took a holiday it was to work, and I have had the pleasure of seeing him at sea working with the late Sir John Murray, Haeckel, and others, and also years ago have seen him organise children's parties with an understanding with which one does not usually credit great men of science; he might, in fact, have been the author of "Peter Pan." No man was ever made to feel a fool by Herdman, and it is only a great man who has that attribute. It needs a man with a big brain to lecture on scientific subjects to a large audience in such a manner that the subject is clear to every one, even the least intelligent. Sir William Herdman had this power in an extraordinary degree.

His last years were full of sorrow, but with his characteristic pluck he never let others see the sadness in his heart. The strain had told upon him, however, and he knew every time he went upstairs that he might not reach the top alive, but he did not let that interfere with his work or the pleasure he gave to others.

He died suddenly as he would have wished, without a long illness, which to him would have been a terrible trial. His friends, Liverpool, and the whole world have lost a great man, and those who knew him intimately can to a small extent realise the sadness felt by his three daughters and their pride in having such a father. I would just like to tell how he died, as there were many garbled reports, which gave rise to misunderstandings. He travelled to London on Monday, July 21, and gave a little family dinner on the eve of his daughter's wedding. Before going to bed he went out for a short stroll, as was a very frequent custom of his, and in the street he had a heart attack. Fortunately, a woman was passing at the time, and seeing him in distress helped him into the nearest house, which was a small hotel; but by the time the doctor had arrived he was dead. The doctor then sent for the police, who identified him by papers in his pockets. It is tragic that his family were not with him; but it is far more tragic that the false reports should have caused any misunderstanding or been misinterpreted by those who did not know him.

We regret to announce the following deaths:

Miss K. A. Burke, assistant lecturer in chemistry at University College, London.

Prof. Heinrich Precht, who was closely associated with the German potash industry and contributed many important investigations in this field, aged seventy-two.

Prof. James Seth, professor of moral philosophy in the University of Edinburgh from 1898 until a few weeks ago, on July 24, at sixty-four years of age.

Current Topics and Events.

RECENT criticism of the British Museum Bill fully justifies the comments in our issue for July 5. Sir Hercules Read, as an ex-officer and former trustee of the Museum, in a letter to the *Times* of July 26, emphasises the point that the objects in the national collection are not duplicates, and that the temporary removal of any specimens other than those of trifling interest would disorganise the exhibition and study series, and would add to the difficulties of the serious investigator. The Trustees, who did not ask for this Bill, would in most cases escape from a difficult or delicate position by exercising their discretionary veto. On the other hand, the provincial museums object to the Bill on two grounds: the categories of permissible loans are not those which they particularly desire, and the conditions imposed are onerous if not impossible. The Museums Association has therefore passed a resolution of protest, and has once more called for a Royal Commission to inquire into the whole question of the national organisation of museums. The resolution, which has been sent to the Prime Minister, is as follows: "This Association regrets that the British Museums Bill No. 2, promoted in the interests of provincial museums, should have been introduced without consulting the body which represents those museums and knows their needs, and expresses a hope that the Prime Minister will be so good as to receive a deputation from the Museums Association, which would explain the urgent necessity for the appointment of a Royal Commission to inquire into the work of all the museums of this country."

THE continued closing of the Museum of Practical Geology, London, was discussed at the meeting of the Museums Association last week, and a resolution upon the subject was passed, to be forwarded to the president of the Board of Education. A question asked in the House of Commons on Monday by Major Church, secretary of the National Union of Scientific Workers, elicited some interesting information on the matter. The question was: "To ask the First Commissioner of Works if he can state how long the Geological Museum will be closed for repairs, in view of the importance of the museum to the nation; and will he state why the structural alterations and repairs now being undertaken were not commenced before." In reply, Mr. Jowett, First Commissioner of Works, said: "It has now been decided to proceed with the erection of a new building at South Kensington to house the offices of the Geological Survey and the Museum of Practical Geology, and a Supplementary Estimate for the provision of funds for this purpose is being presented to the House at an early date. The repairs required to the present building to enable it to be reopened to the public are not being proceeded with, but the administrative work of the Geological Survey will still be carried on, and the public will have access to the Library and Map Room. As regards the last part of the question, the execution of the structural alterations and repairs was suspended pending a decision as to the future of the Museum."

THE annual meeting of the Imperial Cancer Research Fund was held on July 23, when the twenty-second annual report was presented and adopted. The report discloses satisfactory steady progress. The finances are sound, though half the annual income comes from subscriptions and donations. The new laboratory at Mill Hill, adjoining the farm of the Medical Research Council and due to the beneficence of the executors of the late A. C. Stroud, has been erected, and the laboratories at Queen Square continue to make the sound contributions to our knowledge of the biology of cancer which has always characterised their activities. After prolonged discussion the Fund has found a means of co-operating with the British Empire Cancer Campaign through the appointment by the Royal Society and Medical Research Council of an advisory committee which will advise the Campaign on the allocation of funds for investigation. The Middlesex Hospital, the Cancer Hospital, and the Fund have also nominated representatives on the grand council of the Campaign. It is hoped that by this arrangement the newest organisation for the investigation of cancer may have the advantage of the experience gained through many years by the older bodies.

ACTIVITY in the experimental investigation of cancer has recently centred largely around the relation between certain forms of long-continued skin irritation—notably by tar—and the development of malignant tumours. One of the most noteworthy contributions to the same topic, but from the observational side, is contributed by Dr. Alexander Scott, of Broxburn, who has practised for many years among the operatives in the Scottish shale oil works, to the eighth scientific report of the Imperial Cancer Research Fund. We have here a singularly exhaustive study of the inflammatory conditions of the skin brought about by the repeated irritation of crude paraffins and the conditions under which cancer develops in the affected areas of skin. Dr. Scott's observations, which are illustrated by a large number of illustrative photographs, are particularly valuable, because they comprise the history of nearly twenty-five years—a continuity much needed and so often lacking in clinical studies. They bring out clearly the close parallelism between paraffin cancer in man and experimental tar cancer in mice, especially in respect of the length of the prodromal stages and the course of the disease after tumour growth has started. As a result of his work, preventive measures have been installed in the industry: fresh cancers will no doubt develop for some time, as they do in mice, as the result of past irritation, but in the end his pictures will—or ought to—become a unique historical record of something which no longer exists.

"EDUCATIONAL HARMONICS" is the phrase in which the *Times* sums up the character of the debate in the House of Commons on July 22 on the education estimates. With one or two exceptions, the speakers made no attempts to use the debate as an opportunity for scoring points for their respective parties. There was general agreement that the problem of adolescent education is of paramount importance, and Mr. Fisher and Mr. Wood were to that extent at one with Mr. Trevelyan in his proposal that for the next few years extraordinary efforts should be made, whatever political party may be in power, to provide for a great increase in the number of secondary school pupils. Mr. Trevelyan suggested that their number, which is already double what it was only a few years ago, should be again doubled within the next ten years. He is less sanguine than Mr. Fisher as to the potentialities of day continuation schools, and laid less stress than Mr. Wood on the importance of central schools, but is willing to support local efforts to develop either. There was no discussion of educational aims, and no revival of the proposal made two years ago for a commission of inquiry into the subject; yet, as Mr. Wood remarked, the mere expenditure of much money will never be enough unless the system be right, and unless we know where we are going and what we want to get out of it. Mr. Trevelyan's assumption that "there could be no difference in the main objective in education of succeeding governments" may be convenient for preserving harmony in parliamentary debates, but there is little else in its favour. An authoritative statement on the subject commanding general respect would do more to promote real efficiency than the expenditure of many millions, and is doubly desirable in view of the anticipated great expansion of secondary education.

MR. HOOVER, the Secretary of Commerce, U.S.A., in addressing the Izaak Walton League at Chicago in April last, spoke of the attitude that a good government ought to observe in its consideration of fishery problems. Thousands of generations of free fishermen have established their tradition to catch unlimited fish, but now this tradition encounters the spirit of modern industry. There is over-fishing and depletion, so that already the systematised fishing trade, with the "demonic assistance of the tin can," is rapidly destroying the Pacific salmon rivers. Long ago, villages situated on rivers and seashores established a right to deposit their waste products on the nearest stream or foreshore. Little harm was done originally, but now the modern factory, the great city with its sewerage system and the new oil-driven vessel, are rapidly making tidal rivers and shores incredibly foul, so that another ancient privilege has become incompatible with a fishing industry that seeks to develop as others have done. Finally, the conflict between federal government and local autonomy (as represented by the American States, or the provincial systems of regulation in Great Britain) has, so far, led to confusion of policy and waste of effort. To these problems, Mr. Hoover asks the fishery administrators to bring the contemplative mind, the faith and optimism, and the patience and reserve that come to the followers of Izaak Walton; and, one may add, without any suspicion of cynicism, he asks in vain, for the qualities he postulates do not seem to come to those who look at fishery questions through official windows.

THE leading part taken by Messrs. Chance Bros. and Co., Ltd., in the development of optical glass manufacture and their successful efforts during the War to meet the enormously increased demands are well known. These, however, form only a small part of this firm's contribution to the development of glass manufacture during the last hundred years. In 1824 Robert Lucas Chance purchased the works of the British Crown-Glass Company at Smethwick, and thus provided the nucleus round which the modern works of Messrs. Chance have grown. Ever since then, the name of Chance has been intimately associated with the history of glass making in Britain. The firm's first achievement of outstanding importance was the introduction into England, in 1832, of the manufacture of sheet glass. This was soon followed by the production of rolled plate and later of "figured rolled" glass. In 1840 the firm inaugurated the manufacture of thin glass for microscope cover-glasses, which greatly extended the possibilities of accurate microscope work. For many years Messrs. Chance have provided a large proportion of the world's supply of glass for spectacles, while recent developments include the production of heat-resisting glasses for illuminating ware and of chemical resistance glass for laboratory ware. An interesting record of the firm's activities and achievements is contained in an illustrated pamphlet, "100 Years of British Glass Making, 1824–1924," which has recently been issued by the firm to commemorate its centenary celebrations.

THE building of the Literary and Scientific Institution of Bath was opened in January 1825. During the past hundred years much good work, especially in geology, has proceeded from Bath, as the names of William Smith, Lonsdale, Charles Moore, and H. H. Winwood bear witness; and the museum of the Institution houses many specimens of scientific importance, notably the fossils of the Charles Moore collection. Unfortunately the good people of Bath did not keep up their interest in the side of life represented by the Institution, and of late years, particularly during the War, the building was falling into decay, not without danger to its contents. Now there seems to be an intellectual and material revival. Repairs and rearrangements have been effected by the zeal and generosity of a few, and in one year 9000 visitors have passed through the pillared entrance. But more needs to be done if the Institution is to have a home worthy of its traditions and of its beautiful city. It is proposed to celebrate the centenary next January, and the most appropriate form of celebration will be a pecuniary contribution forwarded to the Secretary, Mr. P. E. Martineau. We cordially commend the appeal to our readers, who will be the more ready to help those who are helping themselves.

THE fourth Annual Report of the Forestry Commissioners for the year ending September 30, 1923, shows steady progress in afforestation. During the year, 10,463 acres were planted with about 18,000,000 trees, mostly conifers, the species used being Scots and Corsican pines, Norway and Sitka spruces, European and Japanese larches, and Douglas fir. The cost of planting averaged 7*l*. per acre; and this figure included preparation of the ground, draining, fencing, actual planting, filling in blanks, and weeding. Except for seed, tools, and wire, the whole of this expenditure was on wages. The total land acquired during the four years amounts to 179,207 acres, of which 121,015 acres are classified as plantable, the remainder being either too poor or too good for timber production. In addition, eighteen Crown woods, formerly under the Commissioners of Woods and totalling 120,000 acres, were transferred in 1923 by Act of Parliament to the Forestry Commissioners. Two maps in the Report show the situation of all the areas now under the control of the latter. There are now two schools for the training of woodmen, one at Parkend in the Forest of Dean, and the other at Beaufort in Inverness-shire. Research and experimental work has made good progress. As many as 143 experimental plots, which are regularly thinned and measured, have been established in different parts of England and Scotland. A census of British woodlands is in course of preparation, and a summary of the completed statistics for twelve counties is given in the Report. The Forestry Commissioners were represented at the British Empire Forestry Conference, which was held in Canada during the summer of 1923; and a full account of the important resolutions passed by the Conference is appended to the Report.

"METEOROLOGY in Education" is the title of the reprint, now published, of the papers read on January 3 last at a conference of the Royal Meteorological Society, the Geographical Association, and the Science Masters' Association (Messrs. George Philip and Son, 1*s*. 6*d*. net). Sir Napier Shaw, who presided, introduced the subject as the study of weather as a scientific subject, and Mr. J. Fairgrieve in the course of the discussion claimed that the conference was a successful attempt to get geography teachers and meteorologists to talk to each other. Mr. G. M. B. Dobson contributed a paper detailing recent results of research especially in regard to cyclonic and monsoon rains. Mr. L. B. Cundall in a paper dealing with school work in meteorology pleaded for the creation of a joint advisory committee of the three bodies to decide what should be taught in this connexion, and Mr. W. G. W. Mitchell directed attention to the use of wireless in relation to the compilation in schools of synoptic weather charts. During the discussion Sir Richard Gregory and Mr. W. E. Whitehouse both emphasised the position of the teacher of geography, for whom the results of meteorological science were merely initial data for use in the class-room. Dr. G. C. Simpson advised teachers to teach meteorology because it is a body of knowledge to which the pupil should be introduced. In any event the conference made quite clear that the current geographical teaching concerning rainfall distribution in relation to winds and pressure variation requires considerable emendation. Sir Napier Shaw stated that the wind distribution was only known for about three-fifths of the earth's surface.

