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Research and Industry in India

IT is somewhat remarkable, in view of the great interest which is being displayed in Great Britain in Indian political changes, that so little attention has been directed to the developments in industry. Prior to the War, India was regarded mainly as an agricultural country, an exporter of raw materials, vegetable and mineral, whilst with her teeming population she provided a valuable market for manufactured articles. Of large industries there were few—the textile mills in Madras and Bombay, the jute mills in Calcutta and the leather industry in Cawnpore being notable, whilst in Bihar and Orissa the large Tata Iron and Steel Works were in their infancy. As was natural, the exigencies of the War caused a marked industrial expansion, but, in spite of tariff restrictions, many of the new-born industries, frequently possessing a makeshift equipment, were afterwards unable to withstand the competition of Europe, America and more especially of Japan.

Recognition of the unsatisfactory position of Indian industry resulted in 1916 in the appointment of the Indian Industrial Commission of which Sir Thomas Holland was the president ; and one of the outstanding features of the noteworthy report of this Commission was the emphasis laid upon the necessity for scientific research as a basis for future industrial advance. Whilst recommending a general increase in the staffs of the existing scientific services, the Commission indicated the necessity for a comprehensive scheme for chemical research. It is, therefore, remarkable that, although many of the administrative changes recommended in the report have been carried out, no attempt has been made to implement the suggestions for increased scientific research. It is true that in 1919–20 a technical committee under the chairmanship of Prof. J. F. Thorpe elaborated a scheme for an Indian Chemical Service, but the report of this committee was shelved. As was perhaps to be anticipated, when the effects of industrial depression reached India, the first economies were made in the scientific services. The appropriations for the great Forest Research Institute at Dehra Dun, and to the Geological, Botanical and Zoological Services, were drastically reduced and many valuable schemes of research had to be abandoned. It was not apparently realised that the main hope of recovery from the depression lay in more, and not less, research.

In view of this official attitude it is therefore of interest to note that at a recent conference* held under the chairmanship of Sir Frank Noyce, Member of the Viceroy's Council in charge of the Department of Industries and Labour, a proposal was adopted that there should be established at the Alipore Test House, Calcutta, a Research Bureau. This Bureau, which would be under the general supervision of the Chief Controller of Stores, Indian Stores Department, is apparently to be mainly advisory, since one of its principal functions was approved in the following terms: "Assistance to industrialists in India by giving advice and making suggestions as to the directions in which research should be undertaken". At the same time, it is intended to place at Alipore the nucleus of a research staff consisting of two superior officers with six physical and chemical assistants. It is not clear what are to be the functions of this small staff since, as has been already mentioned, the duties of the Central Bureau are to be purely advisory, the intention being that the actual investigations would be carried out in local institutions.

Whilst any attempt to extend in India the facilities for research must be accorded a warm welcome, it is pertinent to inquire in how far the present proposals are likely to be effective. Is a Research Bureau working under the general control of a department concerned essentially with the purchase and testing of Government stores, with the administrative staff of which no one having experience of original research is associated, likely to stimulate research on a broad and fundamental basis or will it tend to encourage minor and *ad hoc* investigations of little value?

Any consideration of the organisation of research in India necessitates the recognition that industrial conditions in that country are, in many respects, very different from those pertaining elsewhere. The main tendency in countries where industrial conditions are well advanced is to organise in large units with the object of economising in the use of labour. It is becoming more and more doubtful if this programme of rationalisation will, or should, be followed in India. In a country where superabundant labour requires employment, it seems essential that, so far as possible, small scale (cottage) industries should be encouraged. It is obvious that other considerations must apply in the case of certain industries, such as the metallurgical, but there are many others, *inter alia*, the textile industries, the extraction of sugar, of the fixed and essential oils, where economy can be achieved even in small-scale manufacture. Large as are the numbers of workers who find employment in the mills of Bombay and Madras, a far larger number are engaged throughout the country in the handloom industry involving the use of cotton, wool, artificial silk, coir, etc.

It was, therefore, fitting that, at the conference to which reference is made above, much time was devoted to a consideration of the best methods for developing the handloom industries and to the problem of sericultural research. The type of research required for the encouragement of these industries, important as they are, seems to us to be of quite a different order from that research which is so essential if India's great natural resources are to be fully utilised. We do not doubt that the proposed Bureau can, with the assistance of provincial research laboratories, assist these industries, and this is possibly intended to be its primary function. But, even so, the director will have to be something in the nature of a superman if he is to deal adequately with the varied problems which will be referred to him.

It is apparently anticipated that the larger industries will be in a position to provide their own research facilities, and that no direct encouragement or interference by the State is required. It is true that fundamental work of the greatest value has been carried out under the ægis of the Indian Cotton Committee, which has indeed an ambitious programme for future research. Agricultural research is now fostered by the Imperial Council of Agricultural Research, whilst in a somewhat different category, approaching more nearly to the research associations in Great Britain, is the Lac Research Institute at Ranchi financed by the Lac Cess Committee.

