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The Rationalisation of Chemists.

THOUGHTFUL men and women, surveying the part that science has played in the lives of the present generation, have no illusions concerning its potency, for good or for ill, in controlling the destiny of their successors. To have seen science in the grip of Mars, to have watched the wonderful service of chemistry to medicine, is to know how true it is that knowledge applied is power acquired ; those who have lived through a clash of arms in which science, whether acknowledged or not, dominated policy, strategy, and tactics, find no difficulty in applying, indeed they are constrained to apply, that same experience to the problems of the post-War world. In the industrial troubles of to-day—depression, loss of overseas markets, unemployment—they recognise inevitable casualties in the battle of industrial wits, and they know that the struggle must end in favour of the best equipped battalions ; if they did not know it before, they realise now the truly vital position of the scientific basis of industry in the nation's life. Once again science will dominate policy, strategy, and tactics, and in the intense industrial competition, over the threshold of which we have yet scarcely stepped, tradition will count for little beside knowledge, and pride for nothing compared with progress.

What will in the future be the foundation of our national wealth and influence ? Not conquest, nor colonisation ; our position will depend on the use to which we put our heritage of natural resources. Of the basic industries of Great Britain, three—mining, metallurgical, and chemical—are of prime importance. These stand sentinel over our future prosperity ; it is to these industries, aided at almost every step by engineering, and drawing frequently, as occasion requires, on the resources of knowledge gathered by almost every other science, that we turn for means to exploit our potential wealth. The nation which fails to organise its industrial power will scarcely expect to reap commercial rewards ; and the nation which fails to employ methods at least as efficient as those of its competitors will have to go out of business.

Chemists and chemical engineers have long been considering the position. On the commercial side we have seen important amalgamations effected in order to promote efficiency and economy of effort. On the scientific side much advance but little reorganisation has yet taken place, although the need grows with the expansion of chemical knowledge and influence. Nevertheless, British chemists fully realise the responsibility of the position occupied by their profession, and whilst they subscribe whole-heartedly to a policy of international fraternity among scientific workers, they are neither unaware nor careless of their own country's needs. They are anxious, therefore, to modernise professional machinery in the chemical group of sciences for more effective industrial defence and more rapid progress. They desire to put their house in order by eliminating duplicate provision and effort, and thereby consolidating the personnel of the nation's chemical service.

Now chemistry, as is well known, instead of remaining a homogeneous unit in the scientific corpus, has almost acquired the status of a sub-group of sciences. Since the foundation of the Chemical Society, the first organisation in the world to be established for the special purpose of promoting chemical knowledge, there have grown up various societies of chemists and chemical engineers who concentrate their attention on different branches of the science—how different, chemists alone know! Each plays a worthy part in promoting discovery and application, and any scheme of co-ordination will necessarily have in view the intensification, and not the delimitation, of studies in every field. In order that the ground may be more thoroughly surveyed, and to conserve the limited resources of a profession which, on the whole, is in receipt of only a modest competence, Prof. J. F. Thorpe, in his recent presidential address to the Chemical Society, has outlined definite and considered proposals which merit the most careful consideration by the interests concerned. A firm believer in co-operation in science and industry, Prof. Thorpe seeks to put into practice his principles. What appears an impossibly heavy task for the chemical group unaided may become possible by association with other branches of science. Hence he proposes to solve the housing problem by co-operation with societies in the mining and metallurgical branches, and to promote co-ordination of effort in the chemical branch by fusion of publications and, eventually, of membership.

This twofold scheme seems to us to provide at least a firm basis for action. The proposals, by seeking to establish a kind of chemical 'general headquarters' forming a unit in an even more comprehensive scientific and industrial assembly, are thereby invested with an importance which is not only national, but also imperial. Many of the principal societies for encouraging the acquisition, marshalling, and dissemination of scientific knowledge, not least those concerned with pure and applied chemistry, are at present restricted in their usefulness by being inconveniently and inadequately housed; libraries are scattered; there is no general information bureau; even meeting rooms have to be borrowed and lent; there is little social intercourse between members of the same branch and less between members of different branches, office organisations are not in close touch—in short, there is lamentable lack, as regards accommodation, of the elementary needs of inter-group efficiency. Efforts to remedy the situation have been discussed for the past ten years, but proposals have hitherto been rendered nugatory by the financial burden proving too oppressive for societies supported in so large a measure by the annual subscriptions of their members. Even under present conditions the Chemical Society, for example, by the exercise of rigorous economy, finds it only just possible to show a small credit balance when provision has been made for the cost of the publications, which is the chief expenditure.

Accommodation and co-operation, then, are the needs to be supplied. The joint housing project involves only half the capital expenditure previously envisaged, and it has the merit of securing real co-operation with the minimum disturbance of the constitutions and functions of the participating societies, whilst it will facilitate fusion should this course commend itself at some future time. A scheme originating with the mining and metallurgical societies and institutions provided the nucleus of the wider project, which now proposes to secure collaboration by the Empire Council of Mining and Metallurgical Institutions, the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Iron and Steel Institute, the Institution of Petroleum Technologists, the Institute of Metals, the Institute of Fuel, the Chemical Society, the Society of Chemical Industry, the Institution of Chemical Engineers, and the Institute of the Rubber Industry in seeking financial assistance for the erection of a suitable building to serve as a joint headquarters in Westminster. Two-fifths of the space, a veritable 'Chemistry House', would be allotted to the chemical group, and their share of the capital sum involved would be £140,000. In so far as the accommodation then available would not be required for immediate occupation by the participating societies, it would be used by 'tenant' societies directly connected with the industries represented by the constituent bodies. The Chemical Society's library would form the nucleus of the new library whilst continuing to function, as at present, as a sectional library. The central library is, of course, one of the pivots of the whole scheme, as also is the proposed bureau of information.

Prof. Thorpe fully realises that the problem of raising the necessary money is difficult, particularly in view of the present great depression in industry and the incidence of high taxation. He naturally and properly looks, however, to the chief ultimate beneficiaries, namely, the industries concerned, to afford the greater part of the required support. As chairman of the appeal committee, he finds among those engaged in industry an eagerness to play a worthy part; of the total sum of £350,000 required, definite promises amounting to £130,000 have been received. This is an encouragingly large sum, but encouragement is tempered with anxiety in respect of the remaining £220,000. The Government has, we understand, expressed sympathy with the object in view, but has refused—we hope not finally—to accord any financial assistance.

Such is the outline of the important proposals which affect more than twenty thousand of our colleagues. Before we turn to the second group of proposals, we would offer one or two observations on this solution of the 'housing problem'. In the first place, we consider the scheme to be conceived in the interests both of science and of the nation, so that we unhesitatingly and whole-heartedly support it in principle. Whilst we are not willing at this stage to comment on matters of organisation or of detail, matters which will assuredly exercise the leaders of the professions concerned for some time to come, we think the proposals are likely to be effective in their purpose without causing unnecessary disturbance of existing institutions; they have the merit of envisaging more than they are intended immediately to accomplish, and they promise to serve the community. Scientific workers obviously cannot themselves bear the whole financial burden incidental to their public service, and we rejoice that industry is found willing to share it with them. We invite industrialists to sow with a liberal hand that seed of which they will in due time enjoy the fruit; times are hard, but this is an additional reason for helping to consolidate the ranks of their willing, indeed eager, servants.

The attitude adopted by H.M. Government is, we hope, one which will prove amenable to modification on reflection. Some consideration is obviously due, and will presumably be accorded, to the Chemical Society in respect of the surrender of its free tenancy of rooms at Burlington House. In any event, it could scarcely represent the extent of the public interest in the scheme. Public money should be expended for the ultimate good of the public as a whole, and in our opinion the scheme which Prof. Thorpe has outlined is one which both deserves and demands substantial support from the public treasury. We should not like to think that, in its attitude towards the organisation of science for the service of industry, any government of the present day believes that its responsibility can be discharged by merely recording its approval.

While rightly insisting on the service which science renders to the growth of industry, Prof. Thorpe does not, of course, forget that which industry renders to the advancement of so-called 'pure' science. He quoted in illustration the certainty of advance in organic chemistry which is associated with the existence in any country of a successful and well-established dyestuffs industry. Large research organisations created by firms employing many of the most capable chemists in Great Britain promote progress in directions which are not confined to the special needs of the industry itself, but equally serve other related interests.

The further proposals which Prof. Thorpe puts forward are concerned with the publications of the Chemical Society and the Society of Chemical Industry and with a plan for joint membership. It is suggested that joint publication of four journals, in addition to the annual reports, should be undertaken: chemical transactions (monthly), abstracts (A and B together), a publication similar to the American *Industrial and Engineering Chemistry* (monthly), and *Chemistry and Industry*—the news edition (weekly). There are obvious advantages to be secured from such unification, and the proposal merits careful exploration. Six years' successful work by the Bureau of Chemical Abstracts, itself a joint board, has shown that co-operation in publication is both possible and advantageous, and there are many who look forward to the possibility of extension of the principle. Moreover, it is believed that it could be made financially possible for each section of the Society gradually to secure a membership common to both, while preserving financial and administrative autonomy.

Granted that ultimate fusion of the two societies is desirable, Prof. Thorpe's suggestions reflect practical statesmanship and something more than a superficial knowledge of human nature. Whether or not they prove acceptable to chemists without modification, he has performed a substantial service in so carefully exploring the position and in providing a promising basis for discussion. The opportunity for action appears to have arrived; chemists will be well advised not to allow it to pass. Many years may elapse before it recurs.

The Gramophone.

Modern Gramophones and Electrical Reproducers. By P. Wilson and G. W. Webb. Pp. xvi + 272 + 12 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1929.) 10*s.* 6*d.* net.

THE recent development of the gramophone has presented a striking example of the great benefits to be derived when industrial research can be directed upon the basic *phenomena* of an industry. Sufficient co-operation between manufacturers cannot always be secured to finance such comprehensive research, and then little more can be undertaken than an initial quantitative definition of industrial *processes*, as distinct from the natural phenomena underlying them, and a subsequent study of empirical changes made in these quantities. For a period of some twenty-five years, gramophone research was purely empirical and the meagre results gave only a product which the establishment of broadcasting threatened to exterminate. Then the whole gramophone industry was suddenly revitalised by the introduction of electrical recording and the matched impedance type of reproducer. The present volume deals more especially with these remarkable advances, all of which originated in the Bell Telephone Laboratories in New York and, we would emphasise, were merely by-products of an enormous fundamental research.

To know their origin, which happened to lie in practical telephone designing, lends a deeper significance to the book. Some fifteen years ago, an advanced stage had been reached in the art of accurately analysing fluctuating electrical currents into their component frequencies and in the correlated art of describing and measuring the characteristics of mechanically vibrating systems. A part of telephone design was, however, empirical, because speech and hearing could not then be defined quantitatively in physical terms. At this stage the step was taken which ten years later yielded results of such importance to the gramophone. It was decided to attempt a quantitative definition of speech and hearing. Now, although the ear is so delicate, it is so accommodating that its use as a measuring instrument is quite invalid and apparatus of remarkable precision had to be developed. Since this apparatus proved to be costly and often complicated and difficult to adjust, it appeared to be of interest only in the research laboratory. Nevertheless, one of the instruments, an electrical transmitter developed in the early stages of the research, is now used to produce the modern gramophone record.

At the beginning of the book, there is an excellent discussion of the requirements for perfect reproduction. A statement by a music critic is worth quoting: "When I sit in an acoustically perfect hall (full of people), in the best seat for hearing, and listen to an orchestra, I hear such and such sounds. I want to hear precisely this effect from a record." From this simple statement, the dependence of the problems of gramophone reproduction not only upon acoustical, but also upon psychological and physiological considerations, is clearly evident. The acoustical and other physical problems occupy the greater part of the volume, although some of the vagaries of the human ear are described.

The functions of all the separate parts of the gramophone, consisting of needle, stylus-bar, diaphragm, sound-box, tone-arm, and horn, are now well understood, and it is interesting to note that of all the readily conceivable forms which a sound-box might have taken, the one which was developed happens to correspond closely with that which modern theory shows to be desirable. This theory of the design of the whole system from the needle-point to the mouth of the horn has been developed on the lines of the new electro-mechanical acoustics, which utilises the analogies between electrical circuits and mechanical systems. Practice lags behind theory because of the difficulties of providing and measuring the constants of some of the required mechanical analogues. For example, a condenser can be made having large capacity with negligibly small inductance, but it is difficult to make the corresponding spring having compliance without inertia.

From the interesting results given in the discussion of the horn, it is clear that for satisfactory reproduction of low notes the horn must be long and must end in a wide opening. For example, the horn used in the 'Movietone' reproducer is 14 ft. long, and has a mouth of about 5 ft. diameter in order to get a sensibly uniform frequency response over the range from 60 to 7000 vibrations per second. The alternative to the use of these long horns lies in electrical reproduction from the record with the aid of a moving-coil loud-speaker, and some seventy pages are devoted to the complicated problems of the pick-up and amplification. So far as the realisation of theoretical requirements is concerned, the complete electrical gramophone appears to be less advanced than its acoustical rival. There is no discussion of the problems of a sound film gramophone.

The inclusion of a work on architectural acoustics in the bibliography of books, papers, and patent specifications, shows that the authors realise the importance of this subject, but no space is devoted in the text to its application in gramophone acoustics. There is but little detail of the original wax record, and it would be of interest to know if data upon the physical properties of this wax and of the ordinary record material are available. These are, however, comparatively minor points of omission.

It is pleasant to find that this, the first serious book on the gramophone, is so well written and trustworthy that it has all the desirable properties of a standard work. Since the book was written, still another ingenious application of electro-mechanical analogies has resulted in the construction of a motor capable of rotating the original wax master-record with remarkable constancy of speed, ensuring that the grooves in the record are even more faithful to the original sound (Elmer, *Bell Labs. Record*, **7**, 445-50 ; 1929).

W. H. George.

Science and Philosophy.

Philosophy by Way of the Sciences : an Introductory Textbook. By Prof. Ray H. Dotterer. Pp. xv + 469. (New York: The Macmillan Co., 1929.) 10*s*. 6*d*. net.

This book well represents the remarkable change which has come over the study of philosophy within living memory. People who studied philosophy at one of our universities thirty or forty years ago were almost invariably introduced to the subject on historical lines. It was assumed that the best mode of approach to the problems of philosophy lay through the historical systems, beginning with the Greeks and ending perhaps with Kant and Hegel. So far as Britain was concerned, it was a study most assiduously cultivated north of the Tweed, and when an English chair of philosophy became vacant, the list of applicants was bestrewn with the syllable ‘ Mac ’. Philosophy was regarded as a thing apart, an intellectual luxury, something of a holy mystery. The philosopher's colleagues, especially those of the faculties of pure and applied science, were apt to regard his ministrations as harmless diversions; or as interesting attempts to solve problems which, unlike those of physics and biology, were in the nature of the case insoluble. It was all part and parcel of the general attitude of men of science, at a time when positive science was making astonishing progress, and seemed capable of leaving no problem ultimately unresolved.

Gradually, however, a change has come over the scene, a change to which both sides have contributed. Although, of course, the history of philosophical systems holds an important place in a certain type of university curriculum, yet it has become customary to introduce the student to the main philosophical problems as they appear to the modern mind, to show him what philosophy ‘ is all about ’, before plunging him into the history of the systems ; and the advanced student becomes aware that the old puzzles have to be viewed in new lights, and that new puzzles have to be added to the old, under the impulse of the strenuous thought that is being devoted to philosophical issues in our time. It would be easy to name a whole crop of books, produced since the beginning of the twentieth century, which exemplify these changes in the pursuit and the teaching of philosophy.

Not less striking is the changed attitude of men of science, their modified faith in mechanistic explanations of life, and especially of the life of man, their consciousness that every line of scientific inquiry leads to problems which (using the word physics in its older and more general sense) are beyond-physics, that is, are metaphysical. Hence the present position, that some of our leading men of science are also among our leading philosophers.

Dr. Dotterer is, of course, not the first teacher to have led his students to approach “ philosophy by way of the sciences ”. But we do not recall any introductory text-book which conducts its reader along this road so thoroughly and competently as the book under consideration. Other writers are content to propound the problems of metaphysics, and incidentally to show that they begin where scientific explanation leaves off. Dr. Dotterer takes the bold course of devoting one-half of his book to a survey of the sciences—what they have achieved, and where their difficulties begin. A statement of the achievements of astronomy and geology is followed by a statement of the corresponding perplexities. Is the world-process teleological ? Is reality finite or infinite ? What is the relation of time and space ? And so on. The achievements of physics, chemistry, and mathematics suggest perplexities about the constancy of our units, and the absoluteness or relativity of motion. Similarly, the achievements of biology and psychology suggest perplexities about development, and the interrelations of mind and body. Not all his fellow

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teachers would agree with the author's attempt to summarise the achievements of science, and some of them might charge him with an assumption of omniscience. He took the risk, and all we can say is that we think he justifies himself.

So the first half of Dr. Dotterer's book leaves us with a somewhat bewildering bunch of 'perplexities', each of which presents a problem in philosophy. Some of them are philosophical 'chestnuts', such as the issue between realism and nominalism. Among the other problems are the criterion of truth, the problem of being, determinism and its opposite, the authority of values, and the belief in progress.

Dr. Dotterer has written primarily for students of philosophy, but he has aimed at producing something more than a text-book, and in our judgment he has succeeded. To make philosophical discussions clear to the general reader is not an easy task, but it is here accomplished. The author writes lucidly and forcibly, and his criticism is always marked by modesty and sanity. The general reader—and for the present purpose the student of science may be so described—will find this book a most useful introduction to the abstruse but ever alluring problems of metaphysical speculation.

Bacteriology in Medicine.

The Principles of Bacteriology and Immunology. By Prof. W. W. C. Topley and Dr. G. S. Wilson. In 2 volumes. Vol. 1. Pp. xvi + 587 + xvi. Vol. 2. Pp. viii + 589-1300 + xx. (London: Edward Arnold and Co., 1929.) 50*s*. net.

THE authors of this book say, "We have attempted on the basis of our personal experience in post-graduate and undergraduate teaching to provide a text-book which will be of service to those students of medicine and biology who wish to make a serious study of bacteriology, and its application to the problems of infection and resistance". This very desirable end has led them, we think wisely, to divide the book into two volumes, so as to treat in the first place the biological aspects of bacteria, and after that has been dealt with to pass to the subject of infection and the application of bacteriology to medicine and hygiene.

Vol. 1 is divided into two parts; the first of these deals with general bacteriology, and after giving a short, but interesting, historical outline, the authors proceed to the biological and physiological characteristics of bacteria—their growth and resistance to physical and chemical agents, serum reactions, bacterial variation, classification, and, finally, they give some practical details and a well-written chapter on the Twort d'Herelle phenomena.

Though all these chapters bear evidence of wide reading and good critical judgment, we would specially praise the one on serum reactions and antigenic structure of bacteria. This somewhat difficult and, at present, rather confused subject has been made clear to any intelligent reader, and the views of the various writers on this subject are given with great fairness. The chapter on bacterial variation is also a very valuable one, and disinfection is treated very fully.

The authors have thought it necessary to adopt the American classification. This we feel is still crude and unsatisfactory, and we regret its adoption, though possibly if we had been the authors we would have been forced to do as they have done.

Part 2 of the first volume concerns itself with the description of the various bacterial species. This is well written, and the illustrations are, on the whole, very satisfactory. We welcome the absence of detailed descriptions of technique which load up uselessly so many text-books on bacteriology. Why writers on bacteriology should give half a dozen or more different methods for staining a special bacterium has always been beyond our conception, and it is a joy to find a book where this is not done, and where the authors have deliberately omitted these.

Vol. 2 deals with bacteriology in its application to medicine and hygiene. Part 1 deals with infection and resistance, and in a work of this kind for which Prof. Topley has done so much one naturally expects a great deal. We have not been disappointed. The facts are very clearly put, and the critical work is of a high order. Part 2 is very well done, and medical men dealing with any of the bacterial diseases will find valuable information on almost every page.

We congratulate the authors on the production of an extremely valuable text-book, one which should find a place not only in every bacteriological and pathological laboratory but also on the bookshelf of every medical man. The task must have been a very difficult one, for one must recognise that bacteriological literature is, at present, somewhat chaotic. The authors must have read widely, but the strongest feature is the independence shown in departing from the usual text-book routine.

J. M. Beattie.

Our Bookshelf.

Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies. Being an emended and enlarged edition continued up to the end of the year 1920 of Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns, compiled from Botanical and Horticultural Publications of the XVIIIth and XIXth Centuries. Prepared under the Auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew, by O. Stapf. Vol. 2. Pp. iv + 548. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 105*s.* net.

In October 1929 the first volume of this important work made its appearance. It included all plants from *Aa* to *Campanopsis*. The editor, Dr. Stapf, and his collaborators have now brought their great task one stage further with the issue of Vol. 2, which appeared about Christmas 1929, but is dated 1930. It consists of 548 pages and is, therefore, of almost exactly the same size as Vol. 1. It comprises references to illustrations of all plants from *Campanula* to *Dysphania* inclusive. The Clarendon Press is once more to be congratulated on the excellence of the printing.

The work is recognised by very many as one of great utility and a trustworthy and voluminous guide to all who desire to see pictures of plants or parts of plants belonging to the groups cited in the title. It should, in this respect, supply every need of the practical gardener, be he florist or arboriculturist, and of the botanist, whether he be systematist, morphologist, or dilettante collector. The work will help to direct attention to a good deal of the older literature which has been neglected in the past and frequently contains much that is valuable. It will be found to fill many a gap caused by the omission of pictures of intrinsic merit in themselves, but which, for one reason or another, have been entirely left on one side by botanical workers. It should also point the way to a proper discrimination in the choice of illustrations in the future.

Another important function of the "Index" consists in the revision of the nomenclature of well-known large genera such as *Bignonia*, *Croton*, *Pinus*, etc., which hitherto have included a confused medley of plants which, according to modern ideas, should be placed in quite distinct genera.

This revision, let us hope, may have some effect in inducing gardeners to name their plants more correctly. W. C. W.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 307. Abt. 9: *Methoden der Erforschung der Leistungen des tierischen Organismus*, Teil 6, Heft 1. *Methoden der Meeresfischereibiologie. Die Methodik fischereibiologischer Untersuchungen an Meeresfischen.* Von Adolf Büchmann. Pp. 194. (Berlin und Wien: Urban und Schwarzenberg, 1929.) 11 gold marks.

To those who may wish to acquire a working knowledge of the methods employed in modern scientific investigations of the sea fisheries, this section of Abderhalden's great 'handbook' can be recommended. When considering the subject, it should be remembered that the fisheries biologist is largely dependent upon data derived from relatively small samples for his knowledge of the fish population he studies. It should therefore occasion no surprise that great use is made of statistical methods to determine the limitations of the samples taken, and hence to estimate the probability that the samples truly represent the population or stock from which they are taken. Indeed, much of the most valuable work accomplished in recent years has been the development of trustworthy technique based on random sampling. It cannot be too strongly emphasised that in this field of biological investigation, where results are to be applied to the great problems created by the commercial fisheries, nothing less than critical mathematical analysis can suffice. This being so, it follows that the would-be research worker will do well to include in his preparation the essentials of statistical treatment of raw data. Dr. Büchmann's treatise should prove most helpful in indicating the nature of the difficulties lying ahead.

The Great Mathematicians. By Prof. H. W. Turnbull. (The Great Scientists Series.) Pp. viii + 128. (London: Methuen and Co., Ltd., 1929.) 2*s.* 6*d.*

This little volume—one of a series devoted to the history of science—gives, in a very readable manner, an interesting narrative of some of the greatest representative mathematicians from the early Egyptians to Ramanujan. In the preface, the author says: "Fully conscious of the difficulties of the undertaking, I have written this little book in the hope that it will reveal something of the spirit of mathematics without unduly burdening the reader with its intricate symbolism". Herein lies the key to the whole story, for not only has the subject matter been very judiciously selected, but also the way in which it has been woven into a very human narrative is indeed an outstanding feature.

Undoubtedly, in his brief delineation of those great personalities who found in mathematics both an inspiration and a delight, Prof. Turnbull has very successfully achieved his purpose, and in so doing has rendered a real service to the popular development of so abstract a subject. As the historical account is naturally incomplete, owing to the small size of the volume, a list of books for further reading is given.