THE library of the Chemical Society will be closed for stock-taking on August 4-August 16 inclusive, and will close each evening at 5 o'clock from August 18 until September 13.

DR. R. E. M. WHEELER, Keeper of the Department of Archæology in the National Museum of Wales and lecturer in archæology in the University College of South Wales and Monmouthshire at Cardiff, has been appointed Director of the National Museum of Wales, in succession to Dr. W. E. Hoyle, who has resigned owing to ill-health.

IN agreement with the programme of the International Commission for the Upper Air, the Meteorological Office of the Air Ministry sent up twelve registering balloons between March 3 and 22. The *Meteorological Magazine* for July states that of these, nine instruments have been found and returned. Eight ascents were made from the aerodrome at Shotwick, near Chester, and four from Kew Observatory, the losses being respectively 2 and 1. The greatest height reached was 19·3 km., 12 miles, the drifts being towards points between north-north-east and south-east. During five months working, 80 per cent. of the balloons sent up have been found and returned.

A DANISH ship, the *Godthaab*, started from Thorshavn at the end of June, according to the *Meteorological Magazine* for July, to visit settlements in north-east Greenland. The vessel is to keep in communication with Jan Mayen by wireless telegraphy, and meteorological reports are being transmitted via Tromsoe. Reports from the *Godthaab* in the area off north-east Greenland in about latitude 75° N. have been received by the Forecast Division of the Meteorological Office, and they extend the information of the daily weather charts into the region of the Arctic north of the island of Jan Mayen and south-west of Spitsbergen, from both of which places daily reports are regularly received.

UNDER the auspices of the Royal Society for the Protection of Birds, a bird sanctuary has been established near Farnham, in Surrey, consisting of some twenty-seven acres of wild gorse, heather, and woodland, and well watered. This is eventually to become the property of the Royal Society for the Protection of Birds, so that it may be obtained in perpetuity as a wild nature reserve. A watcher who is well versed in wood-craft and bird-lore has been appointed, and an earnest appeal is made for the sum of 500*l*. to provide him with a cottage so that he can continually be on the estate. Donations will be gladly received by the hon. sec., R.S.P.B., 82 Victoria Street, London, S.W., or by Mrs. Minchin, Gorsedene, Farnham, Surrey.

THE marine biological laboratory at Wood's Hole in Massachusetts, founded in 1888 and for many years a centre of attraction to biologists of all parts of America, is to be developed on a great scale by means of a gift of 1,400,000 dollars from the Rockefeller Foundation, the Carnegie Corporation, and a fund endowed by Mr. C. R. Crane of Chicago. A combined laboratory and library building is to be constructed at once at a cost of 600,000 dollars. At Wood's Hole, which has been called the summer capitol of American biology, zoologists, physiologists, embryologists and botanists gather every summer both for independent research and for theoretical and practical instruction courses. During 1923, seventy universities and research organisations contributed to the support of the laboratory.

BY virtue of the Importation of Plumage (No. 2) Order, 1922, and (No. 1) Order, 1923, respectively, the names of the golden pheasant and of the *common or mute swan* were added to the Schedule to the Importation of Plumage Prohibition Act, 1921, which contains the names of certain birds whose plumage may be imported without licence. The Advisory Committee appointed under the Act has now recommended that the common or mute swan should be removed from the Schedule, but that the golden pheasant should remain thereon. The Board of Trade accordingly desires it to be known that an Order will be made in due course removing the name of the *common or mute swan* from the Schedule, with effect from October 1, 1924. On and after that date, the plumage of this bird will accordingly be prohibited from being imported except under Board of Trade licence issued in accordance with the provisions of the Act. The right to import the plumage of the golden pheasant without licence will continue as heretofore.

DR. N. H. DARTON, geologist, has left Washington to join the National Geographic Society's expedition, which is exploring an ancient temple in the Valley of Mexico, the oldest ruins so far discovered in the Americas. Dr. Darton will study especially the sequence of geological events, including the lava flows and the recession of Lake Texcoco, with the view of determining more nearly the exact period of the civilisation which flourished on the American continent some 7000 years ago. Mr. Byron Cummings, the head of the expedition, has already reported remarkable finds among the lava-encased temple mound—finds ranging from pottery, images, and sculpture to parts of human skeletons. It is believed the mound was built on or near the shore of Lake Texcoco originally, but the water line of the lake is now twelve miles distant. The lake had receded a considerable distance when a sudden volcanic eruption half buried the temple mound, which still was inhabited.

A CONFERENCE on Illuminating Engineering has been arranged to take place at the British Empire Exhibition on Tuesday, August 12 (2.30-5.30 P.M.). The conference is timely in view of the two important conferences just held in Geneva, namely the first International Conference on Industrial Hygiene, and the meeting of the International Illumination Commission. In both cases important papers dealing with illumination were read, and special attention was devoted to the lighting of schools and factories. A report on the proceedings at these two congresses is to be presented, and other papers dealing with public lighting and other subjects will be read. It is also interesting to note that the opportunity will be taken at this conference to discuss the question of the lighting of exhibitions. Fuller particulars of the conference will be obtainable in due course from the hon. secretary of the Illuminating Engineering Society (Mr. L. Gaster, 32 Victoria Street, London, S.W.1).

Our Astronomical Column.

SPIRAL AND STRUCTURELESS NEBULÆ.—The *Observatory* for July contains a letter on this subject by Prof. C. D. Perrine. He criticises Prof. Lindemann's suggestion that the spirals are dust-clouds shining by reflection from the galaxy; he notes in opposition to this view that the Coal Sack and other very dark regions appear to be dust-clouds absorbing the light of the stars behind them; we should therefore expect them to shine by reflection much more brightly than the spirals since they are presumably much closer to the galactic stars; nevertheless they appear quite non-luminous both to the eye and photographic plate while the Andromeda nebula is very luminous. Further, he dwells on differences in the spectra of different spirals, some showing bright lines, others not; these would be difficult to understand if all of them shone by reflected galactic light.

Prof. Perrine considers that the structureless nebulæ are related to the spirals, being at an earlier stage of condensation, with less rapid rotation; both alike are supposed to consist of "cosmical matter." Possibly a considerable part of this may attain incandescence through collisions or electrical excitation, sufficient gas being evolved to account for the absorption spectra.

The variety of opinion that prevails about the nature of the spirals is evidence of the difficulty of the problems that they present. It is well to consider all reasonable suggestions, but not to expect a definite or final solution in the near future.

THE PLANET URANUS.—Mr. W. F. Denning writes that Uranus will be favourably visible during the ensuing few months. The planet will rise on August 1 at 9 h. 6 m. P.M. and on August 31 at 7·6 P.M. G.M.T. It will be in opposition to the sun on September 12 and will be perceptible during the whole night. Its position is in the southern portion of Pisces, and its present motion is retrograde amongst the small stars in that region. The planet's place may be found from an ephemeris and by the help of a catalogue of small stars. The intending observer should make a diagram containing the places of Uranus and of the stars in the same locality and then examine the sky with a suitable telescope and low power. In this way the planet may be easily identified; but should this method fail, the object may be known by its disc, which will be apparent with very moderate power and will contrast strongly with stellar images in the same field of view. The planet is distinctly visible to the unaided eye, being about 5½ magnitude, and Mr. Denning considers, from many observations made at Bristol, that it might quite possibly have been discovered without telescopic aid, as it has been watched on many clear evenings near opposition in past years and changes distinctly noticed in its position. Uranus and the Moon will make some near approaches during ensuing months:

1924.	G.M.T. h.	m.				
Aug. 16	9	16	Uranus	1°	44′	north of Moon.
Sept. 12	16	38	,,	1	37	,, ,,
Oct. 9	22	17	,,	1	34	,, ,,
Nov. 6	2	43	,,	1	42	,, ,,

Research Items.

Witchcraft in Medieval India.—Mr. W. Ivanow directs attention in the Journal of the Asiatic Society of Bengal, vol. xix., New Series, No. 3, to a "witch case" which affords a remarkably close parallel in its details to the practices of European witches. Hamid b. Fadli'l-lah Jamāli (a Sufi of Northern India) records about A.D. 1530, in a collection of stories of miraculous deeds, that when Shaykhu'l-Islām Farīdu'd-Dīn Mas'ud (d. A.D. 1265) was suffering from a serious indisposition, it was revealed to his son in a dream that he had been bewitched, but that the spell could be removed by the repetition of certain incantations over the tomb of a sorcerer, the father of the man responsible for the Shaykh's illness. These instructions were followed, and in the course of repeating the incantations the son of the Shaykh accidentally discovered, hidden in the grave, a figure made of flour into which some needles were stuck, and on which were knotted hairs from a horse's tail. The figure was taken to the Shaykh, who ordered the needles to be drawn out, and the hairs to be unknotted. As this was done the pain diminished, and when all the needles had been withdrawn and all the hairs untied, it disappeared. The sorcerer was apprehended, but—and here the parallel with Europe ceases—was pardoned.

Racial Intrusions in Ancient Egypt.—Sir Flinders Petrie in *Ancient Egypt* for June discusses the origin of the XIIth Dynasty in the light of the results obtained by the British School of Archæology in the excavations at Qau. Up to last season, it was known that there had been a Syrian occupation of Northern Egypt, a Libyan occupation of Middle Egypt, and, there was strong presumption, a Galla intrusion which could have originated this Dynasty. The examination of the tombs of the Uahka family at Qau last winter and a study of their names at different periods point to the existence of a principate holding Upper Egypt about the IXth and Xth Dynasties which brought in tombs of a hitherto unknown Nubian type. The measurements of the skulls indicate a close connexion between the Tigre skulls and Middle Dynastic Egyptian types, thus according with the Galla portrait in pointing to a southern origin. It would appear that when in the VIth Dynasty the Syrians took over the kingdom from the Egyptians, a king of the old style remained in the south, holding Nubia and Koptos. He was succeeded by invaders akin to the modern Gallas who held the Thebaid under the Libyan invaders and built the great temple-tombs of Qau. The Qau princes lasted through the Xth Dynasty, and finally one of them, aspiring to hold Thebes, took the name Amenemhat, and at the end of the Antef and Mentuhetep families occupied the throne and founded the line of the XIIth Dynasty, which, to the end, kept the features of its ancestry.

Mosquito Control at Hayling Island.—The third annual report of the Hayling Mosquito Control announces that satisfactory progress has been made in dealing with the local mosquito nuisance, although unavoidable delays have prevented the completion of the important experiments which had been undertaken on the range of flight of the salt-marsh species. The Control has, however, succeeded in obtaining the co-operation of a large number of persons by whose help it is hoped to make a detailed survey of the mosquitoes of south-east England. Such a survey should yield valuable results in elucidating the factors limiting the distribution of the various species as well as the individual range of flight. The year's work confirms the conclusion that the main pest in low-lying areas of the south coast is *Ochlerotatus detritus*. The present report is illustrated by some very fine photographs of this species, taken from a series of illustrations of the British mosquitoes which is being prepared by Mr. J. F. Marshall, the director of the Control, in his laboratory at "Seacourt," Hayling Island, Hants.

A New Crustacean.—The discovery of a representative of a new order in any group of animals is an event of interest to others besides the mere systematic specialist. This may perhaps prove to be the significance of the minute Crustacean which Th. Monod describes under the name of *Thermosbæna mirabilis* (Bull. Soc. Zool. France, xlix. No. 2, 1924, pp. 58-68). It was found at El Hamma in Algeria in a Roman bath-cistern fed by a hot spring at a temperature of 48° C. The animal is about 3 mm. in length, colourless, and without any trace of eyes, its proper habitat being doubtless in the subterranean reservoirs from which the spring takes its origin. Its general appearance is that of a small Isopod, but the fore part of the body, as far as the fourth thoracic somite, is covered by a reduced carapace, the antennules are biramous, and the five pairs of walking legs (the last two pairs are suppressed) carry large exopodites. Pleopods are absent except the first and second pairs, which are vestigial. The telson is coalesced with the last somite and the uropods are peculiar, with the inner branch much reduced. The mandibles are of the typical Peracaridan structure, and the other mouth-parts, although there are difficulties in their interpretation, are probably to be referred to the Mysidacean type. No breeding specimens were found, and it remains to be seen whether the individuals described had assumed fully adult characters and, in particular, whether the female possesses a brood-pouch of the characteristic Peracaridan structure. In many of its features, Thermosbæna shows that simplification of structure which often goes with reduction in size and a subterranean habitat. When allowance is made for this, however, it seems to form a very satisfactory link between the Mysidacea and the Tanaidacea. There are few, if any, groups of arthropods in which it is possible, on morphological grounds alone, to construct so reasonably probable a phylogenetic series as that which leads from the Mysidacea through the Tanaidacea to the Isopoda. In this series there is a place ready for Thermosbæna, either as an outlying member of one of the existing orders or, more probably, as the solitary representative of a new order to be established for its reception when we have fuller knowledge of its structure.

