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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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Zoology in India.

THE Report of the Zoological Survey of India[1]—a phœnix which has arisen from the ashes of the old Indian Museum—gives first impressions of a peculiarly felicitous service. Looking cursorily over its pages we see visions of a zoological and ethnographical museum that might have been designed by Socrates for inclusion in Plato's Republic: a museum of which the Guardians are biologists—philosophers——and the fiduciary appanages of which occupy a minor position as Auxiliaries: a museum where the Guardians do not always work within walls and upon what fortune may bring, but have freedom (within the omnipotent tether of the Treasury) to wander where they will in order to study and collect for themselves from the living stream of Nature.

Closer attention to the Report, however, slightly qualifies these attractive visions. The officers of the Museum are indeed the field-officers of the Survey, and they can indeed work in commodious laboratories upon material that they have studied and gathered in its natural environment in fair places of their own choice. Yet they are not quite happy. There are, says the Director, so few of them, and they are so imperfectly furnished with trained and responsible assistance, that they cannot take enough advantage of their golden opportunities, but have to spend "an undue proportion of their time" in the mere mechanical care, not so much of the housed collections, as of the very bottles in which the specimens are preserved. So the young Department has to endure such bitter taunts as "that it does no solid work, but merely names specimens," and "has neglected its opportunities."

Analysis of the Report gives abundant evidence that these taunts are but wild and whirling words. The staff of the Survey, besides naming specimens, has in

[1] Report of the Zoological Survey of India for the years 1920 to 1923. (Calcutta: Superintendent of Government Printing, India, 1923.) One rupee, or 2s.

the three years under review produced, or caused to be produced, more than 150 scientific papers. Now we all are aware that mere outflow of printed matter from a Government department may have various significations and interpretations, according to circumstances, and also that a good deal of subsidised "research work" is not of very high character or of very serious purpose. Many of the publications here recorded, however, are additions of permanent value to the general stock of knowledge and also have important applications to practice. Among those of a more obvious scientific interest are the series of "notes" on Crustacea, by Dr. S. W. Kemp, which are really the finished material for a critical catalogue; the numerous and varied biological papers by Dr. B. Prashad; and the ichthyological series, also rich in biological interest, by Dr. S. L. Hora.

More particular attention may be directed to several papers on the gastropod molluscan fauna of the Indian Empire, which, in addition to their scientific value, have an important bearing upon practical affairs. In the economy of Nature, it is one of the distressing functions of gastropod molluscs to serve as nurses and distributors of a great tribe of parasitic trematodes, and, among these, of the terrible blood-flukes that so variously, so grievously, and so obstinately afflict mankind in many tropical and subtropical countries. The papers in question include, among others, the "materials" for a revision of the fresh-water gastropod mollusca, by Dr. Annandale, the "Cercariæ Indicæ" of Major R. B. Sewell, and the report on a survey of the molluscs and their trematode parasites by both authors in collaboration. Major Sewell's monograph, which extends to nearly 400 pages of text and is illustrated by 32 coloured plates and numerous text-figures, is in the opinion of an expert parasitologist the finest contribution to our knowledge of this important group of parasites that has ever been produced at one individual effort. Should the extending employment of Indian troops in neighbouring countries infected by blood-flukes threaten ulterior consequences for India, the knowledge embodied in these papers will enable the danger to be handled rationally.

Notwithstanding the home-keeping obstructions complained of, a large amount of well-conceived field-work has been accomplished. In connexion with the general survey of lacustrine life and the particular investigation of the fresh-water molluscan fauna, expeditions have visited various lakes in Burma, Kashmir, and Kumaon, in one case accompanied by an artist to figure living forms. An expedition of a mainly scientific character, and having rather unexpected scientific results, was made to the unexplored Siju cave in the Garo Hills of Assam.

The training, as subsidised "research assistants," of promising young Indians is a praiseworthy educational experiment that further illustrates the enterprising spirit that animates the Zoological Survey of India. So far as the supply of young men having the necessary aptitudes goes, the experiment has been justified, but the difficulty is to find employment for them afterwards. Here we meet, on another road, the Director's complaint of an insufficient staff: the harvest is plenteous, the labourers are there, but the Indian Government cannot supply the gear.

Those who like to think of zoology as essentially a humanising study—a science above all others whereby man may learn to know himself as he really is, an animal, although the beauty of the world and the paragon of animals—do not care to be for ever harping on its value for material ends. There is, however, one of the many economic applications of zoology, namely, its application to hygiene and the public health, in which its humane definement suffers no perdition. From this aspect it is astonishing that a Government having the care of three hundred million souls, most of whom till the soil and live more or less at the mercy of the teeming populations of the jungle, is not supremely anxious to discover all that can possibly be known about that jungle life. For if we would name the diseases that, far beyond all others, undermine the health and shorten the life of the native inhabitants of India, we should have to specify diseases that are directly caused by, or spread by, or both caused and spread by animals, or animalcules, or by both in combination; *i.e.*, are caused in some way by jungle life that by taking thought can be mastered.

To argue that the causes of these preventable diseases were not discovered but were only corroborated and clarified by zoologists, and that since some particular facts are now known any service that zoology can render to the cause of public health is accomplished, is to misunderstand the lesson. The truer argument is that these discoveries have lifted the horizon over new and imperfectly surveyed tracts of pathology and hygiene, in the exploration and occupation of which enormous service can be rendered by concurrent accurate and comprehensive zoological investigations. The general value to India of the sanitary institutions of the West is beyond question; nor is there any doubt that in India, as in other parts of the British Empire that lie within the tropics, the sanitary principles that should find their widest and happiest application are those that are based on knowledge of the kind that is best gathered in the course of an adequate and well-administered zoological survey.

Of course, it may be argued that to the millions of India both zoology and hygiene are things equally

indifferent; that the uneducated masses do not know what zoology is, and, when they think of European dealings with their health, think now of quinine and of the miraculous surgery that restores the blind man's sight, and now of the tyrannical "Sirkar" who would defile them by vaccination; and, therefore, that in the presence of such deplorable ignorance it is almost impious to talk about zoology and its hygienic applications. These arguments, however, are merely the stock of the unbeliever. It may be argued that in times like the present a poor country like India cannot afford to spend money on a luxury like zoology, even with its distinct promise of help in elucidating the problems of human disease. This no doubt would be a good argument if a very large sum of money were required, or if parsimonious treatment of an enterprise holding out a rational and well-justified promise of that kind were really economy. As, however, neither of these alternatives is true, we hope that every encouragement will be afforded to the continued activities of the Zoological Survey of India.

The Alcohol Problem.

The Action of Alcohol on Man. By Prof. E. H. Starling. With Essays on (1) Alcohol as a Medicine, by Dr. Robert Hutchison; (2) Alcohol and its Relations to Problems in Mental Disorders, by Sir Frederick W. Mott; (3) Alcohol and Mortality, by Prof. Raymond Pearl. Pp. vii+291. (London: Longmans, Green and Co., 1923.) 12*s.* 6*d.* net.

IN this book, Prof. E. H. Starling and his collaborators, Dr. R. Hutchison, Sir Frederick Mott, and Prof. Raymond Pearl, have described the action of alcohol on the body both in health and disease. Whereas most of the book is taken up with a scientific but popular discussion of the problem, Prof. Starling has come to certain definite conclusions, on the basis of the facts described, which will cause comment and possibly opposition, and these will be dealt with first. He states that "moderate quantities might be taken throughout adult existence without interfering with bodily health or efficiency, and are sufficient to obtain beneficial results and to produce the increased pleasure in living which are the objects of the employment of alcoholic beverages." It is important to add that 35 c.c. is regarded as a "moderate" quantity of alcohol. This is contained in half a bottle of light wine, or in a pint and a half of ale, or in three ounces of whisky (30 under proof). This "moderate" quantity may be drunk with impunity, according to Prof. Starling, after the work of the day is finished. It will diminish a man's power of muscular co-ordination and other complex processes, but will not influence his behaviour or his powers of comporting himself with propriety as a member of society. On the other hand, if a man drinks alcoholic beverages during the daytime, he ought to take such quantities as will not materially influence his judgment and other mental processes, and in this case, not more than 12 c.c. of alcohol, in the form of a glass of beer or a wineglass of claret, should be taken at lunch. These are some of Prof. Starling's conclusions.

Many people would probably agree that, if all who now drink to excess took their liquor in these quantities and at the times recommended, there would be no such thing as an alcohol problem, and there would be no more reason for the publication of this book than one dealing, say, with the action of sausages on man. Unfortunately, alcohol is a big human problem because it is drunk in immoderate measure by large numbers of people, so that, as pointed out in the book, the expenditure on alcoholic drinks is 8 guineas per head per annum. If it is also true that only 16 guineas per head is spent annually on food, Prof. Starling will find it difficult to get great support for his statement that the expenditure on alcohol in Great Britain "does not seem disproportionate" even if we take into consideration that half of the 8 guineas reverts to the State. If the cares of the world are so intolerable that they require this expenditure on alcoholic beverages in order to increase the pleasure of life and to diminish the frets and worries of daily existence, then either those who do not drink to this extent have a very wrong view of life or else such an expenditure is a great social mistake.

It would be wrong, however, to emphasise too strongly Prof. Starling's conclusions on what might be described as the social problem of alcohol, for in most of the book he discusses in very readable and balanced language the physiological action of alcohol. It would be difficult for any one, whatever his views on the social problem, to have anything but praise for this part of the volume. Where necessary a certain amount of description of normal physiological processes is given in order to enable the general reader to understand how alcohol affects the body in a particular respect. Thus, in describing the action of alcohol on digestion, a brief but adequate account of the normal processes of digestion makes it possible for the reader to get a view of how the substance influences digestion at different stages, so far as our present knowledge goes. There is also an account of the functions of the nervous system in the chapter on "The Action of Alcohol on Human Behaviour." In this case, it would have been interesting if Prof. Starling had also discussed our present knowledge—slight though it be—

of the relation between the cerebral cortex and the thalamus, and how the former with its functions of judgment, fine sensitivity and inhibitions controls the latter, which serves rather the emotional side of a man's nature and the appreciation of coarser and more primitive stimuli. Such an account would probably have helped to make clearer what is not only a prominent physiological effect of alcohol, but is also the most difficult for the ordinary person to understand, namely, that a narcotic drug can have such apparent stimulant effects.

As regards the circulatory system, Prof. Starling states — a point upon which there will be general agreement—that this subject needs further investigation, for, apart from the irritant effect of alcohol on the mucous membrane of stomach and œsophagus, it is difficult to understand the basis for the beneficial effect believed by many clinicians and the general public to be produced by alcohol in cases of circulatory failure. The possibility that alcohol acts in these cases and in conditions of respiratory abnormality by paralysing inhibitory mechanisms has been advanced by Dale and is an interesting speculation, but at the present time remains a speculation. In a special appendix, Dr. R. Hutchison deals with the question of alcohol as a medicine, and in discussing its action in disorders of the circulatory system points out that, not only did older practitioners universally believe that alcohol had a stimulating effect on the heart in acute disease, but that many of their successors still hold the same belief. Nowadays, when all the better hospitals are endeavouring to introduce more scientific methods, both for diagnosis and treatment of disease, it should be possible to ascertain what real basis there is for these long-held beliefs. It is an unpleasant reflection that we should have had so long to wait for accurate information as to the action of a substance so extensively used as a therapeutic agent in circulatory disorder. Positive or negative evidence would be equally valuable. What we want in these cases is the application of a "ruler" to the problem and not simply a descriptive account of more or less casual observation.

In one small respect the book seems open to criticism, although, in fairness to the authors, the same criticism must be extended to the original discoverer of the facts. In Stockhard's work on the influence of breathing attenuated alcohol vapour on breeding guinea-pigs, it will be remembered that (1) a number of the progeny were defective, even two or three generations after the original guinea-pigs were exposed to the vapour, and that (2) ultimately, after elimination of the unfit through three generations, the surviving animals were very superior in their records as compared with normal guinea-pigs. Stockhard suggests that these results may explain the superiority of those European races who indulge freely in alcohol. This may be so, but, on the basis of the first result above described, alcohol may also be responsible for many of the physical and mental defects of these races. Unfortunately, unlike his defective guinea-pigs, which could be easily thrown aside, subnormal and defective human beings, unless very abnormal, often breed as vigorously as any of the supermen. Alcohol is probably a weed-producer and is certainly a weed-killer. Stockhard's results suggest it may also be a superman producer, but, in the meantime, the weed-producer influence is superficially more obvious. In any case these experiments are of prime importance whether considered from the point of view of the action of toxic substances on the germ plasm or because of their sociological significance.

In an essay, Prof. Raymond Pearl discusses the relationship between "Alcohol and Mortality." This is mainly a summary of his previously published statistical observations directed to show that "moderate" drinking does not shorten life, while "heavy and steady" drinking brings about a significantly lower duration of life. We see here again the word "moderate" cropping up, and it is important to notice that Prof. Pearl's "moderate" drinker and Prof. Starling's "moderate" drinker are quite different people; in fact, any person who makes a habit of taking wine or beer with meals even in the amounts regarded by Starling as safe is placed by Pearl under the "heavy or steady" drinking category. According to these statistical results, the person who takes irregularly and at not too frequent intervals an occasional glass of beer or drink of whisky is a moderate drinker, and imbibing alcohol to this extent is shown not to shorten life. Thus, however startling Prof. Pearl's conclusions may appear at first sight, an examination of the real meaning of his groups "moderate" and "heavy and steady" drinkers dissipates our surprise so that we can resume our reading with a sense of comfort. In the meantime Prof. Pearl must settle with Prof. Starling about that pint and a half of ale with the evening meal. Possibly, also, the insurance companies specially interested in temperance may have something to say from the opposite point of view.

Sir Frederick Mott's contribution to this volume deals with the relation of alcohol to mental disorders. He analyses in particular the statistics of admission to the London asylums and the post-mortem records of hospitals and asylums, and concludes that alcohol plays a relatively unimportant part in the production of certified insanity. He points out that people with an inborn neuropathic or psychopathic tendency become anti-social after imbibing relatively small

quantities of alcohol, and that this brings about their segregation in asylums, mentally defective institutions, and prisons. Here we have the view that alcohol is a "weed segregator."

It is obvious that this book deals widely and comprehensively with the problem of alcohol both from a physiological and from a social point of view. Like the book on alcohol published by the Science Committee of the Liquor Control Board, it is evidence that the problem is being removed from the unenviable position of being the shuttlecock of ignorant people. It can only lead to good results when men of standing take a hand at the game and raise the discussion of the problem to the highest level of scientific effort. Many men—especially business men—would greatly reduce their consumption of alcohol if they knew the facts as described in this book, especially if they realised the effect of alcohol on their judgment. On the other hand, it is to be doubted whether complete knowledge of the action of alcohol as at present understood would ever induce normal men to imbibe more than they now drink while in a state of relative ignorance.

E. M.

Chemical Engineering.

Principles of Chemical Engineering. By Prof. W. H. Walker, Prof. W. K. Lewis, and Prof. W. H. McAdams. Pp. ix+637. (London: McGraw-Hill Publishing Co., Ltd., 1923.) 25*s*.

THE work under notice, by three professors in the department of chemical engineering at the Massachusetts Institute of Technology, Boston, is a welcome addition to the literature dealing with the scientific aspects of the subject. It induces serious reflection on the great strides made in America as contrasted with Great Britain in a matter of vital importance to industrial chemical development, and at the same time provides food for thought to a small minority who consider that there is little scope in industry for the trained chemical engineer.

Probably the authors would not claim that their volume constitutes a complete treatise on chemical engineering, or, indeed, that it is more than a special method of treatment of selected aspects of the subject. The method of treatment, quantitative measurement combined with sound mathematical analysis, is a most valuable one, and it will be some time before the whole field of chemical engineering can be covered in the same thorough manner. It is this method of attack that characterises the book as a serious scientific contribution in a field which has hitherto been inadequately served by publications resembling too often the plant-maker's catalogue.

The greater part of the text has been in use as students' notes at the Massachusetts Institute. The book opens with a chapter on industrial stoichiometry, dealing with simple applications of chemical arithmetic, with the object of familiarising the reader with the use of English units in chemical, physico-chemical, and thermo-chemical calculations. English units are used throughout the numerous problems which form a valuable feature of the book. In view of the slow progress which the metric system has made in industrial circles, this choice is perhaps a wise one, though the writer would have preferred to see the use of the centigrade heat unit advocated in place of the B.T.U. on account of its numerical identity with the calorie, in which unit the bulk of thermo-chemical data is expressed in the literature. The chapters on fluid and heat flow which follow are excellently written, and lay the foundation on which the solution of most problems in plant design ultimately rests. The most recent work on fluid friction and the effect of boundary films on heat transfer is well presented.

The next section of four chapters deals in more descriptive manner with fuel, power, the theory of combustion, and the main principles of operation of a few typical furnaces, ovens, and gas producers, and is followed by sections on crushing, grinding, and mechanical separation. There is little new in these chapters, and the latter sections are somewhat cursorily treated. For example, there is only passing mention of froth flotation as a means of separating solids, and no mention of such processes as extraction and lixiviation. Processes for the extraction of solids from gases are dismissed in three pages, of which electrostatic precipitation methods receive twelve lines. Crystallisation, precipitation, and transportation of solids are not mentioned, while centrifuging receives insignificant attention. More surprising is the lack of any appreciable reference to the recovery of condensable vapours from gases by any such process as refrigeration, compression, oil washing, or adsorption. Little attention is given to purely engineering or structural questions, and description of industrial plant, though lucid, is limited to that necessary to enable the reader to visualise the types of apparatus employed. Corrosion, lubrication, and compatibility of materials of construction are not dealt with; neither are such broader questions as the lay-out of plant, and the construction of material and energy-flow sheets—what might be called the strategy of chemical engineering as contrasted with unit plant operation. These lacunæ are mentioned here, not in a spirit of criticism, but to indicate what ground the authors have not attempted to cover.

The best part of the book is to be found in the last

seven chapters, dealing with the unit operations of filtration, evaporation, humidification and dehumidification, water cooling, drying, and distillation. Much of the matter in these chapters is collected from the original papers of members of the Massachusetts Institute. Mathematical equations based on the fundamental physical and physico-chemical characteristics of the particular operations are derived, and these equations are then tested either on small-scale plant or on actual industrial installations, working under carefully controlled conditions. In this connexion the authors do not mention what the writer was privileged to inspect on a recent visit to America —the invaluable "School of Chemical Engineering Practice," set up in certain typical factories to complement (from the training point of view) the more theoretical work at the Institute, and to provide opportunity for the trying out of theoretical conclusions on a factory scale. If English manufacturers, whether of plant or products, see anything of potential value to themselves in the type of work described in this book, one would commend to their notice the mutual arrangement between factory and university which enabled the work to be carried out.

The theory of plant operation as developed by the authors should be of the greatest value to the industry, the only criticism being that possibly the publication is a little premature, as much of the theoretical work is supported at present by comparatively few researches on isolated products. The researches themselves are in several instances published as private theses not accessible to the ordinary reader. Some of the equations will possibly need modification when tried out over a wider range; for example, a recent paper by Fisher (Proc. Roy. Soc., 1923) tends to show, *inter alia*, that shrinkage of material during drying does not at all necessarily have the effect on rate of drying ascribed to it by Prof. Lewis. However, he would in any case be a rash man, who, equipped only with formulæ, essayed at the present stage to build a chemical plant. The great value of a mathematical analysis, as the authors point out, is in the design of plant from data obtained on plants handling the same material, and in the calculation for a particular plant of the effect of altering operation conditions. We are still not in a position to design chemical plants with the same certainty as, say, ships; but by work along the lines indicated by Profs. Walker, Lewis, and McAdams we can at least avoid the blunders of the "telescope fiend," who spies a laboratory scale plant and draws what he sees—a practice not so rare as might be imagined.

The book is attractively written and printed, and is free from those "Americanisms" which sometimes mar the pleasure of English readers. It can be recommended as one of the best works of its kind that has yet appeared. E. C. W.

The Mountains and Rivers of Chinese Tibet.

To the Alps of Chinese Tibet: an Account of a Journey of Exploration up to and among the Snow-clad Mountains of the Tibetan Frontier. By Prof. J. W. Gregory and C. J. Gregory. Pp. 321+16 plates. (London: Seeley, Service and Co., Ltd., 1923.) 25*s.* net.

THERE are certain regions of the earth which will always have a fascination for the geographer who has some knowledge of geology, or the geologist who is interested in geographical problems, by reason of the unexplained peculiarities which they present when he sees them depicted in an atlas. Of these, one of the most remarkable is that region, lying between India and China, where the scattered drainage of a large area in Tibet is collected in three great rivers, the Salween, the Mekong, and the Yangtse-kiang, which flow for more than 150 miles in channels straight, parallel, and separated by high mountains, but so close together that the distance between the two outermost is barely more than 50 miles. It was to this region that Prof. Gregory, accompanied by his son, made a rapid excursion in the summer of 1922, and the book before us is one result of this journey. It is the joint production of the two travellers, who are somewhat quaintly referred to as the Chief and the Assistant, or occasionally as "one of us"; and the bulk of the book is taken up with a narrative account of the journey, mainly the work of the junior, though the inspiration, if not the hand, of the senior can be recognised in places. Of this, all that need be said is that the Assistant has done his work well, and produced a very readable book of travel; for readers of NATURE the main interest lies in the first and last chapters, which must be solely the work of the Chief, for he alone could have written them.

The first chapter states the problems to be solved. The backbone of Asia is formed by a great mountain system extending from the Caucasus to the Himalayas, which is of the same age as the Alps of Europe; but there is also an older mountain system, the Hercynian, represented by the north and south ranges of Indo-Malaya. The problem is, what becomes of the Himalayan system of disturbance when its easterly extension reaches the region of these older mountain chains? According to one view, it is bent back on itself, turning south-westwards, to find its continuation in the mountains south of Assam and west of Burma; according to other views, these ranges must be regarded as mere

offshoots of the Himalayan system, which continues either to the north-eastwards into northern China and Manchuria, or else to the south-eastwards through Yunnan. Also there is the problem of the river valleys, which recent observations had indicated as possibly rifts of the same age and similar origin to those of eastern Africa.

In the last chapter the geographical results are summed up in what reads like a kind of triumphant pæan of victorious solution of these problems. In Chinese Tibet, in the region of those remarkable river valleys, Prof. Gregory found convincing evidence that the district "had been disturbed by mountain-forming movements of a date much later than the formation of the Indo-Malayan Mountains," and, being of later date than the Hercynian, they are assigned to the Himalayan system of disturbance. From observations made on a previous journey in northern China, and on this journey, he rejects all of the suggestions made by earlier writers, and regards the eastern extension of the Himalayan system as being through the district visited by him, to the Nan Shan mountains of southern China; which is not the range of that name in Tibet, but the mountains south of the Yangtse-kiang, generally named Nan Ling on English atlases. As a result of the rise of the mountain range, produced by these rock movements, the east and west valleys of the Sanpo and Brahmaputra were emphasised, but to a great extent the drainage of the interior was ponded up in vast lakes. Then, on the cessation of compression, rifts were opened transverse to the mountain range, and the rising waters of the lakes found outlets, to form the present main channels of drainage; but the southerly courses of the rivers were not as now. The Yangtse-kiang continued south-eastwards to form the head waters of the Red River; the Mekong flowed across Tonkin as it now does; the Salween probably continued south-eastwards and flowed to the sea by Bangkok; the Irawadi must have flowed down the Sittang valley; the Sanpo doubtless flowed across upper Assam to form the head waters of the Chindwin; and the Brahmaputra, then a comparatively insignificant river, flowed to the sea by the delta of the Ganges.