A Textbook of Light. By Dr. R. Wallace Stewart and Prof. John Satterly. (The Tutorial Physics, Vol. 3.) Sixth edition. Pp. vii + 363. (London: University Tutorial Press, Ltd., 1929.) 6*s.* 6*d.*

This popular text-book, designed to carry the student to university intermediate stage, has now reached its sixth edition, in which the type has been re-set and certain sections have been re-written and simplified. The opportunity has also been taken to add new matter to the chapter on dispersion, which serves both to offer a pleasant approach to the study of spectroscopy and to provide clear explanations of many common phenomena, such as lunar haloes, which are not always treated well in text-books.

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.]*

Quantitative Analysis by X-Rays.

WE have read with much interest Prof. Hevesy's address to the British Association on "Quantitative Chemical Analysis by X-rays and its Applications" (NATURE, **124**, 841; 1929). While we are in agreement with many of the statements of that address, our experiments lead us to somewhat different conclusions as to the possibilities and limitations of analysis by X-rays.

Qualitative Analyses.—The simplicity of the X-ray spectrum of an element (particularly of its K-series), the existence of Moseley's law, the known facts relating to the relative intensities of spectral lines and to the potential required to excite a group of lines, make the X-ray spectrum of any substance a comparatively simple one, and give to the identification of the lines a high degree of certainty. It is true, however, that the experimental difficulties of producing such a spectrum and of measuring the wave-length and intensity of the lines are not inconsiderable.

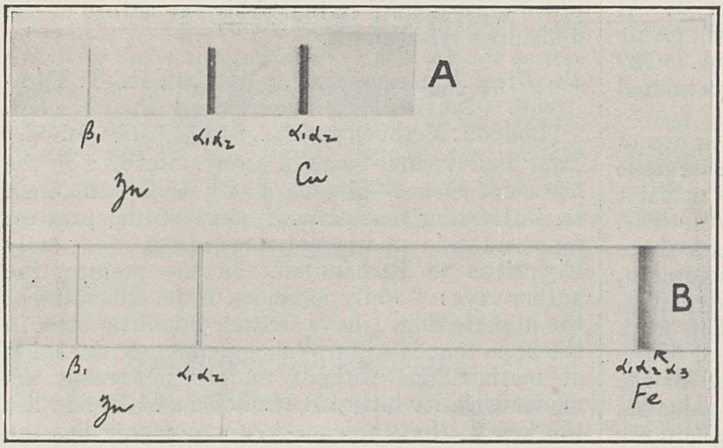

FIG. 1.

Prof. Hevesy discusses the important question of the excitation of the X-ray spectrum of the material being analysed. This is all-important to the practical convenience, to the sensitiveness, and to the quantitative accuracy of X-ray analysis. Three methods of excitation can be used. In the first the material is bombarded in the vacuum of the X-ray tube by cathode rays, in the second by Lenard rays outside the vacuum, and in the third, used by Prof. Hevesy, by primary X-rays which fall on the material either inside or outside the X-ray tube.

The first method involves all the difficulties of high vacuum technique, and is unsuitable for volatile substances. A discussion of these methods cannot be given here, beyond noting that the second method has the important advantage of producing a characteristic spectrum free from general radiation. It may be noted, too, that the metals and their alloys lend themselves to the first method, and when water-cooled can be subjected to intense cathode ray bombardment. The production of a strong beam of X-rays from a non-metal is, however, much more difficult.

Prof. Hevesy refers to the sensitivities of analysis by X-rays, and to the relative advantages of the optical and X-ray methods of spectroscopic analysis, but it is not clear whether his remarks refer to quantitative or qualitative analysis. In the detection of a small quantity of a given element in a mixture of elements by X-ray spectroscopy, a much higher degree of sensitiveness can be obtained than Prof. Hevesy and other writers on this question have claimed.

Fig. 1, A, reproduced from a paper by the writers and Mr. A. H. Turner (*Proc. Roy. Soc.*, **124**, 258; 1929), shows the K spectrum of a zinc containing 7 parts in 10^6 of copper, and B shows the K lines of a zinc containing 3 in 10^6 of iron. It is evident that 1 in 10^6, possibly 1 in 10^7, of iron in zinc could have been detected. The detection of small amounts of impurities in non-metals (usually examined in the form of powders) is more difficult than in metals, as faint lines may be masked by a dark background of continuous radiation from the metal upon which the powder is placed, and by scattered radiation. It is, therefore, desirable to use as this metal one of low atomic number (for example, aluminium), and to select a voltage such that the wave-length of maximum energy in the continuous spectrum does not coincide with that of the spectral line sought. The photographic film must be protected from scattered radiation by suitable screens.

Several quantitative methods of analysis by optical spectroscopy are in use. One due to Lockyer depends on the variation in the length of certain lines in the arc and spark spectra of an element with the amount of the element present; another, due to Hartley, relies on the persistence of certain lines in the spark spectra of solutions when the element giving the line is present only in very small amount; while the third, and most successful, is based on the discovery of de Gramont that each element has several sensitive lines, or 'raies ultimes', which reveal its presence, in some cases, for so little of it as 1 part in 100,000. The amount of the element present can be determined with fair accuracy by the number of its lines which can be observed. Unfortunately, however, for many elements all the lines vanish for concentrations of less than 1 in 10,000, and a further difficulty with a mixture of elements is the masking of the sensitive lines of one element by the strong lines of another.

With the X-ray method, the entire spectrum of an element persists even for amounts less than 0·0001 per cent, and thus the difficulty of identifying its lines does not increase for small concentrations to the same extent as it does for the optical spectra.

Quantitative X-Ray Analysis.—Profs. Coster and Hevesy, incidental to their discovery of the element hafnium, were the first to develop a quantitative method of X-ray analysis. They determined the amount of that element in a number of minerals by an empirical method in which tantalum was added to a mineral until in the spectrum of the mixture the tantalum $L\,\alpha_1$ line ($\lambda = 1{\cdot}518$ A.) gave the same blackening on the photographic plate as the hafnium $L\,\alpha_1$ line ($\lambda = 1{\cdot}566$ A.). The amount of hafnium present was taken to be equal to the amount of tantalum added.

In a paper which is being published in the *Proceedings of the Royal Society*, we have described a quantitative method which gives the ratio of the amounts of the two elements present in an alloy for a wide range of values of the ratio. This method is not restricted, as is that of Coster and Hevesy, to discovering when the elements are present in equal amount, and no addition of an element to the substance to be analysed needs to be made. The assumption is made that, for an alloy of two elements of nearly equal atomic number, the ratio of the number of the atoms of the two elements present is equal to the ratio of the intensities of corresponding lines (say the $K\ \alpha_1$ lines) in the spectrum of the alloy, provided these lines are excited under equivalent conditions. The X-ray line intensities are determined photographically by photometering the lines, and by determining the X-ray Hurter and Driffield curve of the emulsion used. The determination of line intensities in this way is found to be both convenient and accurate. The assumption mentioned has been verified to a quite satisfactory degree of accuracy by making an X-ray analysis of the following six alloys of known composition :

Cu 73 per cent, Zn 27 per cent ; Cu 1·1, Zn 98·9 ; Cu 0·11, Zn 99·89 ; Sn 71, Cd 29 ; Pb 60·5, Bi 39·5 ; and 12 per cent Zn in Zn-Sn-Cu.

The alloys used included both heterogeneous and homogeneous structures ; and in some cases the *K* series was used, in others the *L* series.

Our observations are not in agreement with those of previous workers in respect to the effect of a third element, an effect referred to by Prof. Hevesy. Coster and Nishina found that the presence of a third element in a powder mixture affected the accuracy of their results in cases when no selective absorption took place, and they concluded that the same method as we have used was not accurate. For alloys, however, we find it quite accurate.

T. H. Laby.
C. E. Eddy.

Natural Philosophy Laboratory,
University of Melbourne,
Feb. 5.

Nature of the Magnetisation Curve of Single Iron Crystals.

In recent years various observers have investigated the magnetisation of single iron crystals. Their results differ in several important respects. From investigations of iron crystals made in these laboratories, we believe that the observed differences are ascribable mainly to the unsatisfactory accuracy with which magnetic field intensity has been estimated when the demagnetisation factor is very large, or when it is a function of the magnetisation, as it is in specimens that are not ellipsoids. In the latter case, the only way in which the field intensity can be determined is by direct measurement. Experimenters, strangely enough, have seldom employed this procedure, preferring rather to rely on calculation of the demagnetising component of the field intensity by methods which have been shown to rest on invalid assumptions.

The outstanding problem evoked by these discrepant observations is the question of whether or not there are 'breaks' (abrupt changes of slope) in the magnetisation curves and hysteresis loops. The existence of this phenomenon was announced by W. Gerlach (*Phys. Zeits.*, **26**, 914 ; 1925) four years ago. Since then its reality has been repeatedly confirmed or denied by other observers.

We believe that the breaks appearing in these curves are spurious ; and that in the few cases where it is not possible to draw a smooth curve fitting the points equally well, they are due to incorrect estimation of the field intensities. In support of this idea we offer the following facts :

When a sufficient number of points on the curve are obtained and the *actual* magnetising field—the applied field less the demagnetising component—is *measured* with considerable accuracy, the magnetisation curve has no breaks (Foster, *Phys. Rev.*, **33**, 1071 ; 1929). If, however, these same data are plotted *without* applying the measured field intensity corrections, curves are obtained which in most cases are so flattened at the knee that it is possible to construct that portion of the curve with one or two sharp changes of slope. The reason for this is that the demagnetising component of the field intensity usually goes through a rather sharp maximum in the same range of magnetisation as is occupied by the knee of the curve. This maximum is always present in uniform cylinders. In iron crystals the curve of demagnetising component vs. magnetisation, or 'correction curve', is unlike that for ordinary iron, and is similar in shape to that obtained in polycrystalline permalloy (Foster, *Phil. Mag.*, **8**, 312 ;

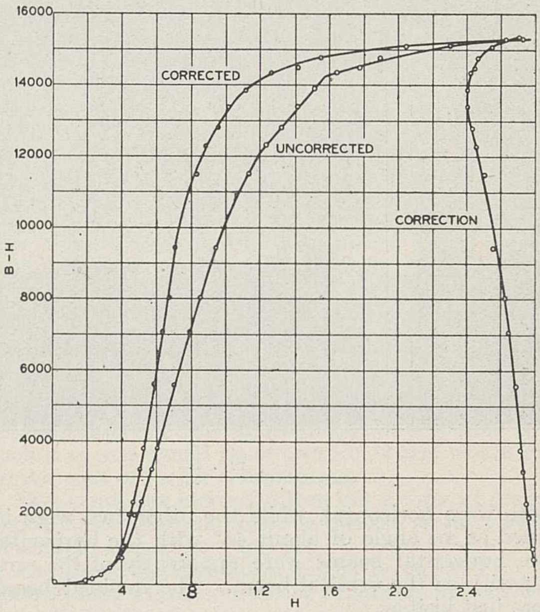

Fig. 1.—Magnetisation curve of an iron crystal showing the characteristic correction curve and the effect of omitting it.

1929). In no case is this correction curve the familiar straight line ('shearing curve') which has been so generally assumed.

There have been three other researches in which the intensity of the actual magnetising field was measured. In two cases (Dussler and Gerlach, *Zeits. f. Physik*, **44**, 279 ; 1927 ; Gries and Esser, *Archiv. f. Elektrotech.*, **22**, 145 ; 1929) the authors show curves with breaks ; but there are not enough points in the region in question to justify them. In the third (Wolman, *Archiv. f. Elektrotech.*, **19**, 385 ; 1928) the published curves are smooth. Sizoo (*Zeits. f. Physik*, **56**, 649 ; 1929), whose specimens were cylinders with rounded ends, regards the fact that his uncorrected curve is broken as proof that the true curve must be regarded as a broken one. Our determination of the actual field corrections for cylindrical iron crystals indicates that only the uncorrected curve is flattened at the knee. The explanation of the breaks is illustrated in Fig. 1.

Donald Foster.
Richard M. Bozorth.

Bell Telephone Laboratories,
New York, N.Y.,
Jan. 15.

Atmospheric Light Columns from Artificial Lights.

Brilliant beams of light, appearing to go upwards vertically from street lamps and electric signs, are seen here frequently during the winter months. The accompanying photograph (Fig. 1), taken on the evening of Feb. 4, shows a typical case.

The beams are seen only when the air is filled with snow or ice crystals. These apparently act as reflectors, since the beams from neon signs show the same colour red as the source itself. Examination of the beams through a Nicol prism indicates that they are unpolarised.

An exceptional case was observed on the evening of Jan. 3. A powerful electric sign showed four beams in addition to the vertical beam. Two of these were horizontal, while the other two were inclined at an angle of about 45° with the horizontal. The horizontal beams were apparently of the same intensity as the vertical beam. The inclined beams were just visible.

Fig. 1.

Up to the present I have been unable to find a mention of this phenomena in the literature on the subject, or to suggest a reasonable explanation.

B. W. Currie.

University of Saskatchewan,
Saskatoon, Sask., Feb. 8.

Light columns over artificial lights have been described previously, but Mr. Currie appears to be the first to photograph the phenomenon.

The columns can be explained in the same way as sun pillars. Mr. Currie suggests that the light is reflected from the surfaces of ice crystals. We may add that to produce vertical columns the reflecting surfaces must be nearly horizontal. The effective crystals are probably laminar. A flat disc falling slowly through the air keeps nearly horizontal.

In the explanation of the sun pillar, stress has to be laid on the fact that the falling disc will wobble or even spin so that the reflecting surfaces are not strictly horizontal and the pillar is analogous to the streak of light produced by reflection from rippled water. Columns such as are shown in Fig. 1 might be due, however, to reflection from strictly horizontal surfaces at different heights in the atmosphere. The elevation of the tallest of the columns may be estimated at about 12°. If the source of this light was a mile from the camera, reflection from a horizontal surface at a height of 500 feet would serve to produce rays coming down at that angle. The narrowness of the beams is in favour of this view of the phenomenon.

As to the exceptional observation of Jan. 3, it is likely that crystals of two types were present; laminar crystals were responsible for the vertical column. On the analogy of the mock-sun ring, the horizontal beams must have been due to the reflection of light from the faces of prisms floating with their axes vertical. Two reasons for the assumption of this position are known. Either the crystals contain air-bubbles or they have flat crystals attached to them to serve as parachutes. The latter explanation is the more likely in the present instance, for flat crystals were certainly present, and it is known that prisms can grow on the under sides of flat crystals.

The beams inclined at 45° have no analogue in daylight observations. Such beams might be due to light reflected twice, once at a vertical surface and once at a horizontal surface.

The growth of brilliant illumination in the cities of the north will provide an opportunity for the observation of various other phenomena. If an artificial mock-sun ring can be seen, the mock-suns themselves should be looked for as well as the circular halo. Mr. Currie is to be congratulated on his pioneer work in this field. The suggestion may be added that when possible the *forms* of the crystals should be recorded as well as the optical phenomena attributed to their presence.

F. J. W. Whipple.

Kew Observatory,
Feb. 26.

The Heat of Dissociation of Oxygen and of the C-H Bond.

In a short notice in *Die Naturwissenschaften*, Dec. 20, 1929, I published a new method of determining the heat of dissociation of oxygen (128 kcal.), comparing the spectroscopical dissociation of nitrogen peroxide with the thermal decomposition according to the scheme

$$\begin{array}{ll}\text{Photochemical:} & NO_2 = NO + O - 77 \text{ kcal. } (\lambda 3700)\\ \text{Thermal:} & NO_2 = NO + \tfrac{1}{2}O_2 - 13 \text{ kcal.}\end{array}$$

In a letter in Nature of Feb. 8, p. 202, Prof. V. Henri has calculated—using exactly the same method and values adopted by me in my note—this heat of dissociation, and arrives, of course, at exactly the same value of 128 kcal. It should be stated here that my computation of the dissociation energy was based not only on the fine work of Norrish on the photochemical decomposition of nitrogen peroxide but also on my own spectroscopical investigations of the absorption spectrum of this molecule. I found that predissociation took place between λ3700 and λ3800 A. A full account of this new method of determining spectroscopically heats of dissociation was given at the meeting of the Physikalische Gesellschaft at Kreuznach on Nov. 23, 1929, and will be published in *Zeits. f. phys. Chemie* (B).

I would especially wish to emphasise here that my method may readily be extended to other problems. From the thermal decomposition of ozone according to the analogous scheme

$$\begin{array}{ll}\text{Photochemical:} & O_3 = O_2 + O - 30 \text{ kcal. } (\lambda 9500)\\ \text{Thermal:} & O_3 = O_2 + \tfrac{1}{2}O_2 + 34 \text{ kcal.}\end{array}$$

it follows that photochemical decomposition should start at about λ9500 if the dissociation products are normal O_2 and normal O, or at about λ4100 or less, if some excited molecule or atom is the end product.

On the other hand, the photochemical formation of ozone will start first at λ2200, since the existence of oxygen atoms is required for this reaction. Decomposition of ozone was found at λ6000 (Kistiakowski) and λ4360 (Bonhoeffer) and formation at λ2070 (Warburg) in agreement with the above statement.

In the same way the energies of different C-H bonds in hydrocarbon compounds might be determined, for example (formaldehyde):

Photochemical:	$H_2CO = HCO + H - 107$ kcal.	(Predissociation at λ2670)
Thermal:	$H_2CO = CO + H_2 - 2$	(calc. from heat of combustion)
	$H_2 = 2H - 101$	
	$HCO = CO + H + 4$ kcal. (!)	

The energy of the C-H bond in formaldehyde is 107 kcal. (acetaldehyde 93 kcal., benzaldehyde 110 kcal.—predissociation at λ3050 and λ2550 according to V. Henri and S. A. Schou). Therefore it requires 111 kcal. to excite normal (bivalent) carbon monoxide to the tetravalent $=C=O$ molecule, which is responsible for the reaction. The same value is obtained from the dissociation of carbon dioxide. The energy of the CO bond, derived from spectroscopical data, is about 240 kcal. (not very accurately known), whilst the decomposition of carbon dioxide into normal carbon monoxide and oxygen requires only 130 kcal., so that the excitation energy is about 110 kcal.

Assuming this value, derived independently from two reactions, to be correct, one is able to calculate the energy of the CH bond in methane to be 115 kcal. and that of the C-C bond in different hydrocarbon compounds to be 110-115 kcal., compared with the old values of 90 kcal. (CH) and 65 kcal. (C-C). The energies of the $C=C$ and $C\equiv C$ bonds come out to be about 200 and 300 kcal.

R. MECKE.

Physikalisches Institut, Bonn,
Feb. 28.

Sex in Fungi.

IN their letter in NATURE of Mar. 1, Prof. R. Ruggles Gates and D. V. Daran appear to welcome the new views on heterothallism in the fungi, such as Dame Helen Gwynne-Vaughan's conception of nutritive heterothallism, which have come in, as they say, "to relieve the tension on the earlier rigid hypothesis of fixed + and − strains corresponding respectively to the female and the male sex".

It is only fair to point out that Dame Helen Gwynne-Vaughan and her colleague, Mrs. H. S. Williamson, only put forward this suggestion of nutritive heterothallism tentatively and frankly admit that "we have not yet been able to justify this term".

To interpret the various forms of heterothallism found in the fungi, the facts discovered in recent years must be fully realised. Sex heterothallism is only one of several forms of heterothallism, and it is perhaps due to the confusion between these various forms that the theory of multiple sexes has gained such a hold. A much simpler and more workable hypothesis, as pointed out by Brunswik, is the conception of two sexes, the inter-reactions between them being controlled by one or more factors other than sex factors. These controlling factors are held by Kniep to be positive sex factors, by Brunswik to be negative sterility factors; and, as the latter also points out, the conception of one or more sterility factors eliminates the necessity (on the positive sex factor hypothesis) for the assumption of multiple allelomorphism (to the *n*th) to account for the complete fertility between geographical races, as found in some of the Coprini. But a corollary must be added to Brunswik's hypothesis. Since, in a number of cases of Coprini, all the mycelia of one fruiting body will show complete fertility towards all the mycelia of another fruiting body, the mycelia must be potentially bi-sexual, although haploid, and the lack of fusion between certain given mycelia from the *same* fruiting body is due to the effect produced by one self sterility factor, or by certain given combinations of two self sterility factors.

The work on *Humaria granulata* has thrown a flood of light on this problem. Here we have a fungus in which the mono-ascospore mycelia are to all appearances female, the first case of the kind to be recorded. When grown singly the mycelia remain sterile; when combined with each other, half the combinations prove fertile. The authors rightly point out that this is not sex heterothallism (haplo-synœcism). If it is a case of nutritive heterothallism, then a further assumption has to be made, to explain the fact that only half the combinations are fertile.

Thus two entirely new assumptions have to be made which only add to the complexity of heterothallism in the fungi of which Prof. Gates and Mr. Daran complain.

The results, however, can be explained adequately in another way, without either of these assumptions, as follows:

The mycelia must be self sterile, and although haploid must be potentially bi-sexual. They fall into two definite groups, in the ratio of 1 : 1, and the members of each group are sterile *inter se*. This sterility can be explained on the basis of one self sterility factor *Aa*. This factor and its allelomorph would segregate at meiosis in the ascus, so that half the spores would receive *A*, and the other half *a*. As like will not fuse with like, mycelia carrying *A* will only fuse with *a*, and the only possible zygote is *Aa*. On this assumption the mono-ascospore mycelia from such a zygote would be of two kinds and would give 50 per cent of fertile combinations.

This is not sex heterothallism but a form of physiological heterothallism based on one self sterility factor in a haplo-synœcious fungus.

The same interpretation might be applied to the heterothallic Hymenomycetes; haplo-synœcism with one self sterility factor in the species showing bi-polar segregation, and two self sterility factors in the quadripolar species.

The results of the experiments on *Humaria granulata* tend to strengthen the evidence in favour of the conception of only two sexes in the fungi, and the occurrence of other factors which disturb their inter-reactions.

With regard to the results of the experiments on the heterothallic *Mucor hiemalis* (a species showing true haplo-heterœcism), it is not quite clear whether it is to be inferred that they bear upon the subject of nutritive heterothallism or not. The striking morphological and physiological changes induced by subjecting the mycelia to adverse conditions are interesting, but although zygospore formation may be completely inhibited, there is no evidence of nutritive heterothallism, and the repulsion shown by the mycelia of both strains suggests some form of staling. Neither does the production of imperfect zygospores support this view, as the formation of abortive fruiting bodies is not uncommon in the heterothallic fungi. In the Hymenomycetes, some strains are even capable of producing haploid fruiting bodies with viable spores, but these spores are all of the same sex (so called).

D. M. CAYLEY.

John Innes Horticultural Institution,
Merton Park, S.W.19, Mar. 6.

Projection of Long Spark upon the Yellow Spot of the Retina.

The entopic vision of the fovea centralis by an instantaneous illumination, especially by blue light, may be well known to ophthalmologists. The following observations, which were made during our physical experiments with long disruptive sparks of a characteristic type, may, however, be of some special interest.

A fine straight spark of several centimetres may be produced between two spherical electrodes of 3·5 cm. diameter which are continuously charged up by means of a Wommelsdorf machine with about 1 m. capacity in parallel, provided that a needle-point leakage is attached to the positive lead at a point not too near the spark gap. With this arrangement the usual irregular bending of spark tracks is effectively avoided, and nearly straight long sparks may be drawn successively at regular intervals. By projecting the magnified image of this spark on a ground-glass screen by means of a proper photographic lens, we obtain a fine luminous line of considerable length and of extremely short duration, which appears at the same position of the screen in regular succession. This constancy of spark track can only be obtained with the use of the needle above mentioned.

It is this type of spark which is specially suited for the observation of the physiological effect here in question. Place a blue filter glass in front of the photographic lens, or before the eye, and look at the image of the spark from a suitable distance. Using a single eye adapted to darkness for a sufficient time, the part of the luminous line corresponding to the foveal region appears very dark and of saturated blue colour. The dark segment seems to make a singular jerky motion, spreading out a little on both sides. This motion can be seen better when a short segment of the spark is observed, screening off the remaining part by an opaque sheet. On looking at a point on the immediate outside of one end of the luminous streak, luminosity seems to move towards the other end. Some observers seem to perceive also a momentary contracting motion of the dark segment at the beginning or the end of the expanding motion.