Amœba Feeding on Frontonia.—C. Dale Beers (*Brit. Journ. Exp. Biol.*, vol. 1, pp. 335-341, 1924) records observations on the feeding of *Amœba proteus* on the ciliate Frontonia. An Amœba was observed to have partially engulfed a Frontonia and by its pressure to have constricted the middle region of the ciliate until the latter was forced into the form of a dumb-bell, not by the pressure of two opposed pseudopodia, but by that exerted by a collar of the Amœba's protoplasm. One half of the Frontonia was enclosed by the Amœba, the other half was exposed, and by the beating of its cilia dragged the Amœba. Later the Amœba attached itself to the microscopic slide and proceeded with the ingestion, extending its protoplasmic collar while still maintaining the pressure exerted by it upon the narrow middle portion of the ciliate, so that this portion became continuously longer and finally gave way. The part of the ciliate within the Amœba was soon enclosed in a large food vacuole—the whole process from beginning to end occupying eight minutes. Digestion of the engulfed part lasted nearly four days. In another case observed, the Amœba carried out the same process, the pseudopodial collar being composed apparently only of ectosarc. The author points out that the observations do not accord with the view that the varied activities of Amœba are brought about entirely by changes in the surface tension of the protoplasm; it appears impossible to believe that surface tension could account for the compression of so turgid an organism as Frontonia, and for other features in the process of ingestion.

CULTURE OF AN ENDAMŒBA FROM THE TURTLE.—H. P. Barret and Nannie M. Smith (*Amer. Journ. Hygiene*, vol. iv., pp. 155-159, 1924) give an account of the cultivation of an Endamœba from the turtle *Chelydra serpentina*. The medium employed was human blood serum one part with nine parts of 0·5 per cent. salt solution. A portion of mucus containing the amœbæ from the intestine of the turtle was placed at the bottom of the culture tube in which the medium formed a column about 50 mm. deep, and the tubes were kept at room temperature or in a cool chest (10°-15° C.). The presence of numerous bacteria or of blastocystis is inimical. The growth of the amœbæ takes place only at the bottom of the tube, never in the supernatant medium. On microscopic examination numerous dividing forms were observed, but no cysts were found even in old cultures. At the time of writing (October 1923) one strain was in its sixty-seventh subculture and had been carried on for 19 months, and two others had been grown 11 months and were each in the 36th subculture. It is pointed out that this material offers an easier problem than the human Endamœbæ as the lower temperature of the culture retards excessive bacterial growth. The authors remark that Cutler is the only recent worker who has succeeded in obtaining cultures of parasitic amœbæ, and though his work has been criticised by Dobell they "cannot fail to give credit to Cutler as being the first to grow parasitic amœbæ from the human intestine." In a paper which immediately follows, W. H. Taliaferro and F. O. Holmes describe specimens of the amœba—*Endamœba barreti*—from the turtle and from the cultures.

UTILISATION OF SEAWEED.—The Fuel Research Board of the Department of Scientific and Industrial Research has issued a Technical Paper (No. 9) dealing with the carbonisation of seaweed as a preliminary to the extraction of iodine and potassium salts. This industry has long been worked in the British Isles, and the weed has also been used as a manure. The old method of kelp-burning is very inefficient, and the work of Stanford, carried out in 1870–90, pointed the way to improved methods. The paper describes further investigations along similar lines, and an endeavour has been made to provide data which will be useful in devising a method of carbonisation of the weed in which there would be no loss of iodine and in which the gaseous products could be used for firing the retorts. A detailed description of the types of weed utilised, principally Laminaria, which contains about 0·5 per cent. of iodine, and of experiments on carbonisation, carried out on a small manufacturing scale, is given. During the nineteenth century the industry provided not a little employment, especially in the west of Scotland and in Ireland, and the report is worthy of attention.

SCARCITY OF TERTIARY CRINOIDS.—In describing a new species of Balanocrinus from the Lower Miocene of Haiti (Proc. U.S. Nat. Mus., No. 2516), Dr. Frank Springer points out that this is the first stalked crinoid of Tertiary age to be described from the western hemisphere, and takes occasion to comment on the rarity of Tertiary crinoids in general. Although the number of crinoid species living to-day is probably as great as the number existing at any one time during the previous history of the earth, still the majority occur in relatively deep waters. Most Tertiary rocks are shallow-water deposits, and the inference is that crinoids assumed their present bathymetric distribution about the beginning of Tertiary time. It is also to be noted that most modern crinoids are of more delicate construction than their predecessors, and more likely to be broken up, especially in shallow water.

PHYSICAL CONSTITUTION OF THE EARTH.—In the *Annales de Physique*, May-June, Mr. Rokuro Yamamoto develops the mathematical theory of the passage of earthquake waves through the interior of the earth, and their refraction in passing through layers of different density. He shows that there is nothing which permits the conclusion that there is a sudden discontinuity in the density at a certain depth, such as was deduced by E. Wiechert in 1897, who assumed a central nucleus of iron, with a surface layer, $\frac{1}{5}r$ in thickness, of lower density. The mathematical treatment applied to the available observations shows that good agreement is obtained by assuming a gradual alteration of density with depth, and a calculation of the time of propagation of the Japanese earthquake of September 1923 to Paris, made on this basis, gives very good agreement with observation. M. Hamy and H. Poincaré showed in 1887 that the theory of density distribution then held was difficult to reconcile with the phenomena of precession and nutation, and A. Veronet in 1912 showed that a continuous variation in density accounts for astronomical and geological observations.

WEATHER AT SELSEY BILL.—An analysis of the climate and weather at Selsey Bill, during the years 1908–23, has recently been issued by Mr. Edward Heron-Allen. The results for the sixteen years are given, not only as being of interest to residents but also as being acceptable to those who wish to know the climatic conditions afforded by the district. The extremely small mean range and variation of temperature, the well-graduated and distributed rainfall, and the great prevalence of sunshine, render Selsey an agreeable health resort. The mean temperature for the year is 50·5° F., the mean of the maximum readings is 56·7° and of the minimum 44·5°. In the eight years 1913–20, the shade temperature did not register 80°. The highest mean temperature for the year is 53·1° in 1921, the lowest 48·5° in 1909; omitting these two years of extreme temperature the range of annual means is 5·9°, from 52·8° in 1911 to 48·9° in 1917. The average annual rainfall is 29·24 in., the annual totals ranging from 38·21 in. in 1909 to 16·34 in. in 1921; the number of days with rain average 173, ranging from 194 in 1916 to 137 in 1911 and 1921. Sunshine is very prevalent, the average days for the year with bright sunshine being 310 and the average duration per day for the year 4·98 hours. A comparison with neighbouring health-resorts in the Book of Normals published by the Meteorological Office shows Selsey to have very favourable weather conditions.

NEW LINES IN THE SPECTRUM OF LITHIUM.—Observing the spectrum of the positive rays (canal rays) of lithium, M. M. Morand has discovered a number of new lines, which he ascribes to an unstable modification, ortholithium, the ordinary spectrum being due to stable paralithium (*Comptes rendus* of the Paris Academy of Sciences, June 2). The new lines are given in the following table:

Wave-length.	Intensity.		
3713	4	1s-2p	first of principal series.
4814	2	2p-3s	sharp series.
4053	1	2p-4s	
3756	0	2p-5s	
5488	3	2p-3d	diffuse series.
4244	2	2p-4d	
3841	1	2p-5d	
3653	0	2p-6d	

It is assumed that in the paralithium ion, the two electrons are in crossed 1_1 orbits, while in the ortholithium ion the orbits are coplanar, one being a 1_1 orbit while the principal quantum number of the other orbit is two. Details are given of the energy relations between the two modifications.

COEFFICIENT OF FRICTION FOR METALLIC SURFACES.—Experiments on the friction between different metals, in various states of polish, and without lubrication, are described by M. M. Fichter in the *Comptes rendus* of the Paris Academy of Sciences, June 2. The coefficient of friction was found to diminish up to a certain point, when the polish was improved; but increase of polish beyond this point increased the friction, so that for each pair of metals used, iron on iron, brass on brass, steel on brass, copper on zinc, there was a certain critical polish, with minimum friction. With brass-brass, for example, the coefficient of friction is lowered to about 0·12, and then increases rapidly; so that to separate the two blocks may require from 1·5 to 2 kg./cm.². To obtain plane polished surfaces, the blocks were rubbed together in water containing aluminium powder in suspension. The effect of heat and pressure on the perfectly polished blocks may produce actual union (welding), so perfect that it requires the ordinary breaking load to separate them. It is suggested that in ordinary friction, in addition to the effect due to the interlocking of the roughnesses of the two surfaces, a succession of partial welds must be produced, followed by the pulling away of elements of the surfaces which have been brought into intimate contact and welded. The tangential force of sliding friction would thus depend upon the elastic reactions of the welded parts, which are stretched to the breaking point, while new welds are produced at other points of the surface.

A NEW METHOD FOR PRODUCING SINGLE METALLIC CRYSTALS.—The method described by I. Obreimow and L. Schubnikow in the *Zeitschrift für Physik*, June 24, is a modification of that employed by Tammann, who poured melted bismuth into a small test tube, covered it with infusorial earth, and allowed it to cool slowly; when crystallisation started from a single centre, and the whole of the material was formed into a single crystal. Strelkow was able to extend the method to zinc, in which the number of crystallisation centres is larger, by introducing a small "bud" crystal at the top of a crucible full of fused zinc; the bud grew to fill the whole crucible when this was cooled from the top. The authors use a glass tube, drawn out to a capillary at the bottom; the metal is melted in the tube by means of a special electric furnace, which enables the temperature of the capillary to be controlled; the air is pumped out of the upper portion of the tube, and the capillary is cooled, an air blast being used for this purpose when necessary. If the capillary is small enough, section less than 1·5 sq. mm. for zinc, 3 sq. cm. for antimony, a single bud crystal is formed in it, and grows when cooling is continued slowly at first, from the bottom to fill the whole tube. Rods from 2 to 10 mm. diameter and 30 cm. long have been obtained with tin, cadmium, zinc, antimony, aluminium, and magnesium. By varying the shape of the glass vessel, the form of the single crystal can be altered, and flat plates or cylindrical test pieces with thickenings at each end, for attachment to the testing machine, obtained.

NEW DEVICES FOR MICROSCOPES.—An exhibition of scientific instruments which is being given by Messrs. Ogilvy and Co. at 18 Bloomsbury Square, London, W.C.1, includes a large number of the most recent designs of Leitz microscopes and apparatus for photomicrographic and micro-projection work. A full range of microscopes for binocular vision suitable for all magnifications is shown. Prominent among these is the Ore Dressing Microscope, which is specially intended for the examination of granular products of concentration. The body is of the Greenough binocular type, but has several useful additions. Each tube is fitted with a revolving eye-piece holder carrying three eye-pieces which afford magnifications of 10, 15, and 20 respectively. Below the eye-piece a slot is provided for the insertion of a ruled glass plate, by means of which the number and size of the grains may be determined. The optical portion of the instrument may be moved in two directions at right angles to one another and to the central axis of the microscope, so as to cover an area of 5×5 cm. The grains to be examined are placed on a glass plate, also divided into squares, in a mount which fits the opening in the stage. Another noteworthy exhibit is the anti-vibration device with which the new Leitz photomicrographic camera is fitted. The optical bench, which carries the microscope, camera, and illuminating system, is mounted on springs which allow it to vibrate freely, the relative positions of the various components on the bench remaining quite undisturbed. The optical bench can be clamped to the table while the preliminary adjustments are being made, and many useful and novel devices are incorporated for simplifying these adjustments. The instruments and apparatus will remain on exhibit during the months of August and September, and may be examined by anyone interested. Demonstrations are given at 11 A.M. and 3 P.M. daily, except on Saturdays and Sundays.

FUSIBLE ALLOYS.—The name "fusible metal" is usually applied to alloys having melting points below that of tin. These are binary, ternary, and quaternary mixtures of lead, tin, bismuth, and cadmium. They are used mainly in the production of readily fusible safety plugs for automatic fire extinguisher systems, but during the War petrol tanks of complicated shape for aeroplane work were made by depositing copper on a casting of fusible metal, then melting out the latter in boiling water. In a paper in *Chemistry and Industry* for July 4, read before the Society of Chemical Industry, Dr. Budgen describes the properties of fusible alloys and communicates new experiments. None of the twelve quaternary alloys was entirely liquid below 73°, nor was any entirely solid above 65·5°. The addition of 16·6 per cent. of mercury lowered these points to 63° and 50° respectively.

THE MELTING POINT OF GRAPHITE.—The *Chemiker Zeitung* of July 15 gives an abstract of a paper read at the Bunsen Gesellschaft at Göttingen in May on the melting point of graphite. The experiments were made by Ryschkewitsch and consisted in passing a heavy current through a graphite rod with a constriction. At a certain temperature this constricted portion suddenly disappears, and kinematography shows that this is not due to a gradual evaporation. The temperature was also practically independent of pressure. Calculation shows that the melting point of graphite is about 3800° abs.

Pre-Columbian Representations of the Elephant in America.

By Dr. HENRY O. FORBES.