As unfolded by Prof. Gregory, this forms a fascinating tale, clear and convincing to the uninitiated; but to one who has some knowledge of the geology and geography of the region, so far as it can be known at present, there are many difficulties. Of these, not the least is the Himalayan system of disturbance. As used by the author, the term is clear enough; he accepts the view, once almost universally adopted, that in fold mountains, among which the Himalayas are classed, the compression and folding of the rocks is the direct cause of the elevation of the mountains. Yet there is a considerable body of observation, growing slowly, it is true, but at an increasing rate, which indicates that the parallelism between geological structure and topographical relief is not so close as was once supposed; that the folding of the rocks preceded the uplift of the mountains; and that this uplift may have been due to a wholly independent cause. So, too, of the author's history of the river system it may be said that there is at present no evidence of the existence of the vast lakes which he postulates, and the statements regarding the changes in the river courses are in every case open to doubt, in some to almost insurmountable difficulties. Of all these doubts and difficulties the author cannot have been unaware, but they leave him unmoved, and perhaps, after all, he is right. Who knows? Who can know?

Our Bookshelf.

Elementary Mathematical Astronomy. By C. W. C. Barlow and Dr. G. H. Bryan. Eighth impression (Third edition). Pp. xvi+445. (London: University Tutorial Press, Ltd., 1923.) 9*s.* 6*d.*

THE teaching of astronomy is attended by many difficulties, and competes against other studies under disadvantages which cannot be denied. When facilities exist for practical work the weather may be trusted to play havoc with any prearranged time-table. When practical instruction is not attempted, astronomy when taken seriously demands so much knowledge of the elements of mathematics and the fundamental principles of physics that it may easily appear that the time would be more profitably spent in gaining familiarity with those primary sciences. Perhaps examinations and the requirements of candidates have a salutary effect in saving the subject from complete neglect. But its difficulties are not small; and even the student who has a fair mathematical equipment rarely finds it easy at first to acquire the jargon and the essential ideas of astronomy.

For the purpose of explaining the traditional terminology and fundamental notions of the science for the benefit of elementary students Barlow and Bryan's work is admirably adapted. It has been in existence for thirty years, and it is not surprising that it is still in demand. It is lucid, concise, and sound. It can scarcely be described as a stimulating book, but it fulfils a definite aim efficiently, and it is too well known to need description. This third edition has been revised by Dr. Crommelin, and its general accuracy should be above suspicion.

In the circumstances it is strange to find the eye arrested by references to the Nautical Almanack. The publication in question is and always has been the Nautical Almanac. Curiously enough, if one consults the first issue in 1767, one finds on a left- and a right-hand page confronting one another the Act of Parliament ordering a Nautical Almanack to be prepared and the authority of the Commissioners (a galaxy of naval heroes!) to the printers to publish a Nautical Almanac. Whitaker's Almanack, of course, is a whole century younger. H. C. P.

British Mammals. Pp. 127+2 plates. 3*s.* 6*d.* net. *British Birds.* Pp. xiii+186+4 plates. 5*s.* net. *British Reptiles, Amphibians, and Fresh-Water Fishes.* Pp. ix+114+2 plates. 3*s.* 6*d.* net. *British Butterflies and Moths.* Pp. xv+106+2 plates. 3*s.* 6*d.* net. *British Insects (General).* By W. Percival Westell. Pp. xii+112+2 plates. 3*s.* 6*d.* net. (The Abbey Nature Books.) (London: Chapman and Dodd, Ltd., n.d.)

IN this series of volumes Mr. Westell gives a rapid survey of the salient features of the commoner forms of British animal life. He recognises the enormity of the subject and, while he has been able to include all the mammals, reptiles, amphibia and fishes, he has had to be content with a selection from the birds and the barest mention of most of the insects.

The information has been culled admittedly from larger and more authoritative works, and the author makes no pretence to originality, but merely desires to direct and impart useful and interesting information in simple and non-technical language. If, however, the reader is to be stimulated to observe on his own account (and this is, ostensibly, the aim and purpose of the series), it is essential that he should know how to recognise his animals, and Mr. Westell would have been well advised to have included more details about the characters which serve for a ready recognition of the animals about which he writes. Unfortunately, the illustrations are of little or no help in this matter. They are mainly outline figures which, while giving a good impression of general habit and characteristic attitude, convey no idea of colour and markings, so important for identification. Miss Meyer's work receives less than justice because of the rough paper on which her drawings are reproduced. The few coloured plates published with these books show that she has an accurate eye for animal form and colour and bear witness to her skill as an artist of Nature.

Mr. Westell's enthusiasm in the cause of Nature-study is unbounded, his energy prodigious, and his aims unquestionably important, but in spite of these things this series of volumes scarcely justifies itself. The information is not sufficiently detailed to be of use to the serious naturalist, and the dilettante reader has read it all elsewhere.

Paläontologische Methoden und ihre Anwendung auf die paläobiologischen Verhältnisse des Steinheimer Beckens. Von Dr. Hans Klähn. Pp. v+127. (Berlin: Gebrüder Borntraeger, 1923.) 4*s.* 8*d.*

DURING the Tertiary Epoch various lake-basins in Central Europe were the home of fresh-water molluscs. Being isolated and at the same time exposed to a variety of influences, these molluscs underwent notable changes, as recorded in the shape of their shells preserved in the successive sediments. Many attempts have been made to interpret those changes in the light of evolutionary doctrines, but the interpreters have failed to agree. Perhaps the most famous of these basins is that of Steinheim in eastern Württemberg, where, during the latter half of the Miocene period, lived crowds of the pond-snail, Planorbis. Studied by Hilgendorf (1866), Sandberger (1873), Hyatt (1880), Gottschick (1920), and many others, these form the centre of interest in the present remarkable book.

That Dr. Klähn should differ from his numerous predecessors was inevitable, but the really important difference lies in his methods of work. First he has re-surveyed the basin, working out the relations of the somewhat disturbed beds and the physical conditions under which each was deposited. Then he has collected from each zone, not the Planorbis alone, but all forms of life. Next, so far as the Planorbid shells are concerned, he has studied them by several statistical methods of much ingenuity, which have enabled him (in conjunction with the field work) to separate and follow out the various lineages. Finally, he has correlated the changes with such external conditions as temperature, concentration of calcium carbonate, depth of water, influx of silicic acid from hot springs, food-supply, and associated fauna and flora.

From Dr. Klähn's many conclusions we select these: There are three main stems, unconnected with each other. Each shows gradual change of form, which, in two series at least, amounts to the evolution of a new species. The generally progressive evolution, with occasional set-backs, of each stem, and its eventual retrogression and extinction, are due to the external factors and not to an inner impulse. The book demands, and will repay, careful study.

F. A. BATHER.

Darwinism and Catholic Thought. By Canon Dorlodot. Translated by the Rev. Ernest Messenger. Vol. 1: *The Origin of Species.* Pp. viii+184. (London: Burns, Oates and Washbourne, Ltd., 1922.) 6*s.*

THE author of this lucid and interesting work is Director of the Geological Institute of the University of Louvain. He was deputed to convey the address from that University to the gathering that celebrated the fiftieth anniversary of the publication of "The Origin of Species" at Cambridge in 1919. The present volume leads us to look forward to one promised on "The Descent of Man," though the lines of the argument can be sufficiently traced from these two "conferences" on the general question of evolution. "Darwinism" is here used as synonymous with the theory that species of organisms have been continuously evolved. The author combats (pp. 26 and 31) the view of Father Brucker, S.J., who has held that a certain number of species were connected with the Creation recorded in the Bible, while others, linked by chains of descent, arose later.

Dr. Dorlodot deals calmly and fairly with such attempts to read the two Biblical versions of the "days" as chronological accounts of actual happenings. He believes that the compiler, Moses or another, acted under divine inspiration, but utilised earlier documents and traditions familiar to the untutored folk whose intelligence he hoped to reach. We may be surprised at the statement (p. 57) that the Deity was "obliged" to use certain phraseology; but this is not the place to dwell on subtleties that lie beyond the province of the layman. Dr. Dorlodot points out the real advance towards the appreciation of the results of scientific research that was made by the Commission for Biblical Studies under Leo XIII. in 1905. His knowledge of Hebrew adds charm and distinction to his comments on the text of Genesis, and his conclusions may be commended to thoughtful naturalists,

and also to those who attack "Darwinism" in educational circles in America.

The Jubilee Book of the Girls' Public Day School Trust, 1873–1923. By Laurie Magnus. Pp. x+204+4 plates. (Cambridge: At the University Press, 1923.) 5*s.* net.

THE Girls' Public Day School Trust is to be congratulated on the excellence of the book in which Mr. Laurie Magnus has commemorated the jubilee of its foundation. It recalls, as did the recent Cambridge Local Lectures jubilee celebrations, the lofty educational aims and the strenuous and efficient endeavours to embody them in practical measures that marked the early seventies of the nineteenth century. About the middle of the century began a revolt against the false ideals and incompetence of the girls' schools (the "select establishments for young ladies") of the period, and an insistent demand for a return to more robust and honest standards. This movement, under the guidance of Mrs. William Grey and others, led to the formation of the "Women's Educational Union," the G.P.D.S. Trust, and the Teachers' Training and Registration Society. The Trust stood for "the training of the individual girl, by the development of her mental and moral faculties, to understand her relation to the physical world around her, her fellow-beings, and God, and to know and perform the duties which arose out of those relations." "The chief object of education should be," they held, "while fitting boys and girls for the tasks and duties of practical life, to preserve intact for them . . . as much as may be of childlike faith, of intellectual reverence and homage, and of gaiety and truthfulness of mind." The story of the several schools is full of interest. Thirty-eight in all, each with its own special features, they became nurseries of genuine culture; and this was due alike to the well-directed initial impetus given by the founders, to the discrimination exercised in the choice of the heads, and to the large measure of freedom from interference and red-tape which they enjoyed.

Dynamics. By Prof. Horace Lamb. Second edition. Pp. xi+351. (Cambridge: At the University Press, 1923.) 12*s.* 6*d.* net.

THE first edition of Prof. Horace Lamb's "Dynamics" was issued in 1914, and reprinted with additional examples in 1920. The fact that a new edition is now called for can be well understood by all teachers and students who have had occasion to use the book. Little change has been made in this second edition, except for the substitution of different examples in the polar co-ordinate section of the chapter dealing with central forces, and for the introduction of more than forty additional "miscellaneous" examples at the end of the book.

Perhaps we may use this opportunity to remark that Prof. Lamb's order of treatment would be changed by some teachers. The interpolation of the chapters on rigid dynamics in the midst of the particle dynamics course does not seem to be advantageous. Further, while agreeing with the author's remarks on pp. 152-3, we nevertheless think that d'Alembert's principle possesses one great advantage: it makes clear that in the case of a rigid body there are just sufficient equations of motion to deal with the six degrees of freedom. Prof. Lamb's book will remain a favourite text-book at British universities for many years to come. S. B.

Fluorescenz und Phosphorescenz im Lichte der neueren Atomtheorie. Von P. Pringsheim. Zweite verbesserte Auflage. Pp. viii+228. (Berlin: Julius Springer, 1923.) 7*s.* 1*d.*

THE first edition of this book appeared two years ago. It was written during the author's internment in Australia on account of the War, and its object was to collect together the known facts of fluorescence and phosphorescence and to show to what extent Lenard's theory agreed with and explained those facts. In this present edition, many new observations are cited which support that theory. According to it, when radiation of frequency n_1 falls on a phosphorescent molecule, it is absorbed by a "resonator" having the same frequency, which in turn gives its energy up to a "photoelectron," and this is driven from its atom. It is immediately captured by another atom of the same molecule, with which it remains associated for a more or less lengthy period before the thermal oscillations of the molecules bring it into a configuration from which it can return to its original atom. In doing so it sets free radiation of frequency n_2, which is in turn absorbed by a resonator of that frequency and given out as phosphorescent light. It does not appear possible at this stage to specify what parts of the nuclear atom furnish the resonators and photo-electrons of Lenard's theory.

Practical Control of Electrical Energy. By A. G. Collis. (Oxford Technical Publications.) Pp. xii+160. (London: Henry Frowde and Hodder and Stoughton, 1923.) 10*s.* 6*d.* net.

THIS book contains technical data which will be useful in the design of electric machines and apparatus. The requisite mathematical reasoning has been simplified so far as possible. We have noticed, however, several misprints in the equations (p. 23). In discussing the measurement of potentials by instruments based on the hot-wire principle, it is stated that owing to their low inductance the current is in phase with the potential difference. In making this inference it is assumed that the resistance of the hot-wire instrument is practically constant over the half-period of the applied potential difference. It would be well to mention this. The chapter on protective gear is useful, but the notes on lightning arresters are too brief to be of much value.

Practical Physical Chemistry. By Prof. Alexander Findlay. Fourth edition, revised and enlarged. Pp. xvi+298. (London: Longmans, Green and Co., Ltd., 1923). 7*s.* 6*d.* net.

THE principal features of the new edition of Prof. Findlay's "Practical Physical Chemistry" are the introduction of additional experiments on hydrogen-ion concentration and of a number of experiments on colloids. Although the figure of the Pulfrich refractometer by Zeiss is retained in the text, the improved instrument of English manufacture (which formed the subject of a recent article in the new *Journal of Scientific Instruments*) is referred to in a footnote.

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 Gorilla's Foot.

I HAVE now examined Mr. Akeley's cast of the gorilla's foot kindly forwarded by Dr. Gregory to the British Museum (Natural History). I regret that I am, in consequence, unable to agree with Dr. Gregory's opinion that the photograph published by Mr. Akeley in the *World's Work* (reproduced here as Fig. 3) gives "a very fair representation" of this cast. I am, on the contrary, confirmed in my condemnation of the photograph, and endorse Mr. Pocock's statement (NATURE, December 8, p. 827) that it is "entirely misleading," since it suggests a resemblance between the hallux of the gorilla and that of man which does not exist. I here submit a photograph of the same cast taken under the direction of Dr. Vevers at the Zoological Society's laboratory (Fig. 4). Proper care has, in this case, been given to the direction of the light falling upon the cast. The deceptive character of Mr. Akeley's photograph is obvious when it is compared with that now submitted.

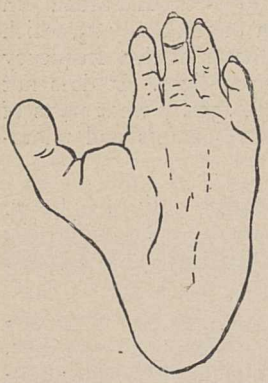

FIG. 1.—Plantar surface of adult gorilla's foot showing position of the toes when the leg is supporting the full weight of the body. Drawn by Mr. R. I. Pocock, F.R.S.

FIG. 2.—Photograph of plantar aspect of the right foot of a gorilla; the animal is lying on the ground, dead. From "In Brightest Africa."

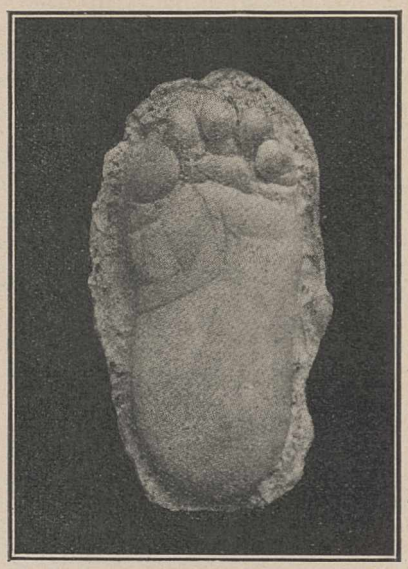

FIG. 3.—Photograph of the plantar aspect of the cast of an amputated gorilla's foot, published by Mr. Akeley in the *World's Work* (1922) and considered by Sir Ray Lankester to be "strangely distorted" and "made to present a false resemblance to the foot of man."

At the same time I wish to record my opinion that the actual gorilla's foot from which Mr. Akeley's cast was taken was distorted by *post-mortem* changes and by pressure tending to bring the hallux alongside of and parallel with the other toes as in man, instead of allowing it to diverge widely from them as it does when not artificially constrained. Fig. 2, taken from a figure in Mr. Akeley's book "In Brightest Africa," shows the plantar surface of the foot of a recently killed gorilla. The great toe is in its natural position.

Misrepresentation and consequent misunderstanding of the mechanism of the gorilla's foot require attention and correction, when detected, because since the publication of Huxley's essay on "Man's Place in Nature," sixty years ago, the gorilla has occupied a special place in the literature of evolution. The suggestion made by Mr. Akeley that zoologists have for sixty years overlooked important resemblances between the gorilla's foot and that of man seems to have been received in some quarters with unquestioning credulity. On the other hand, the evidence adduced in favour of Mr. Akeley's suggestion has proved on examination, by those acquainted with such matters, to be faulty—owing to the distorted condition of the gorilla's foot made use of by Mr. Akeley for casting, and the illusory nature of the illumination of the cast as photographed and published by him.

E. RAY LANKESTER.

December 9.

P.S., December 30.—I find that it is necessary to take up one or two factors in this discussion which are liable to be overlooked in consequence of the intervals caused by delay in postage to and from the United States. I must call to mind Mr. Akeley's share in this matter. He wrote in the *World's Work*, October 1922: "Not only has the gorilla developed a heel, but his big toe is much more like man's than that of any other animal. This may seem a small matter, but a big toe that turns out from the foot, like a thumb does from the hand, can grasp branches and is useful in climbing. A big toe that is parallel with the other toes is useful for walking but not for climbing."

Mr. Akeley publishes his photograph of the cast of a gorilla's foot (reproduced here as Fig. 3) alongside of this statement. The figure is apparently intended to show that the gorilla's great toe is, when the muscles are relaxed, parallel with the other toes as in man. In the face of this astonishing assimilation of the gorilla's great toe to that of man and the implication that it is so articulated as to be used as is man's great toe—in walking—it becomes really necessary to remind readers of NATURE that European anatomists, more than sixty years ago, carefully studied and described the bones and muscles of the great anthropoid apes and compared them with those of man. Their conclusions are known throughout the zoological world, and a brief but still trustworthy exposition of these anatomical facts was given by Huxley in his book "Man's Place in Nature,"

published in 1863. I was therefore startled by Mr. Akeley's assertions, and after careful examination of it came to the conclusion that his figure of the gorilla's foot was "entirely erroneous," and that the cast as shown in his photograph is made to present a false resemblance to the foot of man. I published this opinion in a note to my chapter on the gorilla of Sloane Street in my book "Great and Small Things," December 1922. It is, however, not only the figure of the cast of the gorilla's foot published by Mr. Akeley which is erroneous: his statements on the subject are even more plainly so. The presence of a heel is not (as Mr. Akeley suggests) a special man-like development in the gorilla. The other anthropoids have it—and so have monkeys in general. It is not the fact (as Mr. Akeley would have us believe) that the gorilla's big toe is much more like that of man than that of any other animal. The gorilla's great toe is far more like that of the chimpanzee and of many monkeys than it is like that of man.

Photo] [*F. W. Bond.*

FIG. 4.—Photograph by Dr. Vevers of the same cast as that used by Mr. Akeley (Fig. 3) but properly illuminated to give stereoscopic modelling.

Photo] [*F. W. Bond.*

FIG. 5.—Photograph by Dr. Vevers of same cast with full illumination giving a deceptive "flattening" or "demodelling" effect as in Mr. Akeley's photograph (Fig. 3).

I have been able to account for the misleading nature of the photograph of the cast published by Mr. Akeley, as due to flattening by illumination, which obliterates the modelling of the surface (see Figs. 3, 4, 5, and 6, and the legends printed below each); but in the absence of any information as to the condition of the gorilla's foot when the cast was taken, I have had to suppose that it was in a soft, pliable condition so that a small amount of lateral pressure would suffice to push the great toe out of its natural position when free from muscular tension and diverging from the other toes, and to cause it to take up a pose with its axis more nearly parallel to that of the other toes.

I now learn from Dr. W. K. Gregory's letter dated December 7, in NATURE of December 29, p. 933, that the foot of the gorilla from which Mr. Akeley's cast was taken was cut from the animal's leg in Africa after *rigor mortis* had passed away, and that in order to receive the plaster for forming a mould it was placed in a hollow in the ground with the sole facing upwards. We are not informed as to when or where this operation was performed or whether the amputated foot has been preserved. It certainly is not surprising that in the course of this manipulation the great toe of the "flabby" detached foot was made by lateral pressure to assume the unnatural parallelism with the other toes which it exhibits in the cast. There is no reason to suppose that the cast is itself "faulty" as a cast.

I cannot discuss, on the present occasion, the suppositions made by Dr. W. K. Gregory as to what I do or do not see in the history of the human foot. I can only assure him that he is entirely mistaken in assuming that there is to me anything either novel or improbable in the notion that the human foot is "an anatomical palimpsest." E. R. L.

Photo] [*F. W. Bond.*

FIG. 6.—Photograph by Dr. Vevers of same cast viewed from the outer or fibular side of the foot (stereoscopic illumination). Note the deep fissure between the hallux and second digit.

The Transatlantic Migration of the Eel-larvæ.

I HAVE recently had occasion to draw up a statistical chart showing the distribution of the eel-larvæ according to size. This chart, which is here reproduced (Fig. 1.), I laid before the meeting of the International Council for the Exploration of the Sea, in Paris, last October. It makes a good supplement to the chart which accompanied my article in NATURE of January 13, 1923, but the material is, nevertheless, so differently treated here that it seems to me worth while to make it known in wider circles.

It will be seen that the area where eel-larvæ are found—here shaded on the chart—extends from America to Europe and the Mediterranean. We have ourselves, in the course of years, searched the whole of this area for eel-larvæ, and found them at all stages of development—from the youngest, less than 1 cm.

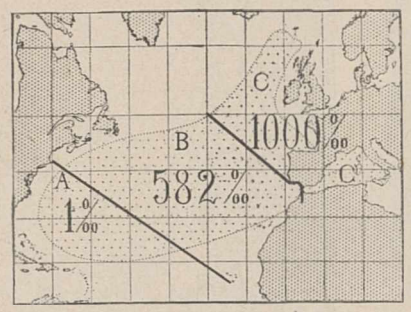

FIG. 1.—Distribution of the larvæ of the European fresh-water eel (*Anguilla vulgaris* Turt.) according to all existing records, showing the number of specimens more than 5 cm. long per mille.

Area A: 7018 specimens.
" B: 794 "
" C: 4871 " (Atlantic, 869 + Mediterranean, 4002).

long, to the largest, approaching 9 cm. in length. For the better understanding of the chart it should be noted that our implements are excellently suited to the capture of larvæ in all sizes, though their fishing capacity is, if anything, greater in the case of the small larvæ, which are less rapid in movement than the larger ones. This applies, by the way, not only to the eel, but also to the conger, and all other murænoids; indeed, to fishes generally.

A line drawn from Cape Cod to the Cape Verde Islands, and another from 50° N., 30° W. to Cape St. Vincent in Portugal, and diagonally across the Straits of Gibraltar, would divide the area of the eel-larvæ into three parts: a western (A), a central (B), and an eastern (C), the last-named including both an Atlantic and a Mediterranean section.