Do not these research activities require a connecting link? Has not the time arrived for the formation in India of a Department of Scientific and Industrial Research on the lines which have proved so successful in Great Britain and other countries? India is not destitute of men of scientific eminence capable of co-ordinating her research activities and of leading them along fruitful lines, nor is it lacking in laboratories with enthusiastic workers. If the Indian Cotton Committee be excepted, we know of no organisation in India which is planning long-period research on fundamental problems. Only by initiating and

* Bulletins of Indian Industries and Labour. No. 52: Proceedings of the Sixth Industries Conference (held in Simla on the 9th, 10th and 11th July, 1934). Pp. iii+167. (Delhi: Manager of Publications.) 2·6 rupees, 4*s*.

carrying through work of this nature can India hope to utilise to the full her great natural resources. Admittedly, with provincial autonomy there may be administrative difficulties in the way of a Department of Scientific and Industrial Research, but these have been overcome by the Indian Cotton Committee and should not prove insuperable. If science knows no international boundaries, surely there can be no national ones.

The Significant Rôle of the Atom in Cancer Therapy

Radium and Cancer : a Monograph. By Dr. H. S. Souttar. Pp. xiii+387. (London : William Heinemann (Medical Books), Ltd., 1934.) 21*s.* net.

RARE indeed is the physicist who would even attempt to write upon biochemical, pathological and surgical phases of a complex subject in addition to his own subject. But in this book a leading surgeon of the London Hospital writes intelligently of atomic physics along with the surgical uses of radium and cancer with which he has had long first-hand experience. Books of this type, involving a bird's-eye view of a great field, are usually written in these days by the clinical method—in other words, by a group of writers each of whom contributes a chapter from his specialised store of knowledge. Sometimes a fairly successful effort is the result, and sometimes a treatise utterly lacking in unity. But not so with Dr. Souttar. Evidently he has had the spirit of unquenchable inquisitiveness into every possible ramification and mechanism of the subjects of radium and cancer. He has not been content to take radium for granted or to use it on his patients in accordance with some approved formula. With a plea for tolerance from his expert readers he launches into a discussion of the atom, the Bohr theory, the spectroscopy of X-rays and γ-rays, and the whole range of such topics which have any fundamental bearing upon the general subject. These early chapters are clearly and painstakingly written and quite sufficiently accurate within every requirement of a fairly popular account. There is not the slightest earmark that these phases in which the author has been not directly trained are merely abstracted from some physics book and then hastily and thankfully dropped as he enters more familiar territory.

In common with many of the great British men of science, Dr. Souttar has the power of writing excellent English which conveys facts accurately, but at the same time entertains and holds the reader. The present reviewer found this volume almost as difficult to put down, until it was read from cover to cover, as a great novel. The author evidently has sought for helpful and homely analogies to aid his own thinking, and fortunately he has given some of these to the reader : ". . . so that the spectral signatures of the atom of the various elements can be read with the certainty of a banker reading the signature of his oldest client". "The writings of Stevenson and of Chesterton might give us some indication of their characters, but we should scarcely attempt to deduce from them the physical form of the authors". "In the same way, the intensity of the applause aroused by a candidate's election speech may be taken as some indication of the probability that any individual will vote for him". Speaking somewhat slyly of lack of agreement as to details of radium treatment, Dr. Souttar says : "Paris regards as inadequate any period under fourteen days. Stockholm is satisfied that four hours is ample, whilst America, as might perhaps be expected, uses a stop-watch".

In the treatment of the origin of radiation, the author uses rightfully the older Bohr mechanical model of the atom, since the accepted modern wave mechanics version would lead both author and reader beyond a mutually safe depth. But just as Dr. Souttar dismisses these modern concepts, he tries one parting shot at putting into a word picture an atom which is a mathematical equation, and he succeeds quite admirably (page 28) :

"This conception of energy levels is fundamental in modern atomic theory, far more fundamental indeed than the idea of the revolving electron which serves as a background to the picture. In some ways it is easier to grasp the meaning of the energy level if one conceives of the electron as a continuous band encircling the nucleus and travelling along itself around this centre. If we endow the band with elasticity, we have a simple picture of the energy required to stretch it to the greater circumference of an outer orbit and the atom to a higher energy level, and we can form the mental picture of the output of energy in the form of radiation as it snaps back to the lower level of the inner orbit. Such an idea is in accordance with modern wave theory, and may indeed be a truer picture of the facts than the rotating electron".

Criticisms of the theoretical portion of the monograph arise only as a consequence of necessarily limited treatment. To take a single example, the impression is given from the text and diagrams that there should be $3K\alpha$ and $5K\beta$ X-ray lines (that is, a transition from all three L and all five M levels to fill a vacancy in the K level), whereas actually the selection

principle operates to cut down the possible transitions and the number of characteristic spectrum lines.