Outside the foveal region the luminosity appears to move towards the yellow spot. This may be observed most effectively when the eye is fixed at a point outside one end of the long spark image.

Another fact which may perhaps be of special interest is that when the image of the spark is thrown across the centre of the foveal region we may observe a pair of faint circular haloes on the two sides of the spark track. The interior of the halo is quite dark and the two dark discs touch the spark as well as each other. The screen was covered by a piece of cardboard with a slit slightly wider than the spark image, such that the faint illumination of the general background in the neighbourhood of the spark could be cut off. The halo remained. This is probably brought about by the propagation of excitation along the marginal part of the fovea centralis.

With a yellow filter, the foveal part appears brighter than the external part and bounded by dark fringes.

The experiments may be varied widely by altering the intensity and magnification of spark, the distance of the eye from the screen, the time interval of successive sparks, the time of adaptation of the eye to darkness, etc.

The visual angle of the foveal dark segment was measured and found to be considerably different for two observers.

Torahiko Terada.
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Tokyo.

The Absorption Spectrum of Selenium Dioxide.

The fact that selenium dioxide, a white solid, gives a brown vapour has been discussed by Meyer and Langner (*Ber.*, 60 B, 285; 1927), who conclude that the colour must be due to the dioxide and cannot be attributed to selenium liberated by dissociation.

The absorption spectrum of selenium dioxide has been partially described in a brief note by E. J. Evans and G. N. Antonoff (*Astrophys. Jour.*, **34**, 277 ; 1911), who, using 0·006 gm. of the material in an evacuated tube at temperatures ranging from 360° to 900° C., observed absorption band heads from λλ3930 to 4470 A. and, at the highest temperature, continuous absorption below λ4200 A. But absorption in this region will not account for the brown colour of the vapour, which is observed, moreover, at temperatures of the order of 300°-400° C. The spectrum has now been photographed in this laboratory on a Hilger E.1 quartz spectrograph and banded structure has been found to extend over a much wider range, namely, λλ3840 to 5740 A.

Evans and Antonoff's result may be due to the selenium dioxide vapour in the tube not being saturated, and further to the fact that selenium dioxide dissociates rapidly *in vacuo*. For this reason, in the present work excess of selenium dioxide was taken and the tube filled with oxygen at a pressure of half an atmosphere at room temperature before sealing off.

The pyrex absorption tube was 1½ metres long and was heated electrically to temperatures ranging from 250° to 400° C. according to the region of the spectrum it was desired to observe. I am indebted to Mr. T. W. Parker, of the Chemistry Department of this College, for a supply of freshly prepared selenium dioxide.

In the near ultra-violet and violet a regular series of diffuse heads is observed, some of which have an appearance of a very complex and fine structure. The diffuseness may thus be due to insufficient resolving power. In the blue-green, green and yellow, the obvious regularity disappears, but there are a number of sharp heads, degraded to the red.

This spectrum is presumably due to selenium dioxide, since saturated selenium vapour at a temperature of the order of 400° C., in a similar tube, was found to give no absorption in the region in question. Evans and Antonoff obtained selenium absorption bands in this region, but at a higher temperature : at 300° C., absorption was confined to the region λλ3200-3700. Further, when an evacuated absorption tube was used in the present work, the spectrum gradually disappeared owing to the dissociation of the selenium dioxide.

The wave-lengths of the band heads are now being measured, and it is hoped to give fuller details elsewhere.

S. F. Evans.
Physics Department,
Armstrong College (University of Durham),
Newcastle-upon-Tyne.

Dissociation Energy of Zn_2 Molecules.

It has been shown by me (*Zeits. f. Phys.*, **55**, 338 ; 1929) that the dissociation energy of Hg_2 molecules is greater than has been supposed. Also, for Cd_2 molecules several optical data show that we have to deal with high dissociation energy (23 kcal./mol. given by Jablonski). The dissociation energy of Zn_2 molecules found by Winans cannot be considered as probable, because Jablonski and Kapuscinski have shown that the considerations of Winans led to erroneus value for the dissociation energy of Cd_2 molecules. Therefore it seems interesting to make direct measurement of the evaporation energy of Zn_2 molecules. This last value was found from changes of the band absorption coefficient to be dependent upon the temperature of saturated zinc vapour. Preliminary microphotometric measurements of photographic plate density were made for three wavelengths, 2313, 2502, and 2558 A. for the range of temperatures 790°-920° C. The results of calculations give a number of values which do not differ more than 3 kcal./mol. from the average value 32 kcal.-mol. It is thus possible to give in a table a comparison of energies of evaporation of atoms (1), of corresponding molecules (2) and their dissociation energies (3), for three elements—zinc, cadmium, and mercury (in kcal./mol.):

	1.	2.	3.
Zinc . . .	30·5	32	29
Cadmium . .	26·5	30	23
Mercury . .	14·5	11	18

The value of evaporation energy of Hg_2 molecules was given by me in a former paper (l.c.); the dissociation energy of Zn_2 and Hg_2 molecules results from the corresponding evaporation energies of atoms and molecules; the value of evaporation energy of Cd_2 molecules were found by putting for the dissociation energy the value given by Jablonski.

These results show that the absorption band system of zinc vapour found by Mohler and Moore in the wave-length range 2636-2551 A. corresponds to the 2^3P-1^1S_0 atom transition. For the author found the continuation of this band system in the directions of shorter and longer wave-lengths; the limit of convergence of these bands corresponds sufficiently well to the calculated dissociation energy of Zn_2 molecules.

S. MROZOWSKI.

Physical Laboratory of the Society
of Sciences and Letters, Warsaw.

Electronic Fine Structure in Helium Bands.

EXPERIMENTAL evidence for the triplet nature of the $2\pi^3\Pi_a$ and $2\pi^3\Pi_b$ terms of the helium molecule has recently been given by Prof. Mulliken and Dr. Monk

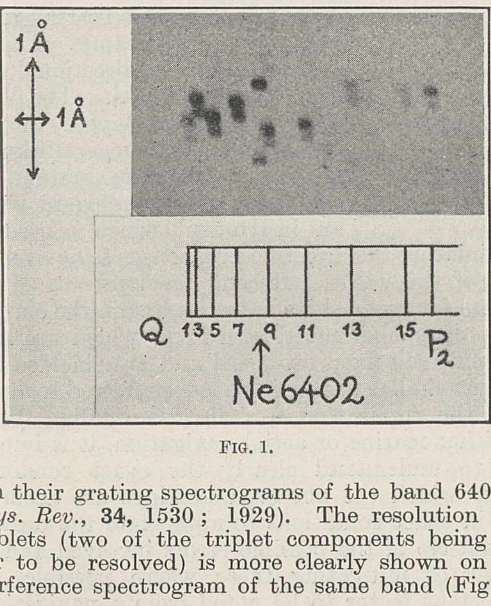

FIG. 1.

with their grating spectrograms of the band 6400 A. (*Phys. Rev.*, **34**, 1530; 1929). The resolution into doublets (two of the triplet components being too near to be resolved) is more clearly shown on our interference spectrogram of the same band (Fig. 1). The photograph was taken by projecting horizontal fringes formed by a 40-plate echelon (resolving power, *c.* 400,000) on to the fairly wide slit of a plane grating spectrograph, the latter giving a dispersion of 3·2 A. per mm. in the first order. The exposure was one hour. The neon (impurity) line 6402·246 A. served as the standard of measurements, as this line appears in two consecutive orders, their distance $\Delta\lambda_{max}$ being 0·64057 A.

The measured doublet separations are:

BAND 6400 A.

Line.	Q_1.	Q_3.	Q_5.	Q_7.	Q_9.	Q_{11}.	Q_{13}.	Q_{15}.
$\Delta\lambda$ (A.)	0·145	0·115	0·119	0·114	0·109	0·111	0·10	0·08
$\Delta\nu_a$ (cm.$^{-1}$)	0·354	0·281	0·290	0·278	0·266	0·271	0·24	0·21

Line.	P_2.
$\Delta\lambda$ (A.)	0·110
$\Delta\nu_b$ (cm.$^{-1}$)	0·268

Further investigation on this and other helium bands, using a tube cooled with liquid air, is in progress.

SUNAO IMANISHI.

The Institute of Physical and
Chemical Research,
Komagome, Tokyo,
Japan, Feb. 20.

Coloured Glass as a Deterrent to House Flies.

SOME years ago Messrs. W. P. Hartley, Ltd., jam manufacturers, Aintree, glazed their storage warehouses with yellow glass. The warehouses are connected by corridors which were glazed with ordinary glass. They noticed that whereas there were always plenty of flies in the corridors these never went into the warehouses. They then glazed the corridors with yellow glass, and found that they got rid of the flies from these also.

We have heard of other instances where coloured glasses have been used as a deterrent for flies, and we understand that some abattoirs have been glazed with blue glass.

As we were continually being asked for advice on this subject, we decided to carry out some experiments in an endeavour to ascertain whether the house fly was susceptible to coloured light, and if so, which colour was the best deterrent. We carried out a series of experiments last summer under advice from Prof. R. Newstead, and found that, everything else being equal, the house fly prefers white light to coloured light, and that red and yellow are the best deterrents. Blue and green are not nearly so effective. The loss in illumination with red glass being too great for general use, it appears that yellow is the best.

Although it cannot be claimed that the use of yellow glass is an absolute preventive, it is a very effective deterrent, and valuable for use in connexion with the storage of food.

We do not suggest the use of yellow glass for any building in which people are continually employed, because it has been found that yellow light is bad for the eyes and general health.

We cannot find a record of any work on this subject, and intend to continue our experiments during the coming summer. In the meantime we wonder whether any readers of NATURE have noticed this peculiar attitude of the house fly towards coloured light, and can offer any explanation.

PILKINGTON BROTHERS LTD.

Crown Glass Works,
St. Helens, Lancs,
Mar. 17.

Radio Direction-Finding by Transmission and Reception.*

By Dr. R. L. SMITH-ROSE.

THE application of the rotating closed loop direction-finder, both as a navigational instrument and as a useful scientific tool in the study of the propagation of electro-magnetic waves, has been developing rapidly during the past few years. So long ago as 1901 the performance of a direction-finder was being studied in America, but owing to its comparative insensitiveness as a receiver the modern radio direction-finder owes its success very largely to the introduction of valve amplifiers, which enabled a moderately large reception range to be obtained. The practical development of the instrument, therefore, dates from about 1915.

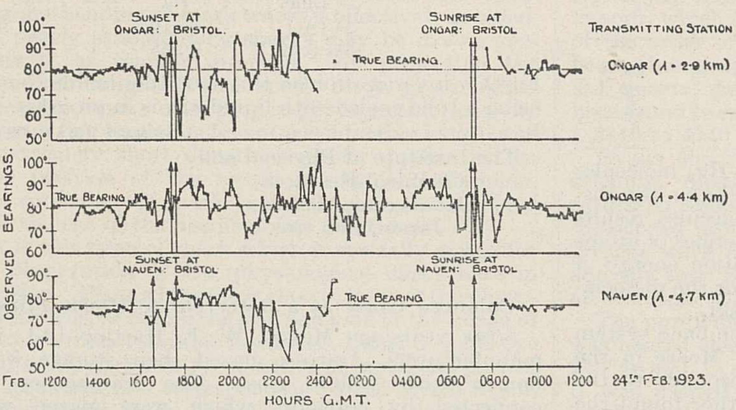

FIG. 1.—Graphs of observed bearings of Ongar (undamped waves, λ = 2·9 km. and 4·4 km.) and Nauen (undamped waves, λ = 4·7 km.) taken at Bristol over a 24-hour period.

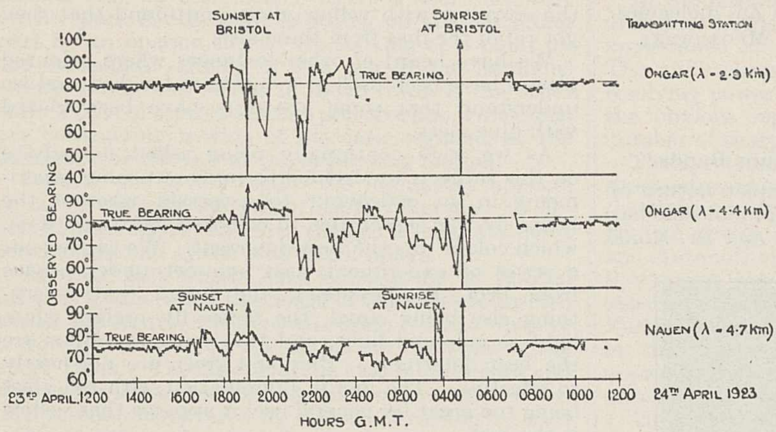

FIG. 2.—Graphs of observed bearings of Ongar (undamped waves, λ = 2·9 km. and 4·4 km.) and Nauen (λ = 4·7 km.) taken at Bristol over a 24-hour period.

THE RADIO DIRECTION-FINDER.

The several commercial types of direction-finder now in use employ the same fundamental principle of the reception of vertically polarised † wireless waves by a closed coil. In the attachment of a valve amplifying receiver to the rotating closed coil, the possibility of obtaining spurious electromotive forces in the system is introduced on account of the phenomena generally known as the 'antenna effect' of the coil and the 'direct pick-up' of signal electromotive force on various parts of the receiver. These spurious electromotive forces make themselves evident by a blurring of the signal zeros, with or without a displacement of these zeros from their correct positions. The methods adopted for overcoming these effects are based upon the use of somewhat elaborate screening arrangements, which were employed in the first place in the construction of direction-finders for accurate research purposes but are now being applied to commercial instruments. In the commercial pattern of rotating loop marine direction-finder, the receiving coil is enclosed in a metallic shielding tube mounted on a robust column on the deck above the operating room, in which the rotation of the loop and all receiving adjustments can be effected when it is desired to make bearing observations upon any incoming signals. In the case of such use of a direction-finder on board ship, the bearing is taken relative to the ship's head, and it is necessary to obtain this direct from the compass reading in order to make the wireless bearing refer to a great circle direction.

Before the development of valve amplifiers made possible the use of rotatable multi-turn loops, Artom, Bellini, and Tosi suggested and used large frames of a triangular shape for directional wireless communication. The large fixed loops employed in this arrangement, now generally known as the Bellini-Tosi system, are connected to a radiogoniometer, an instrument which reproduces in miniature the directive properties of the external field of the waves. Recent developments of this system for use in ships have resulted in the employment of smaller multi-turn loops which are more conveniently fixed on board and are shielded in a manner similar to the single loops referred to above.

In the application of a direction-finding system to either marine or aerial navigation, it is important to understand clearly the exact conditions under which the observed bearings are accurate, and in other conditions to appreciate the order of magnitude of the possible errors involved and the means of mitigating these where possible. An important factor to be noted from a navigational

* Abstract of a lecture delivered at the Royal Institution on Feb. 6.
† The term 'vertically polarised' is used here to indicate that the electric force of the wave lies in the vertical plane of propagation.

point of view is that of any effect of fog on direction-finding, since it is generally during foggy weather that the majority of marine direction-finders are called into action. The experience of all observers for several years past is in agreement that the existence of fog, whether local or widespread, gives rise to no abnormal effects in direction-finding.

Various conditions may be present in the neighbourhood of a direction-finding station to cause an error in the bearing observed on a distant transmitting station. From various detailed investigations into the causes of such errors, it is known that the most prominent effects are due to masses of metal work and wires, either above or below the earth's surface, and to trees. In most cases where the directional station is situated on land, it is possible to select a site which is largely, if not entirely, immune from such effects. In the case of the use of a direction-finder on board ship, it is impossible to be clear of the metal work of the ship itself, and the resulting bearings are subject to a quadrantal error which can either be compensated by circuit adjustment or corrected for by a chart.

Another type of error which is of some importance in the application of direction-finding to marine navigation is that due to the deviation of wireless waves in crossing a coast line when the path of the waves lies approximately parallel to the coast. On wave-lengths of from 450 metres to 1000 metres, normally used for marine working, the coastal error is of the order of 2°–4° when the direction of transmission is within 20° of the coast line. The error is always such as to indicate a bending of the waves towards the normal to the coast line in passing from the sea to the land side of the boundary. In connexion with these coastal errors, it is worthy of note that, with the accumulation of experience of the use of direction-finders on board ship, it is now becoming customary to mark out on charts the 'arcs of good bearings' of various transmitting stations within which results of observations are found to be trustworthy.

As an illustration of the reliability of direction-finding as applied to marine navigation, the results of some tests carried out between a direction-finding station on the east coast of England and various ships crossing the North Sea may be quoted. At the various ranges of transmission up to nearly 120 miles, the limiting error of the direction-finder bearing was about 4°. In more than 80 per cent of the cases the wireless bearings were correct to within 1°, while the proportion correct to within 2° was nearly 95 per cent. These figures refer to bearings taken at a shore station on transmissions from ships across an intervening open sea path at ranges up to about 100 miles. Since it is now generally agreed that an accuracy of 2° is adequate for most navigation purposes, it is evident that under its ordinary conditions of use the direction-finder is a very trustworthy and useful aid to marine navigation. Similar results to the above are obtainable with the direction-finder installation fitted on board ship and observations made on the transmissions from a shore station. A large number of fixed beacon transmitting stations are now in operation in various parts of the world for the specific purpose of emitting a regular series of signals for the use of ships fitted with direction-finders.

NIGHT ERRORS.

When the range of transmission is greater than the figure mentioned above, the accuracy of the observed direction-finder bearings is liable to depreciate during the hours of darkness, when some erratic variations of the observed bearings take place, accompanied by a change in quality of the signal minima. The general nature of these variations can be understood from the typical graphs given in Figs. 1 and 2, which show the apparent bearings of some fixed transmitting stations as observed every few minutes over periods of twenty-four hours at one observing station. On the wave-lengths in question, of 2000–4000 metres, it is to be noticed that the day bearings are much steadier in the summer than in the winter months, but that in either case the approach of sunset is accompanied by an increase in the magnitude and frequency of the variable errors which continues

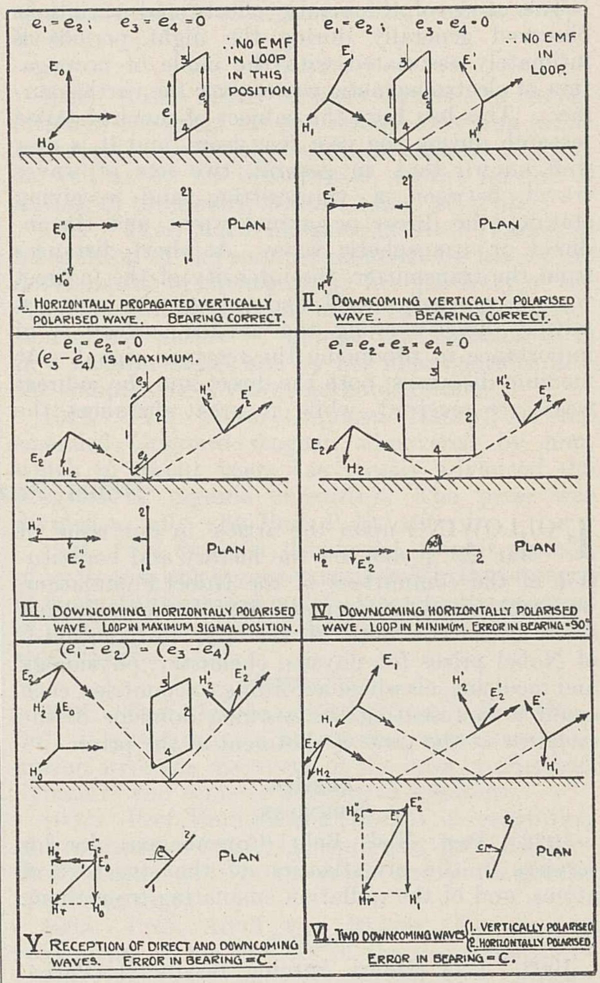

FIG. 3.

throughout the night until sunrise. Such variable errors may range up to 90° or more, but it is noteworthy that during the night periods the observed bearings show no signs of a definite systematic error, and so the variations are on the whole equally distributed about the true bearing. The larger errors are also comparatively rare; in fact, observations over long periods have shown that it is seldom that more than 10 per cent of the night observations give an error exceeding 10°.

The cause of the erratic effects and variations observed generally during the night periods is intimately associated with the mode of propagation of electromagnetic waves over the earth's surface. This has been the subject of much detailed research during the past few years, and it is now well known that, in general, two sets of waves travel between a transmitting and receiving station—the direct or ground wave, and the indirect or atmospheric wave. At short distances from the transmitter, the intensity of the indirect wave is generally small, and only the wave transmitted directly along the earth's surface is of importance in producing the received signal. At medium distances, both the direct and the indirect wave are received, while at great distances the major part or the whole of the received signal is due to the indirect wave which has travelled through the upper atmosphere.

In order to explain the variations in apparent bearings on the closed type of direction-finder we have been considering, it is necessary to assume that the plane of polarisation of the downcoming waves may vary. This is undoubtedly caused by a rotation of the plane of polarisation which takes place while the waves are travelling through the ionised regions of the atmosphere and is due to the presence of the earth's magnetic field. In Fig. 3, diagrammatic illustrations are given of a number of simple cases of the reception of wireless waves on a closed loop, and from these it will be seen that it is the horizontal component of the electric force of the downcoming waves which is responsible for producing an error in bearing. So long as the vertically polarised direct wave is strong compared with the horizontally polarised component of the downcoming waves, the error in bearing will be small. Thus the variations in bearings close to the transmitter will be small, a conclusion which is confirmed in practice, for night variations are not experienced at distances less than about 30 miles for overland working.

(To be continued.)

Nobel Prize Awards.

FOLLOWING upon the article in our issue of Mar. 29, p. 495, on the history and constitution of the committees of the Nobel Foundation, we print below a complete list of the recipients since 1901—the date of the first distribution—of Nobel prizes for physics, chemistry, physiology and medicine, classified according to countries, each country representing the working domicile of the recipient at the time of allotment of the prize.

Physics.

Denmark.

1922. Prof. Niels Bohr (Copenhagen), for his services in the investigation of the structure of atoms, and of the radiation emanating from them.

France.

1903. Prof. Henri Antoine Becquerel (Paris). In recognition of the special services rendered by him in the discovery of spontaneous radioactivity. One half the prize allotted, the other half divided equally between Prof. Pierre Curie (Paris) and Madame Curie, for special services rendered by them in the work they carried out jointly in investigating the phenomena of radiation discovered by Henri Becquerel.

1908. Prof. Gabriel Lippmann (Paris), for his method, based upon the phenomenon of interference, for reproducing colours by photography.

1909. Prof. Ferdinand Braun (Strasbourg), in recognition of services in the development of wireless telegraphy. The prize was divided equally with G. Marconi (Italy).

1920. M. Charles Edouard Guillaume (Sèvres), in recognition of his services to the physics of precision by his discovery of anomalies in nickel steel alloys.

1926. Prof. Jean Perrin (Paris), for his works on the discontinuous structure of matter, and especially for his discovery of the equilibrium of sedimentation.

1929. M. Louis Victor de Broglie (Paris), for his discovery of the wave-character of the electrons.

Germany.

1901. Prof. Wilhelm Conrad Röntgen (Munich), in recognition of the exceptional services rendered by him in the discovery of the special rays which have been called after him.

1905. Prof. Philipp Lenard (Kiel), for his work in connexion with cathode rays.

1911. Prof. Wilhelm Wien (Würzburg), for his discoveries regarding the laws governing the radiation of heat.

1914. Prof. Max von Laue (Frankfort-on-Main), for his discovery of the defraction of Röntgen rays on passing through crystals.

1918. Prof. Max Planck (Berlin), for his discoveries in connexion with the quantum theory. Awarded in 1919.

1919. Prof. Johannes Stark (Greifswald), for his discovery of the Doppler effect in canal rays, and of the decomposition of spectrum lines in an electric field.

1921. Prof. Albert Einstein (Berlin), for his services to the theory of physics, and especially for his discovery of the law of the photo-electric effect.

1925. Prof. James Franck (Göttingen), and Prof. Gustav Hertz (Halle), for their discovery of the laws governing the impact of an electron upon an atom. The prize was divided equally in 1926.