The chart is based on *all available measurements of larvæ*: between 12 and 13 thousand.[1] Of these, 7018 are from area A, 794 from area B, and 4871 from area C. The material is divided into two parts, according to size of the larvæ—those *under* and those *over* 5 cm. long—and we have worked out for each of the three areas the number per mille of *larvæ over* 5 *cm.* found in that area. This gave, for area A 1 per mille, for B 582 per mille, and for C 1000 per mille. In other words: in the western area there were practically no larvæ over 5 cm. long, in the central area there were about as many over as under, while in the eastern area all were over 5 cm.

This distribution speaks plainly enough, and admits of no misunderstanding. It shows that *the larvæ come from A and, as they grow, move via B to C,* shaping their course roughly towards the N.E.

On the last expedition with the *Dana* (1921–22), extending from the Mediterranean to America, we used throughout the same nets and fished in the same way, by which it was easily seen that the eel-larvæ decreased in size from east to west. The results of the work in the Mediterranean (about October 1, 1921) were very clear, and entirely confirmed my previous results with the *Thor*. We captured about 2000 larvæ of eel-fishes in the Mediterranean, a full half being larvæ of the eel. As in 1908–10, we found small larvæ of all the other species (conger, etc.), but *not* of the eel. The size of the eel-larvæ varied from about 5½ to about 8 cm., *i.e.* precisely the same sizes already known from the Mediterranean.

There is only one possible conclusion to be drawn from these investigations—the same which I drew in 1912[2] after the investigations with the *Thor*—namely, that the Mediterranean has no indigenous stock of eels, but that the larvæ found there have immigrated in from the Atlantic through the Straits of Gibraltar. I cannot go into details here, but must just mention that we had the good fortune, with the *Dana*, to encounter a huge invasion of eel larvæ passing through the Straits of Gibraltar. Finally, I must correct an erroneous idea which appears to be widely entertained, namely, that the eel-larvæ in the Mediterranean are found at greater depths than in the Atlantic. In both places we found the greatest quantities at depths of 100 metres or less.

JOHS. SCHMIDT.
Carlsberg Laboratory,
Copenhagen (Valby).

[1] This includes measurements of 2283 larvæ from the Straits of Messina, published since 1912 by B. Grassi; not, however, the thousands of small Anguilla larvæ taken in area A by the *Dana* in the spring of 1922. When these are subsequently included, after separating them from the larvæ of the American eel, the figure for area A will fall below 1 per mille.

[2] "Danish Researches in the Atlantic and Mediterranean on the Life-history of the Fresh-water Eel (*Anguilla vulgaris* Turt.)" (*Internat. Revue der ges. Hydrobiologie und Hydrographie*, 1912).

Half-shade Polarisers and Analysers.[1]

GLAZEBROOK'S "Dictionary of Applied Physics" (vol. iv. p. 482) gives what purports to be the essential features of a Brace polariser, but is in fact a confusion of three devices, namely, the Brace half-shadow polariser, the Brace half-shadow elliptic analyser, and Tool's adaptation of the latter to Stokes's method of elliptic analysis. The object of this note is to clear away the obscurity which obviously exists with some otherwise well-informed writers in regard to the design and use of these different instruments.

The Brace half-shadow polariser (Brace, *Phil. Mag.* (6), 5, p. 161, 1903) is not two plates of mica between crossed Nicols, but essentially a Lippich half-shadow system, in which is substituted in place of the common Nicol type of polarisers the Jamin type, which consists of a thin plate of Iceland spar immersed in a cell of carbon bisulphide at such a slant that it totally reflects the extraordinary ray. Brace used α-monobromonaphthalene in place of carbon bisulphide. The advantages of this type are the fine dividing line between the half-shadow fields and the small lateral displacement which the thin strip of spar furnishes. Being fragile and inconvenient to maintain, it is to be recommended only where the highest precision is demanded. As noted in Glazebrook's "Dictionary," this system was used by Bates (in his attempt to detect anomalous magnetic rotation by an alcoholic solution of fuchsine).

The Brace elliptic analyser (Brace, *Phys. Rev.*, 18, p. 70, and 19, p. 218, 1904) is for measuring *small* ellipticities—ratio of minor to major axis of the elliptic vibration. It consists of a half-shadow strip and a variable azimuth "compensator," both of mica and both very thin. The half-shadow strip

[1] Published by permission of the Director of the Bureau of Standards of the U.S. Department of Commerce.

is of the order of about 0·01λ, showing Newton's colours before mounting. The order of the compensator commonly ranges between 0·02 and 0·04λ. The half-shadow strip mounted in Canada balsam between microscope cover slips is fixed to either the polarising or the analysing Nicol so as to cover half the field and at an azimuth giving maximum brightness when the Nicols are crossed—that is, at an azimuth of 45° to that of the Nicol to which it is fixed. The similarly mounted compensator is inserted on a rotating circle between polariser and analyser. The difference between circle readings for a "match" on plane polarised light and on the given elliptically polarised light serves to determine the ellipticity sought. The device is applicable to measuring ellipticities from zero to about 0·1 with high precision—the chief advantages being a vanishing half-shadow dividing line and relatively large compensator angles. It gives, however, but a crude indication of the azimuth of the elliptic vibration. The use of a thick compensator, *e.g.* 1/4λ, is precluded by the too small angular displacements which it entails. The instrument is found to be both practical and convenient by those who have used it.

Tool's adaptation of the Brace elliptic half-shadow strip and the Cornu-Jellett split Nicol to Stokes's method of elliptic analysis (Tool, *Phys. Rev.*, 31, p. 1, 1910) is used where the measurement of both azimuth and ellipticity with high precision is sought. It has the Brace elliptic half-shadow strip attached to a Cornu-Jellett half-shadow Nicol (at an azimuth therewith of 45°) giving a four-part field. This combination is carried by a rotating circle. Between it and the source to be measured is inserted a near 1/4λ variable azimuth compensator on a second rotating circle. By adjusting both circles a match of the four-part field is obtained. Following Stokes's method of making complementary settings for a "match," the compensator is effectually calibrated each time a pair of settings is made. It measures ellipticities of 0·02 with an accuracy better than 1 per cent. and circularly polarised light (ellipticity = 1), where the Stokes's instrument fails, with an accuracy of 0·05 per cent. Azimuths are measured with corresponding precision. C. A. SKINNER.

I AM indebted to Mr. Skinner for pointing out the oversight. The account given on p. 482 of the "Dictionary of Applied Physics," vol. iv., and called Brace's polariser, is really a description of his "Half-shadow elliptical polariser and analyser."

Brace devised probably the most sensitive instrument we have for measuring optical rotation in his half-shadow "sensitive strip" polariser (*Phil. Mag.* (6), 5, p. 161), and it is a description of this instrument which should properly have found a place in the article on polarimetry.

EDITOR "Dictionary of Applied Physics."

A Formula for the Specific Heat of Ferromagnetic Substances and its Discontinuity at the Critical Temperature.

THE loss of magnetism by ferromagnetic substances at their critical temperatures is accompanied by a striking change in the specific heat. Not only do ferromagnetic substances exhibit an abnormal rise in the specific heat up to the critical temperature, but also at this point there is a sudden diminution amounting to about one-half the increase. For example, the specific heat of iron is 0·119 at ordinary temperatures; it rises to 0·309 at the critical temperature, and at this point suddenly falls to about 0·189, so that there is an abrupt change of 0·120 in the true specific heat—with nickel the discontinuity amounts to 0·0285, and with magnetite to about 0·079. Attempts have been made to obtain a quantitative relation between the loss of magnetic energy and the energy of this thermal discontinuity, and a formula has been given by H. A. Lorentz, based on the theories of Langevin and Weiss, which when reduced to its simplest form is

$$\Delta C = \frac{4{\cdot}97}{m},$$

where ΔC is the discontinuity in the specific heat and m is the molecular mass of the ferromagnetic body. With this formula the calculated values of ΔC are 0·089 for iron, 0·0282 for nickel, and 0·0644 for magnetite, and the disagreement with observed values, except in the case of nickel, is very marked.

From considerations based on the application of Van der Waals' equation of state to ferromagnetism, I have arrived at a formula which allows not only the discontinuity but also the specific heat itself at the critical temperature to be calculated with an accuracy which leaves little doubt of its truth. The formula is

$$C_\theta = \frac{5}{J}\frac{R}{.a}\frac{I_0}{\theta},$$

which becomes, when the numerical values of R and J are inserted,

$$C_\theta = \frac{9{\cdot}95}{a}\frac{I_0}{\theta},$$

C_θ being the true specific heat, I_0 the maximum intensity, θ the critical temperature on the absolute scale, and a the atomic weight of the ferromagnetic substance. Calculated and observed results are as follows:—

	C_θ (calculated).	C_θ (observed).
Iron	0·306	0·309
Nickel . . .	0·142	0·154
Cobalt . . .	0·187	0·193

These calculated and observed results agree within the accuracy with which C_θ, θ, and I_0 are known.

The formula gives ΔC, the discontinuity in the specific heat at the critical temperature, if for the numeral 5 we write 2 for iron and 1 for nickel; thus

$$\Delta C = \frac{2}{J}\frac{R}{.a}\frac{I_0}{\theta}$$

for iron and half of this for nickel.

We then get

	ΔC (calc.).	ΔC (obs.).
Iron	0·122	0·120 to 0·124
Nickel . . .	0·0284	0·0285
Magnetite . .	0·0759	0·074 to 0·079

Cobalt is omitted, as ΔC has not been exactly determined for this metal. We obtain ΔC for magnetite when the numeral in the formula is 4, assuming R/a is that for iron.

In a letter to NATURE of July 1, 1922 (vol. 110, p. 10), the view was put forward that there was an addition of two degrees of freedom to the specific heat of ferromagnetic substances, corresponding to two degrees of freedom of rotational vibrations, as the substance increased in temperature up to the critical temperature. The specific heat at ordinary temperatures is calculable, on the assumption of three degrees of freedom, from 3 R, and we see that at the critical temperature it is calculable from 5 R, which is an increase of 2 R, corresponding to two degrees of freedom.

We may write the equation to ΔC thus,

$$\Delta C\theta \,.\, J = K \,.\, \frac{R}{a} I_0,$$

where K is a constant which has different but simple

numerical values for each of the ferromagnetics. The left side of the equation is thermal energy in mechanical units; and in order that the right side may also represent energy, R/*a* must play the part of a magnetic field. Now it is interesting to find that the expression for the maximum intrinsic magnetic field, as given by Van der Waals' equation, is 2 R/*a* for iron and nickel, 3 R/*a* for cobalt, and 6 R/*a* for magnetite, and thus ΔC may be easily expressed in terms of the intrinsic field if required. J. R. ASHWORTH.

Rochdale, November 19.

Magnetic Boreholes.

IN practical oilfield work many phenomena are met with and investigated from time to time, but one of these, namely, the magnetic state of some boreholes, does not appear to have received the attention it merits, and it would be interesting to learn the experiences and conclusions arrived at by practical oilfield men who have encountered this occurrence.

No doubt many oil men know of instances where tools and casing are found to be highly magnetised upon withdrawal from the borehole, as well as the lifting tackle and headgear in the derrick being affected in a similar manner to a lesser or greater degree.

Some little time ago an instance of this kind came under my notice. A pole became unscrewed while drilling, and the drilling bit with several poles attached remained in the borehole. As the casing was not moving freely, it was decided to move it before fishing for the lost tools; this was done, that is, the casing was raised and lowered several times from four to five feet. A fishing socket was then lowered in, which should have taken hold of the lost tools at about 115 feet off bottom, instead of which it was found that the top of the lost tools was at 70 feet from bottom, at which depth a hold was taken. At the time this difference in depth could not be accounted for, as it was known that the tools and rods had not run away, but had simply become detached, and their maximum possible fall of one foot could not have accounted for the loss of measurement. When the lost tools were brought to the surface the above-mentioned difference was explained, the rods which had been left behind having become bent more or less in the form of a helical spring. This coiling of the rods could be attributed to several ordinary causes as follows:

1. That the tools had fallen a long distance; this, however, was not the case.

2. That the fishing socket had been carelessly lowered in and the rods forced down. As every care was exercised when lowering in the socket, this could not have happened, and was proved by the fact that the rods above the socket were not in any way distorted.

3. That poles had got below the casing shoe when it was lifted and had been forced down when the casing was lowered into position. As the rods stood about 100 feet inside the casing, this was obviously not possible.

4. It might be argued that one of the casing joints had caught the top of the poles or one of the pole joints when the casing was being let down. This is out of the question, because the casing was of the inserted joint type, perfectly flush on the inside, and careful examination showed no trace of catching.

This extraordinary occurrence of loss of distance and coiled rods could not be traced to any ordinary cause; and as it was known that the well was extremely magnetic, which was proved time after time by the condition of the tools whenever they were withdrawn from the borehole, as well as the magnetised state of the lifting tackle and derrick headgear, it would appear that the magnetic influence of the casing was the cause of the occurrence mentioned above.

One can assume that after the rods had become unscrewed they fell over to one side and rested for some considerable distance in contact with the casing, probably 100 feet or more. The casing as a magnet had not sufficient power to lift the poles plus the drilling tools, but upon the casing being lowered into place each time after lifting it partly held and dragged the poles down with it owing to its magnetised condition, and at each subsequent lowering in the poles became more and more deformed.

It may be that highly magnetic boreholes may considerably affect drilling as well as fishing operations, whether with pole tools or with cable, therefore it would certainly be of interest to learn whether experiences of a similar nature have been met with and recorded. ALBERT MILLAR.

Boryslaw, Galicia, Poland.

Experiments on *Ciona intestinalis*.

SINCE I had the pleasure of making copies, the only ones, I think, of Dr. Kammerer's photographs of Ciona during his visit to England, and believe that Prof. MacBride is not at the moment in possession of a complete set, I am taking the liberty of supplying the details requested by Mr. Cunningham in his letter to NATURE of December 15. I will, of course, forward prints to him at the earliest opportunity.

There are three photographs of Ciona. The first is of a single untreated specimen, the second of a group showing artificially produced *var. macrosiphonica*, and the third of two untreated offspring of the latter. In view of the various magnifications, both in the camera and from perspective, and since the whole of the animal is not visible in most cases, simple measurements would be meaningless. However, the increase of the siphon of *v. macrosiphonica* is chiefly in the direction of length, and therefore the ratios of length to breadth of the siphons provide a satisfactory method of comparing the specimens. The ratios are:

Photograph I. (Untreated, fully extended specimen.) Oral siphon 1·9, aboral 1·65.

Photograph II. (Group.) In a single fully extended specimen, doubtless that referred to by Prof. MacBride, the ratios are 2·0 oral and 1·65 aboral. In the remainder the ratios when expanded are 4·0 to 4·3 oral and 2·0 to 4·3 aboral, and when contracted 2·4 oral and 1·9 aboral.

Photograph III. One of these two young offspring of *v. macrosiphonica* is completely expanded or nearly so, the other is quite contracted; in the former the ratios are 4·1 oral and 2·05 aboral, in the latter they are 2·35 and 1·4.

The validity of the means of comparison suggested above is shown by the ratios of length to breadth for the main part of the body lying, in all the four or five specimens in which it can be measured, between 4·1 and 4·8; *i.e.* the error due to varying expansion, position, and focus cannot possibly be more than 20 per cent., yet *v. macrosiphonica* shows an increase in length of the siphons of as much as 125 per cent.

With regard to the possibility of *v. macrosiphonica* falling within the limits of normal variation, the most valuable contribution appears to have been made by Mr. Fox; the very extensive and apparently uniform scale on which, in his experiment, elongation of the siphons failed to result from an altered technique seems to show very clearly, especially in the light of Dr. Kammerer's controls, that the effect is to be correlated with the particular nature of the operation as cause, and not with any normal variation which may be possible from one time to another, or with the nature of the food supply. B. STEWART.

Lovell House, Leeds,
December 18.

The Kinetic Atom.[1]

By Sir OLIVER LODGE, F.R.S.

EVIDENCE FOR THE NUCLEAR ATOM.

THE steps by which the nuclear atom was established are of such interest that it is worth while to remind ourselves of them. Rutherford was bombarding atoms by the alpha particles projected with known velocities from a deposit of radium C. He has carried out such bombardment many times since, sometimes with surprising and exciting results. But this time he was merely driving the particles through matter and catching them on a fluorescent screen, so as to see how many had been scattered or deflected from their original path, and by how much. If the atoms consisted of a nucleus surrounded by electrons, at planetary distances in proportion to their size, the atom would be as porous as a solar system, and the alpha particles could be trusted to go through it, for the most part, without perceptible perturbation. Some of the electrons might be knocked out, and so the atom become ionised; but the massive alpha particle would take scarcely any notice of minor obstructions, and would proceed untroubled on its way, until it encountered or came exceedingly close to a central nucleus, of mass greater than itself. Such an occurrence would be comparatively rare. Judging by the probable size of the nucleus on this theory, it would not occur more often than 1 in 10,000 times—probably not so often.

The circumstances of such an encounter, whenever it did occur, are amenable to ordinary and, so to speak, elementary dynamical considerations, if the law of inverse square holds good. Accordingly, it was possible to deduce beforehand what would happen in all the likely kinds of collisions—if they can be called collisions where there is no contact. The law of probability could be applied to determine the number of scatterings in each direction; and then, by the aid of Crookes's fluorescent zinc sulphide screen, on which the splashes or flashes caused by the impact of the deflected alpha particles could be seen, the number scattered in any direction by the atoms of a given substance could be counted and compared with theory. The result was triumphantly to uphold the theory. The central solid compact nucleus was established as a reality, and a proof was forthcoming that it exerted force, even in its immediate neighbourhood, as the inverse square of the distance;—the first time, so far as I know, that it was ever established that astronomical laws still hold good, even in the hopelessly ultra-microscopic region in the interior of atoms.

The quantum is there too, as Bohr afterwards showed. There are energy levels, surrounding the nucleus of atoms, which gravitation-like theory does not account for; though it must be admitted that in the solar system Bode's Law has not yet been accounted for either. But ordinary dynamical laws are there also. The quantum does not replace them, but supplements them, as Bohr found in his Correspondence Principle, and as Sommerfeld made use of in his brilliant prediction of the fine structure of spectrum lines. This fine structure, by the way, is too fine to be seen in ordinary visible spectra; but it can be seen well enough in X-ray spectra, where the theory clearly indicates that it ought to be much more pronounced and conspicuous. The treatment of that, however, must be postponed. I want to return to the simple dynamics of Rutherford's scattering experiment.

The problem may be stated thus. Take a massive particle with charge E—really equal to Ne, where N is Moseley's atomic number; and fire at it, with known velocity v, a much less massive particle with a charge E'—really $2e$. Consider what happens.

First let the line of fire be absolutely direct. The projectile will approach within a distance $2a$ (Fig. 1), and at that distance (SJ) will rebound and return whence it came. The distance $2a$, which we may call "the stopping distance," is important; for it gives the major axis of all the hyperbolic paths which are the result of a less

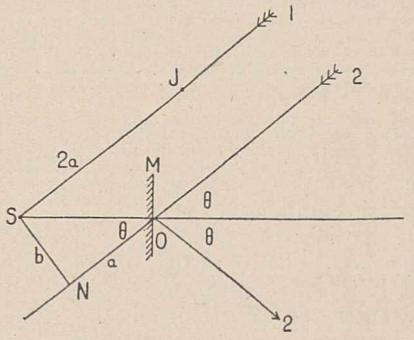

FIG. 1.—Let S be a massive nucleus fired at by an alpha particle, No. 1, correctly aimed. Let SJ be the stopping distance, $EE'/\frac{1}{2}mv^2$, at which the particle will be stopped and driven back. Call this $2a$. Then let a second particle be aimed askew, at a perpendicular distance SN from the nucleus. Call this distance b. Then lay off a length $NO = a$ along the line of fire, and join SO. If now a diagrammatic mirror M is set up perpendicular to SO, as shown, the particle No. 2 will appear to rebound from S exactly as if it had struck this mirror M. The angle of reflection is θ, such that $\tan\theta = b/a$. The path is swung round through the angle $\pi - 2\theta$.

direct impact between the same particles. The bipolar equation of every one of these hyperbolæ will be

$$r_1 - r_2 = 2a.$$

The value of $2a$ can be calculated at once as

$$2a = \frac{EE'}{\frac{1}{2}mv^2};$$

for that is the distance at which the kinetic energy of approach will be converted into the potential energy of recoil, and so the bombarding projectile will there be brought momentarily to rest before being driven back to its source.

In practice, absolute direct impact or accurate aim is infinitely unlikely. Let us take the case then of slightly oblique aim, so that the line of fire approaches the nucleus within a perpendicular distance b. The path will now be a hyperbola, with the above value of a for its semi-axis major, and with b for its semi-axis minor. The equation to the hyperbola being, as stated, $r_1 - r_2 = 2a$, its eccentricity is $\sqrt{(1 - b^2/a^2)}$, or what we may call sec θ. The asymptotic path of the particle will be swung round through an

[1] An expository portion of a presidential address on "X-Rays and the Atom," of which other parts were delivered to the Röntgen Society on November 6.

angle $\pi - 2\theta$, where $\tan\theta = b/a$. In other words the particle will be reflected as if it had struck a mirror in a certain position and with a certain inclination (which can be best depicted in a diagram), and as if it had rebounded from it according to the usual law of reflection (Fig. 1).

Of course, it does not really strike anything: there is no clash or blow of any kind. The path is a perfectly regular curve, as shown in Fig. 2. But all the

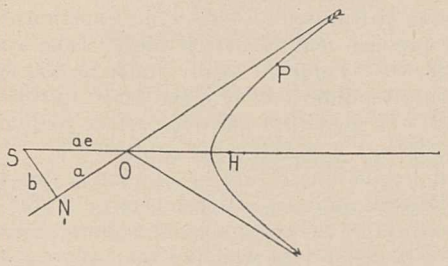

FIG. 2.—The particle in Fig. 1 does not really strike anything, and its path only appears to be straight and angular when seen from a distance. If we could approach close to, we should see the actual path curved, as in this Fig. The real path of the particle is one branch of a hyperbola with major axis $2a$ and minor axis $2b$, with the two foci S and H, and with its centre O equidistant between them. The distance from O to the vertex of the hyperbola is a, while its eccentricity is $e = SO/NO = \sec\theta$. Also $SH = 2ae$. Taking any point P on the path of the particle, its equation is $SP - HP = 2a$. If the particle were attracted instead of repelled by the nucleus, the path would be the same, but the nucleus would be at H instead of at S.

appearance as seen from a distance, or as estimated from the result, will be as if it had been suddenly reflected, from the mirror M, according to the exact geometrical conditions of Fig. 1.

If we consider the projectile as having a sign of electric charge opposite to that of the central nucleus, so that it is attracted instead of repelled, then the circumstances will be very similar. There will still be the appearance of reflection, as in a mirror; the angle turned through will be just the same for the same line of aim; and the same hyperbolic path will be described; but the central attracting particle will be in the other focus. H instead of S.

The accompanying figures, 1 and 2, give a good idea of what a "collision" between charged particles is really like when the inverse square law is obeyed.