The most disappointing feature of the entire monograph is to be found in the treatment of the biochemical phase of the subject—that is, the explanation of chemical, physiological and morphological changes in normal and pathological tissues on irradiation. The author states quite emphatically that essentially nothing is known. Certainly, the information is very scanty, but at least there is a promising beginning. Dr. Souttar is apparently unfamiliar with recent developments, especially in great laboratories in America such as the Mayo Clinic, Rockefeller Institute and the foremost medical schools. Specific radiosensitiveness of cells is mentioned in passing, but not given the emphatic importance assigned by such leaders as Desjardins. Indisputable evidences of changes in *p*H, protein aggregation, viscosity, permeability and osmosis, rate of cell respiration, glycolysis, rate of cell division, etc., are largely overlooked, possibly in an effort to maintain a conservative attitude until further experimental proof is forthcoming.

In the final chapters dealing with the distinctly medical phases of cancer diagnosis and radium therapy, the author is convincingly at home, and everywhere the reader feels the able touch of a surgeon of long experience and successful achievements, deeply and impartially interested as a true man of science, but also glowing modestly with the opportunity to serve suffering mankind. Dr. Souttar is to be congratulated for a notable effort in presenting as a labour of love and as the unified product of a single mind and pen, a book which any intelligent person should be proud to possess.

GEORGE L. CLARK.

Conditioned Reflexes

Vorlesungen über die Arbeit der Grosshirnhemisphären. Von I. P. Pawlow. Autorisierte übersetzung aus dem Russischen von Prof. Dr. G. Volborth. Pp. viii+480. (Leningrad: Medizinischer Staatsverlag d.R.S.F.S.R.; London: Kniga, Ltd., 1932.) 12*s.* 6*d.*

ENGLISH-SPEAKING physiologists have been conscious for the past seven years of the debt which they owe to Prof. Anrep for his admirable translation of the first (1926) Russian edition of this book. The volume before us is a translation into German of the second edition, which was published less than a year after the first. No significant changes have been made in the text, but the bibliography at the end is much more complete. In his preface, the translator states that histological confirmation has now been obtained for the view that destruction of the upper portion of the basilar membrane in the cochlea abolishes responses to low tones while leaving those to high tones unaffected. He also confirms the existence of "conditioned inhibitory stimuli of the second order".

The opportunity which the last few years have afforded of reflecting upon and studying the results of his work since 1900 has done nothing but enhance the prestige of Pavlov as one of the world's greatest physiologists. He first made a reputation by his investigations on the digestive glands and their secretions, and he then made a second reputation by the work now under review. In both series of researches, the ingenuity shown in planning the experiments, the beautiful and difficult technique with which they were carried out, the patience and caution exercised in drawing conclusions, all proclaim the work of a master. But although no one interested in the physiology of the central nervous system can afford to be ignorant of these experiments, there is legitimate room for doubt as to their correct interpretation.

By using the term 'conditioned reflex' for acquired responses dependent upon the integrity of the cerebrum if not upon consciousness, Pavlov implies that the mechanism subserving the response is essentially similar to that of reflex action in the strict sense. He strives to justify this view by reference to the causal relationship between stimulus and response, but when he goes further and mentions "a definite path in the nervous system" as equally characteristic of both responses, our suspicions are at once aroused. There is much evidence that the acquisition of motor habits by a process of learning is a more complex process than the laying down of stereotyped paths in the cerebral cortex, and the same is probably true of the development of 'conditioned reflexes'. To many it would seem advisable to confine the use of so well-established a technical term as reflex to the concept for which Marshall Hall in 1833 introduced it into the vocabulary of science, namely, to describe responses dependent on inherited structure in the nervous system and not on individual experience. Hall considered that "the excited motions which belong to the reflex function are independent of sensation". Unless it can be proved that consciousness is an ineffective by-product of central nervous activity, it is probably wise for us still to exclude from the category of reflex action all phenomena in which mental activities may play an essential part.

There are further difficulties, some of which Denny-Brown has recently emphasised, in identifying psychical secretion of saliva with reflex action. In particular, he finds Pavlov's use of the word 'inhibition' confusing. It is difficult too to find a

parallel in true reflexes for an intense homogeneous stimulus causing no response when a similar stimulus of weaker intensity is effective. It is therefore thought by some to be doubtful whether Pavlov's terminology assists clear thinking. It may be preferable in the present state of knowledge to interpret his findings in psychological terms such as association of ideas, distraction, interest, novelty, attention and memory, and then to look for a physiological basis for these mental processes, rather than to neglect consciousness altogether and fit everything into a hypothetical reflex framework.