IN NATURE of November 25, December 16, 1915, and January 27, 1916, Prof. Elliot Smith set forth very circumstantially his reasons for supporting Von Humboldt in interpreting certain features of a Stela (known as B) from Copan in Central America, as a pre-Columbian representation of an elephant's trunk. This view was combated vigorously in NATURE of January 27 by three well-known American archæologists, Dr. Spinden, Prof. Allen, and Dr. Stozzer. Elliot Smith and his school attach the greatest importance to the correctness of the elephant-trunk interpretation, since it forms one of the crucial facts on which they rest their doctrine of the transference of civilisation from the Old—especially from Egypt and India—to the New World. According to Elliot Smith, the deity, spoken of as the "long-nosed god," "who was most often depicted upon the Ancient Maya and Aztec codices was the Indian rain-god Indra, who in America was provided with the head of the Indian Elephant," seemingly "in confusion with the Indian Ganesa."

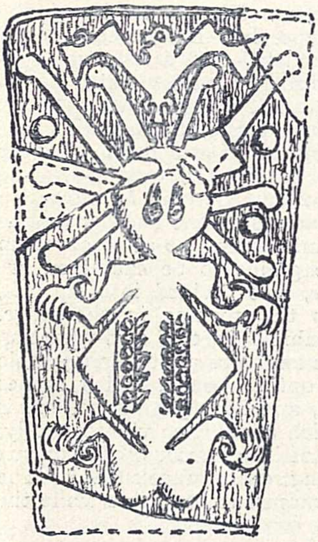

FIG. 1.—Manabi slab. (After Saville.)

I do not claim to have made a special study of Central American archæology, but I took the deepest interest in that of Peru during my sojourn there, and I have since followed with close attention any evidence tending to indicate culture-transfer between the two worlds.

The statements of Elliot Smith seemed on their appearance by their emphatically assured tone, supported by a drawing he gives of part of the Stela, apparently to afford evidence of a contact between East and West. Yet among many anthropologists, both in England and America, grave doubts have been expressed as to his interpretation of this feature of the monolith, owing to the extreme improbability of a totally alien mythology modifying successfully a very highly specialised and altogether different one, "including practically" (as Elliot Smith asserts) "the whole of the beliefs associated with" and the acceptance of "the worship of Indra."

During a tardy convalescence I have devoted some time to a careful study of the literature bearing on this point and of Dr. Maudsley's magnificent illustrations of the Copan monuments, without which it is impossible to form an opinion upon or criticise Elliot Smith's drawing in NATURE, November 25, 1915. The result is that I have arrived at an interpretation of the "elephant-trunk," different from his, which I submit to the consideration of archæologists. The *motif* of the deity's long nose is certainly not an Indian or other elephant's trunk, nor entirely, though perhaps partly, a macaw's beak, nor probably a tapir's snout; but I suggest with some confidence it is a feature derived from one or other of the Cephalopoda—squid, loligo, argonaut, octopus, or a combination of them. This suggestion, if accepted, will, I believe, help to elucidate much of the complicated emblems in which so many Central American sculptures abound.

The cephalopodous genera I have mentioned are all denizens of the eastern or western coasts of America, and any one of them might suitably be adopted as a motive in Maya mythology. Indeed an engraved stone slab from Manabi Island (Fig. 1), off the coast of Ecuador, shows that the squid (although here provided with spurious limbs) clearly entered into the mythology of that country, if not also into that of one or more regions of South America; for I found numerous cephalopod eyes and prehensile suckers from some specially large species in many of the pre-Inca graves I excavated in Peru. On the other hand, the elephant is entirely alien to America. No nation suddenly changes its mental orientation. "Mere similarity of ornament," as Mr. Joyce very truly remarks, "means nothing when the ornamentation in question is found to symbolise beliefs of an entirely different character."

It is perhaps desirable to recall the following characters in the cephalopods for purposes of the comparisons I have instituted: their long tapering serpentiform arms provided with rows of prehensile suckers; their very strong mandibles, so remarkably similar to a macaw's beak, conspicuous in the centre of their surrounding arms; their water-discharging funnel—often absurdly nose-like—opening on the mollusc's (frequently warty) body (or mantle) or between its arms; their immense round, staring, black, crescent-pupilled eyes, calculated to fascinate the superstitious and the timid. Some of the species inhabiting the west coast of America possess arms a score of feet in length and mandibles far larger than any macaw's—formidable and terrorising animals if unexpectedly encountered. Members of the ten-armed section of the group have two tentacles longer than the others, terminating in an expanded club arrayed with four rows of suckers.

My interpretation of the Stela will be more easily followed if I first direct attention to a lintel representing the "serpent-bird" from Tikal, well pictured as Fig. 17, p. 55, of Mr. Joyce's excellent "Guide to the Maudsley Collection of Maya Sculptures in the British Museum." This lintel (Fig. 2), according to Prof. Elliot Smith, reproduces "a highly Americanised representation of the 'winged disc and serpents' [seen over the doors of Egyptian temples]." Here "the god's face now replaces the disc as in some of the Asiatic derivatives of the Egyptian design. . . . A striking confirmation of this interpretation (*i.e.* the conventionalisation of the serpent's 'body' into a simple cross) is supplied by Maudsley, who has shown that the pattern below the cross" (which I have

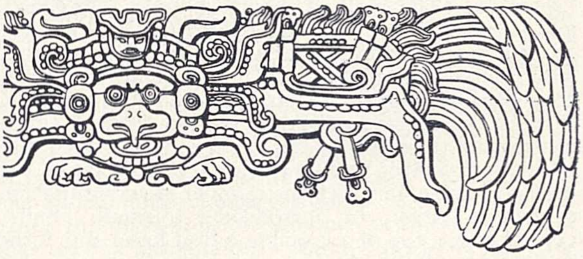

FIG. 2.—Serpent-bird, from Tikal. (After Maudsley and Joyce.)

identified as the snake's body) " is really a very highly conventionalised serpent's head reversed." It is with great diffidence that I venture to differ from so distinguished an authority on Central American archæology as Dr. Maudsley. If, however, he and other interested archæologists will follow the interpretation I submit here, I hope it may prove as convincing to them as to myself.

The interpretation which I would submit is: The Tikal lintel represents, in its central part, neither more nor less than a slightly specialised argonaut or octopus, with its beak displayed in the centre of its radiating tentacular arms, representing the " god's face." Over it two round eyes glare out under a strongly marked corrugated " superciliary ridge." This ridge is the fleshy upper margin of the mollusc's mouth, which continues into its under-margin, formed by a fleshy band, seen resting upon two avian tarsi and toes. This lower fleshy oral border, marked by three circular pedunculated discs representing contracted tentacles on the margin of the mouth, gives origin, right and left, to a clearly defined tentacle, on which are depicted the prehensile suckers of the mollusc in the form of raised circular knobs, and terminating in a hook-like tip. On right and left the oral marginal angles are largely concealed by what may be termed " ear " ornaments (with their pendants), from behind which issues, on each side, a long massive arm, extending horizontally in somewhat angular undulations until it reaches the commencement of the conspicuous feathered extremities of the lintel, where it bends downward and outward, and ends in a hook-like tip (as in the long arm of Rossia). Along its length is sculptured an interrupted series of round elevated discs, representing prehensile tentacular suckers.

Starting from the same point (but in front of this larger tentacle) there can be identified another arm, coiling downwards, with a serrated margin towards its termination, and displaying the usual suckers, coiled end, and characteristic hook-like tip. Immediately above the " ear " ornament a very short, closely coiled-up, contracted arm takes origin from the margin of the mouth, while a stage higher on the lintel is seen stretching upward a very prominent arm serrated on its under margin (as in some living species), broadening towards its free end, and exhibiting conspicuously the usual suckers. This tentacle arises on each side out of the black-edged upper oral margin of the mollusc above the eyes, while from behind it arises yet another, easily traced by its suckers. This latter extends horizontally in the background (having attached to it the wing-coverts and quills of the feathered extremities of the panel) as far outwards as the curious mace-like objects (seen at the inner edge of the feathered area), where it descends in a wide sweep in rear of the longest horizontal arm, to terminate in a scroll which appears below its lower border in a double-hooked tip. Above the flat-ended arm still another, short and closely coiled, takes rise. Its prehensile suckers begin, in a row of circular knobs, beneath the centre of the " chin " of the small central face, on the upper edge of the lintel, and continue onwards (beneath a space-filling detail) along the coil of the tentacle. Finally, behind this detail on each side arises an arm more robust, stumpy, and even " elephant-trunk "-like than the others, the prehensile suckers of which follow along both " cheeks " of the small " face." In all, seven pairs of tentacular arms surround the parrot-mandibled mouth of this design. The digits of the avian foot beneath the lower oral boundary belong to the bird the feathers of which form the terminal ornaments of the lintel. One can easily imagine that the Maya artist, finding a marine creature with a beak so macaw-like, would feel impelled to add some avian concomitants to his sculpture. He obviously took as his model for them the bird on the relief in the Palenque Temple of the Foliated Cross (Joyce's Guide, Fig. 13).

The lintel, therefore, if these interpretations be accepted, represents not " a serpent's head reversed," but an octopus with its beak displayed, as in Nature, amid its tentacular arms, and should be designated rather a feathered octopus than a " feathered snake." In any case, this sculptured design presents in no detail the remotest suggestion of an elephant or, to my vision, of a serpent, nor does it owe any inspiration to Egypt, India, or Asia; it is purely of Maya origin.

If, bearing in mind the interpretation above suggested of " the arms," " tentacular discs," and " body outline " in the " feathered snake," a close examination be made of Plate V. of Mr. Joyce's Guide where the head of the Death-god is pictured, I venture to think a strong confirmation of a cephalopod being a Maya motive will be admitted, for upon it (Fig. 3)

FIG. 3.—Head of Death-god, face of altar-table, Copan. (After Maudsley and Joyce.)

two squids quite unspecialised are clearly sculptured. The " face of the god " anthropomorphised in having human teeth conspicuously exposed by the absence of fleshy lips, takes the place of the parrot-beak of the mollusc, and is completed by a nose with two nostrils—probably derived from the sepuncle of the cephalopod, the function of which would be unintelligible to the artist. Deep set beneath a strong " superciliary ridge " are two organs, which *seem* to be eyes. Yet they more probably represent the large tentacular suckers of the two massive fleshy arms curving up under them, recalling the stumpy tentacles of the Tikal lintel. I lean to the second alternative. If this be so, then the two prominent organs at the upper edge of the altar-face are to be identified as the god's eyes. The " superciliary ridge " forms the margin, fringed with short retracted tentacles, of the monster's body (the continuation of which probably extended over the altar-table), as well as the upper margin of its mouth. Of these small fringe tentacles, one is seen on each side of the " nose." The sulcus between them corresponds with a corrugation observable between the eyes of the " feathered serpent," and helps to support my suggestion that the dark line on that panel also indicates the upper edge of a cephalopod's mouth. Similar circular tubercles, on what are plainly the mollusc's mantle, occur also on the body of the squid carved on the Manabi slab (Fig. 1) already referred to, where there is no question as to its zoological identity. Close examination of the panel reveals on the extreme right of the " superciliary fringe " the trend of the edge (indistinct on the left side) of the oral orifice which, passing behind the robust arm, reappears below as the lower margin of the mouth—scalloped (by retracted tentacles) and " warted " as on the higher part of the mantle—passing underneath what may be called mandibular teeth, then continuing upward to meet the mantle on the left side and complete its oral boundaries. It will be noted that the Maya conventionalism for representing the dermal surface of cephalopods is by circular tubercles. These are observable here on the surface of the body, on the notch of the "nose," on the "lip" between the "nose" and the upper teeth, on the two robust tentacles, and on the lower oral margin. In the argonaut, the two central arms, when all are spread, are often so closely apposed as to appear a single very broad tentacle—a feature very conspicuous in the South Atlantic Bathypolypus.

FIG. 4.—Stela B. Front. (From Maudsley's photograph.)

My interpretation, therefore, of the morphology of this panel is that the whole of what forms here the "face" is delineated upon a much broadened tentacle, emanating centrally from the mollusc's body, so as to overhang and conceal its true mouth, where would naturally be seen its parrot-like mandibles, as in the "feathered serpent." The space to right and left of this broad, face-fashioned tentacle, is filled in by an unmistakable species of squid, the lower end of which rests on the base of the panel, while its oral end gives rise to a circle of prehensile tentacles, two coiling downwards and more than one upwards, while the central line of its mantle is marked by a row of circular warts, as on the Manabi slab (Fig. 1). A tentacle marked with suckers is coiled round each end of the bar over which the cephalopod is apparently holding on, disjoined possibly from its continuation on the altar-table. The right and left extremities of the panel are ornamented by an oblong detail, which I should not hesitate to determine—if asked to do so—as the eye of a large species of Ommatostrophes.

This altar-face panel, I argue, supplies the key to the intricate and foliated ornament in many Maya sculptures, in that the details are traceable to cephalopods of perhaps more than one species—indigenous emblems at all events, in which there is not the slightest suggestion of anything proboscidean.

Coming now to the Stela B, "famous for the realistic representation of the Indian elephant at Copan" (of which Prof. Elliot Smith, in his "Evolution of the Dragon," has reproduced a *front* view Fig. 19 from Dr. Maudsley's plate 36, in the volume on archæology in Godman's "Biologia Centrali-Americana"), we may compare the intricate details of the monolith with those in the two panels discussed above. If, however, the right and left front *edges* of the Stela had been figured, a full view of both "trunks" and other important details, not visible *en face*, could have been more instructively studied. Dr. Maudsley's photograph (in the "Biologia") is accompanied by an elucidatory diagram to render the intricate decoration of the stone more easily followed. This diagram does not, however, quite faithfully reproduce the sculpture, and as its upper portion has been used by Elliot Smith to illustrate his letter in NATURE of November 15, 1915, it is very misleading, as will presently be noted.