In these bombardment experiments, it would appear as if the quantum does not enter. One can scarcely suppose that the line of aim is regulated by quantum conditions, so that the perpendicular distance b for different shots is in arithmetical progression. If, however, we did make such a supposition, we should then have a series of quantised hyperbolic orbits, all with the same major axis $2a$ and the different minor axes $2b$, which are quite analogous with the family of quantised elliptic orbits, in the recognised theory of Sommerfeld and others.

VARIETIES OF POSSIBLE ORBITS.

As every one knows, Kepler discovered that in a planetary orbit the rate of sweeping areas is constant, and that this gives the law of velocity of a planet at every part of its orbit. Newton showed that this was a necessary characteristic of all central orbits, no matter what the law of force was. The moment of momentum, or angular momentum, is constant, the moment of acceleration being zero. Bohr made the assumption—and justified it by results, after the manner of Kepler—that this rate of sweeping areas, admittedly constant for any one orbit, must proceed by definite integer multiples from orbit to orbit, and that only those orbits were stable for which the rate of sweeping areas was characterised by an integer. These, therefore, represent Bohr's energy levels. The most natural kind of orbit to associate with an energy level is circular: and what we have just said means that vr proceeds by steps like the integer n. Ordinary mechanics show that v^2r is equal to a known constant independent of n; and from these two very simple equations a great many things follow.

In general, we may expect that different orbits will correspond to different energy levels; and that is so in the main. But it is possible to have different orbits at one and the same energy level, in the form of a set of ellipses with all their major axes the same. Their periods of revolution will also be the same, since this depends on the major axis. The rate of sweeping areas will be the area of any orbit divided by its periodic time: and since the periods are all equal, the rate of sweeping areas (or the moment of momentum) will be proportional to the area of each orbit. If, then, this has to proceed by integers, in accordance with the quantum, the minor axes of the only possible elliptic orbits are certain definite fractions of the major axis. Thus, suppose the major axis is 4, the minor axis might be either 3, 2, or 1. If the major axis is 6, the minor axis can be 5, 4, 3, 2, or 1. If the major axis is 3, the minor could be naturally 2 or 1. If the major axis is 2, there is only one alternative possible, namely, 1; and if the major axis is 1, no other orbit except a circular one is possible. The number applied to the major axis corresponds to the number of the stable circular orbits surrounding the nucleus in Bohr's theory; K being No. 1, L, No. 2, and so on; their radii being proportional to n^2. These represent the primary or fundamental energy levels; but at all the higher levels elliptic orbits are permissible too. The permissible orbits for main orbit No. 3 are shown in Fig. 3.

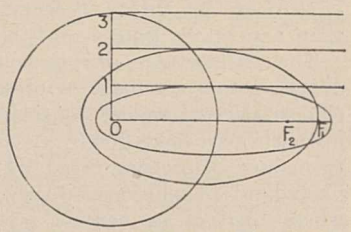

FIG. 3.—To draw the varieties of orbit possible at a given energy level. Let the energy levels K, L, M, N, etc., be called 1, 2, 3, 4, etc. Connect two pins by a single length of string: put the two pins together at O, and with the loop draw a circle. Subdivide its radius into sections equal to the particular number of the energy level to be represented—say 3, as in this Fig.; and draw parellel lines at these points perpendicular to the radius selected. Then, after replacing the string and pencil, separate the pins along the line through O, until the pencil in the loop of string is brought down first to one and then to another of these lines, and each time draw an ellipse. These will be the varieties of possible orbits at the M level; and they are in their right position, with O as common focus. Electrons describing any of these orbits have all the same period, and the same energy except for a cumulative perturbation due to fluctuating speed; but their angular momenta are, like the elliptic areas, as 3 : 2 : 1. A similar construction serves for any level.

EFFECT OF ELLIPTICITY ON THE SPECTRUM.

These alternative elliptic orbits, being in the main at the same energy level as the circular one of which they are variations, will be responsible for the same spectral lines as the circular one, when electrons drop into them. If this were accurately so, they would not

be worthy of attention; but it is not accurately so. The electrical theory of matter, and the consequent variation of inertia at high speeds, necessitates further analysis. The speed in a circular orbit is constant; but is not so in an elliptic orbit. Hence the mass in an elliptic orbit is not constant either. The result can be shown, astronomically, to be a cumulative progression of the apses: that is to say, a revolution of the orbit in its own plane,—like that which has long been familiar in the planets, especially in the planet Mercury [2]—the particle describing a kind of rosette instead of a really closed curve. This progressive elliptic motion can be compounded of two opposite circular motions of nearly but not quite the same period, and nearly but not quite the same energy; accordingly it has the effect of doubling the line which would otherwise be emitted. That is its main effect. Other perturbations are possible too, which will give multiple lines—what is called the fine structure of the spectrum—all which has been worked out in detail by Sommerfeld, and found to agree with observation; though the observations in the visible part of the spectrum are very difficult and delicate, and some of them quite recent.

With X-ray frequencies, these effects are more marked; and it is in the X-ray spectrum that they were first discovered. The fact that they can be accounted for in accordance with astronomical laws, supplemented by the electrical theory of matter, is surely a remarkable testimony to the general validity of what may be called the astronomical theory of the atom.

They strengthen the position of the kinetic atom of the physicist, as against the static atom of the chemist, beyond any reasonable doubt: though for chemical purposes and molecule-building, the static atom is certainly attractive, and, I expect, useful.

[2] See, for example, *Phil. Mag.* for August 1917, *et seq.* If $m=\beta m_0$ a revolution through $2\pi\beta$ is needed for a journey from one perihelion to the next.

The Scientific Renaissance in China.

By Prof. J. W. GREGORY, F.R.S.

THE political changes in China during the last decade have had two opposite effects on the intellectual sides of Chinese life. The Revolution of 1911 gave a powerful stimulus which enabled the intellectual aristocracy to revolt successfully against the domination of tradition, and to advance a scheme of education free from the chains of classicism; but the concurrent political disorder has led to a reactionist triumph in administration. The reform in education which was regarded in 1911 as of primary importance was the replacement of the old written language by one based on an alphabet. The debt China owes to its written characters is incalculable. They have formed the real bond between the many provinces and races of the Empire, and long training in their use has given the Chinese their precision in observation, tenacious memories, and fine artistic perception. These great benefits have been attended by serious drawbacks. Learning the characters practically monopolises all school time. Each character has to be learnt by a distinct effort of memory. A child learns in the four years in the lower primary classes 700 or 1000 characters and a little arithmetic; and if it leaves school with a knowledge of only that number, it in time falls into the ranks of the illiterate. Knowledge of 4000 characters is required for general purposes, and a well-educated man is expected to know 8000 or 10,000. Hence the seven years spent at the lower and higher primary schools, and most of the subsequent four years at a secondary school, are occupied in learning to read and write.

There have accordingly been repeated attempts during the past 2200 years to replace the ideographic by an alphabetic system; but they have failed owing to the inherent advantages of the old system. The primary difficulty is that while the written characters are the same throughout China, the meaning of the words alters with the tone of expression, and the pronunciation varies from province to province. A phonetic rendering of a given character would mean different things in different localities. A uniform alphabetic system is possible only if the same pronunciation be adopted in all parts of China. The first step is therefore the establishment of a standard pronunciation for the whole country. Such a system having been prepared and enacted, the second step is the invention of a set of phonetic alphabetic characters. A Commission for the Unification of the National Language adopted an alphabet of 39 letters, and the teaching of its system was begun experimentally in 1915. In 1918 the scheme was regarded as satisfactory, and it was introduced into the schools. The 39 letters having proved insufficient, another was added in 1920, and in addition to the established 40, others will be required for some dialects, such as Cantonese, which are exceptionally rich in sounds.

This system would give China a unified colloquial language which people could learn to read in a few months instead of requiring a decade of daily toil; it would enable the schools and colleges to give a liberal and scientific education, and would render possible the development of a living literature. The reformers hope that this system will be established throughout China in twenty years.

Concomitant with this reform, a new system of Chinese popular and higher education was promulgated in 1912 by a National Education Conference. This system consists of a universal compulsory course for four years; a higher primary course of three years; a secondary school course of four years; a preparatory course for the colleges of three years; and, finally, three years in colleges or professional institutions for pupils of the ages of 21-24. The scheme included four national universities—Pekin for the north-east, Nanking for the middle east, Wuchang for the north-west, and Canton for the south and south-west. Each of these universities was intended to have faculties in literature, science, medicine, law, commerce, agriculture, and industry.

These noble schemes have been to a large extent frustrated by the political disorders that followed the Revolution. After the collapse of the Manchu Government, the local military leaders seized the reins of power and the revenues. The old officials, who had been selected by severe competitive examination, were replaced by nominees of the military. A riot of corruption and inefficiency has ruined the provincial govern-

ments. In many provinces the educational funds have been seized by the soldiers, and the schools were compelled to close. Education has had a severe set-back instead of being greatly extended.

Nevertheless, the virtues of the individual Chinaman are once again enabling the country to conquer apparently insuperable difficulties. The provinces of Kiangsu and Chekiang have maintained their schools by securing the old grants; in some districts richly endowed temples have been converted into high schools, the lack of which long rendered impossible advanced educational institutions and universities.

The university problem in China is complicated by the existence of numerous foreign Christian universities established by the missionary societies. They are not universities according to British standards. There are two Christian universities in Shanghai—the Aurora University, Roman Catholic, and the St. John's University, Church of England. Others are at Pekin, Wuchang, Nanking, Shantung, Suchow, and Chengtu. The Pekin University was founded in 1888 by the American Methodist Episcopal Mission; and the National University at Pekin has been compelled to adopt the name of the Government University of Pekin.

There are two foreign institutions which promise to reach a high rank and do much for Chinese scientific education. The Union Medical College in Pekin has been richly endowed by the Rockefeller Foundation, and was opened in 1921. Its object is to train not medical practitioners, but medical teachers and investigators; it has at present to undertake some pre-medical classes, but this elementary work will be discontinued as soon as there is an adequate supply of students sufficiently well grounded to profit by the advanced teaching of the College. The College is on a great scale; its teaching staff numbers 67, and one branch of it has a service staff of more than 600. It has already achieved valuable medical research.

What the Rockefeller Institute may do for medical work in northern China, the Hongkong University may do for general education throughout China. It was established by Sir Frederick Lugard when Governor of Hongkong, and opened though the generosity of Mr. H. Mody in 1912.

This institution is planned on novel lines, which seem admirably adapted to the development of an Oriental university. Its original faculties were those of medicine and engineering. These technical departments require chairs in academic subjects; and the number of these chairs is being gradually increased until a wide range of teaching is provided in pure science. A faculty of pure science will thus be founded on those of applied science. A faculty of arts has been already instituted, with commerce as its strongest branch. The university hopes that its external examiners will maintain its degrees on the same standard as those of the University of London, like which it has an external as well as an internal side. Its external side should prove of high service to China as the standardising and co-ordinating agency for the scattered sectarian universities. Their students may enter for its degrees by examination, and Hongkong University may thus raise their standards of teaching and afford a public test of their educational efficiency.

Meanwhile, the Chinese have themselves established universities which promise well. The National University of Pekin has been re-established by its Chancellor, Tsai Yuan-Pei, and is managed by a Senate elected by the professors. The teaching staff numbers 250 in faculties of science, literature, philosophy, history, and economics. At Nanking the High School has been developed into a university for the south-east of China, with its faculty of commerce at Shanghai. A university has been established at Amoy owing to the munificence of Tien Kak Kee, who has endowed it with a million dollars and an annual grant for maintenance of 120 thousand dollars, which is guaranteed for 25 years.

Tsing Hua is a college in the suburbs of Pekin which is extending American influence in China. The United States in 1908 remitted about half the indemnity due to it after the Boxer Rebellion on the understanding that the money was spent in sending Chinese students to American universities and on a college for their preliminary training. The college was founded in the suburbs of Pekin. Its non-Chinese teachers are American, 18 in number.

Shansi University was also due indirectly to the Boxer Rebellion. The two missions in Shansi nobly refused to accept compensation for the murder of their members, and suggested that the provincial government should spend the money in educational work and thus lessen the chance of similar massacres. The provincial government acted on this suggestion and founded the Shansi University at Tai-yan, placing it under European direction for the first ten years. Attached to it is the Nystrom Institute for geological and biological research, from which Dr. Norin has made valuable additions to the geology of north-central China.

Advanced scientific research in China is being promoted by new institutions and societies. The institution which is regarded as most successful is the Geological Survey and Museum, which have been organised by the first director, Mr. V. K. Ting. He has now the help of Dr. Gunnar Andersson, the Mining Adviser to the Chinese Government and head of the Geological Survey Museum, and of Dr. Grabau, the well-known American palæontologist. This Museum is being arranged on lines which combine due attention to scientific research and an educational exhibition. The Geological Survey has been described as the best thing in science which China has done for itself. The Survey has published a series of four Bulletins, five Memoirs, and five volumes of its "Palæontologia Sinica," containing monographs on Chinese fossils. Mr. Ting has given the Geological Survey of China an excellent start, but his recent resignation of the directorship, in order to undertake the general managership of a great Chinese coal company, is a serious loss to Chinese geology. He has an able successor in Mr. W. H. Chang.

An Archæological Society has been founded under the presidency of Dr. Black, director of the Anatomical Department of the Pekin Union Medical College, and has begun publication of contributions to Chinese ethnology; also a Chinese Engineering Society. A Chemical Society has been established at Shanghai, and has adopted the *China Journal of Science and Arts* as

its official organ. That journal is published by the China Society of Science and Arts, which was planned as a Biological Society, but, as it was found that there was more need for a general society, its scope was extended to include the pure sciences and arts. The journal of this society has issued four numbers containing many valuable and interesting contributions. The articles are partly popular and partly technical. The combination of original memoirs with popular articles has obvious drawbacks which may lead to its subdivision into a general magazine and a technical journal.

The Geological Society of China has begun on more normal lines. Its regular meetings are held at Pekin. It has issued the two first volumes of its Bulletin, which contain many important additions to Chinese geology. The Journal of the Chinese branch of the Royal Asiatic Society is available for the publication of technical articles both on science and arts; the volume for 1922 contained seven biological and two geological memoirs, showing the increasing attention paid by that society to natural science.

Much of the new scientific work of China is naturally centred at Pekin, but Shanghai, in addition to being the headquarters of the Chemical Society and the Faculty of Commerce of the University of Nanking, is projecting a first-class science museum, which is being organised by the Shanghai Museum Association.

It may be felt that the outlook for these schemes is not promising and that the existing political chaos in China may bring them all to naught. But Chinese history encourages confidence as to their future. Its general story has been of the gradual decadence of a ruling dynasty until it has become incompetent and corrupt and has been swept away. Then follows a confused interregnum which may be passed through in a decade or may last for a couple of centuries; it ends when some strong man establishes a new dynasty. Though the present disorders may last for years, peace will assuredly be restored. In the meantime, the new Chinese Renaissance promises to make good progress in spite of political turmoil and military misgovernment.

The Serum Diagnosis of Syphilis.

THE Wassermann test for syphilis was discovered by the logical pursuit of a coherent series of observations. From the first it has proved of the highest value for the diagnosis of an infection which is often obscure. But it soon turned out that it was simply an empirical trick and not an application of the general principle which it was originally supposed to illustrate. If the typhoid bacillus, typhoid antibody, and fresh blood serum are mixed together, the three will combine in such a way that the substance in (or property of) fresh serum known as "complement" will disappear. If typhoid antibody is not present, the complement remains and its presence or absence can be determined by a test mixture of red blood corpuscles and red blood corpuscle antibody, in which the red cells will be dissolved if complement is also present. Supposedly the same would apply to a mixture of the spirochæte of syphilis, syphilitic antibody, and complement; and just as typhoid antibody, and therefore typhoid infection, can be detected by this Bordet-Gengou reaction, so was it thought that syphilitic antibody could be found in a patient's serum and syphilitic infection thereby inferred. In practice the idea seemed to work excellently, until it was found that an alcoholic extract of, *e.g.*, normal heart muscle would do as well as spirochætes. The reaction is therefore not specific, and as a matter of fact it is given by the blood in a proportion of cases of many protozoal infections. But it is specially constant in syphilis, and, as other protozoal infections are rare in Great Britain, it comes to be a splendid empirical method of diagnosing that disease.

The widespread use of the method in practical medicine has led the curious to come across a further series of phenomena in which the serum of syphilitics is quantitatively different from that of normal people. Thus it more easily becomes opaque on dilution with water or by admixture with the suspension of lipoids made by adding an alcoholic extract of heart muscle to salt solution—facts which have formed the basis of a number of simplified methods of diagnosis, all of which indicate that the proteids in syphilitic serum aggregate into masses more easily than do those of normal serum. It is doubtless in this formation of aggregates or precipitates—visible or invisible to the bare eye—that the serum loses its property of acting as complement. A number of observations on the opacity of these mixtures of serum and lipoids in the presence of various concentrations of electrolytes have recently been described by Holker,[1] and illustrate the complexity of phenomena which have at present no rational explanation. The whole theoretical basis of the original Wassermann test and its almost innumerable progeny badly needs investigation. The problem is beyond the interests of the practical empiricism which has raised it.

Of the practical modifications of the original procedure, that introduced by Sachs and Georgi has proved one of the best. In this a solution of the alcohol-soluble acetone-insoluble lipoids of heart muscle, to which a small amount of cholesterin has been added, is diluted with salt solution. This opaque suspension is then added to the serum under examination: syphilitic sera give a flocculent precipitate more easily (*i.e.* with less serum) than normal. Experience showed that this simplified procedure was almost or quite as useful in diagnosis as the original more elaborate method.

In 1921 Dreyer and Ward made an ingenious attempt to standardise what at first sight seems rather an uncontrollable reaction, and so reduce it to comparable quantitative terms. The Medical Research Council has lately published[2] an exhaustive account of the method, with an elaborate analysis of the results obtained in a long series of cases in comparison with the more classical procedure. The value of the new "sigma" method is fully confirmed. But the account of the procedure should be studied by others who are concerned with colloids rather than medicine; it evidently raises larger problems than the diagnosis of syphilis.

[1] *Journ. Path. Bact.* vol. xxv. pp. 291, 522; *Proc. Roy. Soc., A*, vol. cii. p. 710.

[2] *The Serum Diagnosis of Syphilis: the Wassermann and Sigma Reactions Compared.* Medical Research Council: Special Report Series, No. 78. (London: H.M. Stationery Office, 1923.) 5*s.* 6*d.*

Electrode Reactions and Equilibria.

By Dr. ERIC K. RIDEAL.

THE conditions of reversibility at electrodes as well as the cause of the phenomena to be noted at irreversible electrodes were discussed at a meeting of the Faraday Society on November 26.

It has long been an accepted fact that the hypothesis of an electrolytic solution pressure as a characteristic property of a metal, originally suggested by Nernst, although convenient for purposes of arithmetical calculation, does not give any insight into the true mechanism of reversible electrodes. The alternative suggestion of a characteristic ionic solubility advanced by van Laar is certainly a more tenable hypothesis, although the enormous values to be attributed to the partition coefficients of the ions between electrode and solution when equilibrium is established somewhat strain the imagination. The hypothesis of Smits, based upon ionic and electronic solubility coefficients, does not appear to be an improvement on van Laar's view, and indeed the accuracy of Faraday's laws appears to offer a very direct proof of its untenability.

A cause for the difference in the electromotive behaviour of the elements is to be found in the nature of the atom itself. The work required to remove an electron from a metal, a value which may be determined from the investigations on thermionic emission by Richardson or from the data on photoelectric emission with the aid of Einstein's quantum relationship, varies from element to element in a manner very similar to the electrode potentials, and indeed it is possible to formulate an expression for the E.M.F. of a cell in reversible equilibrium with the aid of this conception. We are at present uncertain as to the nature of the ionic equilibrium at the surface of the electrode. Attempts have been made to investigate the conditions of a dynamic equilibrium between metal cations and anions being simultaneously discharged at a metal surface resulting in the formation of a definite potential difference and a definite ionic concentration in the solution; but the relationship (if any) of such potential differences to the electro-kinetic potentials due to adsorption and discharge at non-metallic surfaces is by no means clear.

A gap between "reversible" and "irreversible" electrode reactions is to be found in the so-called "inaccessible" electrode reactions. These are generally observed in oxidising or reducing solutions; thus, although a ferrous-ferric ion solution will affect a platinum electrode so as to create a definite reproducible potential difference between metal and solution, yet a solution of glucose or an arsenite-arsenate mixture will not. The inaccessibility of such a potential measurement is due apparently to the relative speeds at which equilibrium at the surface and within the electrode is attained. By suitable artifices, however, inaccessible electrode potentials may be accurately measured.

Certain oxidising and reducing agents, on the other hand, are completely and rapidly electromotively active; such is the quinhydrone electrode of Bijlman, which is now so widely employed for the accurate measurement of the P_H of solutions and the hydrolytic constants of weak acids and bases. A number of similar organic oxidising and reducing agents are likewise electromotively active; the case of the system

$$R\text{–}S\text{–}S\text{–}R \rightleftarrows R\ S\ H$$

which was investigated by Hopkins, appears to be transitional in that equilibrium potentials can only be obtained under very limited experimental conditions.

Truly irreversible electrode reactions embrace, *inter alia*, the phenomena of passivity and overpotential. Although passivity may be caused by films of multimolecular thickness, yet in most cases a unimolecular film is sufficient for the purpose, and, in general, oxygen is the cause of passivity. In the case of the ordinary oxygen electrode consisting of platinum immersed in an electrolyte of definite oxygen pressure, there is little doubt that the oxygen penetrates into the interior of the solid metal. It is uncertain as yet whether definite oxides of platinum are formed, but it is more than probable that the oxygen atoms simply interpenetrate the space lattice of the metal and may take up positions of greatest stability when definite stoichiometric ratios obtain. The irreversible nature of this electrode, at least, must be attributed to the slow diffusion rate of the oxygen in the metal, a factor frequently complicated by a transfer resistance at the electrode boundary in those cases where the chemical reaction of oxidation or reduction is non-ionic and relatively slow.

The many and varied theories advanced to explain the phenomenon of hydrogen overpotential have not yet been reduced to a reasonable number, and it is still a matter of dispute whether the make-and-break or continuous-current method is not suitable for the determination of this value. The use of the positive ray oscillograph for the former and minute polarising currents for the latter appear to be the most promising methods for experimental comparison.

Supporters of the view that overpotential is caused by the formation of small bubbles at the electrode, a suggestion first advanced by Helmholtz, are apparently diminishing in numbers, and the consensus of opinion is gradually veering round in favour of the conception either of a hydrogen atom solid solution or adsorbed hydrogen film; there are, however, numerous difficulties associated with any conception hitherto advanced.

The simple capillary electrometer used almost universally in conjunction with zero potential determinations appears likewise to offer an interesting field for research. The existence of a Quincke electrostatic double layer at the surface of the mercury does not account for the parabolic form of curve obtained when the surface tension is plotted as a function of the applied electromotive force; there appears to be little doubt that the adsorption of ions producing an electro-kinetic potential difference at the interface and a concentration gradient in the electrolyte may give rise to a similar form of curve, and it remains a subject of further investigation whether any effect at all is to be attributed to an electrostatic action unaccompanied by a material or ionic transfer.

Obituary.

COL. C. SWINHOE.