Whatever may be the ultimate verdict on these minor points, there can, however, be no doubt about the greatness of Pavlov's achievement. He has at least given us a reliable method for investigating the ability of lower animals to discriminate between different stimuli, a quantitative method of recording the development and strength of acquired associations between stimuli, and a new method of attacking the problems of cerebral localisation. His work will for long provide data of the utmost importance to students of the physiology of the cerebral hemispheres. R. S. C.

Chemical Engineering

Der Chemie-Ingenieur: ein Handbuch der physikalischen Arbeitsmethoden in chemischen und verwandten Industriebetrieben. Herausgegeben von A. Eucken und M. Jakob. Band 1: *Physikalische Arbeitsprozesse des Betriebes.* Teil 3: *Thermisch-mechanische Materialtrennung.* Herausgegeben von A. Eucken. Pp. x+327. 31.50 gold marks. Teil 4: *Elektrische und magnetische Materialtrennung, Materialvereinigung.* Herausgegeben von A. Eucken. Pp. viii+309. 31 gold marks. Band 2: *Physikalische Kontrolle und Regulierung des Betriebes.* Teil 3: *Messung von Zustandsgrössen im Betriebe.* Herausgegeben von Jakob. Pp. xi+275. 28 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.)

ERK and Kirschbaum in Chap. xiv, the first in part 3, vol. 1, consider the separation of materials by evaporation and after discussing the removal of a liquid by boiling and the calculations connected with evaporating problems, describe various types of evaporators and dryers and the factors which govern their performance.

A theoretical treatment of the subject of distillation and rectification, given by Hausen in the next chapter, is followed by descriptions of stills and the methods of determining such quantities as number of plates, etc., for a given set of conditions. In the chapter on crystal formation and growth, in which the usual treatment is adopted, Thiessen and Banthien seem to have confined their references to papers by German scientific workers only, and this fact is noted with regret in two other chapters.

Absorption and flotation processes by Mantner and Bierbrauer are treated in the final chapter. Emphasis is laid on the importance of the surfaces of the particles, and the methods of operation of the various industrial plants described receive due prominence. On p. 264 the reference to the paper by Hollings Pexton and Chaplin, is given as the *Gas Journal* 1929–715. This, as the *Journal* correctly states, was a paper read before the Institution of Chemical Engineers and published afterwards in vol. 7 of its *Transactions*.

Continuing the subject of separation in part 4, vol. 1, Prausnitz and Reitstötter consider electrophoresis, electro-osmosis and electro-dialysis and laboratory work done in connexion therewith before passing to the industrial applications of these principles.

Ladenburg in the next chapter considers the electrical purification of gases, and describes several industrial units engaged on this operation and the methods of working.

In dealing with magnetic separation, Stein discusses very fully such subjects as the formation of magnetic fields, the magnetic properties of materials and their importance in ore dressing. When describing the different types of magnetic separators, reference is made to Mordey's work on separation using alternating current, but his separator is not described in detail. The remainder of this book is devoted to mixing, and Naske opens the subject by considering the mixing of solid materials and the various types of batch and continuous machines designed for this purpose.

Sintering, briquetting and the fusion of materials are considered by Thiessen in the next chapter more from the academic than the practical point of view and greater prominence could well be given to the latter aspect in a work of this kind.

Merkel and Kirschbaum are the authors of the chapter on the mixing of fluids, and this is designed to include such operations as leaching and dissolving as well as the mixing of gases with solids, liquids and other gases, while the final chapter by Thiessen and Eucken is devoted to the formation of plastics, the stability, decomposition and production of dispersions and emulsions.

Ebert, in the first chapter of part 3, vol. 2, after considering the means of measuring pressure, goes on to describe compressors and pumps, and the transmission throughout the works of gases under pressure, while the measurement and recording of temperature and the instruments used for this purpose are carefully considered by Hencky in the following chapter.

Moisture in a gas is of importance in drying operations, so the chapter by Grüss in which the alteration of the moisture content with varying conditions, and the methods used in its determination and regulation, gives valuable information to those testing drying plants or carrying out research on this subject.

In the second section of this book, Krönert describes the various types of calorimeters available for the measurement of the calorific values of solid, liquid and gaseous fuels, and this is followed by two chapters, one by Grüss on the measurement of heat and the other by Burbach on the loss of heat, both of which are of considerable importance to engineers.

All the contributors, in both volumes, have worked to a carefully prepared scheme in which the theoretical aspect of their subject is first emphasised. This is then followed by, in the first volume, descriptions of suitable industrial plants or units and, in the second volume, information on the instruments and regulators to be used. Often, too, hints are given on the methods of working which should yield good results. The first volume, therefore, should appeal more to the designer and user of chemical plant than the second, which is primarily a volume for those engaged in testing or research.

Many engineers, however, and especially those at the commencement of their career, will only become acquainted with this valuable work through lending libraries; this, in view of the excellent way in which the various subjects are treated, is to be regretted.