The feature, on both "trunks" (Fig. 4), interpreted as a nostril, due to the ignorance (?) of the Maya artist, is clearly in its shape and more or less accurately as to its position a cephalopodous eye, like that of Sepiola, situated, as it should be, on the animal's body or mantle. Turning attention now to the right-hand upper corner of the statue, we discover there Elliot Smith's "auditory meatus." On the left of the "trunk" is (as the photograph, Fig. 5, sufficiently testifies) a tentacular arm issuing from a fold of the mollusc's body (the "forehead" of the elephant) and so coiled up as in Rossia that it ends in a close circular spiral, armed throughout its length with its rows of prehensile suckers. On the right of the trunk the origin of this coiled-up tentacle ("auditory meatus") is concealed by a flamboyant bouquet of tentacles, the suckers of which are nevertheless to be seen between and behind the flambeau. This "scroll below the ear as well as the tree-like appendages above the head," are in Elliot Smith's view "parts of the conventional waves breaking around the *sea-type* of Indian Makara." Yet the elephant of the Stela is a mahout-riding species! I feel convinced, nevertheless, that the "ear-pinnæ" of Elliot Smith (arising from behind the bar-like detail on which are seated the two human figures visible on the front aspect of the monolith) are undoubtedly cephalopod arms recalling those of Cledone. They coil round beneath the "meatus" tentacle, and end in a sharp thorn-like tip (as in Rossia) projecting conspicuously from the plane of the Stela—surely an unusual appendage to an ear-flap. These tentacles, as drawn in the elucidatory diagram, unfortunately show none of the suckers definitive of their function, though they are clearly represented in the photograph. Above both these details another (rather damaged) tentacle can be traced at the summit of the monolith on each side, coiling upwards and inwards from a fold of the mollusc's body (the "elephant's" head)—none of them analogous to any organ in a proboscidean.

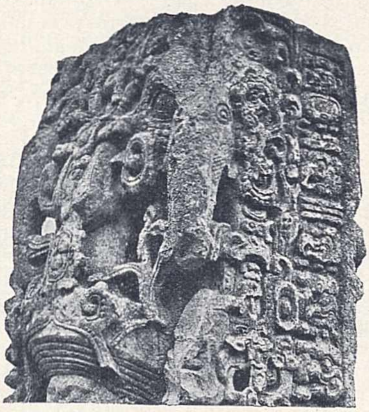

FIG. 5.—Stela B. Right-hand edge. (From Maudsley's photograph.)

Studying now the corresponding angle on the left side of the monolith (Fig. 6) we see a bodyless turbaned head poised on the mollusc's body (the "elephant's" neck). This is interpreted by Elliot Smith as a mahout. On the elucidatory diagram are delineated this driver with his braceleted hand and bent arm resting on the "elephant's forehead," and also the edge of his so-called "driving-stick" and the tips of his fingers. The Stela, however, shows absolutely no such features. Were the arm correctly drawn in the diagram, it must originate from the driver's ear, for he has no fragment of a shoulder, no body, no arms or hands—a head only—the braceleted wrist and arm are imaginary. Underneath the "mahout's" chin originates (as on the corresponding dextral aspect) a tentacle as a closely coiled spiral (again the "auditory meatus") with its prehensile suckers. More to the left the mollusc's body gives off a second tentacle, which meets a third, coiled up reversely, all of them armed with prehensile suckers. The ridge seen in the front view, under wh ch the bent arm of the rider is drawn in the diagram, is clearly the fleshy edge of the mollusc's body, corresponding to that on the right side of the "trunk" on the right corner. From the body of the cephalopod, just beneath the "rider's" chin and above the eye which is overshadowed by it, there clearly originates from the mollusc's body a more slender tentacle, overlaid upon the "trunk," the function of which is denoted by its prehensile suckers. How erroneously this detail has been interpreted as a mahout's driving-stick—which he has no arm or hand to hold—an inspection of the photograph of the Stela itself, our sole witness, proves. The right-hand "trunk" carries no mahout and shows no "driving-stick."

FIG. 6.—Stela B. Left-hand edge. (From Maudsley's photograph.)

Both the "trunks"—neither of which, by the way, is accompanied by tusks although Elliot Smith refers to such a feature—are, therefore, but very large robust tentacles (one enlarged tentacular arm is not an unfamiliar character in living cephalopods) the suckers of which are indicated by the cross-hatching instead of by the usual circular tuberculations, confusing perhaps macaw with cephalopod emblems. The mollusc's body, therefore, gives off around the "trunk" and "head" quite an array of tentacular arms which cannot be associated with anything in proboscidean anatomy. The supposed mahout is not the only human figure on the Stela. Two are seen in the front view, sitting between the two "trunks"; while down both its front edges, below the level of the "trunks," is sculptured a series of figures, or only heads, all of them on the Stela itself, turbaned as in the Rain-god, but none of them showing any proboscidean relationships. They have neither "trunks" to sit on nor "sticks" to drive with. If they are not mahouts, neither may the uppermost figure (seated on the mollusc's mantle) be so interpreted. As this supposed "driving-stick" turns out to be a cephalopodous tentacle, *cadit quæstio*, both as regards the trunk and the mahout.

Moreover, the turban of the "Rain-god" presents a most suggestive and interpretative "ornament." This symbol—if the two panels already discussed be kept in mind, especially that representing the Death-god—clearly represents a cephalopodous animal. On each side (the right broken) of the turban (Fig. 4) there hangs down an octopod (?) tentacle, with its free tip exactly recalling that of the longer arm in the "feathered snake" and of Argonauta or Rossia, both showing the usual circular tuberculations representing prehensile suckers. On the top of the turban and on each side a second suckered tentacle is coiled, while rising perpendicularly from the centre of its crown is seen what is quite easily resolvable into two tentacles, armed with suckers, closely applied edge to edge, as in the argonaut, but diverging half-way up to embrace a "cartouche" enclosing emblems quite in keeping with the motive—three prominent suckers, then still ascending to end in a lingulate finial.

That the cephalopod motive is a real one in South American mythology is evident from the Death-god panel and the Menabi slab; but further confirmation comes from the presence of at least one unmistakable cephalopod in the centre of the beautifully decorated reverse of the monolith (Fig. 7), where it gives off two downward coiled tentacles and two long upwardly directed arms with their characteristic terminal hook and prehensile discs. Cephalopodous emblems run riot indeed over the statue on all its sides, while not a single detail (except the mistakenly named "trunks") recalls anything in the anatomy or life of an elephant of any species, or of any creature alien to America.

It is possible, from my point of view, to interpret in the same sense the emblematic decoration in more than one of the Copan mythological designs—to name only two: the left upper vignette on the Dresden Maya Codex (Fig. 11, Joyce's Guide); and especially the left glyph in the upper row of his Fig. 6 of "Full-figure Numerals." I may add also the glyph figured by Dr. Spinden, Fig. 1, *c* in NATURE of January 27, 1916, which is combined with the macaw motive.

In his letters to NATURE referred to above, Prof. Elliot Smith avers that the scroll (representing the pinna) "was an essential part of the elephant design before it left Asia"; that "the sculptor was not familiar with the actual animal"; that he "has mistaken the eye for the nostril and the auditory meatus for the eye"; has represented "the ventral surface of the trunk in a conventionalised manner without any adequate realisation of the true nature of the features he was modelling"; and that "having converted the auditory meatus into an eye he converted the pinna into a geometrical pattern" which "he was careful to restrict to the area occupied by a relatively small pinna that is distinctive of the Indian species." Yet, notwithstanding these many defaults of memory which are charged to the Maya sculptor,

FIG. 7.—Stela B. Part of the reverse of the monolith. (From Maudsley's photograph.)

one cannot fail to marvel that he could draw the outline of the head so accurately as to enable a zoologist to identify the original model as the Indian species and to distribute its various errors with so much acumen.

Elliot Smith's ardent supporter, Mr. Perry, provides us with a fact that increases still more our amazement: the "movement of culture," he tells us, "that set out from Egypt" [always as stressed by Rivers without their women folk] "about the beginning of the fourth millennium B.C., ultimately landed in America [after centuries spent in India, Indonesia, and Polynesia] about the beginning of our era and there founded civilisations essentially the same as that of Egypt in the Pyramid Age. . . . This movement took 3000 years, more or less, to accomplish the journey, but it can be traced with fair accuracy for thousands of miles." It is therefore scarcely surprising not only that the god Indra was confused with Ganesa and that certain features —nose, ear, pinna, turbaned rider—of the elephant head during that period became but a memory to the bearers of the heliolithic civilisation to America, but that any resemblance even of the outline of its (tuskless) head and the appropriateness of a "driver" were so well conserved, especially as Elliot Smith assures us that the motive on the Stela was not the land elephant but "the sea-elephant design of the mythical Makara [a snouted monster with large prominent tusks and a fish's tail, which never existed on land or sea, and never carried a mahout] which was the commonest form of elephant spread abroad by the sea-men of Southern India copied from an earlier model (or *picture*, according to Elliot Smith) [made thousands of years before] by some immigrant from Asia." Imagine a picture—on what material soever depicted—surviving all these millenniums among a people who were only "food-gatherers" in the palæolithic stage when the heliolithic missionaries arrived among them!

Which is more likely to have inspired the Maya sculptor, a mythical animal, the memory of which 3000 years must have paled to obliteration, the outlines, moreover, of which had never been seen by any human eye; or creatures familiar to him in his own seas, which must have excited his dread, and aroused his artistic sense?

I have to acknowledge Dr. Maudsley's photographs in the "Biologia" as the source of the above figures, and his kindness in permitting me to use them, and to thank Mr. J. Edge-Partington for sketching Fig. 1 for me.

The British Medical Association at Bradford.

Tissue Culture.

At the ninety-second annual meeting of the British Medical Association held at Bradford on July 22-25, Dr. Alexis Carrel, of the Rockefeller Institute, New York, opened a discussion on the method of tissue culture and its bearing on pathological problems. The present position of tissue culture *in vitro* was clearly summarised, and considerable space was devoted to the most recent view of American workers that there are growth-promoting substances—trephones—which are secreted by certain cells of the body to minister to the nutritive wants of other cells. It is believed that leucocytic trephones play an important part in physiological and pathological processes. They secrete substances, *in vitro* and *in vivo*, and enable fibroblasts to grow readily.

Immunity.

At the same meeting, Dr. R. A. O'Brien, of the Wellcome Physiological Research Laboratories, opened a discussion on immunity, with special reference to specificity and the influence of non-specific factors. It is now a hundred years since the great French clinician Bretonneau, from a mass of observations, set free the doctrine of specificity in disease. His particular contributions referred to enteric fever and diphtheria. After long years of confusion, Dr. William Budd, in the 'sixties of last century, again placed the doctrine of specificity on a sound basis, both with respect to enteric fever and to tuberculosis. The exact experiments of Robert Koch from 1876 onwards established the specificity doctrine on an irrefutable basis, which was again extended through the discovery of antitoxin by Behring and Kitasato in 1890. Since that time every well-authenticated observation on man or animals has confirmed the specificity of infective virus.

It has been claimed, however, that certain substances which are non-specific in the sense that they have no direct or immediate affinity with the specific causes of disease, may act in a curative manner. It is the published data on this point which Dr. O'Brien has analysed. In certain instances he has subjected the question to experimental inquiry, and has been unable to find evidence that non-specific substances influence favourably specific experimental infections or intoxications. Against this is a slowly growing mass of clinical observation, which seems to point to therapeutic successes in a variety of diseases. Protein substances such as occur in milk, blood serum, and egg are claimed to be endowed with curative properties believed to be great or even extraordinary. We have recently been asked to believe that injections of milk will cure duodenal ulcers.

Many clinical observations are without much value on account of their uncritical character and the complexity of the factors involved. This non-specific therapy may be a fashion in therapeutics. At all periods there have been many such. It is said that a new drug should be exhibited while it *still* cures. It is also well not to forget that medicine still retains many of the characteristics which it had nineteen hundred years ago, when Celsus wrote, "Medicine is a conjectural art, and the nature of conjecture is such that although it answers for the most part, yet sometimes it fails."

The Microscopy of the Living Eye.

When von Graefe first saw the fundus of the living eye with Helmholtz's ophthalmoscope in 1858, he is said to have exclaimed, "Helmholtz has unfolded to us a new world! What remains to be discovered!" Indeed it is questionable whether any single physical invention has been a greater boon to medical science than the ophthalmoscope. The latest development of ophthalmoscopy is the microscopy of the living eye, the technique of which has been elaborated by several ophthalmologists, but chiefly by the celebrated Allvar Gullstrand of Uppsala. Briefly stated, the method consists of illuminating the living eye by a narrow beam of light furnished by a nitra slit-lamp and condenser, and with diaphragms of various small apertures. The details of the structures so illuminated are observed obliquely, either by the "teleloup" or Czapski's binocular microscope. The teleloup consists of a pair of miniature opera-glasses fixed on a spectacle frame. It gives a stereoscopic image with a magnification of about two diameters. With the microscope, nine diameters or more of magnification can be obtained.