GREAT BRITAIN.

1904. Lord Rayleigh, for his investigations into the density of the most important gases, and for his discovery of argon in connexion with these investigations.

1906. Prof. Joseph John Thomson, in recognition of the great services rendered by him in his theoretic and experimental investigations regarding the passage of electricity through gases.

1915. Prof. William Henry Bragg and Prof. William Lawrence Bragg, for their services in the analysis of crystal structure, by means of X-rays. The prize was divided equally.

1917. Prof. Charles Glover Barkla, for his discovery of the characteristic Röntgen radiation of the elements. Awarded in 1918.

1927. Prof. Charles Thomson Rees Wilson, for the method discovered by him of perceiving by condensation of steam the paths taken by electrically charged particles. The prize for this year was divided equally with Prof. A. H. Compton (United States).

1928. Prof. Owen Willans Richardson, for his researches upon the thermionic phenomenon, and especially for his discovery of the law named after him. Awarded in 1929.

ITALY.

1909. Guglielmo Marconi (born Bologna), in recognition of services in the development of wireless telegraphy. The prize was divided equally with Prof. Ferdinand Braun (Strasbourg).

NETHERLANDS.

1902. Prof. Hendrik Antoon Lorentz (Leyden), and Prof. Pieter Zeeman (Amsterdam), in recognition of the special services rendered by them in their investigations regarding the influence of magnetism upon the phenomena of radiation. The prize was divided equally.

1910. Johannes Diederik van der Waals (formerly at Amsterdam), for his work in connexion with the equation of state for gases and liquids.

1913. Prof. Heike Kamerlingh Onnes (Leyden), in recognition of his investigation into the properties of matter at low temperatures which led, amongst other things, to the production of liquid helium.

SWEDEN.

1912. Gustaf Dalén (Stockholm), for his discovery of automatic regulators, which can be used in conjunction with gas accumulators for lighting lighthouses and light buoys.

1924. Prof. Karl Manne Georg Siegbahn (Uppsala), for his discoveries and investigations in X-ray spectroscopy. Awarded in 1925.

UNITED STATES.

1907. Prof. Albert Abraham Michelson (Chicago), for his optical instruments of precision, and the spectroscopic and metrologic investigations which he carried out by means of them.

1923. Prof. Robert Andrews Millikan (Pasadena, California), for his works on the elementary charge of electricity, and on photoelectric phenomena.

1927. Prof. Arthur Holly Compton (Chicago), for his discovery of the phenomenon known by his name. The prize for the year was divided equally with Prof. C. T. R. Wilson (Great Britain).

The prize for physics for the year 1916 was allocated to the Special Fund for this section.

Chemistry.

AUSTRIA.

1923. Prof. Fritz Pregl (Gratz), for the method of micro-analysis of organic substances discovered by him.

FRANCE.

1906. Prof. Henri Moissan (Paris), in recognition of the great services rendered by him in his investigation and isolation of the element fluorine, as well as by his introduction to the service of science of the electric furnace called after him.

1911. Prof. Marie Skledowska Curie (Paris), in recognition of the services rendered by her to the development of chemistry, by her discovery of the elements radium and polonium, by her determination of the nature of radium, and isolation of it in a metallic state, and by her investigations into the compounds of this remarkable element.

1912. Prof. Victor Grignard (Nancy), for the so-called Grignard reagent, discovered by him, which in recent years has greatly advanced the progress of organic chemistry. The prize was divided equally with Prof. P. Sabatier.

Prof. Paul Sabatier (Toulouse), for his method of hydrogenating organic compounds in the presence of finely disintegrated metals, whereby the progress of organic chemistry has been greatly advanced in recent years.

GERMANY.

1901. Prof. Jacobus Hendrik van 't Hoff (Berlin), in recognition of his special services in connexion with the discovery of the laws of chemical dynamics and osmotic pressure in solutions.

1902. Prof. Emil Fischer (Berlin), in recognition of his special services in connexion with his synthetic experiments in the sugar and purin groups of substances.

1905. Prof. Adolf von Baeyer (Munich), in recognition of his services in the development of organic chemistry and chemical industry, through his work on organic dyes and hydro-aromatic combinations.

1907. Prof. Eduard Buchner (Berlin), in recognition of his investigations in biological chemistry and his discovery of cell-less fermentation.

1909. Prof. Wilhelm Ostwald (Leipzig), in recognition of his works on catalysis, as well as for his investigations into the fundamental principles governing chemical equilibrium and rates of reaction.

1910. Prof. Otto Wallach (Göttingen), in recognition of the services rendered by him to organic chemistry and the chemical industry, through his pioneer work in the field of alicyclic compounds.

1915. Prof. Richard Willstätter (Munich), for his researches into the colouring matter of plants, especially chlorophyll.

1918. Prof. Fritz Haber (Berlin-Dahlem), for the synthetic production of ammonia from its elements. Awarded in 1919.

1920. Prof. Walther Nernst (Berlin), in recognition of his work in thermo-chemistry. Awarded in 1921.

1925. Prof. Richard Zsigmondy (Göttingen), for his exposition of the heterogeneous nature of colloid solutions, and for the methods he used in that connexion, which have become a determining factor in the modern chemistry of colloids. Awarded in 1926.

1927. Prof. Heinrich Wieland (Munich), for his investigations into the constitution of the bile acids and kindred substances. Awarded in 1928.

1928. Prof. Adolf Windaus (Göttingen), for his services in the investigation of the constitution of the sterols and their connexion with the vitamins.

Great Britain.

1904. Sir William Ramsay, in recognition of his services in the discovery of the inert gaseous elements in air, and the determination of their place in the periodic system.

1908. Prof. Ernest Rutherford, for his investigations into the disintegration of elements, and the chemistry of radioactive substances.

1921. Prof. Frederick Soddy, for his contributions to the chemical knowledge of radioactive substances, and his investigations into the origin and nature of isotopes. Awarded in 1922.

1922. Dr. Francis William Aston, for his discovery of a great number of isotopes in several non-radioactive elements, by means of his mass spectrograph, as well as for his discovery of the whole number rule.

1929. Prof. Arthur Harden, for investigations on the fermentation of sugars and of fermentative enzymes. The prize was divided equally with Prof. Hans von Euler-Chelpin (Stockholm).

Sweden.

1903. Prof. Svante August Arrhenius (Stockholm), in recognition of special services rendered by him to the development of chemistry by his electrolytic theory of dissociation.

1926. Prof. Theodor Svedberg (Uppsala), for his works on disperse systems.

1929. Prof. Hans von Euler-Chelpin (Stockholm), for investigations on the fermentation of sugars and of fermentative enzymes. The prize was divided equally with Prof. A. Harden (Great Britain).

Switzerland.

1913. Prof. Alfred Werner (Zurich), in recognition of his works on the linking up of atoms within the molecule, whereby new light has been thrown upon older fields of research, and new fields have been opened up, especially within the realm of inorganic chemistry.

United States.

1914. Prof. Theodore William Richards (Harvard), in recognition of his accurate determination of the atomic weight of a large number of chemical elements. Awarded in 1915.

The prizes for the years 1916, 1917, 1919, and 1924 were allocated to the Special Fund for this section.

Physiology and Medicine.

Austria.

1914. Robert Barany (Vienna), for his work on the physiology and pathology of the vestibular system. The prize was awarded in 1915.

1927. Prof. Julius Wagner-Jauregg (Vienna), for his discovery of the therapeutic value of malaria inoculation in the treatment of dementia paralytica.

Belgium.

1919. Prof. Jules Bordet (Brussels), for his discoveries in connexion with immunity. Awarded in 1920.

Canada.

1923. Prof. Frederick Grant Banting (Toronto), and Prof. John James Richard MacLeod (Toronto), jointly, for the discovery of insulin.

Denmark.

1903. Prof. Niels Ryberg Finsen (Copenhagen), in recognition of his treatment of disease, especially *lupus vulgaris*, with concentrated light rays.

1920. Prof. August Krogh (Copenhagen), for his discovery of the regulation of the motor mechanism of capillaries.

1926. Prof. Johannes Fibiger (Copenhagen), for his discovery of the Spiroptera carcinoma. Awarded in 1927.

France.

1907. Charles Louis Alphonse Laveran (Paris), for his work on the part played by protozoa in the generation of disease.

1908. Prof. Elie Metchnikoff (Paris), for work (with Prof. Ehrlich) on immunity. The prize was divided equally with Prof. Paul Ehrlich (Frankfort-on-Main).

1913. Prof. Charles Richet (Paris), for his work on anaphylaxy.

Germany.

1901. Prof. Emil Adolf von Behring (Marburg), for his work on serum therapy against diphtheria.

1905. Prof. Robert Koch (Berlin), for his work on tuberculosis.

1908. Prof. Paul Ehrlich (Frankfort-on-Main), for work (with Prof. Metchnikoff) on immunity. The prize was divided equally with Prof. Elie Metchnikoff (Paris).

1910. Prof. Albrecht Kossel (Heidelberg), for his achievements in the chemistry of the cell, by his works on proteins, the nucleic substances included.

1922. Prof. Otto Meyerhof (Kiel), for his discovery of the correlation between the consumption of oxygen and the production of lactic acid in the muscles. The prize for the year was divided equally in 1923 with Prof. A. V. Hill (Great Britain).

Great Britain.

1902. Sir Ronald Ross, for his work on malaria.

1922. Prof. Archibald Vivian Hill, for his discovery relating to the heat-production of muscles. The prize for the year was divided equally in 1923 with Prof. O. Meyerhof (Kiel).

1929. Sir Frederick Gowland Hopkins, for the discovery of growth-promoting vitamins. The prize was divided equally with Dr. C. Eijkman, Utrecht.

Italy.

1906. Prof. Camillo Golgi (Pavia), for work (with Prof. Ramón y Cajal) on the structure of the nervous system. The prize was divided equally with Prof. Ramón y Cajal (Madrid).

Netherlands.

1924. Prof. Willem Einthoven (Leyden), for his discovery of the mechanism of the electrocardiogram.

1929. Dr. C. Eijkman (Utrecht), for the discovery of the anti-neuritic vitamin. The prize was divided equally with Sir Frederick Gowland Hopkins (Great Britain).

Russia.

1904. Prof. Ivan Petrovitch Pavlov (St. Petersburg), in recognition of his work on the physiology of digestion.

Spain.

1906. Prof. Santiago Ramón y Cajal (Madrid), for work (with Prof. Golgi) on the structure of the nervous system. The prize was divided equally with Prof. Camillo Golgi (Pavia).

Sweden.

1911. Prof. Allvar Gullstrand (Uppsala), for his work on the dioptrics of the eye.

Switzerland.

1909. Prof. Theodor Kocher (Berne), for his work on the physiology, pathology, and surgery of the thyroid gland.

Tunisia.

1928. Dr. Charles Nicolle (Tunis), for his work on typhus exanthematicus.

United States.

1912. Dr. Alexis Carrel (New York), for his work on vascular ligature and on the grafting of blood vessels and organs.

The prizes for the years 1915, 1916, 1917, 1918, 1921, and 1925 were allocated to the Special Fund for the section.

On Founder's Day, Dec. 10, the anniversary of the death of Dr. Nobel, the adjudicators hand to the designated prize-winners a draft on the Foundation for the amount due, together with a diploma and a medal in gold, bearing the testator's effigy on the obverse, and an emblematic design on the reverse.

It is incumbent on a prize-winner to give a lecture, if feasible, on the subject of the work for which the prize was awarded, within six months of the Founder's Day at which the prize was won, and to be given at Stockholm.

Obituary.

Edward Clodd.

"Thou pirate nested over Alde !
Stern wrecker of the Established Faith !
From whom the parson shrinks appalled
. . . .
A beacon to thy fellows, Clodd."
George Meredith, 1899.

Edward Clodd was born at Margate on July 1, 1840. He died at his home, Strafford House, Aldeburgh, on Mar. 16. He had been cruelly paralysed and largely deprived of his speech during nearly two years past but was otherwise mentally alert; he was overcome by a sudden attack of asthma, lasting barely a week. His body was cremated, at Ipswich, on Mar. 20, at the close of a short Rationalist service at which the few who remain of his old friends were mostly present. His ashes are now cast into Aldeburgh Bay. He seems to have passed away in full consciousness, satisfied to have made good use of his earthly heritage, free from all selfish wish on his own account—only sorry to go because he found the world so intensely interesting. His great friend Hardy held this view at the end. To have been with such men is to know the peace that knowledge can give.

He came from the sea and the soil, the name being one of long standing in Suffolk. At the time of his birth, his father was captain of a brig. He was nurtured at the brink of the sea, at Aldeburgh, of which small town his parents were natives. On joining his yacht, the *Lotus*, you naturally reported yourself—"Come aboard, Sir", he was so thoroughly the stocky, sturdy sailor in figure, with all the sailor's winsome ways. Behind the sailor was a man of an astounding literary culture, burning with curiosity, ever seeking really to know ; at heart he was both the man of letters and the scientific inquirer, a rare combination—though without technical training. He was self-educated in this respect and with wonderful finish. His mother taught him to read, the Bible especially ; to the end, he advocated its use, not in the service of dogmatic teaching but as the greatest work of literature in our language.

Clodd was simply but well trained up to fifteen years of age, at the Aldeburgh Grammar School. The head, Mr. Buck, definitely imbued him with the love of learning ; at his suggestion, in later years (1861), he was to write a guide to Aldeburgh. In 1865 he produced a life of Crabbe, the Aldeburgh poet ; the literary afflatus was in him from an early age. He was meant for the Church but his imagination was so stirred, in 1851, by a visit to the Great Exhibition, that in 1855, like Whittington, he took his future into his own hands and went to London town, where he had an aunt and an uncle. After serving in various offices, in 1862 he became a clerk in the London Joint Stock Bank ; he then married. Ten years later he was appointed secretary, a position he held until June 1915. Although not built of business stuff, he was exactly fitted for this office. It brought him into contact with many interesting men. One instance he gave me—when Hughes, who later invented the microphone, came over from America, he called at the bank and saw Clodd; on leaving he deposited £7000 he had saved mostly from his earnings as a teacher of music. This was at the time when gas was at its lowest owing to the introduction of the electric light and it was by happy investment in gas stock that Hughes was able to amass his fortune. When he died he appointed Clodd his trustee. Clodd was also trustee to 'Amazon' Bates and to Holman Hunt.

He had two great gifts—the one to which he owed his literary success was the rare one of reading exactly. Taking down any book in his library, you saw at once that it had been read word for word. Passage after passage would be underlined and a multitude of cross references written in the margin. Press notices and letters from the authors were to be found in most. He had an astounding memory and to the last remembered what he read. He was a critical master of anthropological literature.

In his first London days he not only read hard but also attended sermons and lectures. It was the time when scientific criticism began to stir the intellectual world and he was soon caught in the stream. He early began to wear the shoes of Nonconformity loosely; they were unlatched when he wrote his "Childhood of the World" (1872) and came off altogether in writing his really daring "Jesus of Nazareth" (1880). From that time onwards, he was a declared anti-clerical. He was a Rationalist through intense logical study of the evidence. He was stirred to write the "Childhood" by asking himself in all sincerity how and what he could safely and honestly teach his young children: he soon felt obliged to depart from current practice. "Jesus of Nazareth" appeared as a gift from the gods to a man like Huxley, to Ruskin it was anathema. The original 'author's copy' on his shelves has in it a most remarkable set of letters received from all and sundry, including advanced clerics, giving their opinions upon the work. Although he had no use for man-made gods, no use for metaphysics, at heart he was deeply religious.

Clodd's second gift, that which made him so loved, was his abounding genius for friendship. His books soon brought him recognition but he had only to make one friend to be offered another and he never hesitated to offer himself freely, even to strangers, if he wished to know them. His Aldeburgh home became a magnetic centre to men of distinction in every walk, excepting politics and the church.

His "Memories" (1916) gives some picture of the variety of Clodd's friendships. Hardy and Meredith were among them; he had author's copies of many of their works. Not a little of the delight of his week-ends was derived from excursions on the Alde in *Lotus* I and II—a small sturdy vessel built much upon his own lines, which sailed almost as close to the wind as he did to dogmatists and doctrine-mongers. I was out with him on his last cruise, two years ago. I shall never forget two occasions when his great friend Sir Mortimer Durand was our only companion. Of course we discussed far Cashmere and Persia. On one of these, a violent thunderstorm, which forced us to down all sail until the clouds rolled by, brought us close to the inner meaning of things: as we now are by the life of a man like Edward Clodd, verily of the salt of the earth. He seemed to have no original genius, yet an innate gift of using knowledge to the full. Is it not time that we followed the great example of scientific service that he has set and made our knowledge of more avail? Relatively, to-day, there is great over-production of knowledge, great under-production of users of knowledge on the public behalf.

Henry E. Armstrong.

Clodd was one of those numerous business men in whom Great Britain may justly pride itself, who devote their leisure to scientific and literary pursuits. During forty-three years he was secretary of the London Joint Stock Bank, but found time to read widely in science and literature, and being endowed with a notable gift of friendship, he became the friend of such diverse people, to name only a few, as T. H. Huxley, Sir William Huggins, R. A. Proctor, H. W. Bates, Joseph Thomson, Paul du Chaillu, Edward Whymper, Sir Alfred Lyall, J. Cotter Morison, F. York Powell, George Meredith, W. Holman Hunt, Andrew Lang, Samuel Butler, Thomas Hardy.

When "The Origin of Species" was published, Clodd was an ardent and inquiring young man of twenty, and the discussions which arose interested him keenly; the publication of "Essays and Reviews", followed ten years later by "Primitive Culture", together with wider reading, finally emancipated him from the strict orthodoxy in which he had been brought up. Owing to the absence of a book suitable for the young on the story of man's progress, Clodd wrote "The Childhood of the World: a Simple Account of Man's Origin and Early History" (1873), which has gone through numerous editions and been translated into many European languages and even into Becowana and Secwana. It is impossible to estimate what effect this lucid and charming presentation of 'the new learning' had in Europe and America. The polemics of the mighty were thus made easily understandable, and the young were made aware of the trend of modern thought in a manner that must have influenced their outlook on life.

Two years later "The Childhood of Religion" inevitably followed, and also had a great sale. Here Clodd was treading on more debatable ground, but the spirit in which it was written is admirable, though it doubtless alarmed some readers. "The Story of Creation: a Plain Account of Evolution" appeared in 1888 and rapidly went through many editions, and it also must have considerably, if unconsciously, affected the rising generation. In 1895 followed "A Primer of Evolution" and "The Story of Primitive Man". "Pioneers of Evolution from Thales to Huxley", in 1897, was the last of his popular expositions of evolution.

Clodd was from its early days an active member of the Folk-Lore Society, of which he was president in 1895 and 1896. Besides his two presidential addresses, he made various contributions to the Society's journal. In 1885 he published "Myths and Dreams", and in 1898, "Tom Tit Tot, an Essay on Savage Philosophy in Folk-lore", which is a delightful example of one aspect of the study of folk-lore. A compact little book, "Animism the Seed of Religion", appeared in 1905, and "Magic in Names and in other Things" in 1920; this is the most elaborate of Clodd's writings on folk-belief and is as vividly written as his other books.

In 1892, Clodd published a memoir of H. W. Bates in "The Naturalist on the River Amazons", in 1900 one on "Grant Allen", and in 1902 another on "Thomas Henry Huxley". In 1916 he delighted his numerous friends with the publication of "Memories", and those who desire to know what Clodd was to his friends should read this book and incidentally they will discover what manner of man he himself was.

The above list of some of his books, and his very numerous contributions to journals of all kinds, indicate that Clodd was a sower of the seed of intellectual freedom and a populariser of evolution, more particularly as regards man. This is not the place to refer to his many literary associations, but no mention of Clodd would be complete without allusion to the stimulating quality of his conversation and to the notable gatherings at his home, where men of varied experience, activities, and research interchanged serious talk enlivened by jest. Clodd was a perfect host, and not least so when as skipper he took his party for cruises in the *Lotus*. We have lost a great friend, and we offer our heartfelt sympathy to his devoted wife, who made his declining years so happy.

A. C. Haddon.

We regret to announce the following deaths:

Prof. J. O. Arnold, emeritus professor and lately dean of the Faculty of Metallurgy in the University of Sheffield, on Mar. 24, aged seventy-two years.

Dr. Wilhelm Biedermann, formerly professor of physiology in the University of Jena, on Nov. 27, aged seventy-five years.

Sir Edward Brabrook, C.B., a past president of the Royal Anthropological Institute and of Section H (Anthropology) and also of Section F (Economic Science and Statistics) of the British Association, on Mar. 20, aged ninety years.

Dr. Hermann von Ihering, honorary professor of palæontology at Göttingen, for many years director of the Museu Paulista at São Paulo, Brazil, who was well known for his studies in zoo-geography, the palæontology and fauna of Brazil, and the morphology and classification of the Mollusca, on Feb. 24, aged seventy-nine years.

Sir William M'Cormick, G.B.E., F.R.S., chairman of the University Grants Committee and of the Advisory Council on Scientific and Industrial Research, on Mar. 22, aged seventy years.

Prof. Wilfred Robinson, professor of botany at the University College of Wales, Aberystwyth, on Mar. 7.

News and Views.

Congratulations from a wide circle of friends will be extended to Prof. George Forbes, one of our veteran electrical engineers, who celebrates his eighty-first birthday on April 5, having been born in 1849. He is the son of Principal David James Forbes, and graduating in the first instance at the University of St. Andrews, he went on later to Cambridge. Respecting his youthful adventures, our readers will doubtless recall a recent article in the *Times* by him recounting work as a war correspondent, and impressions, whilst in the service of Delane, the editor of that journal. Forsaking journalism, Forbes embraced a scientific career, becoming in the first instance professor of natural philosophy at Anderson's College, Glasgow, afterwards devoting himself to notable electrical projects. He was electrical engineer for the initial series of installations at Niagara Falls, 1891–95, besides being associated with numerous other undertakings which attest the foresight and skill of the electrical engineers of a pioneer period. In 1887, Prof. Forbes was elected into the fellowship of the Royal Society. He is a Chevalier of the Legion of Honour of France and honorary LL.D. of St. Andrews.

Celebrations in connexion with the eightieth birthday of Dr. William Henry Welch will take place in Washington, U.S.A., on April 8. A broadcast of the ceremonies will be relayed from the London Regional Station at 5 p.m. Dr. Welch's name is a household word to doctors all over the world. In 1884, when the bequest of a rich American, Johns Hopkins, led to the foundation of a new university in Baltimore, Dr. Welch was chosen first professor of pathology. A few years later he was joined by the late Sir William Osler as professor of medicine. Mainly through the genius and enthusiasm of Welch, Osler, and the late Prof. Halsted—the famous surgeon—the new school rapidly rose to the first rank, and for more than a generation Johns Hopkins has been the goal of advanced students and research workers from all parts of the world. Dr. Welch, who has since been Director of the School of Hygiene of the Johns Hopkins University, and is at present professor of medical history there, has lived to see the educational ideals for which he fought universally adopted, and to be admitted into the class of the great masters of medicine, the class of Lister, Koch, Pasteur, and Manson. In connexion with these ceremonies in America, an address, with lantern illustrations, will be given at the London School of Hygiene and Tropical Medicine, at Keppel Street (Gower Street), W.C., by the director, Sir Andrew Balfour, on Dr. Welch's life and work, on the same day at 4 p.m.

As has already been announced, the Council of the Physical Society has awarded the Duddell Medal for 1929 to Prof. A. A. Michelson, of the University of Chicago, and at the annual general meeting on Mar. 28

the medal was handed to Mr. David Mc. K. Key, Third Secretary of the Embassy of the United States of America, on behalf of Prof. Michelson. The interferometers invented by Prof. Michelson, of which the first was used for carrying out in 1887 the famous Michelson and Morley experiment, have been applied by him, always with complete adequacy of design, to other important and difficult problems, most of them of audacious novelty. These problems included the measurement in 1892 and 1893 of the metre in wave-lengths of light; the measurement of the diameters of stars, the re-measurement of the earth tides, and the testing of the effect of the earth's rotation on the velocity of light. These measurements have had far-reaching consequences for physical science.