Short Notices

Traité de zoologie. Par Edmond Perrier. Fascicule 10: *Les mammifères.* Publié par les soins et avec le concours de Prof. Rémy Perrier. Pp. iv+3343–3610. 45 francs. *Index alphabétiques des 10 Fascicules.* Par Prof. Rémy Perrier. Pp. iv+163. 40 francs. (Paris: Masson et Cie, 1932–1933.)

THE volume upon mammals forms the tenth and final fascicule of Perrier's great "Traité de Zoologie". Like its forerunners in the series, it is essentially a morphological and classificatory textbook, and in it the life and habits of the mammals have no place, apart from a short account of limb adaptations.

The greater part of the work (190 pages) consists of comparative accounts of the organic systems of the body. The text is adequate, but the majority of the illustrations have a familiar look, and we must protest against the reappearance of the figure showing the successive annual stages of the growth of the antlers of the red-deer, ending in three stages in which the crown shows an impossible (or at any rate an altogether abnormal) development; nor is it accurate to say that the addition each year of new tines (*andouillers*) "permet de juger exactment de l'âge d'un Cerf".

The remainder of the book (77 pages) gives, in small type, the classification of the Mammalia, down to the characters of families.

The ten volumes, begun by Edmond Perrier and completed by Rémy Perrier, opened with an account of general zoology, and this was followed at intervals by volumes dealing, mainly on morphological and systematic lines, with the groups of the animal world, each of the vertebrate classes having allocated to it a complete volume. A special account of the embryological development of the allantoidian vertebrates was included in the reptile volume. The index consists of two parts, one confined to technical terms, and the other to the names of genera and subgenera, various typographical characters being used to indicate fossil forms, synonyms, illustrations and other details. J. R.

Die Rohstoffe des Tierreichs. Herausgegeben von Ferdinand Pax und Walther Arndt. Lief. 9. Pp. 881–1040. 16.80 gold marks. Lief. 10. Pp. 1041–1216. 17.60 gold marks. Lief. 11. Pp. xxiv+1217–1400. 34 gold marks. (Berlin: Gebrüder Borntraeger, 1932–1933.)

THESE three parts contain the chapter on fibrous materials of animal origin, the greater part of which is devoted to the account of hair, including wool, and bristles obtained from horse, cattle, camel, alpaca and vicuna, sheep, goat, rabbit and pig. The history of these fibres from early times, and the principal localities from which they are now obtained, are briefly set forth. The physical characters and structure of the various types or grades of fibre and the technical processes by which they are spun, woven or otherwise prepared for use, are described, and the commercial designations of the different sorts of yarn and finished products are defined. The testing of fibres for length, fineness and other qualities and the substitutes used for horse hair, wool and bristles are considered. The characters of the hair and bristles of a number of wild mammals and the uses of these fibres are described, and an interesting section on human hair and its applications is added.

Of other fibres considered in this chapter the most important are produced by silk-spinning Lepidoptera, especially the Bombycidæ. The spinning glands are described and their cells, with remarkable branched nuclei, are figured. Details are given of the culture of the silkworms (some 43,000 of which develop from an ounce of eggs), the characters of the silk fibres, the mode of collection, spinning, etc. Among other fibres considered, are spider's threads for the cross-lines of optical instruments, the fibres of the byssus of the bivalve *Pinna nobilis*, and the tendons and ligaments of mammals.

This useful account of fibrous materials, which extends to more than five hundred pages, is well illustrated and includes lists of works for reference.

Outline of Modern Belief: Modern Science, Modern Thought, Religious Thought. Edited by J. W. N. Sullivan and Walter Grierson. (To be completed in about 24 fortnightly Parts.) Part 1. Pp. viii + 64. (London: George Newnes, Ltd., 1934.) 1*s.* each Part.

THIS much-advertised work is clearly printed, copiously illustrated, and makes effortless reading. Some small errors on points of fact are of secondary importance; so also is the quality of the writing, which is not of the high standard to be expected of the editors—though this defect is mitigated by the fact that the original part consists largely of short connecting-links between quotations. What concerns us most is the avowed object of the book. "The editors of this Outline try to fill the rôle of middlemen between the specialists on the one hand, and on the other the plain man who wants to get at the gist of the thing." Following this we read of "modern science—so unlike the dry-as-dust science of old". "The old astronomy told us about the sun, the stars, the planets, their place in the heavens, their movements, revolutions, their nature and peculiarities; the new astronomy goes far beyond that when it speaks about the birth and death of suns and stars, how they are born and why they die; about the mystery of the immense nebulæ from which the stars are born, and about whence came the nebulæ." "The old science of physics dealt with energies—light, heat, electricity, and gravitation, all a little boring to the general reader." "The recent development of Physics has been called 'the most exciting episode in the history of science'." We cannot help noticing that the alleged uninteresting subject-matter is all concerned with trustworthy knowledge, while the interesting things are matters of sheer speculation. The provision of excitement for minds bored by truth is not an undertaking likely to attract many scientific readers.