The practical value of this new method of micro-ophthalmoscopy formed the subject of an interesting discussion in the Ophthalmological Section, from which it is obvious that it has already yielded results of considerable scientific and practical interest. In opening the discussion, Mr. Basil Graves dealt with the physiological aspect of these results. He showed that it was possible by delicate adjustment of the illumination to demonstrate that the aqueous humour, the most pellucid of the body fluids, is not absolutely transparent, but that the range of what might be regarded as normal relucency could be determined. He has also detected varying degrees of metallic lustre in the crystalline lens, which he attributes to internal reflection from the lamellar surfaces in the interior of the lens itself.

Dr. Harrison Butler's *résumé* of the diagnostic aids which the new technique has already yielded in his hands affords an ample justification for its introduction into the practice of ophthalmology, and gives promise of further useful developments. The exact depth to which ulcerations have extended, and the localisation and extent of inflammatory processes in the cornea, can be determined with accuracy. The various forms of cataract can be detected in their earliest stages, and differentiated from one another with greater precision than heretofore. As the subsequent course and the treatment required for these several forms of cataract are widely different, it is, of course, important to be able to distinguish them early and surely. Another highly important application is in the early diagnosis of the much-dreaded sympathetic ophthalmia, by which disease many perfectly sound eyes are lost as the result of septic infection of the opposite eye. If the diagnosis is made sufficiently early, the good eye can be saved by prompt removal of the damaged eye. The detection of slight increase of turbidity of, or minute floating particles in, the fluid in the anterior chamber is the danger signal in this condition. Most of the points touched upon by the openers of the discussion are much better appreciated by demonstration than by description, consequently the interest of the meeting was focussed largely on the drawings and figures by which the papers were illustrated.

Edinburgh Conference on the Vegetative Propagation of Plants.

TO botanists and horticulturists all over the world the fame of the Botanic Garden at Edinburgh requires little comment. The collection of trees and shrubs is one of its many features; its Rock Garden alone has made it famous. So remarkable is the collection that a leading botanist from abroad was struck, not by the vast number of interesting plants, but by the fact that there are so few uninteresting ones. But the plants which meet the eye of the visitor are largely the production of that deft manipulation in the propagating pits screened from the general view, where much patient work is apt to be overlooked. Only those who have had the experience know the difficulties which so often beset the gardener who has to deal with the growing of a large representation of the world flora.

To make more generally known some of the experiences gained in the Royal Garden at Edinburgh, a well-attended Conference on the Vegetative Propagation of Plants was held on July 17 and 18 under the auspices of the Botanical Society of Edinburgh. By permission of Prof. W. Wright Smith, Regius Keeper, the meeting was conducted at the Garden, and in the large laboratory attached thereto there was on exhibition about 300 species of seed-plants, supplemented by nearly 200 photographs, illustrating various methods of propagation from stem, root, and leaf as practised by Mr. L. B. Stewart, who is in charge of the Department of Propagation. Some of the results obtained in actual practice are remarkable enough in themselves, but an added interest lies in the wide field for anatomical and physiological investigation which they throw open. It is fortunate that close co-operation exists between the Garden and the University Department of Botany, and numerous problems arising out of the experience of the cultivator are under investigation at the hands of the botanist.

Certain specific questions have already received attention and these were brought before the Conference. Thus, in the genus Clematis, it is found that stem-cuttings root freely when the cutting is made through an internode but usually not at all if cut at the node. Miss Edith Philip Smith dealt with this problem and showed that the peculiarity may be related to the large amount of sclerenchymatous tissue occurring at the nodes, since it is found that if stems are etiolated before the cuttings are prepared, rooting from the node takes place readily. Etiolation is considered to act in two ways, resulting in a softening of the mechanical tissues of the stem and in a restoration of the carbon-nitrogen ratio which is regarded as necessary for establishing meristematic activity.

Mr. L. B. Stewart dealt with the propagation of plants possessing horizontal branches, taking Napoleona and Gardenia as special cases. In the former, a non-orthotropic branch-cutting gives rise to a new individual which fails to establish a vertical shoot axis. In the course of time, however, an adventitious bud may develop from the root system to produce an ordinary orthotropic stem. In Gardenia, a cutting prepared from a horizontal branch leads to the establishment of a new plant quite distinct in growth-form from the parent. No leading shoot is formed and horizontal branching does not occur; moreover, the new individual is precocious in flowering. Mr. Stewart discussed also the results of propagation from roots, dealing especially with Pelargonium and *Acanthus montanus*. In the latter, the form of plants raised from root-cuttings is juvenile or adult according to whether young or old portions of the root are used.

Propagation by means of leaves formed the subject of a communication by Dr. R. J. D. Graham. In leaf-cuttings of dicotyledons which do not possess succulent leaves the root system is first established, followed by the development of the shoot. The time of appearance of the shoot seems to depend to some extent on the viability of the leaf. In monocotyledons, however, shoot buds appear before the formation of roots, and succulent leaves of dicotyledons behave in the same way.

Dr. Graham gave an account also of the propagation of bulbous plants by making use of the bulb scales. In Ornithogalum, Drimia, and Hæmanthus, isolated bulb scales are exposed to sunlight to allow the mucilage of the injured surface to dry. The leaf bases are then laid on sand, watered once in ten days, and within four weeks numerous bulbils begin to develop on the adaxial side of the scales. This provides a quick method of obtaining large supplies of saleable bulbs. The induced buds arise in Ornithogalum from meristematic tissue near the leaf base. In Drimia, bud formation may be induced either in the parenchyma cells of the scale or in the callus formed on the injured surface. In Hæmanthus, buds arise from the hypodermal layers of the detached leaf base.

University and Educational Intelligence.

CAMBRIDGE.—Dr. G. H. F. Nuttall, Magdalene College, has been re-elected into the Quick professorship of biology. D. L. Burn, Christ's College, has been elected Wrenbury scholar in economics.

As indicative of the growing place that organised research is holding in the University, a list of studentships awarded by the various colleges at the end of the past academic year may be of interest. At Peterhouse, W. A. Wooster (physics) and W. G. East (history); at Christ's College, A. L. Peck (classics) and D. L. Burn (history); at Magdalene College, G. E. Watts (chemistry); at St. John's College, W. H. Dew (chemistry), T. G. Room (mathematics), G. R. Potter (history), L. H. Titterton (Oriental languages), J. D. Cockcroft (mathematics), T. A. A. Broadbent (mathematics), and F. H. Constable (chemistry); at Pembroke College, H. G. Handisyde (history) and W. J. V. Ward (chemistry); at Gonville and Caius College, A. B. C. Cobban (history), R. Raper (chemistry), I. F. D. Morrow (history), W. I. Jones (chemistry), E. A. Guggenheim (physics), J. T. Irving (biochemistry), W. A. Waters (chemistry), H. T. Deas (classics), and J. C. Jones (physics); at King's College, A. Fletcher (mathematics), H. S. Kenward (classics), C. A. E. Lee (history), G. H. W. Rylands (English), and C. F. Sharman (physics); at Clare College, M. A. F. Barnett (physics). In addition, at certain colleges, notably Trinity College, scholarships are renewed for graduates doing research, so that there is a very marked move in the direction of the endowment of post-graduate research in Cambridge.

LEEDS.—An advanced course of twenty lectures on astronomy will be given on Monday evenings throughout the first and second terms of the session 1924–25, by Dr. S. Brodetsky, reader in applied mathematics, and Mr. R. Stoneley, assistant lecturer in applied mathematics and astronomical observer. Demonstrations will be given in the Cecil Duncombe Observatory. The syllabus includes lectures on such subjects as theories regarding the origin and age of the Solar System, stellar magnitudes, classification of spectra, distribution of stellar motions, double and variable stars, nebulæ, and so on. The lectures will assume such an elementary knowledge of astronomy as is represented by the popular courses given in the University. Advanced mathematical methods will not be used.

Dr. Albert Haworth has been appointed lecturer in chemical pathology. For three years Dr. Haworth has been on the staff of the Pathology Department of the Victoria University of Manchester.

LIVERPOOL.—The late Prof. Grenville A. J. Cole, Director of the Geological Survey of Ireland, and professor of geology in the Royal College of Science, Dublin, expressed a wish during his life-time that his valuable collection of separate geological papers should find a home in the University of Liverpool. After Professor Cole's death recently, his executors forwarded his collection of more than 3000 geological papers to the Department of Geology of the University.

LONDON.—Dr. Morris Ginsberg has been appointed as from August 1 to the University readership in sociology tenable at the London School of Economics.

The title of professor of electrical engineering in the University has been conferred on Mr. J. T. MacGregor-Morris, in respect of the post held by him at East London College.

The title of reader in physical chemistry in the University has been conferred on Mr. W. E. Garner, in respect of the post held by him at University College.

The title of reader in public administration in the University has been conferred on Mr. H. B. Lees-Smith, in respect of the post held by him at the London School of Economics.

The title of emeritus professor of education in the University has been conferred on Prof. J. W. Adamson on his retirement from the University chair of education at King's College.

Prof. H. R. Kenwood has resigned from the Chadwick chair of hygiene at University College as from December next. At a recent meeting, the Senate expressed appreciation of his long and valued services to the College and to the University.

The Senate has approved proposals for affording guidance to external students in their studies. The proposals are designed to meet the needs of those who are unable from any cause to follow courses of instruction either in Colleges or Institutions of the University, or in other universities, or in university colleges in other parts of the country. External students finding difficulty in arranging courses of study may consult the External Registrar.

The following Doctorates have been conferred: *D.Sc. in Physics*: Harry Moore (King's College), for a thesis entitled "The Corpuscular Radiation liberated in Vapours by Homogeneous X-Radiation"; *D.Sc. in Chemistry*: A. D. Mitchell, for a thesis entitled "The Reactions of Phosphorous and Hypophosphorous Acids, with Special Reference to the Evidence they afford for the Tautomeric Character of the Acids," and other Papers; *D.Sc. in Physics*: A. M. Mosharrafa, for a thesis entitled "The Quantum Theory of Radiation," and other papers.

MANCHESTER.—The following appointments have been made: Reader in surgical pathology, Mr. J. Howson Ray; Lecturers in surgical pathology, Mr. P. R. Wrigley and Mr. Garnett Wright; Assistant lecturers in chemistry, Mr. Wilson Baker and Mr. Bernard Cavanagh; Demonstrator in physiological chemistry, Dr. P. W. Clutterbuck. Prof. S. J. Hickson has been reappointed to the chair of zoology for a further period of two years.

ST. ANDREWS.—The Royal Commissioners for the Exhibition of 1851 have, on the nomination of the University Court of St. Andrews, awarded an industrial bursary of from £140 to £175 to Mr. Frank Gardiner Forbes, a student of engineering in University College, Dundee.

WALES.—Dr. E. H. Kettle has been appointed professor of pathology and bacteriology in the Welsh National School of Medicine (University of Wales), Cardiff.

SIR GILBERT T. WALKER, who has recently completed a period of about twenty years' service as director-general of Indian Observatories, has been appointed professor of meteorology at the Imperial College of Science and Technology, South Kensington, in succession to Sir Napier Shaw, who is retiring on August 31.

THE Higher Education Sub-Committee of the London County Council is recommending the Education Committee to award Robert Blair Fellowships, each of the value of 450*l*., to Mr. G. Bird and Mr. J. d'A. Clark. Mr. Bird, who is now with the Westinghouse Brake Company, will investigate signalling and train control problems in the United States, while Mr. Clark, who is at the Sittingbourne Paper Mills, proposes to study the production of wood pulp in the large pulp mills of Canada.

THE Ramsay Memorial Fellowship Trustees have made the following awards of new fellowships for the session 1924–25, the place at which the award is tenable following the name of the Fellow in each case: British Fellowship of 300*l.* to Mr. S. W. Saunders—University College, London; Glasgow Fellowship of 300*l.* to Mr. A. Robertson—University of Manchester; Danish Fellowship of 229*l.* to Mr. K. J. Pedersen—University of Bristol. The following fellowships have been renewed: Dr. S. Coffey (British Fellowship)—University College, London; Dr. A. Titley (British Fellowship)—University of Oxford; Mr. Thomas S. Stevens (Glasgow Fellowship)—University of Oxford; Dr. Miguel Crespi (Spanish Fellowship)—University College, London; Dr. J. Kalff (Netherlands Fellowship)—University of Manchester; Dr. H. Weiss (French Fellowship)—Davy-Faraday Laboratory, Royal Institution; Dr. E. Boomer (Canadian Fellowship)—University of Cambridge. Sir Robert Robertson has been appointed a member of the Ramsay Memorial Advisory Council in succession to the late Sir James Dobbie.

IN "The Londoner's Education" (London, Hodder and Stoughton, pp. 58, 9*d.*), the Education Officer of the L.C.C. presents a popular account of the services of the Council as Local Education Authority, this being one of a series of handbooks "on the L.C.C. and what it does for London." The publication of these booklets is a new departure—interesting both as a means of promoting intelligent interest on the part of the citizens of London in the work of their local government and as a commendable example of municipal advertising. The writer lays stress on the admirable progress made in the field of elementary education and the wonderfully complete provision for defective and tuberculous children, London being in this respect able to challenge comparison with any city in the world. The expenditure on schools for these unfortunates is 4 per cent. of the total cost of the education service. The most remarkable thing about the appropriations of funds to the various kinds and grades of education is that the annual grants to the University of London and colleges and polytechnics for education of university standard amounts to only 0·7 per cent. of the total.