The difficulties of reconciling the result of the Michelson-Morley experiment with the then prevailing physical conception of the nature of the universe were the direct cause of the inquiry of Albert Einstein, which resulted in the theory of relativity. The measurement of the metre in wave-lengths of light resulted in establishing a standard of length free from the uncertainty concerning possible variation which attaches to all material standards. The interferometer for the measurement of the diameter of stars, suggested by Michelson in 1890 and first applied by him to Betelgeuse, has not only confirmed the correctness of the almost incredible dimensions yielded by indirect means of calculation, but also has detected fresh stellar phenomena in the variable diameter of Mira Ceti, and the separation of double stars too close for resolution by the unassisted telescope. The invention by Prof. Michelson of the echelon diffraction grating provided physicists with a potent tool for the investigation of the fine structure of spectral lines, knowledge concerning which has become of such great importance in modern physics. Prof. Michelson has also designed a ruling-engine with which very large gratings have been ruled. As a final example of his work on scientific instruments for the advancement of knowledge, mention may be made of the completion by him in 1926, with apparatus designed by himself, of a redetermination of the velocity of light. The elaborate precautions taken to secure freedom from error included means whereby the distance of eighty-two miles traversed by the light was measured to a higher degree of accuracy than had ever been reached in triangulation.

Two honours highly prized by chemists were conferred at the annual general meeting of the Chemical Society on Mar. 27. Presenting the Longstaff Medal to Dr. W. H. Mills, the president, Prof. J. F. Thorpe, said that this gold medal is awarded triennially to the fellow of the Society who, in the opinion of the Council, has done the most to promote chemical science by research. He mentioned Dr. Mills's investigations of the cyanine dyes and their uses as photographic sensitisers, and referred to his researches on the occurrence of optically active forms of those substances which possess molecular dissymmetry, such as the ketodilactone of benzophenone-2-4-2′-4′-tetracarboxylic acid and the pyridylhydrazone of *cyclo*hexylene dithiocarbonate. Dr. Mills has thereby established the fact that the cause of the absence of optical activity among aromatic derivatives due to the uniplanar character of the benzenoid structure is no longer effective when two rings are joined in such a manner as to make them lie in different planes, and he has emphasised this conclusion by resolving benzenesulphonyl-δ-nitro-1-naphthylglycine, thus showing that the inhibition of free rotation about a single bond leads to molecular dissymmetry. The Harrison Memorial Plaque and Prize was awarded to Dr. R. P. Linstead for meritorious original contributions to chemical science. Prof. Thorpe said that it is seldom that a research worker within the age limits demanded by the trust deed strikes out a line for himself and does not merely elaborate and extend the research problems on which he has been trained. Dr. Linstead has devised and established on a sure basis a means by which it is now possible to determine the relative proportions of the constituents present in equilibrium mixtures formed by the interchange of the $\alpha\beta$ and $\beta\gamma$ structures of substances exhibiting three-carbon tautomerism, whereby the close and quantitative study of this fundamental phenomenon can be effected.

The discussion on beam radio telephony in the House of Commons on Mar. 27 was naturally more political than scientific. Points were scored by the various speakers, but we do not think that these much affect the main issue. We referred to the subject in a note in our issue of Mar. 8, p. 386. World intercommunication cannot be considered with regard to the interests of one centre alone. When H. W. Nicholls read a paper on trans-oceanic radio telephony to the Institution of Electrical Engineers in London on Feb. 22, 1923, he described some of the results obtained by the American Telephone and Telegraph Company and the Radio Corporation, which now allow us to engineer the Atlantic radio link. In particular, he described a method of suppressing one of the side bands, a discussion on the existence of which has recently taken place in our pages. When we first heard perfect speech being reproduced across the Atlantic, we recognised what a debt we owed to the Americans. Now Sir E. Hilton Young says that if the Post Office does not co-operate with Imperial and International Communications, Ltd., it must co-operate with some one else. In particular, he stated that it is co-operating with the great American cable companies and not with British interests. We think that he takes too narrow a view. The Post Office is not jealous of the Imperial and International Communications, Ltd., and on many occasions it has proved that it is not autocratic. It is true that the Standard Company has some American capital, but there are many other large engineering firms in Great Britain which have also American support. It is a British factory employing British workers and doing a large amount of work for foreigners. We see no reason why the Post Office should not establish communication with Buenos Aires through foreign capitals if it is commercially convenient. The development of radio communication has been so rapid of recent years that it is inadvisable to hamper the Post Office in any way.

Dr. John Radcliffe, the outspoken physician who told Queen Anne that she was only suffering from the "vapours", and William III. that "he wouldn't have William's two legs for his three Kingdoms", was a liberal benefactor to his own College and to the University of Oxford. About sixty years after his death, the trustees under his will built the Observatory which bears his name. This was done at the request of the University; and there is no doubt that the trustees from the beginning always considered that they were under special obligations to the University and City of Oxford. The Observatory having lately come into the possession of £100,000 by the sale of its site, the trustees have before them a proposal to move the Observatory and its belongings to South Africa, on the ground that so large a sum could not be usefully spent on astronomy in Oxford. The trust is not a department of the University; but, as has been pointed out by Lord Birkenhead as High Steward, it is at least doubtful whether the trustees are so far independent as to be legally entitled to alienate from the University property with which it has been intimately connected for many years. It may be noted that both the Board of Faculty of Natural Science and the Hebdomadal Council have expressed disapproval of the plan now before the trustees.

Prof. G. von Hevesy, who delivered the Hugo Müller lecture before the Chemical Society on Mar. 26, chose as his subject the chemistry and geochemistry of the titanium group of elements. Speaking in English, without the aid of a manuscript, Prof. von Hevesy first discussed the distribution and geochemical relationships of this group of elements, of one of which, hafnium, he is the discoverer. When the earth cooled, members of the titanium group became concentrated in the earth's crust; the average titanium content of the material of the whole earth is about 1 in 600. From considerations of loss of heat by the earth, thorium has been considered to be strongly concentrated in the earth's crust, and it is significant that geochemical considerations lead to the same result. Of this group, only titanium, zirconium, and thorium are found as the major constituents of minerals. Discussing the comparison of the chemical properties of the elements, Prof. von Hevesy mentioned that, failing an accurate comparison of ionisation potentials, the relative ionic sizes are of value. There is little or no difference in molecular volume between the dioxides of zirconium and hafnium, whilst the atomic volume of hafnium is in fact slightly less than that of zirconium; the ionic radii of the two elements are equal. Separation of zirconium and hafnium is rendered difficult by the very small differences in the solubilities of corresponding compounds, although advantage may be taken of such differences in double fluorides, and of the differing solubilities of the phosphates or oxychlorides in hydrochloric acid. Prof. von Hevesy next discussed the position of hafnium in the periodic classification of the elements with reference to its basicity, and then referred to the analytical chemistry of the group. Success has attended the application of methods employing radioactive indicators to minerals containing very small quantities of hafnium, and X-ray spectroscopy has also proved a valuable analytical instrument.

For his Friday evening discourse delivered at the Royal Institution on Mar. 28, Sir Ernest Rutherford took as his subject "The Transmutation of Matter". The idea that one metal could be transmuted into another first arose among the Greeks in Alexandria in the first few centuries A.D., and spread through Europe in the Middle Ages. With the discovery of the periodic relationship in the properties of the elements the belief in transmutation revived, and Faraday remarked, "To decompose the metals, to reform them and to realise the once absurd notion of transmutation—these are the problems given to the chemist for solution". In 1919, Rutherford showed that some of the nuclei of the atoms of nitrogen could be transformed by bombardment with the swift α-particles emitted by radium. Afterwards, Rutherford and Chadwick found that a number of the lighter elements showed a similar effect, and in all cases a swift proton was found to be emitted in consequence of a violent collision between an α-particle and the atomic nucleus. Our evidence indicates that in the case of nitrogen, the α-particle is captured during this process and the mass of the resulting atom is greater than before. In general, only about one α-particle in 100,000 comes close enough to a nucleus to effect its disruption. Transformation of an atom would occur also if an electron could be forced into a nucleus. In recent years, numerous experiments have been made to change mercury into gold and lead into mercury by means of intense electrical discharges, but there is no certain evidence that any transmutation occurs by this method. Apart from the radioactive bodies, it now seems clear that a large amount of energy must be applied to produce a disruption of the nuclei of the ordinary elements. The old idea that a new source of energy could be tapped by transformation of the ordinary elements now seems untenable. There remains, however, one interesting possibility. If hydrogen nuclei—protons—could be made to combine to form a nucleus of helium, an enormous amount of energy should be emitted during this process. Unfortunately, there is as yet no evidence that such a combination could be produced under conditions available in our laboratories.

In the past few years there has been an unprecedented activity in the development of apparatus for all aspects of kinematography, and the number of applications for patents has been particularly large. There has been much discussion as to the validity of many of these apparently new inventions. These facts give an interest, over and above the purely historical, to the Will Day historical collection of kinematography and moving picture equipment, which is about to be offered for sale. This collection is unique and exceptionally comprehensive. There is no important stage in the development of moving pictures, with the exception of sound kinematography, which is not represented in Mr. Day's collection. The majority of the items are well known to the public, as they have been on exhibition at the Science Museum, South

Kensington, for a number of years. At the Museum they have been so adequately displayed and tended that it is to be regretted that it appears probable that the Museum will be deprived of every item of the collection after the sale. It is, perhaps, unfortunate, that the collection is to be sold as a whole. We should naturally like to know that the objects representing the pioneer work of W. Friese-Green, R. W. Paul, Birt Acres, and other Englishmen had a chance of remaining in England. France would doubtless welcome an opportunity to acquire the apparatus of the brothers Lumière, without having to purchase the entire collection.

The Will Day collection comprises some five hundred items, including not only apparatus for recording and reproducing apparent motion, but many unique specimens of early films, and a collection of books, papers, prints, playbills, and early documents relating to the subject of moving pictures and their public presentation. The illustrated catalogue of the collection, sold at five shillings by the auctioneers, Messrs. Harris and Gillow, 80-82 Wardour Street, W.1, is one of the most valuable contributions to the history of kinematography yet published. A detailed description of each of the separate items is preceded by a foreword on the historical development of moving pictures by Mr. Will Day. Tenders for the collection in its entirety have to be made to the auctioneers before noon on May 3. It is difficult to see how it will be possible to assess the value of such a collection. Is it too much to hope that it will fall into the hands of a public-spirited purchaser, who will see to it that each country eventually has the opportunity of acquiring that portion in which it has a national interest?

The introduction of foreign species of animals to any country is always a matter of difficulty and generally of controversy, owing to the clashing of interests which take very different points of view. The sportsman and the animal exploiter seldom see eye to eye with the purist who would reserve a country for the country's own produce. The position of the sportsman is easily appreciated. He is in sympathy with the preservation of the native fauna—he has indeed done much to keep it in being—but if the supply of game is to be maintained or increased where sport becomes more popular and more democratic, then he must turn to foreign birds. Then he must choose amongst the species which will thrive in his own country, and from these must select those which, while affording good sport, respond most profitably to the known methods of game propagation. The position is particularly interesting at the moment in the United States of America. The love of sport, or at any rate the desire to shoot something within the law, is increasing there enormously, and with it the demand that there should be plenty of sporting-gun fodder. Where native birds are big enough and abundant enough, the only danger is that they may not be able to last out the succession of annual pushes, but where native species are not sufficient, then recourse must be made to introductions of foreign blood.

The situation in the United States is put quite clearly by W. L. McAtee, the biologist in charge of food habits research in the Biological Survey of the U.S. Department of Agriculture. "Let the native game birds enjoy the protection of game sanctuaries as numerous and extensive as can be afforded, but on those parts of our domain where public shooting is practical and its continuance is desired, the practical necessities of the situation require the use of species of game birds that will produce the best results, regardless of their origin." As a consequence an inquiry has been made as to the "Game Birds suitable for naturalising in the United States," and a pamphlet under that title has been issued by the U.S. Department of Agriculture (Circular No. 96). The dangers of introducing possible pests or foreign bird diseases, or of depleting the food supply of native birds, have been foreseen, and in selecting suitable areas for introductions consideration has been given to latitude, temperature, and precipitation compared with those of the original habitat. The bulk of the species regarded as the most promising importations are various kinds of pheasants and partridges, but guinea fowls, Mexican quails, bustards, and sand grouse are also recommended. The natural vegetation of the United States is regarded as unfavourable to the sustenance of red grouse or black grouse, and capercaillie, snow cock, and wood-pigeons are looked upon as undesirable, in the last case on account of the damage they are likely to do and in the former because of the unpalatable quality of their flesh.

By the courtesy of the Trustees of the British Museum, the British Association is enabled to supplement its recent researches on ancient sites in Southern Rhodesia by a loan exhibition of all the more important antiquities from Zimbabwe and elsewhere, which were scattered among the museums of South Africa. Especial thanks are due to the South African Museum at Cape Town, the Rhodesian Museum at Bulawayo, and the Queen Victoria Memorial at Salisbury, for allowing their treasures to travel so far; and also to the Government of Southern Rhodesia for permitting the exhibition of the finds from Miss Gertrude Caton-Thompson's excavations last year at Zimbabwe, and Mr. A. L. Armstrong's exploration of the Bambata Cave in the Matoppo Hills. It is believed that other objects from earlier explorations at Zimbabwe are in private collections in Great Britain; and it is hoped that if their possessors are willing to allow any of these to be exhibited, they will send them without delay addressed to the Zimbabwe Loan Exhibition, care of the Director of the British Museum, W.C.1. The Exhibition, which enjoys the patronage of Their Excellencies the Governor-General of the Union of South Africa and the Governor of Southern Rhodesia, will be opened free to the public on Monday, April 7, in the Assyrian Basement of the British Museum; and will remain open until the middle of May.

According to a message from the Riga (Latvia) correspondent of the *Morning Post*, published on Mar. 24, a communist of the name Volgin has been appointed as the new permanent secretary of the Academy of Sciences of Leningrad, after the dismissal of the former permanent secretary, Prof. S. Oldenburg (see NATURE, Nov. 16, 1929, p. 767). In an interview with representatives of the Press, the newly appointed secretary stated that a new statute of the Academy has been drafted which requires all the academicians not only to show scientific attainments, but also to pay strict obedience to political orders and to help in the Socialistic reconstruction of U.S.S.R. It appears likely that should the present policy be continued, all the older members of the Academy will soon be displaced by others, whose achievements in adhering strictly to the Soviet Government's political principles are likely to be greater than their attainments in science. The recent dismissal of A. A. Birula from the post of Director of the Zoological Museum of the Academy is a further demonstration of the Soviet Government's attitude towards the older scientific workers in Russia. During the same interview, M. Volgin stated that even foreign honorary members of the Academy will be required to show themselves friendly to the revolutionary movement of the proletariat.

IN the presence of members of the Council of the Research Association of British Paint, Colour and Varnish Manufacturers, Mr. S. K. Thornley, the president, on Mar. 21, laid the foundation stone of a large extension of the premises of the Research Station at Waldegrave Road, Teddington. Before laying the stone, Mr. Thornley said that already we have had sufficient experience of the working of the research association idea on the utilisation of existing knowledge and the discovery of new knowledge to know that it is well worth while. It damages no one and is to the advantage of all. Co-operative research is a valuable if not the only convenient means for most people to participate in the inevitable scientific advance. The foundation stone bears the inscription: "Scientia socia industriae" (science the ally of industry). This stone was laid by Samuel Kerr Thornley, President, Research Association of British Paint, Colour, and Varnish Manufacturers, 21st March 1930.

DR. L. COCKAYNE, who was awarded the Darwin Medal for 1928 by the Royal Society for his contributions to ecological botany, has been appointed honorary botanist to the Wellington City Council, New Zealand.

A CONSIDERABLE earthquake was recorded at Kew Observatory on Mar. 26. The first impulse reached the Observatory at 7 hr. 32 min. 12 sec. The records indicate that the epicentre was situated in the south-west of China.

AT the annual general meeting of the Television Society the following were elected officers for the current year: *President*, Sir Ambrose Fleming; *Hon. Treasurer*, Mr. W. C. Keay; *Hon. Secretaries*, Mr. J. J. Denton and Mr. W. G. W. Mitchell. Mr. J. L. Baird was elected an honorary fellow of the Society.

DR. A. T. DOODSON, associate director of the Liverpool Observatory and Tidal Institute, has been awarded a prize of £150 offered by the Royal Society of Arts in 1929, under the Thomas Gray Memorial Trust, for an improvement in the science or practice of navigation, for his work on the analysis and prediction of tidal currents.

AT the annual election of office-bearers of the Royal Philosophical Society of Glasgow, to fill vacancies, the following were elected: *Vice-President*, Mr. David Begg; *Members of Council*, Mr. G. D. Buchanan, Dr. G. H. Edington, Mr. W. Gillies, Prof. G. W. O. Howe; *Hon. Secretary*, Prof. C. R. Gibson; *Hon. Treasurer*, Sir John Mann; *Hon. Librarian*, Dr. J. Knight; *Hon. Auditors*, Mr. J. T. Tulloch, Mr. J. J. D. Hourston; *Acting Secretary*, Dr. J. M. Macaulay.

IT would appear that in our review of "The World's Grasses" by Prof. J. W. Bews in our issue of Jan. 25, p. 119, we failed to view the entire field. We are now informed by Mr. A. S. Hitchcock, of the U.S. Department of Agriculture, that *Bromus secalinus* is cultivated in the valley of the Columbia River. *Bromus arvensis* is also cultivated as a crop in some European countries, so that this fact should have been referred to as an addition to, rather than as a correction of, Prof. Bews's statement.

AT the annual meeting of the Ray Society, held on Mar. 21, Prof. W. C. M'Intosh was re-elected president, Sir Sidney F. Harmer treasurer, and Dr. W. T. Calman, secretary. Sir David Prain was elected a vice-president and Canon Bullock-Webster and Mr. C. H. Oakden new members of the Council. The Council's report announced that the issue for 1930 would consist of a volume on "The Aquatic (Naiad) stages of British Dragonflies", by Mr. W. J. Lucas; it will be illustrated with coloured plates which are now in course of reproduction from the author's own drawings. A work on "British Freshwater Copepoda", by Dr. R. Gurney, has been accepted for publication and its preparation is well advanced.

A GENERAL discussion on "Optical Rotatory Power" will be held by the Faraday Society on Friday and Saturday, April 25 and 26, in the rooms of the Chemical Society, Burlington House, Piccadilly, London. The meeting will open with an introductory paper by Prof. T. M. Lowry, and the proceedings will be in four groups dealing respectively with: (1) The physical basis of optical rotatory power; (2) apparatus and methods; (3) rotatory power of solutions; and (4) chemical aspects of optical rotatory power. The programme is noteworthy for the number of foreign scientific workers who have furnished papers. Members of allied societies, research students, and others interested, whether members of the Faraday Society or not, are invited to be present at the meeting.

Two Chadwick Public Lectures, delivered by Mr. Arthur J. Martin, on "Sewage and Sewage Disposal", have been published (Macdonald and Evans, 8 John Street, W.C.1. Price 2*s*. 6*d*. net). The booklet gives an interesting and instructive survey of the advances that have been made in recent years in the treatment of sewage, and concludes with a description of the activated sludge process, various modifications of which are now regarded as being the best means for the treatment of sewage.

The latest catalogue (No. 523) of Francis Edwards, Ltd., 83 High Street, Marylebone, deals with second-hand works, 371 in number, relating to West Africa.

Mr. J. H. Knowles, 92 Solon Road, S.W.2, has just circulated a catalogue (No. 11) of upwards of five hundred second-hand books on botany, herbals, phanerogams, floras and cryptogams, zoology and geology.

Applications are invited for the following appointments, on or before the dates mentioned :—A principal of the Castleford, Normanton, and District Mining and Technical Institute, Whitwood—M. G. Swaine, Education Offices, Castleford, Yorks (April 7). A head of the Department of Commerce of the Leicester College of Technology—The Registrar, College of Technology, Leicester (April 7). A junior assistant in the Wood Chemistry section of the Forest Products Research Laboratory, Princes Risborough, Bucks—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (April 8). A designing draughtsman in the Naval Ordnance Department of the Admiralty—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (April 12). A lecturer in pharmacy at the Witwatersrand Technical Institute—Chalmers and Guthrie, Ltd., 9 Idol Lane, E.C.3 (April 12). A permanent assistant to the adviser in agricultural economics in the Department of Agriculture and Horticulture of the University of Bristol—The Secretary, University, Bristol (April 12). A public analyst for the Metropolitan Borough of Camberwell—The Town Clerk, Town Hall, Camberwell, S.E.5 (April 14). A pathologist at the Preston and County of Lancaster Royal Infirmary — The Superintendent and Secretary, Royal Infirmary, Preston (April 17). A research worker at the National Institute for Research in Dairying, for the investigation of problems concerning accessory food factors—The Secretary, National Institute for Research in Dairying, Shinfield, near Reading (April 19). Civilian education officers in the Royal Air Force Educational Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1 (April 22). A professorship of education in the University College of Hull—The Secretary, University College, Hull (April 23). A lecturer in historical geography at King's College, London—The Secretary, King's College, Strand, W.C.2 (April 25). A professor of bacteriology at University College Hospital Medical School—The Academic Registrar, University of London, South Kensington, S.W.7 (May 15). Probationers in the Indian Forest Service—The Secretary, Services and General Department, India Office, S.W.1 (July 1). A sanitary inspector in the Sudan Medical Service—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1. A physics lecturer at the Newfoundland Memorial College—S. T. Harrington, Woodfield, Malvern Wells. A lecturer in mathematics and physics in the Dudley Training College for Teachers—The Secretary to the Dudley College Council, Education Offices, Dudley. A full-time teacher of building and civil engineering in the Barnsley Mining and Technical College—The Principal, Harvey Institute, Barnsley.

Our Astronomical Column.

The New Comet Wilk 1930 *c*.—Mr. J. P. Moller has computed the following orbit of this comet :

T 1930 March 28·794 U.T.

$$\left.\begin{array}{lrr} \omega & 46^\circ & 47' \\ \Omega & 90 & 4 \\ i & 67 & 40 \end{array}\right\} 1930{\cdot}0$$

log q 9·6841

Ephemeris for 0^h.

	R.A.	N. Decl.
April 2.	1^h 0^m 24^s	32° 31′
6.	0 43 16	36 37
10.	0 24 8	39 32
14.	0 3 52	41 41
18.	23 43 0	43 14

The comet is visible both in the evening and the morning, but the morning is rather more favourable. It attained the fourth magnitude at the end of March, and was visible in twilight. The orbit bears some resemblance to that of De Vico's comet, 1846 iv., which has been sought for ten years ; but the differences are greater than perturbations are likely to have caused. It should, however, be observed as long as possible, to test for any deviation from parabolic motion.

Distribution of Matter in Interstellar Space.—Dr. J. S. Plaskett and Mr. J. A. Pearce contribute an important paper on this subject to *Mon. Not. Roy. Ast. Soc.* for January. Some months ago Dr. O. Struve suggested that the intensity of the *H* and *K* lines of calcium in the spectra of early-type stars might be used as a measure of the distance of these stars, since the lines had been shown to arise from matter external to the stars. The chief uncertainty was as to whether it was safe to assume that the density of the interstellar gas was uniform throughout space. The present paper gives a definite affirmative answer to this question. The spectrograms of 261 stars taken at the Victoria Observatory were examined, and the radial velocities both of the stars themselves and of the interstellar gas were analysed by the formulæ derived by Dr. Oort for radial motion arising from galactic rotation. It is found that the interstellar lines indicate a rotational term of 7·9 km./sec., indicating a mean distance of 465 parsecs, and give galactic longitude 332° (referred to the intersection of the galaxy with the equator of 1900), a value agreeing closely with that found in other ways. The distances of the stars, found in a similar manner, are in the mean twice those of the gas, thus giving strong confirmation of the uniformity with which the interstellar matter is distributed, and showing that it shares in the galactic rotation.

The Trans-Neptunian Planet.—The telegram announcing Dr. G. Struve's observation of the new planet, to which reference was made in Nature of Mar. 29, p. 507, was received at the Royal Observatory, Greenwich, by telephone ; through an error, the word 'planet' was taken down as 'comet'. The writer of the note in Nature learnt of the mistake and immediately communicated with the Editor, requesting the deletion of the words "who called the body a comet". Instructions were telegraphed to the printers, but the message was misunderstood, and the words appeared. Apologies are due to Dr. Struve for the misrepresentation.