An Introduction to Plant Biochemistry. By Dr. Catherine C. Steele. Pp. viii + 356. (London: G. Bell and Sons, Ltd., 1934.) 15*s.* net.

THIS book might be taken as affording a measure of how much chemistry the student of botany is expected to know. Somehow, chemistry does not as a rule find favour with botanists; it is perhaps too remote from the other sides of their subject, so that plant physiology is not nearly so developed a field as animal physiology. Indeed it has been largely left to the chemist, whose achievements in unravelling the constitution of the pigments, chlorophyll, anthocyan and carotene, of the alkaloids, sugars and what not else, are well known. But there remains so much to find out in the plant world, there are so many questions unanswered, that every encouragement must be given to any effort to impart and acquire knowledge in this field.

It is from this point of view that we welcome Miss Steele's monograph. It contains a neat and satisfactory summary of the present state of chemical knowledge of the various groups of substances of plant origin. As this information is largely available elsewhere in the up-to-date monographs, in particular those of Dr. Plimmer's series, it has not been difficult for the author to ensure accuracy in its reproduction, and these have obviously been freely used. Superimposed on this framework are allusions to the plants in which the substances occur and there is an index of botanical names.

It should be understood that the material is an elaboration of a series of lectures given to students in biochemistry: the text is interspersed with a number of experiments.

Byzantine Civilisation. By Steven Runciman. Pp. 320. (London: Edward Arnold and Co., 1933.) 16*s.* net.

THIS welcome contribution to Byzantine literature gives an excellent introduction to the historical, social and intellectual atmosphere of the ten centuries during which flourished the eastern portion of the Roman Empire (330–1453). The Imperial constitution and administration, the status of religion and the Church, the organisation of the army, the navy and the diplomatic service, the characteristics of commerce and everyday life, and finally the legacy of Byzantium in the realms of learning, literature and art, are carefully analysed and surveyed in their historical setting.

Many institutions of the Empire can be compared with advantage to present-day ones. The manufacture of arms, for example, was a State monopoly. There was no unemployment. Middlemen were unnecessary, and there were practically no labour troubles. The growing competition of the West, however, hastened on the steady debasement of the coinage, which would appear to be the main cause of the decline and fall of Byzantium. Mr. Runciman gives very brief indications of the scientific and philosophical thought of the Byzantine Empire. What is mentioned, however, shows clearly that the disinterested pursuit of learning was one of the major characteristics of this important civilisation. T. G.

Newnes' Chemistry in Commerce. Advisory Editor: M. D. Curwen. (To be completed in about 32 weekly Parts.) Part 1. Pp. 56. Part 2. Pp. 57–104. (London: George Newnes, Ltd., 1934.) 1*s.* each Part.

THIS work has two main objects, first, to serve as an illustrated 'guide-book' to the chemical works which the articles describe, and secondly to deal with the industries not so much by discussions of the principles on which they depend, as by indicating how such principles are applied in practice.

The excellent illustrations play an important part in the achievement of the first object, particularly where they show 'close-ups' of the more intricate analytical operations; and so far as one can judge from Parts 1 and 2, the second is also being fulfilled. The work is therefore worthy of a wide sale among students, laboratory assistants and junior chemists in industry. If one may venture a criticism it is that occasionally the treatment is uneven; as an example, five out of the seven pages on routine tests for milk at cooling stations are devoted to the Gerber test.

J. G.

The Problem of Ether Drift

By DR. C. V. DRYSDALE, C.B., O.B.E.

IN these days of preoccupation with the wonderful recent advances in what may be called corpuscular physics, and the remarkable achievements of the theory of relativity, the old problem of the existence and properties of a basic medium or ether has receded into the background, and there seems to be a general disposition to disregard an ether as being an unnecessary, or at least an unprovable, hypothesis.

As Sir Oliver Lodge has pointed out in "The Ether of Space", the scientific belief in an ether is essentially of British origin, arising from our 'common-sense' repugnance to the idea of 'action at a distance' without some connecting medium to transmit electrostatic, magnetic and gravitational forces and disturbances. It has dominated the minds of our most illustrious physicists, from Newton to Faraday, Maxwell, Kelvin, Rayleigh and Lodge ; and it has been accepted by a great majority of the most eminent Continental and American physicists, including Einstein.

But since the advent of Planck's quantum theory, the Heisenberg wave electron and Einstein's theory of relativity, we have realised that many phenomena which we used to regard as being unexplainable on a corpuscular hypothesis may be at least partially explained by it. The diffraction phenomena exhibited by an electron stream, when reflected from or transmitted through a thin metallic film, provide a striking example of interference on a corpuscular basis, and it leads to a feeling that all optical phenomena may possibly be ultimately explainable on that basis.