THE death of the distinguished entomologist, Col. Charles Swinhoe, who had for many years past been recognised as a leading authority on the Lepidoptera of the Indian region, took place on December 2 at his residence at West Kensington. Born on August 29, 1836, of a family which has produced more than one distinguished zoologist, Col. Swinhoe entered the army in his nineteenth year as an ensign of the 56th Regiment. Shortly after the end of the Mutiny, the young officer was dispatched to India, and was gazetted to the Bombay Staff Corps, in which he served for upwards of thirty years, and was with Lord Roberts in the historic march to Kandahar. The rich and varied Indian fauna soon engaged his attention, and he became an enthusiastic student of the Lepidoptera, of which order of insects he formed one of the largest and most comprehensive collections in existence; though his energies were by no means confined to entomology, as is shown by several able memoirs on Indian birds from his pen. In collaboration with Mr. E. C. Cotes, of the Indian Museum, he published the first great "Catalogue of the Moths of India" (Calcutta, 1887–89), and also gave much assistance in the compilation of the "Lepidoptera Indica," this work having been completed by him after the death of its principal author, Dr. Frederic Moore.

On his retirement from active service, Col. Swinhoe at first made his home at Oxford, where his time was largely devoted to the preparation of the "Catalogue of Eastern and Australian Lepidoptera-Heterocera in the Oxford University Museum." This important work appeared in two volumes in 1892 and 1900, and the honorary degree of M.A. was conferred on its author by the University of Oxford. Col. Swinhoe removed to London in 1902, and was for many years a familiar figure at the Natural History Museum. He contributed largely to the publications of the learned societies of which he was a member, and as recently as last spring his "Revision of the Genera of the Family Liparidæ" appeared in the "Annals and Magazine of Natural History." A paralytic seizure in August last, just as he was entering on his eighty-seventh year, brought his life-long work to a close. He had been since 1881 a fellow of the Linnean Society, and had served on its Council, as well as on that of the Entomological Society of London, of which in 1892 he was vice-president. J. J. W.

CANON THEODORE WOOD.

THE sudden death on December 13, at the age of sixty-one, of Canon Theodore Wood, vicar of St. Mary Magdalene, Wandsworth Common, has taken from us one who, both by his writings and by his lectures, did much to popularise natural history, and to awaken in the public mind a sympathetic interest in the birds, insects, and other common animals that come under the notice of dwellers in country places. Brought up under the influence of his father, the Rev. J. G. Wood, who was known even better to a former generation than the son is to the present as the author of excellent books on natural history, he early acquired the seeing eye of the expert naturalist, and a close, personal acquaintance with the ways and habits of many forms of animal life.

In manhood Canon Wood handed on to others the torch that he had thus received. His frequent articles in "Our Country Page" of the Saturday issues of the *Morning Post*, though adapted to the general rather than to the scientific reader, were accurate, showed a considerable knowledge of current scientific literature, and were always worth reading. The titles of his books, "Our Insect Allies," "Our Insect Enemies," "Our Bird Allies," "The Farmer's Friends and Foes," to name but a few of them, indicate his desire to instruct the public on the economic importance of many of the lower animals, and to prevent the ignorant slaughter of useful and beautiful creatures by fruit-growers, farmers, and gardeners; while many a boy naturalist has to thank him for "Butterflies and Moths," a useful introduction for the young collector. As a lecturer he was eminently successful, holding his audiences by his simple, clear language and enthusiasm for his subject, and not less by the skilful and rapidly executed blackboard drawings with which he would illustrate his discourse.

M. GUSTAVE EIFFEL.

THE death is announced, at the age of ninety-one years, of M. Gustave Eiffel, whose name will always be associated with the gigantic tower named after him and built by him in Paris in 1889. Alexandre Gustave Eiffel was born on December 15, 1832, and was educated as an engineer. His earlier work was concerned mainly with bridge-building on the Continent, and in this, as in all his engineering work, he introduced novel means of construction.

In 1900, M. Eiffel took up meteorological research, and for some years published an annual "Atlas Météorologique." A laboratory with a small wind-tunnel was established at the Champ de Mars, and experiments on air resistance were also carried out at the Eiffel Tower. In 1907 he published "Recherches expérimentales sur la Resistance de l'Air exécutées à la Tour Eiffel," and in 1910 there appeared a volume describing the experimental work; this was translated into English and German (*v.* NATURE, November 20, 1913, p. 342). A better equipped laboratory was secured at Auteuil, some account of which was given in our issue of February 20, 1913, p. 677; it contained a wind tunnel in which velocities of 2 to 32 metres per second could be produced. The results obtained were embodied in a volume issued in 1914. Work on aeroplanes, propellers, and projectiles was carried on throughout the War, a report on the experiments being issued in 1919, and in 1920 M. Eiffel published "L'Hélice aérienne." His work was of primary importance in aeroplane design and construction.

M. Eiffel was an honorary member of the Institution of Mechanical Engineers and a former president of the French Society of Civil Engineers. In 1913 he received the third Langley medal of the Smithsonian Institution of Washington, "for advancing the science of aerodromics by his researches relating to the resistance of the air in connexion with aviation."

WE much regret to announce the death of Dr. Otto Klotz, chief astronomer and director of the Dominion Observatory, Ottawa, aged seventy-one.

Current Topics and Events.

THE list of New Year honours includes the following names of men known by their scientific work or associations: *Baronet:* Sir Donald Macalister, K.C.B., M.D., F.R.C.P., F.R.S.E., president of the General Medical Council. *Knights:* Dr. Byrom Bramwell, for services to medicine; Dr. H. L. Ferguson, Dean of the Faculty of Medicine, University of Otago, Dunedin, New Zealand; Mr. T. H. Mottram, H.M. Chief Inspector of Mines, Mines Department, Board of Trade; and Mr. H. Murray, Assistant Forestry Commissioner of England and Wales. *K.C.B.* (*Military Div.*): Sir William B. Leishman, Director-General, Army Medical Service. *C.B.* (*Military Div.*): Maj.-Gen. D. J. Collins, Deputy Director of Medical Services, Southern Command, East Indies. *K.C.M.G.*: Prof. W. R. Dunstan, for services as Director of the Imperial Institute.

ON November 6 Sir Oliver Lodge gave a presidential address to the Röntgen Society, entitled "X-rays and the Atom." In it he dealt first with the way in which X-rays had been employed by various experimenters in elucidating the structure of the atom. He also described the X-ray spectrometer, whereby the wave-length of any given set of X-rays can be quickly determined; thus furnishing a measure of their penetrating power, and the characteristics which make them serviceable for any particular kind of surgical or medical examination. These portions of the address will be published in the Journal of the Röntgen Society. On account of the length of the address, certain portions had to be omitted. Some of these portions were of an expository character, and two sections, appropriate to the pages of NATURE, are published elsewhere in this issue. The concluding portions were of a more speculative character, and endeavoured to suggest hydrodynamical inquiry into the exceptional or peculiar behaviour of electrons inside the atom, so as to reconcile it with dynamical or electromagnetic theory.

WE are very glad to learn that, through the generous intervention of a guarantor who prefers to remain anonymous, and an educational trust with which he is associated, the publication of the accurate and interesting monthly periodical of progressive knowledge, *Discovery*, is to be continued. The journal has maintained a high standard throughout its existence, and its contributors have included men of distinction in many departments of learning. The articles and illustrations have represented popular science—natural and humane—at its best, and have always been attractive without being tawdry and superficial. Every endeavour to enlighten the community in this way, and thereby to stimulate interest in human achievement in intellectual fields, merits all the encouragement that can be afforded it. We welcome, therefore, the announcement that the beacon of *Discovery* is to continue to shine for the pleasure and guidance of all who care to profit by its light.

IN an article in our issue of December 1, p. 781, reference was made to the future of the Industrial Research Associations. In the September-October issue of the *Scientific Worker* the belief is expressed that further public funds will be available for their preservation if the industries themselves will show by their financial support that they believe them to be vital for progress in the distant as well as the near future. So far, the work of these associations has been wrapped in mystery and the public has known too little of their doings. An estimate carefully made of the increase in national wealth due directly or indirectly to research financed out of public funds would be most valuable at the present juncture. The United States estimates that the 400,000*l.* spent during the past ten years on the Forest Products Laboratory at Madison saves American industries 6 million pounds sterling annually. In order that the best methods of administration and control of Research Associations may be adequately discussed, the journal invites the business firms constituting, and the scientific staff employed by the Associations, to express their candid opinions on the subject.

As a result of the success of the "Scientific Novelties Exhibition" held a year ago in support of King Edward's Hospital Fund for London, King's College, Strand, is once more housing a similar exhibition open December 29–January 9. The exhibits are supplied by the colleges, hospitals, and associated institutions of the University of London. The college is lent by the Delegacy, and the gas and electricity are given by the respective supply companies. With this combination the organisers of the enterprise hope to raise funds for the hospitals. The exhibition is designed to bring before the man in the street (and his children) the wonder aspect of science, and to present interesting and amusing applications of scientific principles. Though most of the demonstrations and exhibits are scarcely novelties, they appear to delight the crowd of visitors which daily passes through the building between the hours of 2 and 9 P.M., and no doubt many of the devices will find a place in college and school conversaziones of the future. The exhibits include many old favourites, such as large Wimshurst machines with accessories, stroboscopes old and new, discharge through gases and X-rays, howling tubes and Chladni's figures, polarisation and ultra-violet light. In one very amusing exhibit a professor of engineering surpasses his previous efforts with high tension discharge by the production of thunder by the suitable use of students and stage properties. As an alternative to such a display, a room near by tempts those with a taste for anthropology, with skulls, casts of skulls, etc. But this is a mere outline of the contents of the rooms open to the public. Another feature of the exhibition is the very full lecture list. On most days four or six lectures are given, on a large variety of subjects, mostly by people whose names would normally draw crowds to a lecture. Without a doubt one may say that, if the public is made aware of the exhibition, by suitable advertisement, the organisers will not be

disappointed in the amount of money which they will hand over to the hospital fund at the end of the ten days.

PROFS. BOHR (Copenhagen), Einstein (Berlin), and von Kries (Freiburg) have been elected foreign members of the Göttingen Academy of Sciences.

DR. W. BOTTING HEMSLEY, Keeper of the Herbarium and Library, Royal Botanic Gardens, Kew, from 1899 to 1908, well known by his work on insular floras and on the floras of China and of Central America, attained his eightieth birthday on December 29. He was elected a fellow of the Royal Society in 1889.

THE following free public Gresham Lectures are announced for delivery at Gresham College, Basinghall Street, E.C.2, at 6 o'clock each day: Geometry, by W. H. Wagstaff, on January 15, 16, 17, and 18; Astronomy, by A. R. Hinks, on January 22, 23, 24, and 25; Physic, by Sir Robert Armstrong-Jones, on January 29, 30, and 31, and February 1.

DR. PAUL VON GROTH, the distinguished professor of mineralogy in the University of Munich, is, according to the *Chemiker Zeitung*, to retire on April 1, 1924. It will be remembered that a special number of the *Zeitschrift für Kristallographie*, which was referred to in NATURE of October 6, p. 519, was issued to commemorate the eightieth birthday, on June 23, of its founder and first editor, Prof. von Groth, who has devoted his long life to the study of crystallography.

To mark the seventy-fifth anniversary of the American Association for the Advancement of Science, it is announced in *Science* that a member of the Association has given the sum of one thousand dollars to be awarded as a prize to the author of a paper containing a notable contribution to the advancement of science, presented at the Cincinnati meeting either before the Association or before one of the affiliated societies. The award will be made by a committee to be appointed by the council of the Association.

THE Council of the Institution of Automobile Engineers has established a medal to be awarded to a member of any grade for any paper or similar service which may be considered likely to have special influence on the advancement of automobile engineering. The medal, which is of bronze, bears on its obverse side a replica of the head of Dr. F. W. Lanchester as symbolical of progress in the industry. The Council has decided to award the first medal to Dr. Lanchester for his contributions to scientific knowledge.

THE Council of the Royal Anthropological Institute has resolved to offer medals, not more than two in number in any one year, as a reward for specially meritorious anthropological work in the field. All British subjects and anthropologists of other nationalities who may be fellows of the Institute will be eligible for the award. The medals will be known as the Rivers Memorial medals in memory of the late Dr. W. H. R. Rivers, who was president of the Institute at the time of his death.

REFERRING to the article "Science in Agriculture," based on the Rothamsted Experimental Station Report for 1921–22, in NATURE, December 15, p. 881, Dr. B. A. Keen, Assistant Director of the Station, informs us that the report is not an annual one, but covers the two years 1921 and 1922; its "somewhat belated" appearance is due to the extra work of dealing with a double set of figures. The arrears of work arising out of war and post-war conditions have now been dealt with, and it is hoped that it will be possible to recommence the issue of annual reports.

THERE has been issued from the British Museum (Natural History) a calendar for 1924, attractively decorated by a brilliant coloured representation of a Morpho butterfly. On the mount are stated the hours of admission to the Museum and of the official tours, the publications issued by the Trustees, a few of the more notable recent additions to the collections, a list of the Museum staff, and the postage rates. We should also like to direct attention to the list (N.H.M. Form 170) of picture cards issued by the Museum, many of which could be employed effectively by teachers.

IN connexion with the twelfth annual conference of Educational Associations now in progress, the Selborne Society has arranged a demonstration of the kinematograph in education at the Stoll Picture Theatre, Kingsway (which Sir Oswald Stoll has kindly lent for the purpose), on Thursday, January 10, 1924, at 10.30 A.M. Illustrations will be given of the teaching of physical geography, history, and natural history with the aid of films. Admission will be by tickets only, which will be sent on request by the honorary secretary of the Selborne Society, Mr. Wilfred Mark Webb, The Hermitage, Hanwell, W.7.

DR. F. M. BECKET, of the National Carbide and Carbon Co., N.Y., has been awarded the Perkin medal, and, according to *Chemistry and Industry* for Nov. 30, the presentation is to take place at the meeting of the American Section of the Society of Chemical Industry on January 11. Dr. Becket's most noteworthy achievement was probably the discovery and development of the process for reducing ores by silicon. In the case of the more valuable metals, this process made possible the economic production of a superior quality of alloy of low carbon content which is admirably suited to the manufacture of certain tool-steels. Dr. Becket has also carried out valuable work in electrochemical and chemical engineering fields.

THE programme of Friday evening discourses before Easter at the Royal Institution covers a wide range of subjects and includes the names of many distinguished scientific workers. The first discourse of the session, on January 18, by Prof. Henry E. Armstrong, will be on the scientific work of Sir James Dewar, Fullerian professor of chemistry (1877–1923). Among the other lecturers and their subjects are the following: Sir William Bragg (recent research on crystalline structure), Sir Arthur Evans (recent lights on the Minoan art of Crete), Dr. J. H. Jeans (origin of the solar system), Prof. G. Elliot Smith (the

human brain), Dr. Walter Rosenhain (inner structure of alloys), Sir Frederick Keeble (the plant commonwealth and its government), Prof. Hugh Maclean (insulin), Sir Ernest Rutherford (the nucleus of the atom), Prof. Jocelyn Thorpe (colours, stains, and dyes). The complete programme of discourses and lectures can be obtained from the assistant-secretary, Royal Institution of Great Britain, 21 Albemarle Street, W.1.

THE following awards have been made for papers read before or published by the Society of Engineers (Inc.) during 1923: President's gold medal to Mr. J. W. Gordon for his paper on "Railway Surveying by Photography"; Bessemer premium to Mr. Mauclere for his paper on "The Pneumatic Handling of Petrol and other Inflammable Liquids"; Nursey premium to Mr. A. Hiley for his paper on "The Impact of Imperfectly Elastic Bodies, with particular reference to the Effect of the Hammer Blow in Pile-driving"; Bernays premium to Mr. A. Ferguson for his paper on "A new entirely automatic Machine for the Mass Production of Glass Bottles"; Society premium to Mr. A. S. E. Ackermann for his paper on "The Physical Properties of Clay (fifth paper) and the Dynamics of Pile-driving"; Clarke premium to Mr. R. C. Hill for his paper on "Work Beneath the Waves" read before the Gloucestershire Engineering Society, associated with the Society of Engineers; and Geen premium to Mr. H. F. Jones for his paper on "Boilers" read before the Crystal Palace Engineering Society, associated with the Society of Engineers.

THE fourth report of the National Institute of Agricultural Botany, for 1922–23, shows steady progress since the founding of the station. The first series of field trials has been completed and a new series begun with improved methods in the light of the experience gained. The volume and importance of the results of the scientific and practical work has justified the establishment of an Institute Journal, of which the first number has already appeared. A decision has had to be made as to the relative importance of trial and distribution of seed in the work of the station, and it is proposed to concentrate for the next few years on the elaboration and improvement of methods of trial, in order that eventually it may be possible to issue authoritative reports on the yield and quality of different forms of farm plants and their suitability for different climates and soils. The work of the Official Seed Testing Station goes on steadily, though there has been a decline in 1922–23 in the number of samples tested owing to seasonal and trade conditions. A second course of instruction in seed testing was given. The financial position of the Institute is such that at present sufficient funds are available for the fulfilment of the present programme. Any extension of this, however, is impossible unless adequate outside assistance is forthcoming from the general public, and an appeal is made by the Council to all who are interested to assist either by becoming fellows of the Institute or by making donations to the general funds.

WE are informed by Dr. N. A. F. Moos, late director of Bombay and Alibag Observatories, that the selection of disturbed Bombay magnetic curves mentioned in our issue of October 20, p. 603, was prepared by him, and that he had hoped it might have been possible to include introductory matter and a discussion in the publication.

Our Astronomical Column.

COMETS.—D'Arrest's Comet was observed by M. P. Chofardet at Besançon on Dec. $6^d\ 6^h\ 27^m\ 36^s$ G.M.T., its apparent place being $22^h\ 53^m\ 56{\cdot}30^s$, South Decl. $24^\circ\ 8'\ 41{\cdot}2''$. It was estimated to be of magnitude $12\frac{1}{2}$ to 13; it appeared as a small, ill-defined nebulosity, at most 20″ in diameter, without definite nucleus. The observation was difficult owing to low altitude and the presence of mist near the horizon; it is very creditable to have obtained an observation under these conditions.

Dr. Baade of Bergedorf Observatory is still keeping his comet of October 1922 under photographic observation. It is now well outside the orbit of Jupiter, and its magnitude is less than 15. The long arc of observation will enable the orbit to be calculated precisely and reveal any departure from a parabola that may be present.

STELLAR PHOTOMETRY AT YALE OBSERVATORY.—It was found that the stellar images on photographs obtained with the Loomis Memorial telescope at Yale were unsuitable for purposes of exact measurement of position, and it was accordingly decided to use the instrument for stellar photometry, measuring by means of a Hartmann wedge photometer the density of extra-focal star images. The calibration of the wedge to star-magnitude was determined from some Pleiades plates, using Hertzsprung's standard photographic magnitudes.

Vol. 3, Part II., of the Observatory Transactions contains an investigation of the light curves of the Cepheid RR Ceti and the Algol-variable VV Orionis. The curve of the former differs in two respects from the visual curves of Ichinohe and Praçka: (1) the light range is 0·9 mag. visual, 1·2 mag. photographic, indicating that the star gets redder at minimum; (2) the pause midway in the descent is not shown in the photographic curve, which has, however, a slight hump just before the minimum.

VV Orionis has a curve with two minima, indicating that both stars are luminous, but the brighter star gives nine times the light of the fainter one, which it totally eclipses at secondary minimum. Only one spectrum is seen, so the mass ratio cannot be determined. Assuming that it is 2 to 1, the masses in terms of the sun are 6·9, 3·4, and the diameters 5·3, 2·5.

PARALLAX AND PROPER MOTION OF RR LYRÆ.—Many researches have lately been carried out on the parallaxes of variable stars. *Astr. Nachr.* No. 5260 contains a photographic investigation by H. Fuss of that of RR Lyræ, the period of which is 0·567 days, the spectral type varying from B9 at maximum to F2 at minimum.

A very small value for the parallax, $0{\cdot}0003'' \pm 0{\cdot}0038''$, is found; Van Maanen had found $0{\cdot}006'' \pm 0{\cdot}006''$, so there is no doubt that the star is very remote. In spite of this it has the considerable annual proper motion of $-0{\cdot}0098^{sec.}$, and $-0{\cdot}202''$ in R.A. and Decl. respectively, so that its linear velocity must be large.

Research Items.

ANCIENT MAN IN NORTH AMERICA.—In the Bulletin of the American Museum of Natural History (December 4, 1923) Dr. William K. Gregory and Mr. Milo Hellman analyse in still greater detail the two molar teeth attributed by Prof. H. F. Osborn to "a new and independent type of Primate"—Hesperopithecus—which existed in North America during Pliocene times. They find that the "type" tooth is, as has been maintained, a second upper molar of the right side, but do not definitely reject the suggestion of Dr. Gerrit Miller, that it may prove to be a third molar. While Dr. Gregory sees in these recently found fossil teeth a resemblance to the molar type of the gorilla and chimpanzee, his partner leans towards their human resemblances. With only drawings to guide him, Dr. Smith Woodward (NATURE, June 10, 1922, p. 750) was disposed to regard the type tooth not as that of a primate but of a carnivore—possibly Hyænarctos—and he considered that the tooth had the characters of a lower rather than an upper molar. In their present paper the authors state that the tooth of Hesperopithecus differs profoundly from that of carnivores and that it has fundamental points of agreement with those of the ape-man group of the primates. They cite altogether ten opinions, all of them different, which experts have passed as to the nature of the two teeth ascribed to the enigmatical Hesperopithecus. Prof. Osborn was right when he wrote in NATURE (August 26, 1922, p. 283) "we must seek more material before we can determine its relationships"; and in truth the same may be said of the teeth.

THE IRON AGE.—Dr. J. Newton Friend, in a paper entitled "Iron in Antiquity" which has been published in the Carnegie Scholarship Memoirs, volume xii., has brought together a great deal of information relating to the early use of iron. He agrees with Sir Flinders Petrie in regarding the iron which occurs in Egypt between the find of the pre-dynastic beads at El Gerzeh and the 18th Dynasty as belonging to the "Sporadic Iron Age of Egypt," and inclines to the view that the earliest iron used there was meteoric in origin, notwithstanding the fact that the earliest known larger piece of iron—that found in the pyramid of Khufu—was telluric. In support of the likelihood of the use of meteoric iron by primitive man, he cites the cases of the Eskimo of the Coppermine River and Cape York quoted by Zimmer. Dr. Friend has some interesting notes on the use of iron in India. These include an account of the remarkable pillars of *wrought* iron at Delhi, dating from 300 A.D., and at Mandu near Dhār. Of these, the former is 23 ft. 8 in. in height, and the latter, now in three pieces, was originally 43 ft. 4 in. or possibly 50 ft. in length. Discussing the peculiar freedom from rust of early Indian iron, Dr. Friend states that he has found by experiment that after one year's exposure to the corrosive influence of alternating wet and dry, the relative corrodibility of modern mild steel is 100·0 as compared with iron from the Black Pagoda at Konarak, Madras, 89·3.