Research Items.

Indian Chronology.—In the *Indian Antiquary* for February Mr. F. J. Richards outlines a scheme of periods in Indian history which was originally put forward and discussed at a meeting of the Indian Section of the Royal Anthropological Institute. The object of the scheme is to correlate the periods of the historian with the ebb and flow of culture both inside and outside India. The historic period is divided into three 'major' divisions: (1) The Early, 600 B.C. to A.D. 300; (2) the Medieval, A.D. 300 to A.D. 1500; and (3) Modern, A.D. 1500 to A.D. 1900. Each of these is again subdivided into three. For the early period the suggested division is (I.) 600 B.C. to 300 B.C.; (II.) 300 B.C. to 1 B.C., and (III.) 1 B.C. to A.D. 300. Of these, I., 600 B.C. to 300 B.C., roughly answers to the Hellenic period of Europe, the Achæmenid period of Persia and the close of the Chou dynasty of China. In northern India it covers the rise of Jainism and Buddhism and the consolidation in the lower Gangetic plain of the kingdom of Magadha. Foreign influence is represented by the Persian conquest of the north-west in 512 B.C. and the invasion of Alexander. From 300 B.C. to A.D. 300, roughly the period of Hellenistic Greece and imperial Rome, covers in India the Mauryan empire at its zenith under Asoka and its partition between Sungas, Andhras and Greeks from Bactria, and at a later stage Sakas and Pahlavas from Iran, and secondly the rise and decline of the Kushan empire. Southern India is obscure, but Roman traders were busy in Malabar. As regards foreign contacts, the Mauryas were in touch with Greece, and the Kushans with Rome, but the main thrust came from China. In the period A.D. 300 to A.D. 650 when in Europe imperial headquarters were transferred to Constantinople, in northern India the 'Gupta period' falls into two phases with the Huna invasion (480 to 528). The period 650 to 1200 covers the struggle between the Byzantine Empire and Islam, and the second great expansion of China under the T'ang dynasty and the struggle with the Tartars. In India it answers to the Rajput period, a period of conflicting States around Kanauj. The period from 1200 to 1500, the closing epoch of the Roman empire and of Mongol domination in Asia, witnesses two phases in the Delhi sultanate, but in southern India interest centres in the Chalukyas of the western Deccan.

Mammals formerly eaten in the Dominican Republic.—The examination by Gerrit S. Miller of the remains of mammals from the food refuse of Indians, Spaniards, and an extinct owl left in the coast region of the Dominican Republic, has afforded interesting evidence of the presence of species now extinct, as well as of the peculiar tastes of the feeders. Nineteen species are represented, and although none is new to science, new light has been thrown upon the characters and distribution of some. The presence of a ground sloth is demonstrated in this recently extinct fauna; and there have been identified four of the native mammals, the hutia, the quemi, the mobuy, and the cori, which Oviedo y Valdés, the first European chronicler of West Indian history, stated about 1546, were habitually eaten by natives and Spaniards during the early years of the sixteenth century (*Smithsonian Misc. Coll.*, vol. 82, No. 5; 1929).

Polydactyly in Fowls.—The extra toe in fowls was first shown by Bateson to behave as an irregular dominant in inheritance, following the rule regularly in some families but being transmitted sometimes through normals without an extra toe. The extra toe is also known to vary in size and in its freedom from the next. Bond has shown that in cases of asymmetry it occurs more frequently on the left than the right foot. Punnett and Pease (*Jour. of Genetics*, vol. 21, No. 3) have summarised the evidence on this subject and added some fresh data which are in accord with earlier results. They conclude that there is probably a definite factor for polydactyly, and that normals may transmit polydactyly owing to the presence of one or more factors which inhibit its expression. In some families, the F_1 are all polydactylous, the F_2 giving 3 : 1, and the back-cross a 1 : 1 ratio. This was especially true of the light dorking crosses. Moreover, out of 142 polydactylous chicks, only 7 showed any degree of asymmetry. The silky crosses gave more exceptions. It is suggested that certain 4-toed birds may really represent double asymmetry, factors being present which suppress both the right and left extra toe. Normal birds from a polydactylous parent sometimes in crosses with polydactyls give a high number of birds without an extra toe. Such normals are spoken of as 'resistant', and the evidence indicates that this condition is mainly due to the presence of one inhibitor. In certain cases, however, another factor must also be concerned in inhibiting the appearance of the extra toe. There is no evidence of linkage between polydactyly or asymmetry and sex.

Polyzoa.—The presidential address to the Linnean Society delivered by Sir Sidney Harmer on May 24, 1929, on Polyzoa, has recently been issued (*Proc. Linn. Soc.*, Session 141, 1930). In the first four sections all zoologists will find much of interest since they deal with the group in general, its economic importance, and early chapters of its history finishing with those connected with the names of Linné and Ellis. The latter had remarkably clear ideas on the Polyzoa for the time in which he worked. In recent years, a great deal of important work has been done on these animals by Jullien, Levinsen, Borg, and the author himself, the greater part of which has not yet found its way into the ordinary text-books and so is familiar only to those who have worked in the same field. These investigations have added greatly to our knowledge of the morphology and physiology of the group, and consequently modified its classification extensively. Sir Sidney Harmer has reviewed this work in a critical manner and provided a clearly illustrated account of its most important results. In the concluding pages is a discussion of the most recent classification that has been put forward by Borg. The whole forms an interesting and useful essay for which the author deserves the thanks of his colleagues.

Fresh-Water Crustacea of Norfolk.—Dr. Robert Gurney (*Trans. Norfolk and Norwich Nat. Hist. Soc.*, vol. 12, part 5, December 1929) gives a general survey of the fresh-water Crustacea of Norfolk. He considers the plankton of the Norfolk Broads belongs generically to the Baltic type, but it has marked specific differences attributable partly to marine influence and partly to the factors of depth, size, and climate. The shallow weed-grown Broads are extraordinarily rich in Entomostraca but the richness depends to a large extent on the nature of the vegetation and the salinity of the water. In general, the crustacean fauna is characterised by its great variety and the absence of all northern forms. Of the river crustaceans the most interesting is *Leander longirostris*, the 'white prawn' or 'jack shrimp', recorded for the first time as a British species in 1921, and now known to occur also in the Tamar in Devonshire. This prawn is almost as much at home in fresh water as in salt water, its range of tolerance being much greater than that of *Palæmonetes varians*, which is very sensitive to water of low salinity. The jack shrimp, however, goes to the sea to hatch its young, and indeed its eggs will not hatch in fresh water, while the larvæ of *Palæmonetes* thrive in brackish water. The author does not accept the view that *Cordylophora lacustris* and *Dreissensia polymorpha* are two species actually in process of migration from the sea to fresh water. *Dreissensia* is very definitely a fresh-water species quite intolerant of salt water and there is no evidence that it has changed its habits in historic times. *Cordylophora* is not an estuarine or even a brackish-water form, and its distribution does not indicate recent penetration from the sea.

Fauna of Sinai.—The results of an expedition to the Sinai Peninsula in 1927, under the auspices of the Hebrew University of Jerusalem, have recently appeared as a small volume edited by Drs. F. S. Bodenheimer and O. Theodor and published by J. C. Hinrichs'sche Buchhandlung, Leipzig, 1929 (price 12 gold marks). The editors contribute general articles on the climate, topography, geology, etc., of the Peninsula, but the greater part of the book is devoted to the insect fauna. Probably the most interesting chapters are those devoted to the manna produced on tamarisk: the history of the subject, the insects responsible for the manna production, and the chemical composition of the latter being discussed. There are also separate articles by specialists dealing with the Orthoptera, Coccidæ, and Formicidæ collected by the expedition. With reference to the Orthoptera, it is noteworthy that the only previous account of these insects from the Peninsula is that of Krauss published in 1909. In the present collections one new genus and four new species are described, and there seems little doubt that a thorough exploration of the Sinai Orthoptera would throw considerable light upon the origin and evolution of the desert fauna generally. The report, it may be added, is well illustrated by text-figures and half-tone plates.

Cereal Breeding.—Dr. E. S. Beaven, chairman of the Council of the Institute of Agricultural Botany, made some interesting comments upon the work of the Institute at the meeting of its Council in December 1929, which received the tenth annual report. Referring particularly to the work of the Crop Improvement Branch, he pointed out that originally emphasis was laid, in the statement of the aims of the Institute, upon the growth and marketing for the trade of new varieties. He points out that, as a matter of fact, in ten years the Institute " has only distributed one new variety and that was only a modified form of an older variety already in cultivation" . Dr. Beaven, from his long practical experience of cereal breeding, had anticipated this situation, in view of the fact that it was the Institute's declared policy " to market no new variety unless there is clear proof of its superiority to races already in cultivation in respect of probable monetary value to growers ". Dr. Beaven pointed out the practical significance of another task carried out by the Institute: " the testing by systematic and repeated trials at our headquarters and sub-stations in six different locations—all in corn-growing areas—of the relative merits of different races of farm plants ". Dr. Beaven also dealt with the practical question of the return for the outlay upon work of this type carried out by the Institute. The records of the Institute's trials show that there are frequently differences of 10-20 per cent in the values of the crops due to the variety or race of seed sown. Dr. Beaven added : " It is a modest estimate that something over 5 per cent would be added to the monetary return of the arable farmers of the country if they all grew the races of plants best suited to their localities and soil conditions. That would add about £2,000,000 every year to the net returns for arable farm produce."

Earth-Tiltings before Earthquakes.—Two interesting papers have recently appeared on the tilting of the ground before earthquakes in Japan. Messrs. W. Inouye and T. Sugiyama have examined the records for nearly two years, 1927–29, of a pair of tiltometers erected at the seismological station half-way up Mt. Tukuba (*Proc. Imp. Acad.*, Tokyo, vol. 5, pp. 457-459 ; 1929). The vector-diagrams show that the earth-tiltings exhibit an annual variation probably connected with changes of air-temperature. From time to time, this regular variation is disturbed by irregular fluctuations of short period during which the earthquakes of the district usually occurred. The centres of two of these earthquakes were close to Mt. Tukuba. Before each shock, earth-tiltings were more or less pronounced for a month or more and they ended simultaneously with its occurrence. Prof. A. Imamura and Mr. T. Kodaira have made similar observations on the tiltings before the Kii earthquake of July 4, 1929 (*Proc. Imp. Acad.*, Tokyo, vol. 5, pp. 460-462 ; 1929). The earth-tiltings at Tanabe, 12½ miles from the epicentre, showed that the regular annual variation was interrupted by a 'tilt-storm' on June 20. This lasted until July 3, when the tiltings returned to normal conditions, the earthquake occurring on the following day. The authors of both papers conclude that the abnormal tiltings observed were actual precursors of the earthquakes.

A Grating Periodograph.—An interesting application of the methods of pure science to an important industrial problem is described in the January number (vol. 21) of the *Journal of the Textile Institute*, which contains a paper by G. A. R. Foster on " The Grating Periodograph for the Analysis of Series of Observations for Hidden Periodicities". Though the procedure described is applicable to the analysis of any series of observations in which periodicities are suspected, it has been developed at the Shirley Institute, the headquarters of the British Cotton Industry Research Association, expressly for the purpose of detecting periodic variations in the dimensions and properties of cotton yarns as produced under various manufacturing conditions. Briefly, the method consists of throwing an image of the graph to be tested, via a grating, on to a ground glass screen or photographic plate. If the area under the curve has been previously blackened out, there are formed, at certain distances of screen and grating, bands of light and dark fringes of spacing simply related to the hidden periodicities of the curve. Both the practical details and the theory of the method are given. It is undoubtedly a simple and elegant way of carrying out a periodogram analysis, which furthermore allows Schuster's method of secondary analysis to be performed in a very convenient manner.

Illumination Requirements.—A statistical analysis of the requirements in artificial light of the average American family was recently presented before the New York section of the American Institute of Electrical Engineers. The authors commenced by analysing needs in regard to 'work illumination' (reading, writing, sewing, factory work, etc.), 'social illumination' (in the home, places of public assembly, etc.), and 'utility illumination' (passages, store rooms, streets, etc.). For these the following values of illumination (foot-candles) are suggested :

	Activities requiring—		
	Work Illumination.	Social Illumination.	Utility Illumination.
A. Minimum present good practice . . .	15	5	3
B. Minimum recommended . . .	30	10	5
C. Probable levels of greatest economic advantage . .	50	15	5
D. Possible desirable levels from eye-considerations only	300	50	30

An attempt is next made to determine the 'light-hour' needs of the average family and hence the possible total demand for electrical energy for light in the United States. The estimate based only on consideration of the eye (*D*) attains the prodigious total of 778,900 millions of units a year. It appears that the total actual consumption of electricity for lighting in 1929 was about 20,000 million units. It is estimated that at the levels in the above table the saturation is respectively 30, 17, 13, and 3 per cent.

Conduction of Electricity in Metals.—On the classical electron theory of metals, the exact hypotheses made concerning the type or absence of directed motion of the electrons were often not of great importance for the final description of any particular effect. This result, which, although scarcely to be expected, was frequently useful, has now been shown by T. E. Stern, in a paper in the March number of the *Proceedings of the Royal Society*, to be closely connected with the fact that on classical theory the kinetic energy of the electrons is a linear function of their density. On Prof. Sommerfeld's theory, in which the electrons are treated as a degenerate gas, the linear dependence of energy upon density disappears, and with it the equivalence of the different methods of analysis. The properties of a metal which is passing a current cannot be safely deduced from those of an insulated metal, without making careful inquiry as to the nature of the phenomenon in question, a general result which is illustrated by the special cases of the Thomson effect, the evaporation of electrons, and some others. Mr. Stern also raises the question of the applicability of thermodynamical reasoning, such as was applied by Kelvin to the thermoelectric circuit—a problem also recently treated by Bridgman—but shows that Sommerfeld's formula for a thermal electromotive force is in at least approximate accord with Kelvin's results. Mr. Stern's conclusions, although expressed in terms of the present electron theory of metals, are not entirely dependent on this, but retain their main features for any theory in which the kinetic energy is not proportional to the density.

The Kennelly-Heaviside Layer—The Radio Research Board has issued a report of the work carried out from the foundation of the Board until March 1929. It is the first of a series of annual reports. We learn that four committees have been appointed to study the problems connected with the propagation of radio waves, atmospherics, directional radio, and thermionic valves respectively. In each of these committees radio physicists and practical engineers are adequately represented. It is stated that the most important result obtained in the study of wave propagation is the direct experimental proof of the existence of the Kennelly-Heaviside layer. Observations under Prof. E. V. Appleton's supervision were made at King's College, London, and at Cambridge and Peterborough with the primary object of investigating the effects of ionisation of the atmosphere on signal fading and the propagation of waves in general. Considerable use was also made of a second method in which the variations of signal strength in a loop and vertical aerial are compared. Transmissions on waves of 100 metres length from the National Physical Laboratory were observed simultaneously at the three stations. Downcoming waves were detected at King's College, only eleven miles from the transmitter, almost as easily as they were detected at Cambridge and Peterborough. This indicates reflection on this wavelength at almost vertical incidence. The results obtained from the three stations show very close agreement. The height at which deviation of waves takes place appeared to be normally 50-70 miles, but on many occasions in the middle of the night the height was found to be 130-180 miles. On such occasions the lower region is re-formed after sunrise and lower heights from 50 miles to 70 miles in height are again found. Day observations indicate that a third ionised region exists beneath the reflecting layers, which, however, merely attenuates the waves.

Equilibria in Sulphur Dioxide Solutions.—In spite of the fact that sulphur dioxide is such a well-known compound, there is surprisingly little information in the literature as to the properties of its aqueous solutions. In the January number of the *Canadian Journal of Research* (National Research Council of Canada), which contains several other interesting communications, there is a study by W. B. Campbell and O. Maas of the equilibria in solutions of sulphur dioxide, which has a bearing on the sulphite cellulose industry. They point out that the sulphurous acid behaves as monobasic even at high dilutions, so that SO_2, H_2SO_3, $H^{\cdot}$ and HSO_3' are the constituents concerned. The proportion of H_2SO_3 decreases rapidly with rise of temperature, whilst the true ionisation constant $K = [H^{\cdot}][HSO_3']/[H_2SO_3]$ is 0·03 and does not change much with temperature. Experiments on vapour pressures, densities, and conductivities of solutions of concentrations up to 8 per cent and temperatures to 110° are described which extend the results just stated. These show that sulphurous acid is a strong acid, the apparently weak character being due to lack of hydration of sulphur dioxide in solution.

Ignition of Carbon Monoxide.—It is well known that the ignition of a mixture of carbon monoxide and oxygen is greatly promoted by the presence of small amounts of water vapour or of hydrogen. In the February number of the *Journal of the Chemical Society*, Smithells, Whitaker, and Holmes describe experiments in which the efficiencies of hydrogen and water vapour are compared by passing a spark through two eudiometers in series, one containing the carbon monoxide-oxygen mixture with hydrogen and the other the mixture with water vapour in equimolecular amount. When the drying of the carbon monoxide-oxygen mixture had not been greatly prolonged, it was found that hydrogen was more effective than water vapour, the estimated minimum quantities being 0·03 per cent and 0·12 per cent. With more intense drying of the combustible mixture, the activity of the hydrogen was altogether inhibited. In other words, the superior catalytic effectiveness of hydrogen was in its turn conditioned by the presence of a minimal quantity of water vapour. It may equally well be said, alternatively, that in the presence of hydrogen a minimal quantity of water sufficed to confer ignitibility.

The Pine-Sawyer Pest in Sweden.

In No. 25 of *Meddelanden från Statens Skogsförsöksanstalt*, 1929 (Reports of the Swedish Institute of Experimental Forestry), Ivar Trägårdh has a paper on the injury caused by the pine-sawyer (*Monochammus sutor*, L.) in Sweden and its prevention ("Om Tallbockens Skadegörelse och Bekämpande").

It is a remarkable fact that, even in parts of Europe (it is of course more easily comprehensible in great tropical regions), so little should have been known until comparatively recently of some of the injurious forest insect pests; especially certain families and genera of beetles. In his paper the author states that "some ten years ago very little was known about the pine-sawyer and its economic importance in Sweden. It is true that since the days of A. E. Holmgren it was considered a common but indifferent insect, and it was not known that the data given by Holmgren regarding the wood-boring activity of *Acanthocinus ædilis* is in reality referable to the pine-sawyer".

Trägårdh published his studies on this latter longicorn in 1918, his investigations having shown that owing to the galleries penetrating deep into the wood the insect was capable of causing serious losses in timber. These investigations especially led to the establishment of the fact that the ravages by this pest, after a forest fire, were very serious—"One of the most astonishing facts in the biology of the pine-sawyer is its regular and extremely prolific occurrence after forest fires. This is partly due to the fact that in Sweden forest fires as a rule break out at the end of June and the beginning of July . . . just before the breeding season of the pine-sawyer. But this does not explain the reason why thousands of trees a few weeks after a forest fire should be infected to such an extent that one may find as many as 100 eggs per m. It seems evident that the sense of smell in the pine-sawyer is very keen and that the beetles are attracted from regions several miles away whither the reek of the forest fire is carried by the wind."

It is not certain that all authorities would agree with the author that it is the sense of smell which attracts longicorn beetles to trees in the condition they require for oviposition. In the case of *Hoplocerambyx spinicornis*, the now well-known serious pest of the sal (*Shorea robusta*) forests of India, Stebbing (*Ind. For. Insects*) attributes the power of unerringly discovering suitable trees to instinct, pointing out that a newly felled green tree will be discovered and infested within twenty-four hours. It is an interesting point which requires, if it is at all possible to institute them, further careful observations.

Trägårdh has a number of useful observations in this paper anent longicorn groups in general, their habits of oviposition, the feeding capabilities of adult beetles and those of the larvæ, the methods of pupation and so forth. The paper and the illustrations merit a careful study—for it appears undeniable that the powers of this family of beetles for destruction in the forest itself, and havoc to the timber after the trees have been felled, are equally as serious (if not more so) in sub-tropical and tropical forests as is the case in European temperate ones.

Geological Climates.

The meeting of the Royal Society on Mar. 27 was devoted to a discussion of the subject of geological climates, which brought out several points of great interest, and showed that the conflict of views, though still considerable, is less direct than it was some years ago. In opening the discussion, Dr. G. C. Simpson defined the problem from the point of view of a meteorologist, and laid down some fundamental principles with which all reconstructions of past climates must conform. He pointed out that the earth being approximately a sphere rotating on an axis inclined at an angle of about $66\frac{1}{2}°$ to the plane of the ecliptic, there must always have been climatic zones in which the mean annual temperature decreased from the equator to the poles, and there must always have been summer and winter.

Dr. Simpson then passed to the conditions existing at present, and showed that in spite of the great differences in the land and sea distribution of the two hemispheres, the mean annual temperatures of corresponding latitudes between the equator and 70° nowhere differ by more than 3° C. From this he drew the conclusions that the mean temperature in any latitude is almost entirely independent of the distribution of land and water, and that the mean temperature of corresponding latitudes is always the same in both hemispheres. Hence it is impossible to explain great changes of climate in geological periods by means of changes in the distribution of land and sea. The reason is that the gradient of temperature from equator to poles is controlled by the strength of the atmospheric circulation; an increase of the gradient is automatically followed by a strengthening of the circulation, and more heat is carried from the equatorial to the polar regions until the balance is restored. The supposition that large ice-sheets could exist at sea-level in the tropics, while tropical conditions prevailed in middle latitudes of the northern hemisphere, is quite untenable. The only way in which major climatic changes could be brought about was by changes of solar radiation, and these had more effect on the cloudiness and precipitation than on the temperature. Extensive changes of mean annual temperature could only be brought about by movements of the crust relative to the poles, in the manner described by Wegener.

The subsequent discussion turned mainly on two points, the value of fossil plants and animals as indices of past climates, and the power of changes in the distribution of land and sea to modify the zones of temperature and introduce major climatic variations. Prof. A. C. Seward said that the climatic value of fossil floras has been greatly overestimated in the past, and there is now no justification for speaking of the climate of the earth as having been uniform or of high northern latitudes as having been tropical. It is not possible to infer the climate from a study of extinct genera or even species, because to-day allied species often live under quite different climatic conditions. Moreover, in the course of ages, plants may have altered their constitution as they passed from youth to senility. New plant types frequently originate in arctic regions and spread southward, while in high latitudes they are driven out by the competition of later types, but this does not necessarily imply a change of climate. The vegetation of past ages was more uniform than that of to-day, but the uniformity has often been exaggerated, because the early floras consisted exclusively of gymnosperms, which resemble each other much more closely than do flowering plants. There is no justification for the assumption that the vegetation of the coal-measures was tropical; on the other hand, the presence of glaciers does not necessarily imply temperatures at freezing point, for glaciers in New Zealand still end among vegetation of sub-tropical aspect.

Prof. J. W. Gregory illustrated another difficulty in the interpretation of fossil floras by showing how a coal bed may be in process of formation in Jan Mayen at present, the material being supplied by timber drifted from Siberia.

Sir Peter Mitchell agreed with Prof. Seward that the climatic value of fossils has been over-estimated, since animals have power to adapt themselves to changing climatic conditions. He added that for animal life the range of temperature is more important than the annual mean, and the annual range is closely dependent on the distribution of land and sea.

These modifications of the former claims of palæontologists concerning past climates represent a great advance towards the meteorological view of the permanence of climatic zones, put forward by Dr. Simpson. The gap is not entirely bridged, however, for several speakers expressed the opinion that while there must always have been zones of temperature, Dr. Simpson has under-estimated the possible effects of changes in the distribution of land and sea. Prof. Gregory referred to a dictum by Lord Kelvin, that if the greater part of Europe, Asia, and North America were submerged beneath the sea, the Arctic Ocean would be free of ice, and an island at the north pole would have a mild climate. Dr. C. E. P. Brooks referred to investigations by Prof. Kerner and himself which led to the same conclusion, and described the transfer of heat by ocean currents, especially in the Atlantic. He pointed out that the North Atlantic between 30° N. and the Arctic Circle is, on the average, about 5° C. warmer than the South Atlantic between 30° S. and the Antarctic Circle. This difference is almost entirely due to the fact that two-thirds of the warm equatorial water is carried into the North Atlantic by the Gulf Stream and Antilles Current. In many of the geological periods the distribution of land and sea, according to the usual palæogeographical reconstructions, was such that the whole of the warm equatorial water was diverted into the northern hemisphere, and he argued that under such conditions the oceans of the northern hemisphere must have been much warmer than those of the southern hemisphere, and the thermal equator must have been well to the north of the geographical equator. Finally, Dr. C. Tate Regan described the distribution of fresh water and marine fishes during the Cretaceous and Eocene, which does not fit in with the drift of the continents as inferred by Wegener.