In spite of these successes of the corpuscular theory, however, we have only to turn our minds back to some of the elementary facts and theories to see that the need for an ether remains as cogent as ever. The four fundamental electromagnetic equations of Maxwell are merely statements of elementary experimental facts which any schoolboy can now verify, and they lead by a simple and rigid mathematical demonstration to the conclusion that electromagnetic disturbances are propagated as waves of electric and magnetic forces and displacements which are mutually perpendicular to each other and to the direction of propagation, and with a definite velocity which depends upon two constants respectively analogous to the rigidity and density of an elastic solid and has been shown experimentally to be the same as the velocity of light. The success of Maxwell's theory, with its experimental confirmation by Hertz and further development by Drude, Lorentz and Zeeman, renders it the greatest generalisation in the domain of physics ; and it seems imperatively to call for the existence of an all-pervading medium having a quasi-rigidity and quasi-density.

Moreover, the phenomena of interference, which gave rise to the first demand for an undulatory theory of light, still seem to demand it, in spite of the electron diffraction phenomena. The accuracy with which optical interference effects can be predicted and observed over distances of several metres would involve a constancy of phase relationship between travelling vibrating corpuscles, and therefore identity of their velocities, to within one part in a hundred million, which seems inconceivable on any theory of emission.

Now that we have got down to bed-rock, so to speak, in the experimental demonstration of the existence of the two ultimate particles of opposite electrical charge, the electron and the positron, it would seem that the problem of the existence and properties of the connecting link, the ether, is the greatest outstanding problem in physics. Unless, or until, this problem is solved, the whole fundamentals of science will remain in a confused and unsatisfactory state, and even all our units of measurement will remain irrational and semi-empirical.

It cannot, of course, be claimed that the mere demonstration of the existence of an ether would go far to clear up this confusion, as we are still without any clue to a means of determining the separate values of its two fundamental constants, or to an explanation of its apparently antagonistic properties of elastic resistance to electrical displacements combined with complete freedom from resistance to the motion of discrete electrical charges ; but a definite experimental demonstration of its existence would be a valuable first step, and the only one which seems likely to be convincing would be a demonstration of some influence of motion or 'drift' on optical experiments.

EARLY ATTEMPTS BY 'DRAG' METHODS

Attempts at demonstrating such an effect have been made by numerous scientific workers for more than a century, but it has so far proved the most intractable of all experimental problems. The proof that light travels more slowly in dense transparent media than in air naturally led to the idea that such media would exercise a retarding effect or 'drag' on any motion of the ether relative to the medium, which should enable that motion to be detected by a change in the velocity of light if the motion is in the line of propagation, or by a

deviation if the motion is transverse. As early as 1818, Arago attempted to detect a change in the deviation of an achromatic prism with its orientation, but failed completely. He communicated this failure to Fresnel, who pointed out that it would be accounted for if a moving medium of refractive index n only imparted a fraction $(n^2-1)/n^2$ of its velocity to the light. This suggestion was apparently confirmed in 1851 by the direct experiments of Fizeau with moving water, and by the similar but more refined measurements of Michelson and Morley in 1886.

Meanwhile, Arago's prism experiment had been repeated in a more refined manner by Maxwell in 1867, Airy had attempted to detect any change in astronomical aberration with a water-filled telescope; and Hoek in 1868, and Mascart and Jamin had tried to detect any effect of longitudinal motion by interferometer methods. All these experiments, however, gave the same negative result, and it is easy to show that any attempts at detecting either a longitudinal or a transverse drift by the drag of dense matter must fail if the Fresnel formula is exactly true.

Although comparatively recent, the well-known 'ether model' experiments of Sir Oliver Lodge, which were commenced about 1902, may be mentioned here, as they were an attempt to demonstrate a motion of the ether by the drag of neighbouring moving masses. No such motion could be detected, even when the revolving discs were strongly electrified or magnetised; but it would seem from the theory of Lorentz to be described later that the ether in a dense medium is not entrained by the motion of the medium, and as the connexion between the ions of the medium and the enclosed ether is so much closer than that between the revolving discs and the intervening ether, the negative result scarcely seems surprising.

The Michelson-Morley Experiments

In 1878, however, Maxwell pointed out in his article on "Ether" in the ninth edition of the "Encyclopædia Britannica", that a relative motion of the ether in the line of propagation should produce a second order change in the time required for light to travel to a distant station and return. For the orbital velocity of the earth, of about 30 km. a second, this would only involve an increase of one part in a hundred million in the time, which Maxwell regarded as beyond the limit of detection. Michelson, however, who was at that time studying in Berlin, resolved on making the attempt, and devised his celebrated interferometer, the first example of which with a 100 cm. base was constructed by Schmidt und Haensch and tried at the Potsdam Observatory in 1881. For the orbital velocity this instrument should have shown a displacement of 0·04 of a fringe, but only 0·004–0·015 of a fringe was observed, and these displacements were regarded as errors of experiment and as giving no evidence of ether drift.