WITCHES AND VAMPIRES.—During the past year, Miss M. Edith Durham has contributed to *Man* a number of interesting articles dealing with the ethnography of the Balkans. In the December issue she writes of witches and vampires in Bosnia, Montenegro, and Albania. In Montenegro the Vilas, the female spirits, usually evil, live in the underground caverns frequent in limestone rocks, and sometimes swear sisterhood with a warrior and protect him from his foes. They also make love to male animals, and it is interesting to note that the tangled knots in a horse's mane, which used to be known to the negroes of the United States as "witches' stirrups," are also said in the Balkans to be a sign left by the Vilas. In Albania, the population being more primitive, the belief is universal. The witch or *shtriga* is especially powerful in the first week in March. Weakness and pallor are commonly ascribed to the night attack of a witch in the form of a fly, bee, or moth. The witch here has evidently assimilated to the vampire. The belief in the vampire, which is a characteristic folk belief of the whole of eastern Europe, is very prevalent, and Miss Durham records a case in which it was believed that a woman's betrothed had returned to her as a vampire after his death and had become the father of her child.

CINCHONA PLANTATION IN BURMA.—In NATURE of April 21, p. 547, reference was made to the Report of the Botanical Survey of India for 1921–22 and the efforts therein described to introduce Cinchona cultivation in Burma. The original locality chosen had proved to be far too wet, the heavy rainfall being disastrous to the young plants, and in that Report the decision was recorded to make a new start in the neighbourhood of Tenasserim. The Report for 1922–23 of the Botanical Survey of India records interesting progress in spite of the necessity of retrenchment due to the limitation of funds; 250 acres only were planted instead of 500 acres, but the new situation so far seems admirably adapted to the plants. The plants are described as having made phenomenal growth, whilst, in the process of hardening the seedlings to the sun, "methods which have never been deemed possible in Bengal have been successfully employed this year in Burma." But one of the most interesting points is that the plants grown in unfavourable conditions at the earlier Burma experimental station at Tavoy provided sufficient bark to enable the alkaloid contents to be estimated. In spite of adverse climatic conditions under which these plants at Tavoy have been grown, at two years of age the bark showed an alkaloid content of 4 per cent., and at one year old of between 2 per cent. and 3 per cent., percentages obtained in Bengal only from trees of from four to seven years of age.

TIDE PREDICTION.—At a meeting of the Royal Geographical Society on December 10, Dr. A. T. Doodson gave a remarkably clear and interesting account of the past work and future plans of the Tidal Institute, Liverpool, of which he is secretary. Many phases of this work have previously been mentioned in this column in connexion with the annual reports of the Institute, issued by the honorary director, Prof. J. Proudman. Dr. Doodson's present article surveys the field of tidal investigation more generally, and with more reference to the work of others in the same field, than would be appropriate in the annual reports. He postulates, as the ideal to which tidal research must address itself, the power to explain the tides quantitatively without tidal observations; the tide generating forces of the sun and moon are known, and the problem is that of mathematical treatment of forced oscillations of water in various basins the geographical form and depth of which are known. Henri Poincaré indicated a sequence of direct mathematical operations, based on the dynamical equations of the tides, which would enable this problem to be solved; but he admitted that the amount of computation involved in applying his method to the actual oceanic basins would be prohibitive. A mathematical method of the same

general nature, though entirely different in detail, has been devised at the Institute, and will be tried; the computations are necessarily still very laborious, but perhaps not prohibitively so. Further details are given also of work on the effect of winds, and of friction, on tidal oscillations.

WEATHER IN KOREA.—A volume containing results of observations has recently been issued as the annual report of the Meteorological Observatory of the Governor-General of Chosen for the year 1920, compiled at the Meteorological Observatory at Zinsen. Hourly values of pressure, temperature, and wind are given from self-registering instruments, and other data commonly observed in European weather establishments. Monthly and annual results of the several elements are given, from four-hourly observations for the Observatory at Zinsen and 13 branch stations, together with earth temperatures, hours of sunshine, and various data. There are 205 auxiliary stations which supply observations of air temperature and precipitation for climatological investigation. Headmasters of the ordinary schools continue to supply observations of thunderstorms, and a report of past work has been issued for 1918. Weather telegrams are said to be much improved since the beginning of 1920 by the wireless communications between China and Korea. Storm warnings are exhibited at 43 stations round the Korean coast, and there are three typhoon signal stations at Chemulpo (Zinsen), Fusan, and Gensen. Seismic observations at Zinsen are given at the end of the report. Results of the meteorological observations in Korea for the lustrum 1916 to 1920 have also been recently published; these will add much to our knowledge of Korean weather. Rainfall at the several stations shows that there is an excess of rain in the summer months, and the precipitation is given for 8-hourly periods throughout the discussion; the totals for the several periods seem to vary considerably and somewhat irregularly, both position and height above sea level entering into the difference between day and night values.

THE ROTARY SYSTEM OF OIL-WELL DRILLING.—On December 11, Mr. L. R. McCollum presented to the Institution of Petroleum Technologists an account of the rotary system of drilling, now of increasing importance throughout the principal oilfields of the world. Broadly speaking, two systems of drilling are employed to-day—the cable-tool or percussion system, whereby the hole is literally pounded out by a cutting-bit alternately raised and lowered to produce a succession of "blows," and the rotary system, in which a rigid pipe-stem rotates a special type of cutting-bit, a mud-flush being pumped down under hydraulic pressure through the drill-pipe. This flush serves to lubricate the process of drilling, drive the cuttings up out of the hole, and at the same time "mud up" the formations to prevent them caving; hence the special adaptability of the system to unconsolidated and caving sands or silts such as are commonly met with in the Gulf Coast fields of Texas and Louisiana, where the system was perfected in the first instance. The cable-tool system is better suited to harder rocks. The chief advantage of the rotary system is the rapidity with which a well can be drilled, 450 feet per day being made under exceptionally good conditions, a far greater depth than is possible with the cable-tool in normal circumstances. Further facts in favour of the system are that high gas and oil pressures are more easily controlled, less casing is required for the lining of the well, it is less costly to employ than cable-tools, and it is more universally adaptable to conditions of modern oilfield development. Two inherent disadvantages are the tendency through "mudding" for the driller to miss oil shows, and the difficulty of obtaining uncontaminated samples for elucidating subsurface geological data. The first depends for its solution on the efficiency of the driller. The second has been lately successfully combated by the introduction and use of the core-barrel, a device by which adequate sampling can be carried out satisfactorily. The rotary system probably finds its greatest exploitation in California and the Mid-Continent fields to-day, a fact that has materially contributed to the development of petroleum production in North America during the last three or four years.

ASPHALT AND RELATED BITUMENS.—There has been a noteworthy increase both in production and utility of asphaltic material for commercial requirements during the last few years, especially in the United States, where domestic and Mexican petroleum and native bituminous rock constitute the chief sources of supply. In 1922, according to Mr. K. W. Cottrell's recent report (Mineral Resources of the United States, 1922, Part 2), the sales of asphalt and allied material represented increases amounting to 11 per cent. in quantity and 13 per cent. in value in the case of native products, and to 29 per cent. in quantity and 15 per cent. in value in the case of material manufactured from crude oil; asphalt obtained from Mexican petroleum showed an increase of 37 per cent. in quantity and 18 per cent. in value. Internally, California, Texas, and Illinois (in that order) were principally responsible for the sources of manufactured asphalt. Chief among the uses to which asphalt is put, either in its solid, semi-solid, or liquid forms, are those in connexion with paving and roofing. Refined asphalt and asphaltic cement are used in a fluxed or unfluxed condition for the construction of sheet asphalt, asphaltic concrete, asphaltic macadam, block and monolithic pavements; the saturation, coating, impregnation, or cementing of suitable fabric with asphaltic material is an equally important process in the production of waterproof roofing. Nowadays few motor-car tyres are manufactured which do not possess a certain amount of asphalt or asphaltic cement as a constituent, and this in itself has created an ever-growing market for this form of bitumen. With the popularisation of wireless telephony, insulating materials and acid-resisting compounds have been in increasing demand, both in the United States and in Great Britain, and here again asphalt has supplied the requisite raw material. Putty, mastic, asphaltic briquets, paint, varnish, or as a road-oil—all these are uses to which this valuable product is being applied. It is interesting to note that the two chief countries to which asphalt is exported from the United States are Canada and England in the case of unmanufactured products, and Canada and Spain in the case of manufactured products.

PHOSPHORESCENCE AND CRYSTAL STRUCTURE.—In the *Zeitschrift für Physik*, 18. 2. p. 109, 1923, Herr A. Scheelde states that the sulphide phosphores can be most simply considered as being built up in the following manner. Certain metal atoms of the ground substance are replaced by foreign metal atoms, and these, with the surrounding arrangement of atoms in the crystal lattice, are identical with Lenard's phosphorescent centres. Inorganic substances capable of luminescence show phosphorescence when prepared by melting, but not when prepared by roasting, or by slow crystallisation from solution. In the first case the crystallisation takes place suddenly, and lattice deformations may be expected; in the second case there will be no such disturbances, and it seems possible that the difference in phos-

phorescence is due to this cause. Zinc sulphide, in the wurtzite form, prepared by reduction of zinc sulphate, was found to be luminescent, but not phosphorescent; when this was compared by the X-ray method with a strongly phosphorescent zinc sulphide, the latter showed strong deviations in its lattice constants. Zinc silicate and calcium tungstate show a diminution of the period of phosphorescence, when they are maintained at a high temperature for a long time, without any flux; the intensity of the fluorescence is not diminished by this treatment. Certain organic substances give a similarly explained long period phosphorescence when frozen in alcohol, or mixed with molten boracic acid, which is then solidified. The electrons separated in consequence of these deformations probably return to their stable orbits only when, by chance, a heat vibration brings the atom again into its normal position with respect to its neighbours.

ELECTRIC CONDUCTIVITY OF THE VAPOUR OF CADMIUM IODIDE. — Although the easily vaporised halogen salts of metals are good conductors, the conductivity alters greatly with the time, and the irregularities are such that in most cases it is not possible to reproduce the results of a given measurement. The salts of zinc, cadmium, etc., easily decompose, and, except in the case of cadmium iodide, the vapour densities are very variable. In the *Annalen der Physik*, November 1923, Messrs. G. C. Schmidt and R. Walter describe an investigation of the last-named salt. They determined the density by passing a measured volume of dry nitrogen over the heated salt and finding the loss of weight due to evaporation; it vaporises normally, the density depending only on the temperature. This is not the case with other halogen salts. Conductivity determinations of the vapour show that the heated salt gives out only positive ions and no electrons, so that there is a surface ionisation, and not, as previously assumed, a volume ionisation; this takes place when the salt is heated on nickel, glass, or platinum. The conductivity is very dependent on the time during which the tube containing the salt and vapour is kept at a given temperature, generally rising to a maximum and then falling, at first rapidly and afterwards slowly. This is not due to any foreign substance being distilled out of the salt by degrees, and the explanation finally offered is that, the cadmium positive ions being given off, iodine is left behind in the solid. The distillate of cadmium iodide is always richer in cadmium than the original material, and this increases for each distillation. Complex salts, CdI_3 or CdI_6, seem to be formed in the residual salt. The action seems to depend in some way on the catalyser (platinum, nickel, or glass); and the halogen produced by decomposition of CdI_3 is supposed to "poison" the catalyser, reducing the reaction velocity and diminishing the conductivity of the vapour.

USE OF DESENSITISERS IN X-RAY PHOTOGRAPHY.— Dr. A. Bruce MacLean has tested the use of safranin (pheno-safranin) as a desensitiser in developing X-ray negatives. A pair of films were inserted in a film-holder and exposed for each part radiographed. One film of the pair was developed by the usual routine, in a Kodak developing tank, the other was treated to an aqueous bath of safranin (1 in 5000), well rinsed and then inserted in the developing tank. Development by a weak white light (such as a single candle) may then be carried out with safety. It was found that, with correctly exposed negatives, any advantage gained by the method is so slight as to be negligible. With under-exposed negatives the method is not to be recommended. With over-exposed films better results are obtainable than by the usual method of development, as the dye acts as a powerful restrainer of development (*Archives of Radiology and Electrotherapy*, No. 280, November 1923, p. 184).

EARLY OPTICAL INSTRUMENTS.—The index part of volume 24 of the Transactions of the Optical Society contains two of the series of lectures intended to direct the attention of the Society to the early optical instruments in the Science Museum at South Kensington. The first, by Dr. L. C. Martin, deals with surveying and navigating instruments from the astrolabe and cross staff to the sextant and theodolite, and includes a valuable bibliography. The second, by Mr. D. Baxandall, is on early telescopes, and begins with the treatise on optics written about 1279 by the monk John Peckham of Oxford. It directs attention to the 12-inch "double convex perspective glass" of 15-foot focal length described by Bourne in his book on glasses written about 1585, and brings the history of the telescope down to the time of Herschel. By the co-operation of Col. Lyons, Director of the Science Museum, many of the instruments were exhibited at the lectures, and photographs of them are reproduced in the Transactions.

THE MICROSCOPIC STRUCTURE OF SOAP.—A paper on this subject by Kenneth Maclennan appears in *Chemistry and Industry* for October 5. The author found that the use of polarised light rendered magnifications of more than 100 diameters unnecessary. Fluid crystals and soap fibres were found to be very prominent in the specimens examined. The paper is illustrated by a series of microphotographs showing the structures of a variety of soaps. The bearing of the work described on manufacturing processes is considered.

INFLUENCE OF PROPELLER REVOLUTIONS UPON THE PROPULSIVE EFFICIENCY OF MERCHANT SHIPS.—A paper upon this complicated subject was read by Dr. Ing. Karl Schaffran before the North-East Coast Institution of Engineers and Shipbuilders on December 7. The author is superintendent of the Berlin ship experimental tank, and illustrates the research and design methods adopted in his department for estimating the power of a vessel from the results of ship models and model propeller experiments by reference to the high-speed passenger liner *Duilio*. A model of this ship was first of all run in the tank in the usual manner, without screws attached, and a second series of experiments was carried out under the same conditions and over the same speed range, but with a 4-bladed screw. The results of both sets are given in the paper, including a series of behind tests with a set of four 3-bladed screws. A discussion of these results substantiates the claim that the results of model experiments with screws attached, in addition to having an undeniable comparative value, can also make some claim to absolute value in the determination of the machinery horse-power and the propulsive efficiency of full-sized ships. The author proceeds to show how the results of systematic model experiments may be employed in the correct designing of the screws for a given case and the influence upon the propeller efficiency of a chosen number of revolutions. In order to use the results, a knowledge of the thrust deduction and wake fractions of the particular form of vessel under consideration is necessary; both of these factors are dealt with, and the results are used in the analysis which follows. A large number of diagrams is included, and the author illustrates their use by several numerical examples of practical design. In the appendices attached to the paper will be found descriptions of the model dynamometer used at the Berlin tank, as well as the propeller milling machine and the propeller dynamometer.

The Pan-Pacific Science Congress, Australia, 1923.

THE relationships of the Australian flora were the subject of several communications at the recent Pan-Pacific Congress. Dr. J. McLuckie said there was a strong Antarctic element in the Australian flora, the main centre of which to-day was Tasmania; these Antarctic elements ranged northwards throughout Victoria and New South Wales, chiefly along the western slopes of the main range, and their northerly limit was determined by the climate. Mr. L. Rodway (Tasmania) stated that there were more endemic species in the wet west of Tasmania than in the drier east; thus the western pines were vestiges of a former flora which elsewhere had been overwhelmed by migrations from Australia. All the Proteas had dry country characters although they grew in wet areas; one of the two species of beech was very like a Northern Hemisphere tree. Dr. Rogers (South Australia) pleaded for the recording of the distribution of orchids as this might throw light on former land connexions. Dr. E. D. Merrill (Manila) stated that representatives of several families of plants, for the most part confined to Australia, occurred in the Philippines, but were scarce in other parts of Malaysia. His conclusion was that Australian plants, as well as those of New Caledonia and New Guinea, reached the Philippines through remote geological connexions, but were inhibited by constant arms of the sea from travelling the shorter distance to Borneo and Java. According to Mr. R. H. Cambage (Sydney), the original acacias belonged to the tropics, and there seemed no doubt that the wattles had entered Australia from the north; some of them suited themselves to dry conditions by dispensing with small leaflets, and by developing their leaf stalks into flat blades, or phyllodes, which served as leaves; in all cases the first leaf of a seedling was pinnate. One species in the Blue Mountains could revert to leaves after it had developed phyllodes.

Information was given of the experiments made by the Queensland Government with the view of combating the growth of the prickly pear which has ruined enormous areas and is increasing at an alarming rate; numerous kinds of insects have been imported from various parts of America, and it is hoped that some of these, combined with destructive fungi, may prove effective. The Sections of Agriculture, Entomology, and Forestry combined in recommending that the distribution of plant diseases and insect pests should be limited as much as possible by plant quarantines, and that plant diseases, insect pest surveys, and epidemiological studies, which are prerequisite to intelligent action, be undertaken in all countries bordering on the Pacific. The Section of Botany recommended that botanical surveys be made of Macquarie Island and the Aleutian Islands to obtain records of distribution and migration of the Antarctic and Arctic floras, and that the survey of Krakatau Island be continued. It was also recommended that there should be more interchange of information and specimens in the Pacific area.

It is generally recognised that reafforesting has become a matter of urgency if the needs of the population in Australia fifty years hence are to be provided for, and resolutions were suggested by the Section on Forestry to the Commonwealth Government to establish and maintain an efficiently equipped Forest Products Laboratory and to reserve permanently for forestry all suitable timber-bearing areas in the Commonwealth. All Pan-Pacific countries were asked to give immediate attention to the planting of coniferous woods in regard to the approaching world's shortage. Further investigation was required on the drying and seasoning of various kinds of wood, on the treatment of timber to preserve it from attacks of rot and insects, on the utilisation of waste timber, and on the mechanical testing of all commercial woods. The conversion of waste timber into alcohol was regarded by Mr. I. H. Boas as of the most fundamental importance for Australia, as alcohol must become the fuel of the future, and it was the only known fuel which did not draw on the stored energy in the earth.

The topics discussed by the Section of Zoology comprised marine biological investigations in the Pacific, the geographical distribution of certain animal groups in the Pacific, the phylogeny of the marsupials, and the problem of introduced pests and their natural enemies. The entomologists suggested that the Federal Government should provide funds for a Federal Bureau of Entomology for research to combat the danger to Australian industries from insect pests, and also that provision should be made for the training of economic entomologists in the Australian universities. One meeting was devoted to the discussion of certain parasitological problems, such as hookworm and beef nodule; the latter, which is caused by the Nematode worm, Onchocerca (the carrier of which is still undiscovered), has been the cause of enormous losses to the cattle industry in Northern Australia. Dr. R. J. Tillyard (New Zealand) said that the first insect fauna was received by Australia from Gondwana-land, and that remnants of it still persist, though all are absent from New Zealand. The insect fauna of New Zealand had resemblances with that of Tasmania through unions with Antarctica, and with Queensland through the northward union with New Caledonia, Australia, and New Guinea; it thus belonged to the Australian region, but it lacks the latest immigrant groups from the north into Australia, as it lacks the earliest. Prof. J. Cossar Ewart (Edinburgh) said there was a veritable gold mine for Australia in a study of the principles of genetics as applied to sheep. He also aroused great interest by his account of his researches into the ancestry of domesticated breeds of sheep, and of his crosses between certain primitive breeds quite unknown in Australia. Prof. A. F. Barker (Leeds) referred to the experiments at Cambridge on breeding a double-purpose sheep (wool and mutton) on Mendelian lines, and further dealt with genetics applied to wool production.

Australian biologists took advantage of the Congress to emphasise a matter which is very dear to their hearts, namely, the adequate protection of their native fauna from the extermination which is threatening many of their most interesting species. The mongoose in New Zealand and the fox in Australia were introduced to prey upon rabbits, but they have done serious damage to native birds; for example, the spotted pigeon, scrub turkey, and even the emu are threatened with extinction in Queensland. Dr. M. Oshima (Formosa) declared that the preservation intact of the Australian fauna was an international affair as the nation was trustee to the world of a unique possession. Of late years public interest has been thoroughly aroused in this matter, and in addition to the legal protection of many species throughout a part or whole of the year, extensive National Parks have been set aside as animal sanctuaries in various States. Prof. Harrison (Sydney) stated that reservations were required upon various types of country so that suitable environment might be available for all kinds of animals.

In the Section of Anthropology, as in other Sections,

there were papers of more or less local interest, as well as others that dealt with general problems. Sir Edgeworth David (Sydney) produced evidence to show that certain stone implements were contemporary with the last glacial age of Tasmania, which was then united to Australia. Mr. A. S. Kenyon (Melbourne) gave a classification of Australian stone implements; some of those from the south resemble Tasmanian types, but there is no evidence that these are older than other types; no chronological sequence has yet been established. The material culture of the Maori was illustrated by lantern slides and cinematograph films by Dr. P. H. Buck, and Mr. H. D. Skinner discussed the affinities of the Moa hunters of New Zealand. The linguistic problems of Oceania were discussed on several occasions. Dr. van H. Labberton gave the preliminary results of a research into the original relationship between the Japanese and Polynesian languages, in which he demonstrated that in the earliest form of the Japanese language there were numerous close affiliations with the Austronesian family of languages which have been overlaid by a later Asiatic language. He also showed that comparisons between various recent Oceanic languages and those of Indonesia and of mainland Asia are apt to be misleading, since changes have taken place in course of time, and comparison is valid only between the oldest forms of the words.

Capt. G. H. Pitt Rivers read an elaborate paper on variations in sex ratios in relation to racial decline, the main result of which was to show that more exhaustive and precise information was required before the causes of the decline in native populations could be established, this being a very complex problem; he adduced evidence which suggested that a preponderance of males over females was an indication of a declining population. The decline in native populations in the Pacific was also discussed in conjunction with the Section of Hygiene.

A discussion took place on the organisation of research in anthropology and ethnology, at which were read suggestions made by distinguished British anthropologists. It was agreed that the most urgent preliminary step to take was the establishment in Australia of a chair of social anthropology, and the suggestion was made that the professor should teach anthropology (*a*) in co-ordination with geographical, historical, psychological, anatomical, and other departments of the university to which he may be attached; (*b*) as a training for Government officials, missionaries, and others; (*c*) as a training for investigators in the field; and should himself undertake and direct field research. A report was drawn up indicating the need for research in Oceania and Australia and the objects of that research. This was desirable since the attention of the anthropologists at the first meeting of the Congress in Honolulu was largely confined to Polynesia. The suggestion was made that the various main regions of Oceania should severally be more particularly investigated by certain countries, so as to avoid undue overlapping and permit of more intensive study.

The problems of the relations of the various cultures and peoples in Oceania and Australia were discussed on several occasions. The latest conclusions of Mr. W. J. Perry (London) were submitted by him and led to interesting debates by Prof. J. Macmillan Brown, Mr. H. D. Skinner (both of New Zealand), and others. The final meeting consisted of a joint discussion with the Section of Geography in which Prof. T. Griffith Taylor (Sydney) explained his views on "zoning" and the geographic principles governing early migration—corridors, shatter-belts, etc. Dr. Haddon gave a blackboard demonstration of his views concerning the early distribution and migrations of peoples, more particularly of the Indo-Pacific area, which differed fundamentally from that proposed by Dr. Griffith Taylor, though resembling it in some particulars.

Several papers were concerned with various aspects of hygiene, connected more especially with Australian and tropical conditions. There was a joint discussion of the Sections of Hygiene and Geography on tropical settlement, a subject which is engaging wide attention at the present time in view of the "White Australia" policy. If the tropical portions of Australia are to be settled solely by a white population, it is obvious that the settlers must adapt themselves and their mode of living to climatic conditions, and the respective State Governments should provide all the alleviations in their power, give instruction in hygiene, and supply a sufficient medical staff. A meeting in conjunction with the Sections of Entomology and Veterinary Science discussed the distribution of insects in relation to disease.