The general result of the discussion may be summed up by saying that the geological changes of climate have not been so great as was at one time supposed; but there is not yet any agreement as to whether they were small enough to be accounted for by ordinary agencies, or whether they were on a sufficient scale to necessitate an appeal to movements of the continents relative to the poles.

University and Educational Intelligence.

Cambridge.—The Appointments Committee of the Faculty of Economics and Politics has reappointed P. Sraffa, of King's College, University lecturer in economics.

The Appointments Committee of the Faculty of Biology *A* has appointed H. Gilbert-Carter, of Trinity College, to be University lecturer in botany.

Smith's Prizes have been awarded to R. E. A. C. Paley, of Trinity College, and J. A. Todd, of Trinity College. Rayleigh Prizes have been awarded to W. R. Andress, of Trinity College, and L. C. Young, of Trinity College.

London.—Dr. Morris Ginsberg has been appointed as from Aug. 1 to the Martin White chair of sociology tenable at the London School of Economics. He has been University reader in sociology at the School since 1924, and has published articles and books on the science of sociology.

The title of 'Professor in the University of London' has been conferred on the following members of the professorial staff of the Imperial College of Science and Technology: Profs. H. B. Baker, V. H. Blackman, W. A. Bone, W. Brown, Sir Harold C. H. Carpenter, S. Chapman, A. E. Conrady, C. G. Cullis, S. M. Dixon, C. L. Fortescue, A. Fowler, P. Groom, J. W. Hinchley, H. Levy, E. W. MacBride, J. C. Philip, A. F. C. Pollard, A. O. Rankine, J. F. Thorpe, S. J. Truscott, Sir Gilbert Walker, W. W. Watts.

It has been resolved to institute a University chair of physics tenable at the Imperial College—Royal College of Science.

St. Andrews.—The Senatus Academicus has resolved to confer the honorary degree of LL.D. on Mr. James Morton, chairman and governing director of the Scottish Dyes, Ltd., and on Prof. O. W. Richardson, Yarrow research professor of the Royal Society, at the graduation ceremonial to be held on June 27.

Wales.—The agreements between the University of Wales, University College, Cardiff, and the Cardiff Royal Infirmary, which establish the Welsh National School of Medicine as a separate school of the University, were ratified at a meeting of the University Court held at Cardiff on Mar. 28.

A Mathematical Colloquium, under the auspices of the Edinburgh Mathematical Society, will be held at the University Hall of St. Andrews on July 19–30. The courses arranged include the following: Rational curves and surfaces (Prof. H. F. Baker), arithmetical properties of curves and surfaces (Mr. H. W. Richmond), the wave mechanics (Prof. C. G. Darwin), elementary mathematics from the higher standpoint (Prof. H. W. Turnbull), and recent developments in symmetric functions, determinants, and algebraic equations (Dr. A. C. Aitken); Prof. E. T. Whittaker and others will give informal talks. Particulars can be obtained from the honorary secretary of the Colloquium, Dr. E. T. Copson, 144 North Street, St. Andrews.

The University of Leeds records in its report for 1928–29 a number of important developments, marking, to quote the wording of the report, the opening of a new chapter in its history. Among these are the laying of the foundation stone of a new mining block, the opening of a new wing of the textile department, the adoption of a plan for a pathological institute, the construction of a new hostel for men students, the creation of a Montague Barton chair of industrial relations, the conclusion of a reciprocal arrangement with the University of Reykjavik in Iceland for exchange of students, and the acquisition of a very valuable collection of Icelandic books. The number of full-time day students attending during 1928–29 was 1385, and of part-time 144; evening students numbered 223. Along with the report we have received a forty-page pamphlet containing a list of publications by members of the University in 1928–29 and titles and abstracts of theses accepted for higher degrees in science (12), medicine (5), and technology (8).

Historic Natural Events.

April 7, 1408. End of Severe Winter.—The winter of 1407–8 was one of the coldest of the past thousand years. The great rivers of western and central Europe and the Swiss lakes were frozen for a month or more, and the ice was five or six feet thick. The frost began on Nov. 11 and continued until Jan. 30 ; then, after a brief respite, it re-commenced on Feb. 15 and did not break until April 7. The cold was so great that the roots of the vines and fruit trees froze. The water-mills were stopped, and there was a great shortage of bread as well as a lack of fuel. In France the thaw of Jan. 30 caused great destruction of bridges by floating blocks of ice. The North Sea was said to be frozen between Denmark and Norway. In Great Britain, Holinshed records that "this year the winter was exceeding sharp through frost and snow that continued and covered the ground by all the months of December, January, February, and March, insomuch that thrushes, blackbirds, and many thousand birds of the like smaller size perished with very cold and hunger".

April 7, 1420. Early Season.—According to the *Journal d'un Bourgeois de Paris*, 1405–1449, at Pasques the roses were already in bloom on April 7, and were all over by May 15. At the beginning of May good cherries were on sale, and at the end of May the corn was more ripe than the preceding year's crop had been on St. John's day (June 24).

April 8, 1233. Mock Suns.—According to Miss Ormerod's collection, between 6 A.M. and 7 A.M. "in the parts about Hereford and Worcester there appeared four suns in the element, beside the natural sun of red colour and a great circle of crystalline colour, the which compassed with his largeness as it had been the whole circuit almost of the whole realm of England, from the sides whereof went forth certain half circles, in whose sections appeared the said four suns".

April 8, 1709. Baltic Frozen.—The early months of 1709 were excessively cold in Europe, and the Baltic was still frozen and snow-covered so late as April 8. The frost began between Jan. 3 and 5 with a north-east wind over all central and western Europe, from Stockholm and Riga to Naples and Cadiz. Even the Ebro was frozen. The greatest cold occurred from Jan. 11–13 and Feb. 24–26, but the winter was more notable for duration than for extreme severity. In France the people suffered severely from hunger, and roots were eaten instead of bread. In Italy the ground was deeply frozen and the olives perished ; the lagoon of Venice was frozen more than a mile from shore. In England the winter lasted three months, but was not exceptionally severe, and in Ireland and Scotland it was comparatively mild.

April 10, 1446. Storm Flood.—A terrible storm broke over western Germany, France, Holland, and Switzerland, with violent thunder, very heavy snow, and deadly cold. At the same time there was a severe storm-flood in the North Sea, by which sixteen towns were submerged and about 100,000 men drowned. This catastrophe was followed by a period of very cold and windy weather, especially severe from April 29 to May 10.

April 10, 1657. Flood.—The village of Langtoft in Yorkshire, encircled by hills, was flooded to a depth of eight feet, as shown by a memorial stone placed in one of the houses.

April 11–12, 1815. Eruption of Tomboro.—A volcanic eruption, one of the most violent known, began on April 5 in the island of Sumbawa (to the east of Java), culminated on April 11–12, and continued until July. Out of a population of 12,000 in the province of Tomboro, only 26 survived. The sounds of the explosions were heard in Sumatra (1118 miles) and in the opposite direction at Ternate (830 miles). In Java, the darkness caused by the ashes was deeper than on the darkest night. The coasts of Sumbawa and the adjoining islands were swept by a sea-wave 2-12 ft. in height.

April 11, 1917. Mirage.—It is recorded in the "Official History of the War, Mesopotamian Campaign", vol. 3, p. 316, that Gen. Cayley's force had a Turkish division in front of them in a position almost destitute of cover, but they were completely hidden from view by a mirage, and fighting had to be temporarily suspended.

April 12, 1527. Long Continued Rains.—It rained in England every day or night from April 12 to June 3, and in May it rained 30 hours continuously, which caused great floods and much damage to the crops.

April 12–15, 1920. Gale.—The weather was extremely unsettled during April 1920, and at some stations the average barometric pressure for the month was the lowest on record during April. An especially deep depression lay off south-west Ireland on April 11–14, after which it moved north-eastward, and on April 15 a wind velocity of 110 miles an hour at a height of 3000 feet was shown by a pilot balloon ascent at Lympne. With high pressure over north-west Africa, a violent westerly gale occurred in the Straits of Gibraltar, the wind velocity at 1 P.M. on April 12 being estimated as 68 miles per hour.

Societies and Academies.

LONDON.

Society of Public Analysts, Mar. 5.—S. Judd Lewis : (1) The spectroscopic investigation of jams. An ethereal extract was examined, using a special form of sector photometer and a spectroscope. 'Absorption curves' having extinction coefficients for ordinates and wave-lengths for abscissæ, were disturbed by the presence of small amounts of foreign ingredients, such as benzoic acid, salicylic acid, saccharin, certain colouring matters, etc.—(2) A simple polarimetric test for sugars in jams. A modification of the method of determining the specific rotation of an aqueous extract of the jam, after inversion of the dissolved sugars, is described.

Linnean Society, Mar. 6.—Sidnie M. Manton : Notes on the segmental excretory organs of Crustacea. (5) On the maxillary glands of the Syncarida. Detailed reconstructions of the maxillary glands of *Paranaspides*, *Anaspides*, and *Koonunga* have been made from fresh material obtained in Tasmania. The general disposition of the coils of the efferent duct in the maxillary glands of the three types is similar, but there are differences in detail. The pattern of the duct shown by *Anaspides* and *Koonunga* could have been derived from a type resembling that of *Paranaspides* in general form, but lacking its peculiar features, such as excessive duct fenestration.—Major R. W. G. Hingston : In the canopy of the forest (British Guiana). An outline was given of the methods adopted by the recent Oxford University British Guiana Expedition to explore the tropical rain-forest. The party worked in a small area of forest on the right bank of the Essequibo River, about fifteen miles above Bartica. One of the chief objects of the expedition was to get into the canopy of the forest and to study at close quarters the life found to exist in it. Hitherto our knowledge of the canopy life consisted in what could be shot from it with a gun or observed in it with binoculars from the ground. Ascents were made in four places. Access to the canopy was obtained either by rope ladders or by a seat that could be hoisted on a block-and-tackle. Observation posts were fixed in the canopy and rope ladders were spread in the branches, which permitted some freedom of movement in it. From the collections made at different levels it is considered that a tropical forest should be regarded as consisting of strata of life spread out one above the other.

Optical Society, Mar. 13.—**T. Smith**: Imagery around a skew ray. The usual criterion by which conjugate points are defined fails unless neighbouring rays intersect in both object and image spaces. The criterion is extended to include the points of nearest approach of non-intersecting rays. The relation connecting conjugate points is, then, of the same form as for the simpler cases generally recognised. The coefficients which determine the imagery are elements of a square matrix of the fourth order. A more natural matrix for refraction in three dimensions would be of the sixth order. The coefficients of the eikonal and characteristic function can be derived from the elements of either type of matrix.—**R. A. Sampson**: The purpose and design of the new equipment at the Royal Observatory, Edinburgh (see Nature, Mar. 22, p. 467).

Edinburgh.

Royal Society, Mar. 17.—**Lt.-Col. L. M. Davies**: The genus *Dictyoconus* and its allies: A review of the group together with a description of three new species from the Lower Eocene Beds of northern Baluchistan. Numerous specimens of *Dictyoconus*, *Coskinolina* and *Lituonella* mixed indiscriminately together were found within the same narrow limestone bands. The differences between these genera are shown to be confined to the peripheral portion of the test; sections reveal the closest agreement in their internal characters as a whole; their generic characters alone affording the means for distinguishing between them. These Indian forms are regarded as affording clear evidence of the close affiliation of these three genera. They are the first representatives of their respective genera to be found so far east, and are very similar to such western forms as *Dictyoconus egyptiensis* (Chapman), *Coskinolina liburnica* Stache, and *Lituonella roberti* Schlumberger and Douvillé.—**F. Walker**: The doleritic isles of the North Minch. The small islands in the Minch to the north of Skye include the Shiant and Fladda groups. They are all composed of crinanite sills with 'schlieren' of syenite, essexite, and teschenite, and in some cases with floors of picrite. The alkaline bands and ultrabasic floors are thought to be the result of crystallisation differentiation. The sills are doubtless the continuation north of the well-known Trotternish examples.—**William J. McCallien** and **Robert B. Anderson**: The Carboniferous sediments of Kintyre. Carboniferous sediments in Kintyre form the Machrihanish coalfield, west of Cambeltown. The rocks and structure of the coalfield are described and the positions of eight coal seams are indicated on a large scale map. A smaller area of coal-bearing strata occurs south of the coalfield in Tirfergus Glen. An interesting point brought out by the study is the existence of a group of bauxitic clays and laterites at the top of the calciferous sandstone lavas. The coals of the Machrihanish coalfield are correlated with the better known members of the Ballycastle coalfield in Northern Ireland.—**William J. McCallien**: A contribution to the geology of north-eastern Antrim; being an introduction to the correlation of the Dalradian rocks of Scotland and Ireland. The following subdivisions of the Dalradian rocks of the south-west Highlands of Scotland have been recognised in north-east Antrim: Ben Lui schists to the north-west, Loch Tay limestone and associated epidiorite, Glen Sluan schists, Green Beds, Beinn Bheula schists. The Old Red Sandstone rocks from Cushendun to Cushendall are also described, and a marked resemblance is shown to exist between the Antrim rocks and those of Kintyre. This paper indicates a starting point for future correlation of the Dalradian rocks of Ireland and Scotland.—**D. F. Martyn**: A new method of measurement of minute alternating currents. The current to be measured is passed through the filament of a diode valve, the main heating current in which is an alternating current of the same frequency supplied by an auxiliary oscillating circuit. In these circumstances the two superposed currents in the filament settle down into a state in which they are either in the same or in opposite phase. Their combined heating effect then depends simply upon the sum or difference of the current amplitudes. The effect of the small superposed filament current upon the anode current is measured by a microammeter connected, with a balancing battery, as a shunt across a resistance of several hundred ohms in the anode circuit. The value of the current to be measured is then found from the slope of the anode current—filament current characteristic of the valve. The method is suitable for the measurement of alternating currents of the order of 1 microampere, the sensitiveness being about the same as that of the microammeter used. One great advantage is that it allows each component of a complex oscillatory current (for example, a receiving aerial current) to be measured separately.

Paris.

Academy of Sciences, Feb. 24.—**Ch. Fabry**: A new method for the experimental study of elastic pressures. A description of a modification and improvement of the optical method suggested by Henry Favre.—**André Blondel**: Diagrams for the study of the normal running and static stability of connected alternators. —Prof. A. E. H. Love was elected a *Correspondant* for the Section of Mechanics in succession to the late Sir George Greenhill.—**F. Marty**: The distribution of the values of a meromorph function.—**Guichard, Clausmann, and Billon**: The influence of the initial state of certain metals and alloys on the variation of hardness as a function of cold hardening. For certain alloys the curve of hardness is the same whether the initial state was cast or annealed metal. This applies to copper, silver, and copper-nickel alloy. With copper silver alloys, on the other hand, the limit of hardness depends on the initial state.—**L. Ravier**: The results of experiments on the thrust of soil.—**Benjamin Jekhowsky**: The calculation for the orientation of the great circle for seeking asteroids.—**Maurice Michel**: A perpetual calendar giving instantaneously the Julian or Gregorian calendar of any given year.—**L. Gaurier**: The change of the alluvium in lakes converted into reservoirs. A discussion of the problems presented by the introduction of considerable quantities of alluvium into reservoirs and the modifications in the shape of the resulting delta by lowering the water level. Some actual cases are cited.—**A. Gruvel**: The principal trawling zones of the eastern Mediterranean. Fishing map of the gulf of Alexandretta.—**L. Décombe**: The undulatory theory and black body radiation. The Planck formula is deduced without recourse to the hypothesis of discontinuity for the energy.—**G. Foëx**: The diamagnetism of the halogen ions. Assuming that the diamagnetism of the neutral atoms is due to the superficial electrons, it is concluded, as a first approximation, that the diamagnetism of the ion should be 8/7 that of the neutral atom. This is supported experimentally by the results of Weiss, Hocart, and Pascal. For elements other than the halogens, precise numerical data on the diamagnetism of the atom and ion are wanting.—**Augustin Boutaric and Mlle. Madeleine Roy**: The radioactivity of various metals obtained from old roofs. The authors confirm the results obtained by Mlle. Maracineanu in that the exposed faces of old metal sheets taken from roofs are radioactive, and this applies not only to lead but also to zinc and copper roofing. Discussing the various possible hypotheses as to the cause of this radioactivity, the authors reject the view that the effect is due to a disintegration of the metal under the action of sunlight and consider that the absorption of radioactive emanations from the air and from rain is more probable.—**H. Muraour and G. Aunis**: The law of combustion of colloidal (explosive) powders.—**P. Bary**: The study of solutions of colouring matters by pectography. A plate of glass is placed vertically in a solution of the dye and this is submitted to a slow evaporation. The figures formed on the glass plate are termed pectographs and fall into three groups: from these, conclusions are drawn regarding the nature of the solution.—**Chilowsky**: A new method of gasifying heavy oils. A method of preheating the air and pulverising the oil is described which, it is claimed, prevents the formation of carbon deposits and reduces the amount of tar formed below one per cent.—**Mme. Ramart-Lucas and F. Salmon-Legagneur**: The configuration of molecules in space. The absorption in the ultra-violet of the alkylmalonic acids. The study of the ultra-violet absorption of the acids of the malonic series leads to a different structure in space being attributed to the monoalkylacids and the dialkylacids.—**M. Weizmann and S. Malkowa**: The action of the hydracids on phthalimide epihydrin—**Mme. Bruzau**: The preparation of some trisubstituted α-arylketones.—**V. Brustier**: The ultra-violet absorption spectrum of chelidonine. From the analogy between the ultra-violet absorption produced by chelidonine and the alkaloids of the morphine group, it is considered that chelidonine is a phenanthrene derivative rather than a derivative of isoquinoline as suggested by Gadamer.—**Georges Brus and G. Peyresblanques**: The fixation of ozone by unsaturated compounds. Curves are given showing the velocities of absorption of ozone. These give much information on the mode of formation of the perozonides and their polymers.—**L. Royer**: The possible influence of the surrounding medium on the symmetry of the forms of some natural minerals.—**Louis Glangeaud**: The extension and the facies of the lower and middle Cretaceous in the Atlas coast of the north of the province of Algiers.—**René Baillaud**: Earthquakes and falls of roof (in mines).—**A. Maublanc and G. Malençon**: The nature and the organisation of the gleba of *Battarrea Guicciardiniana*.—**Paul Guérin**: Hydrocyanic acid in the vetches. Its distribution in the various organs of the leguminous Papilionaceæ containing a cyanogenetic glucoside. In the cyanogenetic Leguminosæ, the glucoside producing the hydrocyanic acid may, according to the genus, be found localised in quite different organs. Examples are given.—**Maurice Hocquette**: The influence of the decalcification and of the acidity of coastal sands on vegetation.—**Mlle. M. L. Verrier**: The structure of the retina of an Agamidæ: *Agama Tournevillii*.—**D. Santenoise, H. Verdier, and M. Vidacovitch**: Pancreatic vagotonine and hepatic glycogen.—**J. Malassez**: The distribution of energy in the compound colours.—**R. Lienhart**: The genetics of the castorrex rabbit. This rabbit is a mutation which appeared in the Sarthe in 1919, the fur of which resembles that of the beaver.—**A. Lacassagne**: The difference in the biological action caused in yeasts by various radiations. Comparison of the action of ultra-violet rays, soft X-rays, and the α-rays on the yeast *Saccharomyces ellipsoideus*.—**F. Holweck**: Energy study of the biological action of various radiations.—**N. Bezssonoff**: Vitamin A and carotene.—**E. Couture**: The oxidation of oils in the presence of irradiated sterols.—**L. Boëz and J. Guillerm**: The microbial factor in the manufacture of Indo-Chinese pickle (*Nuoc-mam*).

Official Publications Received.

BRITISH.

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Year 1928-29. Pp. ii+96+6 plates. (Madras: Government Press.) 1 rupee.

The Indian Medical Association. Some Problems of the Medical Profession in India. Compiled by Kumud Sankar Ray. Pp. vii+88. Presidential Speech of Dr. B. C. Roy at the All India Medical Conference, Lahore, 27th December 1929. Pp. 10. Address by Colonel Bhola Nauth at the All India Medical Conference held at Lahore on 27th and 28th December 1929. Pp. 61. Resolutions passed at the All India Medical Conference, Sixth Session, held at Lahore, 27th and 28th December 1929. Pp. 7. (Calcutta.)

Proceedings of the Royal Society. Series A, Vol. 126, No. A803, March 3. Pp. 542-728+xviii+vi. (London: Harrison and Sons, Ltd.) 6s.

Report of the Department of Industries, Madras, for the Year ending 31st March 1929. Pp. vi+108. (Madras: Government Press.) 12 annas.

The Journal of the Royal Technical College: being a Record of some of the Research Work carried out in the College by the Staff and Senior Students. Vol. 2, Part 2, January. Pp. iv+161-366. (Glasgow.) 10s. 6d.

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 16, No. 2, March. Pp. 365-676. (Plymouth.) 10s. 6d. net.

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1928-1929. (Cmd. 3496.) Pp. 153+2 plates. (London: H.M. Stationery Office.) 3s. net.

Transactions of the Institute of Marine Engineers, Inc., Session 1930. Vol. 42. Pp. 103. (London.)

The National University of Ireland. Calendar for the Year 1929. Pp. viii+275+482+208. (Dublin: Alex. Thom and Co., Ltd.) 2s.

Quarterly Journal of the Royal Meteorological Society. Vol. 56, No. 233, January. Pp. 102. (London: Edward Stanford, Ltd.) 7s. 6d.

Colony and Protectorate of Kenya. Agricultural Census, 1929: Tenth Annual Report. Pp. 41. (Nairobi: Department of Agriculture.) 2s.

Survey of India. Professional Paper No. 25: The Representation of Glaciated Regions on Maps of the Survey of India. By Major Kenneth Mason. Pp. 18+4 plates. (Dehra Dun.) 8 annas; 10d.

Union of South Africa: Department of Agriculture. Annual Report of the Director of Veterinary Services, Onderstepoort, Pretoria. 15th Report, October 1929. Vol. 1 (Sections 1 to 4). Pp. xiv+573. 10s. Vol. 2 (Sections 5 to 9). Pp. iv+575-1209. 10s. (Pretoria: Government Printing and Stationery Office.)

The South African Journal of Science. Vol. 26: Being the Report of the Twenty-seventh Annual Meeting of the South African Association for the Advancement of Science, Joint Meeting with the British Association, Johannesburg, Cape Town, Pretoria, 1929, 22 July to 3 August. Pp. xlii+988. (Johannesburg.) 30s. net.

Union of South Africa: Fisheries and Marine Biological Survey. Report No. 7 for the Year ending June 1929, by Dr. Cecil von Bonde, and Special Reports. Pp. 62+8 charts+84+8 plates+12+11+19+3 charts. (Pretoria: Government Printing and Stationery Office.)

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 2, Stuk 1: Vrystaatse Fossiele Perde. Deur Dr. Ir. E. C. N. Van Hoepen. Pp. ii+11. (Bloemfontein.)

Association of British Chemical Manufacturers. Directory of British Fine Chemicals produced by Members of the Association. Pp. 55. (London.) Free.

Department of Agriculture, Trinidad and Tobago. Flora of Trinidad and Tobago. Vol. 1, Part 2: Parietales, Polygalinae, Caryophyllinae, Guttiferales, Geraniales, by R. O. Williams; Malvales, by R. O. Williams and E. E. Cheesman. Pp. 23-164. (Trinidad: Government Printing Office, Port-of-Spain.) 6s.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 32: The Thermal Instability of the Earth's Crust, II. By Dr. J. H. J. Poole. Pp. 385-408. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s.

The Journal of the Institute of Metals. Vol. 42. Edited by G. Shaw Scott. Pp. xii+846+48 plates. (London.) 31s. 6d. net.

The British Gliding Association Journal. No. 1, March. Pp. 28. (London.) 2s. 6d.