IN the early part of this year the Governing Body of the Imperial College of Science and Technology was enabled, by generous donations from the Rt. Hon. Sir Arthur Acland and Sir Otto Beit, to establish a scheme of ten Dominion scholarships for research work in science tenable at the College during the academic year 1924–25, open to university graduates in the several Dominions and in India. With the cooperation of the India Office and the Colonial Office respectively, appointments to these scholarships have now been made by the respective Governments as follows: *India*: Mr. Sarbbanisahay Guha Sircar (Calcutta University), and Mr. A. S. Gancean (University of Madras). *Australia*: Miss M. I. Collins (University of Sydney) (for work in economic botany, including forestry), and Mr. A. S. Fitzpatrick (University of Melbourne) (for work in applied chemistry, specially in relation to fuels). *Canada*: Mr. Armand Circe (École Polytechnique, Montreal), and Mr. R. J. Henry (University of Toronto). *New Zealand*: Mr. H. L. Richardson (Victoria University College, University of New Zealand), and Mr. H. O. Askew (Canterbury College, University of New Zealand). *South Africa*: Mr. Hans Pirow (for mining engineering), and Mr. Lawrence P. McGuire (for plant physiology).

Early Science at the Royal Society.

August 3, 1664. The experiment of the velocity of descending bodies was tried with three leaden balls of different sizes. The height of their descent was sixty-one feet. Mr. Hooke was desired to find some convenient place in Westminster or Paul's for the prosecution of these experiments in a place free from wind.

August 4, 1686. A letter of Mr. William Molyneux of Dublin, to Mr. Halley, was read, wherein he owned himself fully satisfied of the performance of Mr. Hooke's level; promised what account he could of the tides on the coast of Ireland, and gave his sentiments about the properest way for actual mensuration, in order to survey a degree of the earth.

August 5, 1663. Sir Gilbert Talbot received the thanks of the Society for sending them the mace, which his majesty had given them, without taking any fees.—Sir Robert Moray produced again the stones taken out of the Earl of Balcarre's heart, and desired that the figure of them might be drawn; and Dr. Wilkins moved, that it might be taken in plaister: the care of both which was committed to Mr. Hooke.

1682. Ordered—That the list be printed with several titles distinguishing all the fellows . . . and that a little mark be made before the names of such as have been benefactors, and such as frequently account for their arrears: and that the president intimate to the Society, that he hopes they will esteem such, who shew their affection to the Society this way, as more properly eligible for office.

August 6, 1662. Mr. Wilde was desired to communicate his method of laying leaf-copper without tarnishing.—Dr. Charlton was desired to give in writing the account of the boy killed by lightning.—Dr. Goddard brought in an account of his experiments of weighing glass canes with the cylinders of quicksilver in them, according to the Torricellian experiment; which was ordered to be registered.

1668. A microscopical observation devised by Mr. Hooke, was made on a little lump of charcoal of fir-wood, in which appeared here and there interstices or partitions intersecting the great pores. Several of the members saw it and were satisfied.—Several queries were proposed about the texture of trees.

August 7, 1661. Mr. Henshaw produced a stone called "Astroites" or "Lapis stellaris," of which the following account is registered; That it moved with a little vinegar upon a declining plate several times repeated; and that it was observed, that the stone grew somewhat hot, and brak at the top. It is to be remarked, that there are two sorts of "Astroites," the one marked with starry spots, and the other stellate in its form.—Dr. Wilkins was desired to try salt-petre in water, to see if it increased in bulk.

1679. The Society adjourned for the ensuing vacation, not to meet again till summons given; but such members as pleased to meet to discourse in the mean time, might do so at the repository or library on Thursdays in the afternoon, where there would be some entertainment for them.

August 8, 1666. The president reported, that the experiment mentioned April 18, 1666 by Mr. Povey, of a new way of laying on colours, had been made that morning by Mr. Streeter at his house before himself, Sir Robert Moray [and others] viz., that an egg was beaten yolk and white together, with a few shreddings of a fig-tree branch, whereby the egg was reduced into an oily substance, without any tenacity or ropiness, so that it would be ductile, and fall on the pencil like oil.

Societies and Academies.

LONDON.

Faraday Society, July 7.—Sir Robert Robertson, president, in the chair.—G. R. D. **Hogg**: A note on the conduction of heat down the necks of metal vacuum vessels containing liquid oxygen. Approximate methods are given for calculating the "neck loss" of metal Dewar flasks containing liquid oxygen. These may also be used for determining the most suitable dimensions for the inner neck of a metal Dewar flask, the other dimensions of which are known.—C. L. **Haddon**: The mechanism of setting of calcium sulphate cements. There are fundamental differences in the hydration processes between plaster of Paris, flooring plaster and anhydrite. Further evidence in favour of Desch's theory of crystal thrust as the cause of expansion is put forward. There is a similarity between the coherence of calcium sulphate cements and that of metals.—J. J. **Doolan** and J. R. **Partington**: The vapour pressure of tellurium. The vapour pressure of sulphur has been determined in various ways, and at least one determination of that of selenium has appeared. The vapour pressure of tellurium, however, has, apparently, not previously been measured. Its value, at least approximately, has been determined at different temperatures.—E. E. **Turner** and W. H. **Patterson**: Cryoscopy in sodium sulphate decahydrate. The molecular weights of a number of sodium salts have been determined, using sodium sulphate as cryoscopic solvent, a method first investigated by Löwenherz, whose results have, in general, been confirmed. Abnormal results were obtained for the molecular weights of sodium oxalate and borax. The low result for the former substance is not due to solubility effects, whilst the molecular weight obtained for borax is in good agreement with the value obtained by Boutaric, Chauvenet, and Nabot, using sodium thiosulphate as solvent.—D. B. **Macleod**: The viscosity of binary mixtures.—J. B. **Firth** and F. S. **Watson**: The catalytic decomposition of hydrogen peroxide solution by animal charcoal; the production of highly active charcoals.—A. J. **Allmand** and A. N. **Campbell**: The electro-deposition of manganese. The best conditions for the electro-deposition of pure manganese consist in the electrolysis of a solution containing manganous and ammonium sulphates (the catholyte) separated by a diaphragm from the anolyte (ammonium sulphate solution), the H· concentration being kept at 10^{-6} to 10^{-8} by the regulated addition, as required, of sulphuric acid or of ammonia. The temperature is 30° C. and the current density at the cathode 10-15 amps./d.m. The rotating aluminium cathode has a burnisher lightly pressing against it. Electrolyte manganese contains a considerable quantity of dissolved hydrogen, which is not, however, responsible for its brittle nature.—J. **Grant**: Concentration-cells in methyl alcohol. Part II. Solutions containing tetraethyl ammonium iodide.—F. H. **Jeffery**: The electrolysis of solutions of potassium oxalate with a tin anode, and an electrometric determination of the constitution of the complex anions formed. Electricity passes from anode to anolyte in accord with the equation—

$$Sn + 2C_2O_4'' - 2\ominus = \{Sn(C_2O_4)_2\}''.$$

A solid phase corresponding with this complex ion,

$$K_2\{Sn(C_2O_4)_2\}.H_2O,$$

can be isolated. When the tin anode is coated with finely divided metal and the products of electrolysis allowed to accumulate on it, anodic oxidation takes place probably in accord with the equation—

$$\{Sn(C_2O_4)_2\}'' + C_2O_4'' - 2\ominus = \{Sn(C_2O_4)_3\}''.$$

A solid phase derived from tetravalent tin is formed, but it has not been determined whether it is of the form $Sn(C_2O_4)_2$ or $K_2\{Sn(C_2O_4)_3\}$. No tin is deposited on the cathode during this stage. The anode potential remains constant for a wide range of current density provided the anode be kept free from finely divided metal and the products of the electrolysis: failing this precaution it may rise to more than nine volts referred to the normal hydrogen electrode as zero, the current being 0·1 amp. The Darwin thread recorder has been adapted to the measurement of variations of the electrolysis current and also the time-integral of this current. It shows the rapidity of the change from the stage of the formation of the stanno complex alone to the stage of anodic oxidation.—F. J. **Fraser**: An improved form of Crook's elutriator.

CAMBRIDGE.

Philosophical Society, July 14.—Mr. C. T. Heycock, president, in the chair.—E. V. **Appleton**, K. G. **Emeléus**, and M. **Barnett**: Some experiments with an α-particle counter. The "wave-form" and intensity of the transient impulses resulting from discharges stimulated by single electrified particles have been determined using a cathode-ray oscillograph. The nature of the impulse is determined largely by the capacity and resistance of the system. The potential impulse normally detected by string electrometer methods is proportional to the current responsible for the re-charging of the electrostatic capacity of the counter after the rapid discharge of the capacity initiated by the electrified particle. When the pressure in the ionisation chamber is made less than that at which self-restoring action is possible, persistent oscillations are found. These represent the periodic charging of the counter capacity after its periodic discharge between the point and the plane. The impulses normally produced by α-particles are thus represented by one unit of the sustained oscillation. The total quantity of electricity circulating round the system when an α-particle enters the chamber is, in normal cases, of the order of 10^{-10} coulomb, but in low resistance circuits may be made 10^{-6} coulomb. The "energy trigger ratio" of the counter for α-particles, which represents the ratio of the energy released in the system to that of the electrified particle acting as stimulus, is normally of the order of 10^5, but may be made as high as 10^9.—J. E. **Littlewood**: On the zeros of the Riemann zeta function.—S. **Lees**: A case of steady flow of a gas, in two dimensions.—P. A. M. **Dirac**: Note on the Doppler principle and Bohr's frequency condition.—B. M. **Sen**: The applicability and deformation of surfaces.—E. C. **Titchmarsh**: A system of linear equations with an infinity of unknowns.—J. B. S. **Haldane**: A mathematical theory of natural and artificial selection. Part II. Expressions are found for the effects of various degrees of self-fertilisation, inbreeding, assortative mating, and selective fertilisation, on the composition of Mendelian populations, and the progress of natural selection in them.—H. W. **Turnbull**: The vector algebra of eight associated points, of three quadric surfaces.

CALCUTTA.

Asiatic Society of Bengal, July 2.—Gilbert T. **Walker**: On the wings of gliding birds. A peculiar feature in the structure of the wings of gliding birds is comparable to a device adopted in the construction of Handley-Page aeroplane wings.—E. W. **Gudger**: The sources of the material for Hamilton-Buchanan's "Fishes of the Ganges," the fate of his collections, drawings and notes, and the use made of his data.—

L. M. **Davies**: Notes on the geology of Kohat, with reference to the homotaxial position of the salt marl at Bahadur Khel. The beds at Kohat are homotaxial with the beds at Bahadur Khel.—Baini **Prashad**: Revision of the Japanese species of the genus Corbicula.—W. **Ivanow**: (1) More on the sources of Jami's "Nafahat." A summary description of the rare work, Risāla-i-Iqbāliyya, containing an account of the discourses of 'Alāu'd-Dawla Samnānī (d. 1336). (2) Imam Ismail. New information concerning Ismail, the sixth Imam of the Ismailiyya. It was found in a rare and early book on Shi'ite tradition, by Kashī, dating from the tenth century.—K. N. **Dikshit**: Two Harsola copper-plate grants of the Paramara Sikaya (II.), V.S. 1005.—Amareshvar **Thakur**: Jail administration in ancient India. A brief review, mainly based on data furnished by the Buddhist Jātakas and Kautilya's Arthasāstra, drawing the conclusion that a humane element was not wanting in ancient Indian criminal justice.—Sir Gilbert T. **Walker**: A note on Indian boomerangs. Description, with illustration, of a new species, called *Kâtar*, used as a throwing stick by the Bhils.—Paul **Tedesco**: The dialectical position of Ormurī.—N. G. **Majumdar**: A list of Kharosṭhī inscriptions.—H. Srinivasa **Rao**: Note on a brackish-water actinian from Madras. A form apparently new to science, probably closely allied to *Pelocoetes*, which was collected in 1922, was described.—H. **Chaudhuri**: *Oedogonium Nagii sp. nov.* Found at Lahore, developing in a bottle containing a collection of Zygnemas.

OTTAWA.