The subject that, not unnaturally, engaged the greatest attention was the hygiene of mining. Dr. W. Watkins-Pitchford (South Africa), from long and successful experience in the Transvaal, showed that silicosis (wrongly termed "miners' phthisis") could readily be almost eradicated if precautions were taken to prevent miners and others from inhaling minute particles of silica; these are conveyed into the areolar tissue of the lungs by means of wandering cells, and there give rise to fibrous tissue; this new tissue is eventually absorbed if the patient changes his occupation and escapes a tuberculous infection. As a disease, this simple silicosis might almost be ignored were it not that the patient becomes specially liable to tuberculosis. The arrangements for preventing the inhaling of silica dust and for the prevention of tuberculous infection are very imperfect in some Australian mines, and the inspection of the miners, clinically and by radiographs, is often inadequate. In certain mines, such as those at Broken Hill in N.S.W., the hygienic conditions are, however, fairly satisfactory. Apparently nowhere in Australia are radiographs taken periodically of all the miners, as they are in the Transvaal. Apart from the health of the miner and the risk of early death, the matter is of economic importance, as compensation has to be paid to those patients who have become seriously affected. Although no new method of prevention or treatment was presented, the Section of Hygiene as a whole, and individual members in their visits to various mines, performed a valuable service to Australian miners and mine managers.

The decline of population in the Pacific was discussed in conjunction with the Section of Anthropology, and the following resolution was passed: "That the scientific problem of the Pacific, which stands first in the order of urgency, is the preservation of the health and life of the native races by the application of the principles of the sciences of preventative medicine and anthropology."

A. C. HADDON.

In addition to the resolutions referred to above, and in the article which appeared in NATURE of October 27, p. 635, a number of further resolutions were discussed in the various sections.

A question which caused considerable discussion and on which there was wide difference of opinion was the proposal that in future the Pan-Pacific Congress should include all branches of physical and natural science, and that in particular chemistry, mining and metallurgy, and physics should be

included in the next meeting of the Congress. The inclusion of social science and economics was also suggested. Several members supported these proposals, and in particular favoured the inclusion of special sections for chemistry and physics. Others thought, however, that the introduction of new sections would merely mean the weakening of those already included, and they strongly urged the limitation of scope to subjects with direct bearing upon the natural history of Pacific regions. When these proposals were put to the meeting the voting for and against was practically equal. On the suggestion of the president (Sir David Masson), it was decided to recommend the governing body of the next Congress that it should give very serious consideration to the question of whether or not these further subjects should be included as specific sections.

Another matter of considerable interest was a proposal made by Dr. T. Wayland Vaughan (U.S.A. Geological Survey, Washington) that steps should be taken to create a permanent organisation for the Congress. This proposal was agreed to, and it was decided that the National Research Council (or similar institution) in each of the following countries, namely, Australia, Canada, Chile, France, Great Britain, Japan, the Netherlands, New Zealand, Philippine Islands, and the United States of America, should each be asked to appoint a member of an organisation committee to prepare a draft constitution for consideration at the next Congress.

On behalf of the Japanese Government and the National Research Council of Japan, Dr. J. Sakurai conveyed to the Congress an invitation to hold its next meeting at Tokyo in 1926. This invitation was gratefully accepted.

Agriculture.—On the proposal of Dr. T. H. Easterfield, Director, Cawthron Institute, Nelson, N.Z., the Congress approved the appointment of a special committee to collect information on all genetic research in progress in Pacific countries.

On the joint recommendation of the Agricultural, Entomological, and Forestry Sections, the Congress recommended that a survey of diseases of insect pests of sugar-cane and other natural means of control be undertaken in New Guinea by the Pacific countries interested in sugar-cane cultivation.

Botany.—It was resolved that a suggestion be made to the State Government of Victoria that it should reserve an area or areas of land on which the tallest Eucalypts now living have their stand.

Geodesy and Geophysics.—On the motion of Sir Gerald Lenox-Conyngham (University of Cambridge), resolutions were adopted by the Congress urging first the necessity for the preparation of maps of Australia on the International Scheme, and secondly the importance, on national, economic, and scientific grounds, of carrying out a geodetic survey of Australia. The Congress placed on record its appreciation both of the decision of the Commonwealth Government to proceed with the establishment of the Commonwealth Solar Physics Laboratory, and of the valuable work which has been carried out on the American non-magnetic survey yacht *Carnegie*.

Pacific Radiotelegraphy.—The Congress emphasised the importance of the speedy erection of wireless stations in all countries bordering the Pacific capable of communicating directly with each other. It recommended that arrangements be made for all wireless stations in the Pacific regions to keep daily records on an approved basis with regard to atmospherics, their effect on wireless communication, and their relation to meteorological conditions. It was suggested that Governments of the different countries concerned should establish a daily mean time signal.

Geography and Oceanography.—On the motion of Dr. N. Yamasaki, of the Imperial University, Tokyo, it was agreed to urge the increasing importance of accurate coastal surveys being carried out in accordance with the recommendations of the International Hydrographic Bureau, and that special attention should be given to the scientific and economic interest of the construction of detailed charts of the Great Barrier Reef of Australia. The Congress also invited attention to the need for an adequate wireless meteorological service in the more remote parts of the Pacific Ocean, and urged that the international exchange of meteorological information for the purposes of forecasting be extended to these regions.

It was also decided to recommend the Australian National Research Council to appoint a committee for the investigation of the temperature, salinity, currents, etc., of the Pacific Ocean.

Geology.—On the motion of Sir Edgeworth David, a number of resolutions were passed by the Congress arising out of the work of the Geology Section. It was recommended that geological maps of the Pacific countries on a scale of 1 : 1,000,000 be completed at as early a date as possible and that a committee consisting of representatives of the different countries concerned be appointed to expedite this work. In view of the many geological problems of the Commonwealth which called for investigation in areas transgressing the boundaries of the States, the Congress was of the opinion that a Federal Geological Survey Office should be established. It was pointed out, moreover, that the efficient administration of the Northern Territory can be effected only with geological assistance and that the work now being carried out in Papua, excellent though it is, requires considerable extension.

The Congress was impressed with the scientific and economic value of the results achieved in Papua by the Government Geologist, and it urged that these investigations should receive increased support. As regards the Fiji Islands, the Congress urged the desirability of a geological survey both on scientific grounds, particularly in throwing light on the origin of coral reefs and on earth movements in the Pacific regions, and also because it may procure valuable information of the mineral resources of the islands and cannot fail to be of great assistance in opening up the country for settlement.

In view of the importance of meteorological and seismological observations in the Pacific regions, the Congress urged that the staff and equipment of the Observatory at Samoa should be increased so that it may continue efficiently the good work already begun. The Congress strongly commended the proposal for the establishment of a seismological and volcanic observatory in the thermal region of New Zealand. It was urged that different agencies should co-operate in the study of coral reefs, and in this connexion it was suggested that, where practicable, aeroplane surveys should be made.

Veterinary Science.—The Congress recommended the creation of an International Bureau of Animal Health, to which all the countries represented at the Congress should forward a monthly notice of all outbreaks of contagious and infectious diseases of animals. The information thus obtained by the Bureau should be transmitted regularly to all the countries concerned. Another resolution was passed recommending that greater encouragement be given to the study of animal genetics so as to improve the breeds of productive animals in the various countries.

In conjunction with the Zoological Section a recommendation was approved that the Congress should express its appreciation of the work already done by the Commonwealth and State Governments of Australia in protecting the unique native fauna

of their territories. The Congress also decided to recommend that a veterinary survey of Papua and the Australian Mandated Territories should be carried out by the Commonwealth Government under the direction of a veterinary bacteriologist experienced in the tropical diseases of animals.

Zoology.—The Congress adopted resolutions recommending that the investigation and survey of terrestrial and marine fauna and flora of Pacific countries should be carried out. Attention was directed to the fact that many valuable species of marine mammals such as fur seals, sea otters, whales, elephant seals, and dugongs once occurred in various portions of the Pacific, but owing to extremely unwise and wasteful methods of prosecuting these industries, most of these animal resources have been reduced nearly to commercial extinction. There is a strong belief in the possibility of securing the restoration and perpetuation of many of these useful animals. The Congress recommended that the Pacific nations concerned should make a thorough scientific investigation into the present condition, and should obtain such governmental measures as are necessary for the protection and restoration of the depleted herds and species. The Congress also urged the necessity for the establishment of marine biological stations in such parts of the Pacific coasts as do not already possess them.

As regards the resolutions submitted by the different sections, it was decided that approval of any of these resolutions by the whole Congress should mean approval only of the principle implied, and that the precise wording and the action to be taken in regard to the resolutions should be left to the executive committee of the Australian National Research Council.

The French Physical Society's Exhibition.

INTENDED to commemorate the fiftieth anniversary of the Société Française de Physique, the "Exposition de Physique et de T.S.F." was held in the Grand Palais, Paris, on November 30–December 24. The title chosen for the Exhibition was perhaps a little too modest, a large part of the Exhibition being, in fact, devoted to industries, in the development of which applied physics has played an important rôle. In addition to the purely commercial exhibits, a well-organised experimental physics section enabled the visitor to become acquainted with some of the problems to which research is now directed. Every afternoon demonstrations were given by eminent physicists and a number of college graduates. Amongst a very large number of exhibits, spread over the entire floor and galleries of the Grand Palais, the following may be mentioned:

Historical Section.—An interesting collection of apparatus from various museums, including Fresnel mirror (1788–1827), Jamin circle (1818–1886), Van Marum's friction machine (1797), Ampère's table (1822), Masson's induction coil (1842), Branly's coherer (1890), Turpain's resonator for Morse reception of wireless signals (1894) and recorder (1911), Ferrié's electrolytic detector (1900), Lee de Forest's triodes (1907), Bellini's radiogoniometer (1909).

Experimental Physics Section.—Apparatus for counting α-particles (Laboratoire Curie), Observation of Brownian movement in smoke (de Broglie), "Cellular tourbillons" (Bénard), piezo-electric apparatus for measuring the energy in sound waves in absolute units (Langevin et Ishimoto), apparatus for measuring speed of combustion of explosive powders (de Watteville), electrical deposition of dust, smoke, etc. (Société de Purification Industrielle des Gaz), apparatus showing dilatation and contraction of gelatinous substances due to the passage of an electric current and, inversely, the production of a current by mechanical deformation of the substance (Michaud), electrometer for measuring high potentials utilising the displacement of a liquid dielectric (Michaud), auto-excitation of a 3-phase squirrel-cage motor by the use of condensers (Soulier), remarkable insulating properties of "acroleine" (Moureu), high-power amplifying relay for continuous and low-frequency alternating currents, using stator and rotor windings of a high-speed dynamo (Monnier), differential manometric method for the dosage of carbon dioxide in flue gases (Picard and Laurent), cathode-ray oscillograph (Dufour), molecular vacuum pump (Holweck), dismountable triodes (Holweck), chronometric motor driven mechanically by electrically-maintained tuning fork (Lepaute).

The exhibits of the Bureau International des Poids et Mesures and the Conservatoire des Arts et Métiers were somewhat disappointing. The former showed a number of standards, including a set of étalons for the absolute measurement of wave-lengths, the latter a small collection of testing appliances. Other state and private testing and research laboratories represented were: Section technique de l'Artillerie (a large and interesting display of instruments), Radiotélégraphie Militaire (wireless installations in tanks, etc.), Service Géographique de l'Armée (examples of map production, geodetic station, surveying instruments), Service de Santé (manufacture of clinical thermometers for army use), Ministère de la Marine (aerial photography for coastal surveys, navigational and signalling instruments), Postes et Télégraphes (Baudot apparatus, automatic wireless, etc.), Observatoire d'Astronomie Physique de Meudon (astronomical photographs), Office National des Inventions (high-frequency furnace, production of photographic portraits in relief, stereoscopic projection apparatus), Laboratoire Central d'Électricité (Blondel-pattern spherical lumen-meter, absolute electro-dynamometer, standard mercury ohm, cadmium cells), Office Central de Chauffe Rationnelle (examples of heat balances, statistics and information relating to heat-economy courses for engineers, works' foremen, etc.), Société Française de Photographie (various testing equipment), Société de Recherches et Perfectionnements Industriels (automatic weighing machines).

Telegraphy and Telephony.—As might be expected, the domestic wireless industry was strongly represented, and a very large choice of excellent receiving sets proved that a host of French manufacturers and amateurs are taking full advantage of their freedom from government restrictions. The Cie. "Radio-France" showed models of the high-power transcontinental stations at Sainte-Assise and Villecresnes. Other interesting exhibits were:—Établissement Éd. Belin: telegraphic transmission of photos, drawings, manuscripts, etc., a public service for which is being given a trial in France from January 1; "L'Infra-rouge" (Procédés Charbonneau): infra-red transmitters and receivers for secret signalling, landing of aircraft in fogs, etc.; Société de Condensation et d'Application Mécaniques: location of submarine objects by "ultra-sound" waves (Langevin-Chilowsky system); Cie. Générale d'Entreprises Électriques: portion (full size) of 150,000-volt transmission system (as installed in connexion with the electrification of the Midi railway and in other parts of France)—the line insulators were supported by girder masts 72 feet high and the lines connected to a battery of distance-operated oil-tank switches, each capable of dealing

normally with 750,000 K.V.A.; Société Alsacienne de Constructions Mécaniques: high-frequency alternators for wireless transmission (32,400 periods/second, 6000 R.P.M.); Ateliers Carpentier: measuring instruments; Szilard: extra-sensitive electrometers for radio-activity and ultra-violet measurements; Étab. Gaiffe-Gallot and Pilon: Dauvillier's absolute dosimeter for X-ray therapy, etc.

Optics.—Jobin and Yvon: flint, quartz, and fluor-spar spectrographs, Fabry-Buisson microphotometer, Yvon spectrophotometer; Beaudouin: Féry spectrographs; Prin: automatically-controlled meridian instrument with 190 mm. telescope and circles 1 metre diameter; Optique et Précision de Levallois: stereoscopic range-finder for anti-aircraft use, range-finders for survey and military purposes, speed recorder for aircraft, photo "machine-gun"; Société d'Optique et de Mécanique: range-finders, surveying instruments, seismograph; interesting exhibits of different light-sources, optics and automatic appliances for lighthouses, searchlights, etc., were shown by the Service des Phares and by the manufacturers Barbier, Bénard, and Turenne, Sautter-Harlé, and the Cie. Générale d'Acétylène.

Photography and Cinematography.—In the section devoted to photography and cinematography, Messrs. Pathé-Cinéma, the Établissements Gaumont, and others, exhibited their latest models of cameras and projectors. Other exhibits were: apparatus for 3-colour cinematography and for vocal synchronisation, micro-photographs in colours of sections of wood for musical instruments, showing degree of ageing.

Metallurgy.—A fully-equipped metallurgical laboratory formed an interesting collective exhibit. Among the exhibitors were: S.A. de Commentry-Fourhambault: invar, elinvar, and other special alloys and their applications, Chevenard's recording dilatometer for the rapid determination of critical points. An instructive set of experiments illustrating the anomalous properties of certain alloys included a "thermo-elastic oscillator," showing the effect of temperature in increasing the elasticity of the alloy "modulvar," a "thermo-magnetic wheel" made of the alloy "N.M.H.G." which becomes a magnetic at 30° C.; Jacob Holtzer: special magnetic steels; Aciéries et Forges de Firminy: electrolytic iron. Progress in electro-metallurgy and in the electro-chemical industries was illustrated by an historical display of furnaces and products by the Comité Électro-Métallurgique de France and other firms. Resistance and arc furnaces of industrial dimensions were shown in operation. Samples of electrically-welded apparatus in steel, aluminium, and other metals were also exhibited.

Glass and Ceramic Industries.—These industries were well represented. Parra Mantois and the Manufacture de St.-Gobain showed a large assortment of optical glass in various forms. Demonstrations of heat-resisting domestic glassware attracted large crowds. The firm of "Quartz et Silice" exhibited chemical apparatus, insulators, lamps, etc., in fused silica.

The Exhibition, which was visited by the President of the Republic and by many high officials, was a great success, and its educational value was appreciated by a large section of the general public. The authorities are to be congratulated on the artistic decorative effects, and especially on the pleasing uniformity of the name-signs. With a very few exceptions, the exhibits were of French manufacture, and one was struck by the vast progress made in recent years in the manufacture of many commodities which were previously imported from Great Britain and other countries. It would be interesting to know to what extent this industrial development has been assisted by the depreciation of the franc.

University and Educational Intelligence.

BRISTOL.—Dr. J. A. Hanley has been appointed as Agricultural Information Officer. Dr. Hanley has been a member of the staff of the University of Leeds since 1915, and is lecturer in agricultural chemistry and advisory chemist in that University.

A Joint Extension Board for the University of Bristol and the University Colleges of Southampton and Exeter has recently been set up which will undertake the arrangement of Extension Lectures over the whole of the south-western counties. The first representatives of the University on the Board are the Vice-Chancellor and the Director of Extra-Mural Studies (Mr. Hubert Phillips).

CAMBRIDGE.—Dr. C. E. Tilley, Emmanuel College, has been appointed demonstrator in petrology. The John Bernard Seely prize has been awarded to A. E. W. Nutt, Gonville and Caius College, for an essay on "Aviation and Commerce."

EDINBURGH.—At the request of the London and North-Eastern Railway, the University has resolved to institute courses of lectures, for the managing and clerical staff of railways, in law, geography, and economics, with special reference to railway requirements, and in railway operating. A course of lectures will be delivered in each of four successive years. The first course of twenty lectures on railway law will begin on January 7.

LONDON.—Prof. G. B. Jeffery, at present professor of mathematics at King's College, has been appointed to the Astor chair of mathematics tenable at University College.

Miss Eleanor M. Scarborough has been appointed to the recently instituted readership in pharmacology tenable at the London School of Medicine for Women. Miss Scarborough was appointed demonstrator in pharmacology at the London School of Medicine for Women in 1919, and since 1921 has been assistant lecturer in that subject at the School.

The degree of D.Lit. has been conferred on Mr. Morris Ginsberg (University College) for a thesis entitled "The Psychology of Society."

Prof. Hugh MacLean has been awarded the William Julius Mickle fellowship (of the value of 200*l.*) for 1924 in respect of the work which he has carried out during the past five years in experimental medicine. This fellowship is awarded annually by the Senate, under the terms of the Mickle bequest, to the man or woman who, being resident in London and a graduate of the University, has done most to advance medical art or science within the preceding five years and has therein shown conspicuous merit.

Mr. Harold Claughton has been appointed Financial Officer and Secretary to the Senate as from January 1, 1924. He was educated at Radley and at Trinity College, Oxford, graduating with honours in modern history.

DR. J. N. GREENWOOD, of Stocksbridge, near Sheffield, has been appointed to the chair of metallurgy in the University of Melbourne.

THE *Times* of December 28 reports that a fire on December 26 at the Imperial University at Fukuoka, South-Western Japan, destroyed the entire building and the Engineering College. The damage is estimated at 500,000*l.*

Societies and Academies.

LONDON.

British Mycological Society, November 17.—Mr. F. T. Brooks, vice-president, in the chair.—A. A. **Pearson**: An account of the fungus foray of the Société Mycologique de France.—W. J. **Dowson**: A mould causing a disease of sweet-pea. The mould causes a white mealy growth, in some cases covering both sides of the leaf. No damage apparently is caused under ordinary climatic conditions, but in warm moist temperatures there is considerable effect: spots develop in ten days after infection, and produce spores in about a week. The fungus simulates a white form of *Hormodendrum cladosporioides*.—J. Jackson **Clarke**: Some mycological chromidia. A comparison of nuclear phenomena observed in Synchytrium and its allies with those of *Molluscum contagium* and other human diseases.—R. **Paulson**: Field observations on mycorrhiza. Fungus-roots occur most frequently at a depth of one to three inches below the surface of masses of decaying leaves or under moss. In the birch, most of the roots become infected within the first few weeks. The seed while still on the tree frequently has fungal hyphæ between the persistent styles. These are carried down by hook-shaped processes on the hypocotyl. What part is played by this fungus (Sporotrichum) in mycorrhiza formation is as yet uncertain.—E. C. **Stakman**: The rust problem in America. An extempore account of the damage caused to cereals by rust, and the methods being used to overcome the disease.—A. S. **Horne** and G. N. **Jones**: A new species of Eidamia. The species differs from *E. acremonioides* morphologically in its tuberculate macrospores and physiologically in its ability to hydrolyse starch, invert sugar, etc. The authors prove the identity of *Monopodium uredopsis* and *E. acremonioides*.—R. **Bracher**: Notes on *Rhytisma acerinum* and *R. Pseudoplatani*. Infection takes place from an ascospore germ tube penetrating a stoma on the lower surface. The mycelium ramifies in the palisade layer, but finally concentrates in the upper epidermal cells, subsequent development occurring in these cells and killing them, the walls being ruptured and pushed apart. Black sclerotium formation is first apparent in the thickened outer walls of the upper epidermal cells, and is later increased by the formation of an inferior plectenchymatous layer. Splitting of the apothecia is accompanied by the development of a special mechanism whereby the sclerotium is broken down by hyphal secretion in the region of the split.

Optical Society, December 13.—T. **Smith**: The primary and secondary constant magnification surfaces of thin lenses. From theoretical considerations, the surfaces of constant magnification on which the primary and secondary focal lines for a thin lens are situated form families of similar surfaces, and lie between easily constructed surfaces (spheres for the secondary surfaces) determined by the power of the lens together with the Petzval sum for the one limit and the sum of the lens curvatures for the other.—W. **Swaine**: A suggested standard trial case and simplification in ophthalmic policy. Plano-form trial lenses were suggested in a previous paper to supersede the existing symmetrical form. A standard trial case is described with specified thicknesses, diameters, tolerances, etc., which would introduce minimum confusion—actually none—in practice, would materially help both refractionist and manufacturer, and would remove the uncertainty between them.—B. K. **Johnson**: Optical revolution counter. The instrument, which can be used without being in actual contact with the object the speed of rotation of which is being measured, contains a reversing prism which when rotated through 180° rotates the image of the object through 360° in the same direction. If a rotating object be viewed through the prism when the latter is also revolving, the object appears stationary when the prism is rotating at half the speed of the object. When two such prisms are mounted on the same axis and made to rotate in opposite directions, the prisms need only rotate at one quarter of the speed of the object to make it appear stationary.