Department of Scientific and Industrial Research. Report of the Radio Research Board for the Period ended 31st March 1929. Pp. iv+166+4 plates. (London: H.M. Stationery Office.) 3s. 6d. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 399, March. Pp. 317-412+xxxvi. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending 31st August 1929. Pp. ii+105+3 plates. (Bombay.) 2 rupees.

Indian Journal of Physics, Vol. 4, Part 5, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 5. Conducted by Sir C. V. Raman. Pp. 349-447. (Calcutta.) 1.8 rupees; 2s.

Western Australia: Geological Survey. Bulletin No. 94: Geology and Ore Deposits of the Boulder Belt, Kalgoorlie. By Dr. F. L. Stillwell. Pp. 110+17 plates. (Perth: Fred. Wm. Simpson.)

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology. No. 2: Studies of the Transport of Nitrogen in the Cotton Plants, Parts 1, 2 and 3. By E. J. Maskell and T. G. Mason. Pp. 205-231+615-652+29. (London: Empire Cotton Growing Corporation.) 2s. 6d.

British Board of Film Censors. Report, Year ended December 31st, 1929. Pp. 12. (London.)

Researches published from the Wards and Laboratories of the London Hospital during 1929. 48 papers. (London: H. K. Lewis and Co., Ltd.) 7s. 6d. net.

Engineering Training for Officer's Rank. Report of the Council of the North East Coast Institution of Engineers and Shipbuilders, 14th February 1930. Pp. 16. (Newcastle-upon-Tyne.)

Transactions and Proceedings of the Perthshire Society of Natural Science. Vol. 8, Part 6, 1928-29. Pp. 265-280+viii+lxi-lxxxii. (Perth.)

Proceedings of the Society for Psychical Research. Part 114, Vol. 39, March. Pp. 247-271. (London.) 2s.

FOREIGN.

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1929. Pp. ix+207. (Washington, D.C.: Government Printing Office.) 25 cents.

Cornell University Agricultural Experiment Station, Ithaca, New York. Bulletin 479: The Relationships between Roads and Agriculture in New York. By J. L. Tennant. Pp. 84. Bulletin 483: Economic Studies of Dairy Farming in New York. 9: Grade B Milk with Cash Crops and Mixed Hay Roughage, Crop Year 1925, with Five-year Summary. By J. C. Neethling. Pp. 93. Bulletin 487: Rural Population, Tompkins and Schuyler Counties, New York, 1925. By Bruce L. Melvin. Pp. 58. Bulletin 489: The Clover-Leaf Caterpillar (*Olethreutes cespitana* Hübner) and the Clover-Leaf Tyer (*Anchylopera angulifasciana* Zeller). By Lawrence Paul Wehrle. Pp. 27. Bulletin 492: Organization of the Sewing Center in the Home. By Ella M. Cushman. Pp. 37. (Ithaca, N.Y.)

United States Department of the Interior. Fiftieth Annual Report of the Director of the Geological Survey to the Secretary of the Interior, 1929. Pp. ii+87+1 plate. (Washington, D.C.: Government Printing Office.)

United States Department of the Interior: Geological Survey. Water-Supply Paper 578: The Mohave Desert Region, California; a Geographic, Geologic and Hydrologic Reconnaissance. By David G. Thompson. Pp. xi+759+34 plates. 2 dollars. Water-Supply Paper 598: Geology and Ground-water Resources of North Dakota. By Howard E. Simpson. With a Discussion of the Chemical Character of the Water, by Harry B. Riffenburg. Pp. v+312+3 plates. 50 cents. Water-Supply Paper 602: Surface Water Supply of the United States, 1925. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+107. 15 cents. Water-Supply Paper 603: Surface Water Supply of the United States, 1925. Part 3: Ohio River Basin. Pp. vii+343. 40 cents. Water-Supply Paper 604: Surface Water Supply of the United States, 1925. Part 4: St. Lawrence River Basin. Pp. v+179. 25 cents. (Washington, D.C.: Government Printing Office.)

United States Department of the Interior: Geological Survey. Professional Paper 158-C: The Helderberg Group of parts of West Virginia and Virginia. By Frank McKim Swartz. (Shorter Contributions to General Geology, 1929.) Pp. 27-75+plates 6-9. 20 cents. Professional Paper 158-D: Petrography of the Pioche District, Lincoln County, Nevada. By Joseph L. Gillson. (Shorter Contributions to General Geology, 1929.) Pp. 77-86+plate 10. 10 cents. Professional Paper 158-E: The Varves and Climate of the Green River Epoch. By Wilmot H. Bradley. (Shorter Contributions to General Geology, 1929.) Pp. 87-110+plates 11-14. 15 cents. Professional Paper 158-F: Contact Metamorphism of the Rocks in the Pend Oreille District, Northern Idaho. By Joseph L. Gillson. (Shorter Contributions to General Geology, 1929.) Pp. 111-121+plate 15. 10 cents. Professional Paper 158-G: Early Pleistocene Glaciation in Idaho. By Clyde P. Ross. (Shorter Contributions to General Geology, 1929.) Pp. 123-128+plates 16-19. 10 cents. Professional Paper 158-H: The Flora of the Frontier Formation. By Edward Wilber Berry. (Shorter Contributions to General Geology, 1929.) Pp. 129-135+plates 20-21. 5 cents. (Washington, D.C.: Government Printing Office.)

Sveriges Geologiska Undersökning. Ser. Aa, No. 144: Beskrivning till kartbladet Nyed. Av Nils H. Magnusson och Gunnar Assarsson. Pp. 109. 4.00 kr. Ser. Aa, No. 167: Beskrivning till kartbladet Säffle. Av Nils H. Magnusson och Lennart von Post. Pp. 96. 4.00 kr. Ser. Aa, No. 170: Beskrivning till kartbladet Katthammarsvik. Av Henr. Munthe, J. Ernhold Hede och G. Lundquist. Pp. 120. 4.00 kr. (Stockholm.)

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 157: Distribution Coefficients of Magnets. By George Hartnell. Pp. iii+30. 10 cents. Special Publication No. 159: The Bowie Method of Triangulation Adjustment as applied to the First-Order Net in the Western Part of the United States. By Oscar S. Adams. Pp. iii+32. 10 cents. (Washington, D.C.: Government Printing Office.)

United States Department of Agriculture. Technical Bulletin No. 149: Fungous Diseases of the Honeybee. By C. E. Burnside. Pp. 43+6 plates. (Washington, D.C.: Government Printing Office.)

United States Department of the Interior. Bulletin, 1929, No. 33: Record of Educational Publications, comprising Publications received by the Office of Education, January-June 1929. Pp. iii+54. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the United States National Museum. Vol. 77, Art. 2: New Land and Fresh-Water Mollusks from South America. By William B. Marshall. (No. 2825.) Pp. 7+2 plates. (Washington, D.C.: Government Printing Office.)

Zur Geschichte der Zeissischen Werkstätte bis zum Tode Ernst Abbes. Von Moritz von Rohr. Mit Beiträgen von Max Fischer und August Köhler. Pp. viii+120+10. (Jena und London: Carl Zeiss.)

Meddelande från Lunds Astronomiska Observatorium. No. 121: Messungen der Höhenstrahlungsintensität zwischen 55° und 70° nördlicher geographischer Breite. Vorläufige Mitteilung. Von Axel Corlin. Pp. 6. Ser. 2, Nr. 53: Studies on the Proper Motions of Long-period Variable Stars. By W. Gyllenberg. Pp. 20. Ser. 2, Nr. 54: The Period-Luminosity Curve of Long-period Variables. By W. Gyllenberg. Pp. 18. (Lund: C. W. K. Gleerup; Leipzig: Otto Harrassowitz.)

Memorie della Pont. Accademia delle Scienze. Nuovi Lincei. Serie 2, Vol. 13: I Coleotteri d' Italia. Catalogo Sinonimico-Topografico-Biblio grafico. Pp. v+1160. (Roma: Scuola Tipografica Pio X.)

Japanese Journal of Geology and Geography: Transactions and Abstracts. Vol. 7, No. 1, October 1929. Pp. 42+5 plates. Vol. 7, No. 2, January. Pp. 43-73+plates 6-7. (Tokyo: National Research Council of Japan.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 25, Part 4: Vierter Beitrag zur Ichneumoniden-fauna Japans; Fünfter Beitrag zur Ichneumoniden-fauna Japans; Allgemeine Beschreibung über den Beitrag zur Ichneumoniden-fauna Japans. Von Toichi Uchida. Pp. 243-376+plates 4-6. (Tokyo: Maruzen Co., Ltd.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 18, No. 5, December 1929. Pp. 581-744+4+4. (Tokyo and Sendai: Maruzen Co., Ltd.) 2.00 yen.

Carnegie Institution of Washington. Year Book No. 28, July 1, 1928, to June 30, 1929; with Administrative Reports through December 13, 1929. Pp. xix+439. (Washington, D.C.: Carnegie Institution.)

Division of Fish and Game of California. Fish Bulletin No. 18: The Pismo Clam; Further Studies of its Life History and Depletion. By William C. Herrington. (Contribution No. 81 from the California State Fisheries Laboratory.) Pp. 69. Fish Bulletin No. 19: Sardine Fishing Methods at Monterey, California. By W. L. Scofield. (Contribution No. 84 from the California State Fisheries Laboratory.) Pp. 62. Fish Bulletin No. 21: Analysis of Boat Catches of White Sea Bass (*Cynoscion nobilis*) at San Pedro, California. By S. S. Whitehead. (Contribution No. 86 from the California State Fisheries Laboratory.) Pp. 27. (Sacramento: California Government Printing Office.)

Proceedings of the United States National Museum. Vol. 76, Art. 14: The Middle Devonian Traverse Group of Rocks in Michigan; a Summary of Existing Knowledge. By Erwin R. Pohl. (No. 2811.) Pp. 34+2 plates. Vol. 77, Art. 1: Two new Species of Trematode Worms of the Genus Eucotyle from North American Birds. By Emmett W. Price. (No. 2824.) Pp. 4. (Washington, D.C.: Government Printing Office.)

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 161: First-Order Leveling in Hawaii. By Howard S. Rappleye. Pp. iii+21. (Washington, D.C.: Government Printing Office.) 10 cents.

Publications of the Allegheny Observatory of the University of Pittsburgh. Vol. 8, No. 1: Spectroscopic Notes. By Keivin Burns. Pp. 14. Vol. 8, No. 2: *a*. A New Type of Comparator, by Heber D. Curtis; *b*. A Computing Attachment for Comparators, by Keivin Burns. Pp. 15-25+6 plates. (Pittsburgh.)

Iowa Geological Survey. Vol. 34: The Pre-Illinoian Pleistocene Geology of Iowa. By George F. Kay and Earl T. Apfel. Pp. 304. (Iowa.)

Japanese Journal of Engineering. Abstracts. Vol. 7. Pp. x+74. (Tokyo: National Research Council of Japan.)

The American Institute of Mining and Metallurgical Engineers. Technical Publication No. 316: Absorption of Electromagnetic Induction and Radiation by Rocks. By A. S. Eve. (Class L, Geophysical Prospecting, No. 19.) Pp. 11. (New York City.)

The University of Chicago. Publications of the Yerkes Observatory. Vol. 7, Part 1: Radial Velocities of 500 Stars of Spectral Class A. By Edwin B. Frost, Storrs B. Barrett and Otto Struve. Pp. vii+79. (Chicago: University of Chicago Press; London: Cambridge University Press.) 6s. 9d. net.

CATALOGUES.

Chemie: Physik. 10 Verzeichnis antiquarischer und neuer Bücher und Zeitschriften. Pp. 88. (Berlin: Verlag Chemie, G.m.b.H.)

The Taylor-Hobson Outlook. Vol. 3, No. 16, March. Pp. 145-152. (Leicester and London: Taylor, Taylor and Hobson, Ltd.)

Books relating to West Africa. (Catalogue No. 523.) Pp. 32. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, APRIL 4.

INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting) (at Hotel Victoria, Northumberland Avenue), at 11.30 A.M.—Presentation of Medals: The Moulton Medal, The Junior Moulton Medal, The Osborne Reynolds Medal.—At 12.15.—J. A. Reavell: The Rôle of Science in Industry (Presidential Address).—At 2.15.—H. Tongue: The High Pressure Equipment of the Chemical Research Laboratory, Teddington.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Lieut.-Col. Sir Wolseley Haig: The Maratha Nation (Sir George Birdwood Memorial Lecture).

FEDERAL COUNCIL FOR CHEMISTRY (at Burlington House), at 4.30.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (Annual Meeting) (at Liverpool University), at 6.—A. H. Amery: Methods of Extracting Oil from Seed.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—A. Read: Ship's Electrical Deck Auxiliaries.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (Annual Meeting) (at Chamber of Commerce, Birmingham), at 6.30.—At 7.—A. R. Warnes: Some Little Known Causes of Stone Decay.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—Major A. G. Church: The Attitude of the Government towards Scientific Research.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—Dr. E. H. Rayner, W. G. Standring, R. Davis, and G. W. Bowdler: Studies in Low-Power-Factor Measurements at High Voltages.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—A. L. Stanton and others: Discussion on Smoke.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

Junior Institution of Engineers (Informal Meeting), at 7.30.—W. M. Hurrell: Visits to Iceland and other Places.

Geologists' Association (at University College), at 7.30.—A. L. Leach: Geological Structure and British Coastal Scenery (Lecture).—A. L. Leach and A. C. Young: On a Section in River Ravensbourne Valley Gravels at Lewisham.—A. L. Leach: Recent Excavations in the Shooters Hill Gravel.

SATURDAY, April 5.

Institution of Municipal and County Engineers (at Town Hall, Manchester), at 10.30 a.m.—D. T. Tansley: Town Planning in the Manchester Regional Area.—H. C. Swindells: Road Construction in Manchester.

Gilbert White Fellowship (Annual General Meeting) (at 6 Queen Square, W.C.1), at 2.30.—At 3.—Sir Richard Gregory: Primitive Astronomy (Lecture).

Institute of British Foundrymen (Lancashire Branch) (at College of Technology, Manchester), at 4.—E. J. L. Howard and H. Milner: Some Aspects of Foundry Service to Engineers.

Mining Institute of Scotland (at Glasgow).—Annual Meeting.

MONDAY, April 7.

Royal Society of Arts (Dominions and Colonies Section), at 4.30.—Sir Edgar Jones: The Empire Canning Industry.

Royal Institution of Great Britain, at 5.—General Meeting.

Society of Engineers (at Geological Society), at 6.—R. Borlase Matthews: Rural Electrification and Electro-Farming in Great Britain.

Royal Institute of British Architects, at 8.—J. H. Worthington: Antonio da San Gallo the Younger.

Royal Society of Arts, at 8.—Comdr. F. G. Cooper: Aids to Navigation (Thomas Gray Lectures) (3).

Society of Chemical Industry (London Section) (at Chemical Society), at 8.—C. Ainsworth Mitchell: Circumstantial Evidence from Fibres and Hairs.—J. P. O'Callaghan: Recent Advances in Water-softening Practice.

Surveyors' Institution, at 8.—Prof. T. Wibberley: The Future of British Agriculture.

Twickenham Literary and Scientific Society (at Free Library, Twickenham), at 8.—C. Carus-Wilson: Coal.

Royal Geographical Society (at Æolian Hall), at 8.30.—Miss E. J. Lindgren: North-Western Manchuria and the Reindeer-Tungus.

Textile Institute (London Section) (at Clothworkers' Hall, E.C.).—W. Kershaw: Scientific Research as it affects Cotton Manufacture.

TUESDAY, April 8.

Institution of Petroleum Technologists (at Royal Society of Arts), at 5.30.—N. Matheson: Some Features of Modern Steam Operated Deep Hole Rotary Drilling Plant.

Institution of Civil Engineers, at 6.—B. B. Haskew: The Rebuilding of the Bassein Bridges on the Bombay, Baroda, and Central India Railway.—W. T. Everall: The Reconstruction of the Attock Bridge across the River Indus on the North-Western Railway, India.

Institute of Marine Engineers, at 6.30.—S. L. Archbutt: Recent Metallurgical Research in Relation to Marine Engineering.

Institution of Electrical Engineers (Scottish Centre) (Annual General Meeting) (at Royal Technical College, Glasgow), at 7.30.

Quekett Microscopical Club, at 7.30.—Dr. B. F. Barnes: Induced Variation in Fungi.

Eugenics Society (at Linnean Society), at 8.—Dr. M. Hamblin Smith, Judge R. E. Moore, and others: Discussion on Delinquency.

Television Society (in Botanical Theatre, University College), at 8.—Dr. T. H. Harrison: Photo-Electric Cells and their Applications.

Royal Anthropological Institute, at 8.30.—A. D. Hornblower: The Elements of Egyptian Religion.

Royal Society of Medicine (Psychiatry Section), at 8.30. — Dr. E. Mapother and Dr. A. A. W. Petrie: Impressions of American Psychiatry.

Illuminating Engineering Society.—S. Anderson: Textile Lighting.

WEDNESDAY, April 9.

Geological Society of London, at 5.30.—Dr. L. W. Collet: The Structure of the Canadian Rockies.

Institution of Civil Engineers (Informal Meeting), at 6. — S. T. Dutton: Recent Developments in Railway Permanent-Way Practice, with Particular Reference to the Use of Metal Sleepers.

Institute of Chemistry (London and South-Eastern Counties Section), at 7.—Dr. R. M. Brontë: The Medical Witness.

Royal Society of Arts, at 8.—Prof. F. A. E. Crew: Genetical Methods of Live Stock Improvement.

THURSDAY, April 10.

Child-Study Society (at Royal Sanitary Institute), at 6.—Dr. R. H. Crowley: Parent Education; the Home and the School.

Institution of Electrical Engineers, at 6.—S. W. Melsom, A. N. Arman, and W. Bibby: Surge Investigations on Overhead Line and Cable Systems.

Institute of Marine Engineers (Junior Section), at 7.—Film Display: The Manufacture and Operation of the Babcock and Wilcox Water-tube Boiler, etc.

Institute of Metals (Swansea Local Section) (at St. Thomas's Café, Swansea), at 7.—Annual General Meeting.

Institute of Metals (London Local Section) (Annual General Meeting) (at 83 Pall Mall), at 7.30.—Discussion on The Solidification of Metals.

Royal Society of Medicine (Neurology Section) (at Hospital for Epilepsy and Paralysis), at 8.30.—Clinical Meeting.

British Institute of Radiology, at 8.30.

Royal Society of Medicine (Disease in Children Section).

Optical Society (at Imperial College of Science and Technology).—Annual General Meeting.

Institution of Welding Engineers.—H. B. White and R. Tuddenham: Some Interesting Arc Welded Jobs.

FRIDAY, April 11.

Royal Astronomical Society, at 5.—R. O. Redman: The Galactic Rotation Effect in Late Type Stars.

Physical Society (at Imperial College of Science), at 5.—Prof. P. Debye: The Scattering of X-Rays in Gases in Relation to Molecular Structure (Guthrie Lecture).

British Institute of Radiology (Medical Meeting), at 5.—Discussion on Radiology in Bone Tumours.

Malacological Society of London (at Linnean Society), at 6.

Institution of Electrical Engineers (London Students' Section), at 6.15.—Col. Sir T. F. Purves: Address.

Institution of Chemical Engineers (at Municipal College of Technology, Manchester), at 7.—Dr. W. H. Hatfield: The Fabrication of Acid-resisting Steel Plant (Lecture).

Oil and Colour Chemists' Association (Manchester Section) (at Milton Hall, Manchester), at 7.—Annual Meeting.

Junior Institution of Engineers, at 7.30.—W. T. Dunn: Gas in Japan and the Far East.

Institute of Metals (Sheffield Local Section) (Annual General Meeting) (at Sheffield University), at 7.30.—F. Russell: Refractories and their Uses.

Society of Chemical Industry (Chemical Engineering Group) (at Chemical Society), at 8.—Discussion on Asphalt as a Chemical Engineering Material.—A. W. Attwooll: The Principles of Manufacture of Mastic Asphalt.—D. McDonald: Experience with Some Applications of Mastic Asphalt in a Chemical Works.

Royal Society of Medicine (Electro-Therapeutics Section), at 8.30.—Dr. H. A. Bulman, Dr. L. H. Clark, Dr. S. Russ, and Dr. S. Wright: The Physiological Effects of Penetrating X-Rays upon the Cat and Rabbit.

Society of Dyers and Colourists (Manchester Section) (at Manchester).—Dr. J. L. Hankey: Some Remarks on the Treatment of Aniline Black subsequent to Ageing.

SATURDAY, April 12.

Physiological Society (in Department of Physiology, University, Louvain), at 10 a.m.—G. Debois: Glycogen Recovery after Mammalian Muscular Activity as an Insulin Function.—C. Heymans and J. J. Bouckaert: Sinus Caroticus Reflexes upon Venous Pressure, Liver Volume, and Heart Volume.—P. Rylandt: Conduction in Mammalian Auricles.—J. Morelle: Calcium Shifting. Experimental Rickets.—J. P. Bouckaert, J. L. Petit, and J. de Blende: Variations in Muscular Viscosity.—J. P. Hoet and H. Ernould: On the Nervous Control of Insulin Secretion.—P. de Nayer: Glycogen Deposition in Rabbit's Muscles.—L. de Borggraef: Ions and Excitability.—E. J. Bigwood: Chemical Properties of Gelatin Jellies. — Thomas: The Nature of Blood Sugar.—T. Lewis: Reaction of the Human Skin to Cold.—Prof. A. V. Hill: The Osmotic Pressure of Muscles.—Dr. W. Cramer: On Inhibition of the Adrenal Gland and Vitamin B Deficiency.—Dr. J. F. Fulton, Dr. E. G. T. Liddell, and D. McI. Rioch: The Influence of Experimental Lesions of the Spinal Cord upon the Knee-jerk and Crossed Extensor Reflexes.—E. W. H. Cruickshank: An Adjustable Automatic Shaker for Gas Analysis.—*Demonstrations*:—F. Malengreau: Micromethod for Estimation of Bismuth in Biological Material.—J. Rutten: Isoelectric Point of Bence-Jones Protein.—J. Morelle: Calcium Shifting. Experimental Rickets.—J. P. Bouckaert: Determination of Muscular Viscosity.—A. K. M. Noyons: Differential Calorimeter.

PUBLIC LECTURES.

TUESDAY, April 8.

London School of Hygiene and Tropical Medicine, at 4.—Sir Andrew Balfour: The Life and Work of Dr. William Henry Welch.

Gresham College, at 6.—Sir George Newman: Physic. (Succeeding Lectures on April 9, 10, and 11.)

ANNUAL MEETING.

April 9, 10, and 11.

Institution of Naval Architects (at Royal Society of Arts).

Wednesday, April 9, at 11 a.m.—Presentation of Institution Gold Medal to J. Johnson and Premium to Lieut.-Col. F. Dondona.

Lord Wester Wemyss: Presidential Address.

Sir Westcott S. Abell and A. J. Daniel: Safety of Life at Sea (1929 Conference).

Eng.-Capt. J. Hope Harrison: Some Materials used for Naval Engineering Purposes.

Thursday, April 10, at 10.30 a.m.—Dr. W. M. Meijer: Recent Results Obtained in Service with the High Pressure Steam Installation of the Holland-America Liner *Statendam*.

W. J. Belsey: Performance of Two Vessels with Electric Transmission Gear.

At 2.30.—Col. F. Modugno: On the Final State of a Gas Discharged from a Reservoir into a Space under Constant Pressure.

Dr. B. C. Laws: Notes on the Behaviour of Two Passenger Vessels during a Voyage to and from Australia.

F. H. Alexander: Stability of a Vessel with a List.

Prof. E. G. Coker and G. P. Coleman: Stress Distributions in Notched Beams, and their Application.

Friday, April 11, at 11 a.m.—R. Sulzer: Causes and Prevention of Vibration in Motor Ships.

Dr. J. L. Taylor: Vibration of Ships.

Lieut.-Col. F. Dondona: Sea Trials of Italian Flotilla Leaders.

At 3.—G. S. Baker and Miss E. M. Keary: Experiments on the Resistance and Form of Towed Barges.

W. C. S. Wigley: Ship Wave Resistance—Some Further Comparisons of Mathematical Theory and Experiment Result.