Royal Society of Canada (Section V., Biological Sciences), May 19-22 (Annual Meeting at Quebec).—F. C. **Harrison** (Presidential Address): Historical review of the red discoloration of foodstuffs.—A. H. Reginald **Buller**: (1) Luminous leaves; (2) *Sphærobolus stellatus* and the dispersion of its spores by herbivorous animals.—C. W. **Lowe**: The fresh-water algæ of Central Canada.—B. T. **Dickson** and G. A. **Scott**: Identity of the organism causing black-dot disease of the potato, Part I. and Part II.—B. T. **Dickson** and W. L. **Gordon**: The effect of various smut control treatments on the germination of oats.—C. D. **Kelly**: The bacteriology of the Kingston cheese.—N. S. **Golding**: A study of the moulds in blue-veined cheese.—A. G. **Lochhead**: (1) Microbiological relationships in frozen soils; (2) Psychrophilic soil bacteria.—G. W. **Scarth**: The toxic action of distilled water and the antagonism to it of cations.—A. B. **Macallum**: The origin of karyokinesis.—A. T. **Cameron** and J. **Carmichael**: After-effects of feeding thyroid to young rats.—A. T. **Cameron**: (1) The action of absorbable intestinal toxins on metabolism; (2) The cranio-facial axis of Huxley—Pt. I., Embryological considerations.—J. G. **FitzGerald** and Dorothy G. **Doyle**: A further study of the question of utilisation ("fermentation") of saccharose by *B. diphtheriæ*.—J. J. R. **Macleod**, J. **Hepburn**, J. K. **Latchford**, and N. A. **McCormick**: The effect of insulin on the percentage of sugar in blood from different regions of the body.—J. J. R. **Macleod**, E. C. **Noble**, and M. K. **O'Brien**: The influence of insulin on the glycogen content of the liver and muscles during hyperglycæmia.—G. S. **Eadie**, J. J. R. **Macleod**, and M. D. **Orr**: The soluble carbohydrates of liver and muscle and the influence of insulin on them.—F. N. **Allan** and S. S. **Sokhey**: Further observations on depancreatised animals.—S. U. **Page**: The effect of insulin on chloridzin diabetes in dogs.—J. **Markowitz**: The behaviour of the diastases in diabetic animals treated with insulin.—Frederick R. Miller and H. M. **Simpson**: Viscero-motor reflexes.—R. **Miller** and R. A. **Waud**: Pulse and cardiac records obtained with electropolygraph.—G. A. **Ramsay**: Amplification of heart sounds by radio apparatus.—J. **Miller**: Classification of tumours arising from the trophoblast, with illustrative cases.—C. McLean **Fraser**: *Acaulis Primarius*, Stimpson.—A. G. **Huntsman**: Some results of the Belle Isle Strait Expedition, 1923.—R. H. **McGonigle**: The distribution of pile borers on the Canadian Atlantic coast.—A. H. **Leim**: Certain features in the life-history of the shad.—A. G. **Huntsman** and M. I. **Sparks**: Resistance of marine animals to high temperatures, and their distribution in Nature.—C. H. **O'Donoghue**: A list of the Nudibranchiate Mollusca recorded from the Pacific coast of North America, with a note on their distribution.

VIENNA.

Academy of Sciences, January 10.—Kurt **Ehrenberg**: On the development of the base of the skull in cave bears from the Drachenhöhle near Mixnitz. The communication is chiefly concerned with the confirmation of a hitherto unobserved epiphysis formation in the lower half of the posterior head condyles of the cave bear (*Ursus spelaeus*), which appears during the second year of life. Later the epiphysis fuses completely with the original condylus occipitalis. Its formation is conditioned by a change in the attitude of the skull, a downward inclination of the skull as it becomes heavier, and appears to have arisen only in the males.—A. **Skrabal** and H. **Airoldi**: On the rate of hydrolysis of ethyl ether.—A. **Skrabal** and M. **Baltadschiewa**: On the rate of hydrolysis of ortho-acetic-ethyl ether.—R. **Andreash**: Note on the paraban acids.—R. **Andreasch**: On the carbamide and guanidin derivatives of the sulphur-substituted fatty acids; Part II.—E. **Müller**: On combined conic sections of conic section pencils.—K. **Ehrenberg**: On the development of the anterior region of the skull of the cave-bear from the Drachenhöhle near Mixnitz.—A. **Pisek**: The development of the anthers and the meiotic division of the pollen mother cells in the juniper-mistletoe, *Arcenthobium Oxycedri*; the structure of the anthers and the number of chromosomes in the cells of *Loranthus europæus*. The anther of Arcenthobium is regarded as equivalent to a microsporangium. The meiotic division of the pollen mother-cells sometimes shows disturbances caused by insufficient nourishment of the parasite by the host plant.—R. **Kreman**, R. **Kienzl**, and R. **Markl**: Electrolytic conduction in fused alloys; Part III., The electrolysis of lead-cadmium and of lead-sodium-cadmium alloys. With currents of about 1 amp. per sq. mm., an increase in the concentration of lead was found to occur at the anode and of cadmium or sodium respectively at the cathode.

January 17.—R. **Kreman**, R. **Müller**, and H. **Kienzl**: Electrolytic conduction in fused alloys; Part IV., The electrolysis of mercury-sodium alloys. The increase in concentration of sodium at the cathode and of mercury at the anode was found to grow with the density of the current to a maximum of about 9 per cent.—R. **Kreman**, R. **Müller**, and R. **Ortner**: Electrolytic conduction in fused alloys: Part V., The electrolysis of mercury alloyed with potassium, calcium, and cadmium. An increase in the concentration of potassium, calcium, and cadmium is observed near the anode, the effect increasing with the density of the current.—L. **Moser** and A. **Brukl**: On solid compounds of hydrogen and arsenic. The formation of solid As_2H_2 according to Reckleber and Scheiber is confirmed. A new solid compound, tetra-arsenic hydride As_4H_2 was obtained by the use of weak oxidising agents on gaseous AsH_3.—K. **Schnarf**:

Remarks on the position of the genus Saurania.—K. **Keissler**: Fungi novi Sinenses a H. Handel Mazzetti lecti II.

January 24.—H. **Micoletzky**: Final report on free-living nematodes from Suez. The Mediterranean and the Red Sea appear to have more nematodes in common than the Mediterranean and the North Sea.—G. **Götzinger**: Morphological studies after the great landslide of the Gras-mountain at Oberwang in Attergau.—H. **Handel-Mazzetti**: Plantæ novæ Sinenses diagnosibus brevibus descriptæ.

February 7.—F. **Werner**: New or little known snakes from the State Museum of Natural History at Vienna. New genera of aglyptic Colubrides, *Procteria viridis* (n. sp.), South-west Africa, allied to *Pseudoxenodon, Pachyophis temporalis* (n. sp.), *Triœnopholis arenarius* (n. sp.), *Aryrogena rostrata* (n. sp.), Argentine, *M. elegantissima* (n. sp.), *Pseudoromacer lugubris* (n. sp.), San Paolo, Brazil, *Nerophidion hypsirhiroides* (n. sp.), allied to *hydrœthiops, Padangia pulchra* (n. sp.), Padang, Sumatra, *Eoninophis lineolata* (n. sp.), East Africa.—A. **Skrabal** and M. **Baltadschiewa**: On the rate of hydrolysis of ortho-carboxyl-ethyl-ether.—A. **Skrabal** and A. **Matievic**: The dynamical equilibrium of malic ester.—E. **Schweidler**: Studies in atmospheric electricity, No. 65, On the characteristics of the current in slightly ionised gases. The characteristic of the ions is calculated by linear recombination law and the proportionality between conductivity and the saturation deficit of the current is found to hold. The term semisaturation potential (corresponding to 50 per cent. saturation) is defined. The application to practical measurements is demonstrated.—W. **Schlenck**: Studies in atmospheric electricity, No. 66, Experimental investigations on the characteristic of the current in weakly ionised gases. With a cylindrical condenser as ionising vessel, the current-potential function was found to correspond to the linear law of recombination.—M. **Blau**: On the disintegration constant of radium A (Mitt d. Ra-Inst's No. 161). A new experimental determination gives the radioactive constant . . . $\lambda = 0{\cdot}2273 \pm 0{\cdot}0007\ \text{min}^{-1}$; the half value period was found to be $T = 3{\cdot}05 \pm 0{\cdot}009$ min.—W. **Riss**: On the composition of bröggerites and on the genetic relationship between thorium and uranium (Mitt. d. Ra-Inst's No. 162). A large number of analyses on bröggerites have proved that idiomorphic bröggerites are probably all (many of them without doubt) older than the lodes in which they are found. As there are also non-idiomorphic bröggerites, it remains an open question whether these can be used for age measurements and also whether the large differences in the ages of the lodes found in this way are real. The results do not contradict the assumption of a genetic relationship between thorium and uranium.—E. **Lohr**: On the comparison made by Fr. Schenner between the Jaumann's theory of gravitation and observations.—G. **Flumiani**: On a dimethyl - tetroxy - anthrachin. — K. **Brunner**, W. **Seeger**, S. **Dittrich**: Diacyamine.—A. **Tauber**: On the integration of linear differential equations, IV.—O. **Storch**: Studies on dragonflies from the biological station at Lunz, Lower Austria, and the second Zoological Institute of the University of Vienna. *Somatochlora metallica*, an anisopterate odonate, lays its eggs in the earth inserting its ovipositor in the intervals of its flights over water. The Odonata anisoptera are not gliding air-machines; they make the best use of the freedom of movement which their mode of flight permits, lifting themselves straight into the air and performing all sorts of evolutions during oviposition.—F. M. **Exner**: On the release of cold and warm outbursts in the atmosphere.—F. **Feigl**: Contributions to the study of the relationship between the grouping of atoms and specific affinity, Part I.

February 17.—P. **Weiss**: (1) Regeneration of the whole from half the cut surface of an extremity in *Triton cristatus* (from the Institute of Experimental Biology of the Academy of Science, Vienna). If the leg be split and both parts shortened by amputation, a whole foot will regenerate from the half-cut surface when the second half regenerates nothing; otherwise regeneration of a whole foot occurs, divided between the two stumps, forming a split extremity or merging into one blastema. (2) Regeneration from a double cut surface of an extremity in *Triton cristatus*. When the arm is artificially bent in such a way that the radius lies parallel to the humerus, fixed in such a position, and the elbow cut off, exposing two cut surfaces, one from the humerus, one from the lower arm, a symmetrical structure regenerates, the regenerating part from one cut surface being the mirror image of the other.—I. **Sciacchitano**: The stage in which dopa is formed in the cocoon of the moth *Lophyrus pini* (from the Institute for Experimental Biology of the Academy of Science, Vienna). Dopa, *i.e.* dioxyphenyl-alanin, is only produced in the caterpillar during spinning and is already lost when the state of pupation is attained.—L. **Kober**: Contribution to the geology of anomalies in the gravitational force.—A. **Köhler**: Petrographic-geologic observations in the south-western forest district.—L. **Kölbl**: Report from petrographic-geological studies in the western part of the forest district in Lower Austria.—L. **Waldmann**: Preliminary report from the survey of the Moravian district to the south of the Eggenberg-Siegsmundherberg railway line.

February 21.—A. **Skrabal**, F. **Pfaff**, and H. **Airoldi**: On saponification of keto-carbonic-ester.—H. **Lieb** and D. **Schwarzl**: On elemic acid from Manila elemi-resin.

Official Publications Received.

Bulletin of the American Museum of Natural History. Vol. 51, Art. 1: Miocene Oreodonts in the American Museum. By F. B. Loomis. Pp. 37. (New York City.)

University of Illinois Engineering Experiment Station. Circular No. 11: The Oiling of Earth Roads. By Prof. Wilbur M. Wilson. Pp. 27. (Urbana, Ill.) 15 cents.

Colony of Southern Rhodesia. Report of the Director of Veterinary Research for the Year 1923. Pp. 8. (Salisbury, S. Rhodesia: Government Printer.)

Memoirs of the Department of Agriculture in India. Botanical Series, Vol. 13, No. 2: The Wilt Disease of Safflower. By S. D. Joshi. Pp. 39-46+3 plates. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 1 rupee; 1*s*. 6*d*.

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 24, Part 5: Economic Fruit-bearing Plants of Ecuador. By Wilson Popenoe. Pp. x+101-134+plates 34-49. (Washington: Government Printing Office.) 15 cents.

The South African Journal of Science. Vol. 20, No. 2, December 1923: Comprising the Report of the Twenty-first Annual Meeting of the South African Association for the Advancement of Science, Bloemfontein, 1923, July 9-14. Pp. iv+285-604. (Johannesburg.) 15*s*. net.

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Cheshunt, Herts. Ninth Annual Report, 1923. Pp. 97. (Cheshunt, Herts.)

Proceedings of the Royal Society of Edinburgh, Session 1923-1924. Vol. 44, Part 2, No. 15: An Investigation into the Structure and Life-History of the Sulphur Bacteria (I.). By Dr. David Ellis. Pp. 153-167. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 1*s*. 3*d*.

The Organization, Achievements and Present Work of the Dominion Experimental Farms. Pp. 302. (Ottawa: Government Printing Bureau.)

National Association of Master Bakers, Confectioners and Caterers. Reports on Research at the National Bakery School, London, conducted by Dr. C. Dorée and John Kirkland. Pp. 26. (London: 89 Kingsway, W.C.2.) 2*s*. 6*d*.

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 58: Statistics of Kindergartens 1921-22. Prepared by the Statistical Division of the Bureau of Education under the Direction of Frank M. Phillips. Pp. 7. (Washington: Government Printing Office.) 5 cents.

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 75, 1923. Pp. iii+429+29 plates+87. (Philadelphia.)

Ministère de l'Instruction publique et des Beaux-Arts. Enquêtes et documents relatifs à l'enseignement supérieur. 119: Rapports sur les observatoires astronomiques de Province, année 1923. Pp. 129. (Paris: Imprimerie Nationale.)

Rapport annuel sur l'état de l'Observatoire de Paris pour l'année 1923, présenté au Conseil dans sa séance du 14 février 1924. Par M. B. Baillaud. Pp. 43. (Paris: Imprimerie Nationale.)