Linnean Society, December 13.—Dr. A. B. Rendle, president, in the chair.—R. D'O. **Good**: The germination of *Hippuris vulgaris*, Linn. Seedlings were raised from fruits taken from the gizzards of wild duck shot in Scotland. The lengthening of the hypocotyl pushes the hard plug out of the foramen of the endocarp. The hypocotyl then turns towards the mud, and produces a ring of root hairs near its tip. Beyond these hairs the radicle is developed and grows straight down into the mud. Meanwhile the hypocotyl has become erect. The ring of root hairs seems to provide a stable base from which the straightening of the hypocotyl can take place. Passage through the alimentary canal of a bird does not appear to be a necessary preliminary to germination.—H. G. **Jackson**: A new terrestrial Isopod from Zululand.—C. C. A. **Monro**: A new Polychæte worm, *Mercierella enigmatica* Fauvel. The worm is a brackish water Serpulid from the London Docks. Specimens have also been obtained by Prof. Fauvel from the brackish water of a canal near Caen. Their habit of growing upon floating timber makes it probable that they were imported into Great Britain on the hulls of ships. They now appear to be spreading on both sides of the English Channel.—S. **Hirst**: Arachnida from the Rhynie Chert. Among these arachnid remains is one species of mites (Acari), one species doubtfully referred to the spiders (Araneæ), and five species belonging to two genera of Anthracomarti. Of the Anthracomarti, which are ancestral to the Pedipalpi (whip-scorpions and their allies), and the Opiliones (harvest-spiders), several genera and species have been described from British Coal-Measures. Their Devonian representatives are much smaller and are distinguished by two small caudal segments, clearly the degenerate remains of a once larger tail. Mites were previously unknown before Tertiary times. The occurrence of Anthracomarti suggests that the evolution of Arachnida from the primitive Arthropod stock may have begun in Silurian times.—F. A. **Bather**: Binary and binominal nomenclature.

Physical Society, December 14.—Dr. Alexander Russell in the chair.—L. F. **Richardson**: The aerodynamic resistance of spheres shot upward to measure the wind. The resistance of the air to accurate steel spheres has been measured by two new methods: (1) by observing the tilt from the vertical at which the sphere must be projected in order that a measured wind-distribution may bring it back to the gun; and (2) by comparing the muzzle velocity with the time of flight of the sphere.—E. A. **Owen** and G. D. **Preston**: The X-ray analysis of zinc-copper alloys. The zinc-copper system crystallises on a rhombohedral hexagonal lattice from copper to γ brass, and on a close-packed hexagonal system from ϵ (or possibly δ) brass to zinc. The observed parameter of the lattice of ϵ brass suggests that the copper atom causes the zinc atom to rotate about an axis perpendicular to a 1120 plane, until the zinc atoms in successive 0001 planes are separated by a distance equal to the side

of the lattice of pure zinc. Fusion would then take place at about the same temperature in both cases. The hardness of the brasses attains a maximum in the region of γ brass, where the atomic volume curve shows the greatest departure from the straight line joining the atomic volumes of copper and zinc. The hardness of the α phase is ascribed to local distortion and that of the β phase to the difference in type of lattice. The relatively very great hardness of γ brass is due to small atomic volume and loss of symmetry. The fact that the atomic volume curve consists of two straight lines suggests the existence of an allotrope of zinc with an atomic volume of 13·92 A^3. The β phase may be due to an allotropic modification of copper, with an atomic volume of 12·79 A^3.—K. R. **Brain**: Investigations of piezo-electric effects with dielectrics. The dielectrics examined were ebonite, glass, hornoid, sealing-wax, rubber, celluloid, and hard paraffin. With sensitive specimens the magnitude of the charge is of the same order as that found by Curie with crystals. Fatigue and hysteresis effects were established. Experiments on cubes showed a dissymmetry in results, suggesting an irregularity of structure. The general similarity of the behaviour of these dielectrics to that of crystals suggests that they possess a quasi-crystalline character, and the effects are explained on this assumption, which has been verified by X-ray photographs.

The Faraday Society, December 17.—Sir R. Robertson, president, in the chair.—W. H. **Vernon**: First Report to the Atmospheric Corrosion Research Committee of the British Non-Ferrous Metals Research Association. In the main, tarnishing as distinct from corrosion in the ordinary sense is dealt with. Specimens have been exposed to representative atmospheres, including open-air conditions (at South Kensington), together with several "indoor" types. Apart from visual (and microscopical) examination, the study of tarnish films has been conducted in two principal ways: (1) by measuring the loss in reflectivity of the metal surface; (2) by measurement of the increase in weight of the specimen. The former method gives quantitative expression to the relative behaviour of materials in the very early stages. Weight-increment and period of exposure give three types of curve, each corresponding with a definite function of the corrosion product: (1) a parabola about the time-axis (*e.g.* copper, within a wide range of humidity conditions); (2) a straight line (*e.g.* zinc, in an unsaturated atmosphere); (3) a parabola about the weight-axis (*e.g.* iron, in an atmosphere of relatively high humidity, intermittently reaching saturation). Thus, the rate of attack is, respectively, (1) retarded, (2) maintained constant, (3) accelerated, as the period of exposure increases. The tarnishing of copper in an ordinary (polluted) atmosphere appears to be due directly to the presence of gaseous sulphur compounds, the presence of solid or liquid particles having relatively little influence; with zinc, or iron, however, the converse obtains. With copper, the rate of tarnishing appears to be retarded slightly as saturation is approached; with zinc and iron it is accelerated considerably. The tarnishing of brightly-polished silver, under certain conditions (*e.g.* the atmosphere of a domestic kitchen), appears to be largely inhibited by alloying with copper (as in sterling silver); this effect is not observed upon emeried surfaces. The characteristic "filming" or "fogging" of nickel surfaces occurs when the temperature falls within the vicinity of, but still appreciably above, the dew-point; when once formed, the film is extremely persistent. At temperatures sufficiently far removed from the dew-point to prevent "fogging" with nickel-copper alloys, ordinary tarnishing occurs approximately in proportion to the copper content.

Aristotelian Society, December 17.—Prof. T. P. Nunn, president, in the chair.—R. G. **Collingwood**: Sensation and thought. Sensation and thought are not two distinct cognitive activities each with a scientific object of its own—whether separable or inseparable—but correlative aspects of a single activity with a single object. This object cannot, either really or ideally, be divided into a *sensum* and an *intellectum*. The sense datum and the universal taken as real are philosophical errors. The activities of sensating and thinking, regarded as two modes of cognition by which we apprehend two kinds of objects, are as non-existent as the objects themselves. Of all knowledge we can say two things: that it is immediate and that it is mediate. There is a sense in which all knowledge is just a subject's immediate and intuitive apprehension of an object; but knowledge is never only this—it is always also mediated by reflection and reasoning. Philosophies of abstract change omit the immediacy; philosophies of static contemplation omit the mediation. The *what* and the *that* of knowledge are, both in reality and in thought, inseparable but distinct: opposites, like the convex and the concave of the curve, of which each determines the other and is determined by it.

Royal Statistical Society, December 18.—Harald **Faber**: Agricultural production in Denmark, 1909-13 and 1922. The comparison between British and German agriculture during the five years preceding the war, made by Sir T. H. Middleton and published by the Board of Agriculture in 1916, is extended to Danish agriculture. While the British farmer fed 45 to 50 persons on 100 acres, and the German farmer 70 to 75 persons, the Danish farmer fed 45 to 52. The reason for the low Danish figure was the large extent of animal produce, of which a large proportion is exported. Over 88 per cent. of Denmark's total exports, by value, were agricultural produce, and nearly 40 per cent. was exported. Converted into calories, the total agricultural production of Denmark yielded enough for the requirements of her own population, and of an additional population corresponding to 40 to 60 per cent. of her population. But this production consisted so largely of animal produce that by itself it would be unsuitable for human consumption. When corn, potatoes, milk, etc., are fed to live stock in order to produce food for man, there is a very large reduction in the number of calories, and the same applies to dairy produce. The number of persons fed per 100 acres is no measure of agricultural efficiency. Danish agriculture can, in times of enforced isolation, easily curtail the animal production and thereby produce food enough for a considerably greater number of persons. Denmark imported a quantity of corn and feeding stuffs corresponding to a little more than one-fifth of her own harvest. About 15 per cent. of the food of Danish cattle and about 27 per cent. of the food of pigs and poultry consisted of imported foodstuffs.

Royal Meteorological Society, December 19.—Dr. C. Chree, president, in the chair.—W. H. **Pick** and S. P. **Peters**: A note on the vertical visibility (estimated looking downwards) at Cranwell, Lincolnshire, during the period February 1922 to June 1923. The vertical visibilities as estimated by aeroplane pilots looking downwards from a height of 2000 feet are compared with other meteorological factors prevailing at the time. For at least seven of the fifteen types of Gold's classification, the vertical

visibility bears a definite relationship to the pressure type. The most outstanding feature resulting from an investigation of the distribution of vertical visibility with regard to wind direction is the predominance of " excellent or good " vertical visibility with surface winds blowing from between east by north and east-south-east. Surface wind velocity appears to be unrelated to the degree of vertical visibility. At 2000 feet the greater the wind velocity, the poorer the visibility. In general the vertical visibility appears to decrease progressively with increasing low cloud amount, and the presence of surface convection currents is accompanied by good vertical visibility. The relationship between vertical and ground horizontal visibility is slight.—H. **Jeffreys**: The cause of cyclones. The fixed cyclone of continental dimensions that produces the monsoons can be explained as a steady motion under the influence of a variation of temperature over horizontal surfaces. Instability convection may explain thunderstorms. A millpond eddy theory may explain tropical cyclones. Waves in the polar front are likely to have a wavelength comparable with that shown in cirro-cumulus clouds, but not that of cyclones. The mixing of air from the two sides of the polar front, however, must produce air with a tendency to rise, and it is possible that such air may provide the mechanism of the cyclones of temperate regions.—A. W. **Lee**: The relation of the circulation in the upper air to a circumpolar vortex. The circulation of the upper air in the region between 30° N. and 70° N., as determined from the isobars at 4, 6, and 8 km., is approximately the motion of a series of V/r vortices. It appears that each layer is an aerosphere which rotates around the polar axis as a solid, but on ascent there is relative motion between consecutive aerospheres; the velocity of the aerospheres in different latitudes is shown by a series of curves. The circulations which must be superimposed upon solid rotation at 4 km. in July in order to give the observed distribution of pressure are obtained.

PARIS.

Academy of Sciences, December 3.—M. Albin Haller in the chair.—Paul **Appell**: Definite integrals connected with the constant C of Euler.—Louis **Gentil**: Overlapping strata of north-west Africa.—A. **Blondel**: The use of flywheels in electric generators and the dangers of resonance of the shafts of the internal combustion motors which drive them.—C. **Guichard**: Some properties of the traces of the asymptotic tangents to a surface in a fixed plane.—C. **Camichel** and L. **Escande**: Similitude. A study of various cases of similitude in hydraulics. Similitude, as expressed by Froude's law, was verified in the cases examined.—J. B. **Senderens**: The catalytic dehydration of the aromatic alcohols. A description of the hydrocarbons produced by the catalytic action of sulphuric acid ($H_2SO_4 + 3H_2O$) upon cyclohexanol and the three cyclohexanediols.—Léon **Pomey**: The last theorem of Fermat.—Nikola **Obrechkoff**: The development in series of a system of analytical functions.—Miécislas **Biernacki**: A new algebraical theorem.—Mlle. Nina **Bary**: The unicity of trigonometrical development.—David **Wolkowitsch**: The infinitely small movements at a point of an elastic body in space.—R. **Risser**: The oscillations in the neighbourhood of the place of immersion of a solid in the case of waves by immersion in an indefinite medium.—M. **Delanghe**: A graphical method for the adaptation of helices to aeroplanes.—F. **Baldet**: Comparison of the various radiations emitted by the nuclei of comets, and of still unknown origin, with the spectrum of the Mecker burner. The wave lengths of the lines in the spectrum of comets are tabulated side by side with those observed in the spectrum of the Mecker burner, and the close analogy between the two is pointed out.—E. M. **Lémeray**: The sidereal universe and the theory of relativity.—E. **Brylinski**: The precision of Michelson's experiment. It is shown that in this experiment the displacement of the fringes may vary with the geographical position of the observer, and with the date and time of the experiment.—Edmond **Bauer**, Pierre **Auger**, and Francis **Perrin**: The theory of the diffusion of X-rays. An alternative proof of the results of Compton.—H. **Chipart**: The theories of natural rotatory polarisation.—Mlle. St. **Maracineanu**: Researches on the penetration of radioactive substances in metals. An account of experiments on polonium and actinium supported on thin sheets of gold, lead, and glass. Variations in the constant for polonium might be attributed to phenomena of penetration of the metal: when discs of glass were used, no penetration was observed for polonium nor for actinium. Hence for the determinations of the constants of radioactive deposits, glass is preferable to metal.—M. **Chavastelon**: The diffusion of the vapour of sulphur in air at the ordinary temperature.—A. **Vila**: The estimation of small quantities of molybdenum. The application of ammonium phosphomolybdate for the indirect titration of phosphorus. The ammonium phosphomolybdate is reduced by hydrogen at 700° C., dissolved in a solution of molybdic acid in phosphoric acid, and the blue solution titrated with N/400 potassium permanganate until colourless. Quantities of the order 0·01 milligram of phosphorus can be determined.—A. **Gascard** and G. **Damoy**: The acids of beeswax. Four acids have been isolated, neocerotic ($C_{25}H_{50}O_2$), cerotic ($C_{27}H_{54}O_2$), montaric ($C_{29}H_{58}O_2$), and melissic ($C_{31}H_{62}O_2$). The existence of these four acids with odd numbers of carbon atoms is in contradiction with the general view as regards the number of carbon atoms in the natural fatty acids.—Marcel **Godchot**: Some syntheses of dibasic acids of ether-oxide function. An account of the preparation of $\alpha\alpha'$-diphenyldiglycollic acid, $C_6H_5 . CH(CO_2H) . O . CH(CO_2H) . C_6H_5$, α-methyl-α'-phenyldiglycollic acid, and α-phenyldiglycollic acid.—C. **Gaudefroy**: The variations in the dispersion of double refraction in the same crystal.—M. E. **Denaeyer**: The rocks of Aïr (Central Sahara).—P. **Lasareff**: The anomalies of terrestrial magnetism and of gravity in the province of Koursk (Russia). A study of the magnetic anomalies has led to the conclusion that immense deposits of magnetic oxide of iron ore must be present in this district. The magnetite deposit thus indicated has been found at a depth of about 150 metres: the outcrop is impure and contains only 40 per cent. of iron, but the purity increases with the depth.—René **Souèges**: The embryogeny of the Salicaceæ. The development of the embryo in *Salix triandra*.—L. **Ravaz** and G. **Verge**: The reddening of the vine. This disease can be caused by excess of stagnant water in the soil, and can be remedied by drainage and aeration.—Marcel **Baudouin**: A new method of prehistoric trepanning with circular or oval openings, cut with flint. A description of a method of making openings in the skull by means of flint with two cutting edges, used like a compass.—H. **Cardot**: The influence of the cooking of food on the development of *Agriolimax agrestis*. Both in the young and adult slug, at first the cooked food is more favourable, but the formation of the eggs in the adult and of the tissues in the young are hindered by the absence in the cooked food of a factor indispensable to growth.—Jacques **Benoit**: The histological structure of an organ of testicular nature developed spontaneously in

an ovariotomised hen.—Edouard **Chatton**: Parasitic peridinians of the Radiolaria.—L. **Panisset** and J. **Verge**: Bird diphtheria and contagious epithelioma.

SYDNEY.

Linnean Society of New South Wales, October 31.—Mr. A. F. Basset Hull, president, in the chair.—P. **Esben-Petersen**: (1) Australian Neuroptera. Pt. iv. Four genera and eight species of Myrmeleonidæ are described as new, and observations made on a number of described species; a list is also given of the species which have been described from Australia. (2) Australian Neuroptera. Pt. v. Observations are made on fourteen species of Mantispïdæ and a list of the described Australian species.—A. **Théry**: Note on the genus Synechocera, with description of a new species. Only two species of the genus are known—one from Amboina, described in 1801, and the other from Swan River. A third species is here described from Tasmania, larger than *S. elongata* and of different habitat.—John **Mitchell**: The Strophomenidæ from the fossiliferous beds of Bowning, N.S.W. Fifteen species of Stropheodonta from the Bowning Beds (Silurian) are described as new.—R. J. **Tillyard**: Mesozoic insects of Queensland. No. 10. Summary of Upper Triassic insect fauna of Ipswich, Q. A summary and analysis of the insect fauna of the Ipswich Series, containing, as far as at present described, 122 species belonging to 63 genera. The composition of this fauna indicates that "the age of the Beds was not earlier than the lowest division of the Upper Triassic, and not later than the top of the Upper Triassic; it was most probably a little older than Rhaetic." In an appendix, one genus and one species of Neuroptera and two species of Hemiptera are described as new.—A. A. **Lawson**: The life-history of Pherosphæra. This investigation of the life-history of Pherosphæra affords the first knowledge we have of the gametophytes and embryo of this very rare and interesting Australian genus of Conifers. The structures of the male and female gametophytes and the embryo show no features that justify us in classing Pherosphæra among the Podocarpineæ.

Official Publications Received.

Astrographic Catalogue 1900·0. Sydney Section Dec. −51° to −65°. From Photographs taken at the Sydney Observatory, New South Wales, Australia. Vol. 3: R.A. 12h to 18h, Dec. −51° to −53°. Plate Centres Dec. −52°. Pp. vi+83. Vol. 4: R.A. 18h to 24h, Dec. −51° to −53°. Plate Centres Dec. −52°. Pp. 37. (Sydney: Alfred J. Kent.)

Total Eclipse of the Sun, 1922 September 21, Sydney Observatory. Pp. 13. (Sydney: Alfred J. Kent.)

The Physical Society of London. Proceedings, Vol. 36, Part 1, December 15. Pp. 66. (London: The Fleetway Press, Ltd.) 6s. net.

The University of Colorado Studies. Vol. 13, No. 1. Pp. ii+65. (Boulder, Colo.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1922. Pp. iv+46. (Trinidad.) 6d.

Ministry of Public Works: Physical Department. The Rains of the Nile Basin and the Nile Flood of 1913. By Dr. H. E. Hurst. (Physical Department Paper No. 12.) Pp. iv+98+8 plates. (Cairo: Government Publications Office.) P.T. 10.

Transactions of the Royal Society of Edinburgh. Vol. 53, Part 2, No. 22: Geology of the Outer Hebrides. Part 1: The Barra Isles. By Prof. T. J. Jehu and R. M. Craig. Pp. 419-441+4 plates. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 4s. 6d.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1922. Pp. iii+60. (London: H.M. Stationery Office.) 1s. 6d. net.

Diary of Societies.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Concerning the Nature of Things: The Nature of Crystals—Ice and Snow (Juvenile Lectures (5)).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Sir David Prain: Gilbert White and Moral History.

MONDAY, JANUARY 7.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Dr. M. G. Kyle: The Problem of the Pentateuch from the Standpoint of the Archæologist.

MATHEMATICAL ASSOCIATION (at London Day Training College), at 5.30.—Prof. H. H. Turner: Earthquakes.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at University College), at 5.30.—Dr. J. Glover: Recent Advances in the Relations of Psycho-Analysis to Education.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 6.—J. W. Beauchamp and others: Discussion on Troubles experienced with Domestic Electrical Appliances.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Dr. E. Fyleman: The Estimation of Butyric Acid in Presence of Acetic Acid.—C. E. Barrs: The Estimation of Cadmium in Spelter and Zinc Ores.

INSTITUTION OF RUBBER INDUSTRY (London Section) (at Engineers' Club), at 8.—Dr. S. S. Pickles: Consistency of Rubber and Rubber Compounds.

TUESDAY, JANUARY 8.

MATHEMATICAL ASSOCIATION (at London Day Training College), at 10 A.M.—W. C. Fletcher: Mathematics and English.—W. Hope-Jones: A Plea for Teaching Probability in Schools.—A. W. Lucy: Exhibition of a Surveying Instrument, and explanation of its use in connexion with practical work in Trigonometry.—At 2.30.—Sir Thomas L. Heath: Presidential Address.—Discussion on the Report on the Teaching of Geometry.—G. Goodwill: Euclid and his Successors: Some Confusion and a Way out.—Prof. C. Godfrey: Construction in Geometry. What is legitimate?

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Concerning the Nature of Things: The Nature of Crystals—Metals (Juvenile Lectures (6)).

ROYAL SOCIETY OF MEDICINE (Medicine, Pathology, Therapeutics and Pharmacology Sections), at 4.30.—Sir Almroth Wright, Sir Thomas Horder, and others: Joint Discussion on The Uses and Limits of Vaccine Therapy.

ASSOCIATION OF TEACHERS OF DOMESTIC SUBJECTS (at University College), at 5.30.—Sir Henry Gauvain: Light and Life.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—J. Kewley: The Crude Oil of Sarawak.—Dr. A. E. Dunstan: The Crude Oil of Maidan-i-Naftun.

INSTITUTION OF CIVIL ENGINEERS, at 6.—H. T. Tudsbery and A. R. Gibbs: An Account of an Examination of the Menai Suspension Bridge.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—R. G. Reid: Modern Refrigerating Machines.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—G. A. Clarke: A Note upon the Upper Cloud in Advance of the Depression of August 28-30, 1923.—H. M. Cartwright and others: Discussion on A Consideration of some Problems concerning the Measurement of Photographic Density.—W. J. G. Farrer: Exhibition of an apparatus for testing the Ultra-violet Transmission of Colour Filters.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—E. Cuzner: The Respiration of Aquatic Organisms.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Eoliths found *in situ* at South Ash.—De Barri Crawshay: Azilian-Tardenoisian Flint Industry in Mesopotamia.

RÖNTGEN SOCIETY (at British Institute of Radiology), at 8.15.—Dr. J. A. Crowther: Studies in X-ray Production.—H. Moore: The Quality of the X-rays excited in hot cathode and in "gas" tubes by various types of generators of High-tension Current.

WEDNESDAY, JANUARY 9.

ROYAL SOCIETY OF ARTS, at 3.—Prof. W. A. Bone: Fire and Explosions (Dr. Mann Juvenile Lectures (2)).

GEOLOGICAL SOCIETY, at 5.30.—Prof. S. H. Reynolds and Dr. E. Greenly: The Geological Structure of the Clevedon-Portishead Area (Somerset).—Dr. F. S. Wallis: The Avonian of the Tytherington-Tortworth-Wickwar Ridge (Gloucestershire).—Miss Agnes E. Bamber: The Avonian of the Western Mendips, from the Cheddar-Valley Railway to the Sea, West of Brean Down.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—J. M. Moncrieff: The Work of a Constructional Engineer's Office.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, INC. (at Engineers' Club, Coventry Street), at 7.—T. Lindsay: A New Universal Regulator for the Control of Temperature, Pressure, Humidity, etc.

THURSDAY, JANUARY 10.

LINNEAN SOCIETY, at 5.—A. J. Wilmott: Some further Additions to the British Flora.—Mrs. Henshaw: Plant Life in British Columbia.—R. H. Burne: Exhibition of Specimens of the Carotid Arteries of Lamna and other Sharks.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Dr. Aitchison and Mr. North: Materials from the Aeronautical Point of View.

INSTITUTION OF ELECTRICAL ENGINEERS AND THE SOCIÉTÉ DES INGENIEURS CIVILS DE FRANCE (British Section) (in the Lecture Theatre of the Institution), at 6.—Continuation of discussion on A. Bachellery's paper on the Electrification of the Midi Railway.

INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers, Inc.), at 8.—W. T. Griffiths: X-rays and Metallurgy.

FRIDAY, JANUARY 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—C. O. Mourant: Concrete Engineering.

PUBLIC LECTURE.

SATURDAY, JANUARY 12.

BIRKBECK COLLEGE, at 5.30.—Dr. F. H. Hayward: Homage Celebration of Leonardo da Vinci.