After his appointment as professor of physics at the Case School, Cleveland, in 1881, Michelson collaborated with Prof. E. W. Morley to carry on the investigation on a larger scale; and it has been continued to the present time with successively improved interferometers and technique by Morley and Miller, and since 1905 by Prof. D. C. Miller alone, who has recently published a very complete historical account of the researches*. The first Michelson-Morley interferometer consisted of a concrete base, 150 cm. square and 30 cm. thick, with a wooden float and circular mercury tank so as to allow it to turn freely in azimuth without risk of distortion. Upon this slab the interferometer with a set of additional plane mirrors was mounted so as to reflect each beam backwards and forwards eight times and thus give the equivalent of arms about 1,100 cm. long. This should have shown a displacement of 0·4 of a fringe for the orbital velocity, but when observations were made in a basement laboratory in 1887, the displacements obtained were much smaller, and the experiment is always quoted as having given a null result, although the published conclusion was that the observed drift did not exceed a quarter of the orbital velocity. Miller claims that the observations indicated a definite drift of about 7 km. a second.

The supposed null result of this experiment, however, led Fitzgerald in 1891 to suggest, and Lorentz in 1895 to develop, the famous contraction hypothesis, which should render the detection of a drift as impossible by the Michelson-Morley method as Fresnel's formula made its detection by 'drag' methods. Under the impression that this contraction might vary for different substances, Morley and Miller, at the instigation of Lord Kelvin, determined to repeat the experiment with another material as base, and constructed an interferometer with a wooden cross with arms 430 cm. long, the optical arrangements remaining as before and giving a total length of path for each beam of about 33 metres. Tests with this apparatus in a basement laboratory at Cleveland in 1902–3 again indicated a maximum drift of about 8 km. per second, but the wood was not very satisfactory and it was decided to replace it by a similar cross of steel with a wooden float and annular mercury trough, and to increase the number of mirrors to eight in each arm, thus increasing the total light path of each beam to 64 metres, which should give a displacement of 1·12 fringe for the orbital velocity. After

* *Rev. Mod. Phys.*, July, 1933.

preliminary laboratory trials in 1904, which gave about 7 km. per second for the drift, the apparatus was transferred to the Cleveland Heights and set up in a temporary hut surrounded with glass windows, at an altitude of 285 metres ; and trials in October 1905 gave a velocity of 8·7 km./sec. for the drift.

Shortly after this, Prof. Morley retired, but plans had been made for further trials, and in 1921 the interferometer was set up in a hut in the grounds of the Mount Wilson Observatory at an altitude of 1,750 metres, and surrounded with canvas windows. Trials were carried out in April 1921 and indicated a maximum drift of 10 km./sec. Before this result was announced, a careful series of tests was made concerning the possible effects of temperature changes, loading, magnetisation and magnetostriction, and centrifugal and gyrostatic forces. A cross of concrete reinforced with brass was then made up so as to eliminate any possible magnetic effects, and gave similar results in December 1921. As this cross, although heavier, was less rigid than the steel one, the latter was reverted to ; and, after further optical improvements had been made at Cleveland, the apparatus was again set up at Mount Wilson in a hut on a new site, with all the refinements previous experience had suggested. Trials made in September 1924 gave the same value of 10 km./sec. for the drift.

(*To be continued.*)

Science and Food Supplies

A NUMBER of topics came under discussion at the recent symposium on food preservation held by Section I (Physiology) on September 11 during the annual meeting of the British Association at Aberdeen, and a wealth of information and suggestion of biochemical and physiological interest was forthcoming from the authors of the papers. In general, the communications were in fact far too condensed and obviously represented an attempt, which we understand was made at request, to provide a review of the underlying problems of food preservation.

Muscle Proteins

Two of the most interesting problems which are at present to the fore in the study of post-mortem changes in muscle proteins are those of lactic acid formation and of protein denaturation. In the view of Drs. T. Moran, G. A. Reay and E. C. Smith, lactic acid formation is governed by the concentration of salt, the same general relations being obtained whether salt concentration is varied (1) by drying intact muscle, (2) by freezing intact muscle, or (3) by adding salt to suspensions of minced muscle. The salt concentration which determines maximum rate of lactic acid formation is that which determines maximum solubility of the myosin (salt-soluble) fraction of the muscle proteins, and hence it is suggested that an intimate relation must exist between this protein and the enzyme substrate complex responsible for lactic acid production. It is the salt concentration obtained by freezing muscle to equilibrium at − 2° to − 3° C.

In the study of denaturation, care must be taken that there is nothing in the technique itself which may render the protein insoluble. Toluene as a temporary preservative, for example, must be avoided. Although it has been claimed that so much as 70 per cent of the proteins of muscle are rendered insoluble within twenty-four hours of death, more critical methods show that rigor mortis is not accompanied by appreciable denaturation. The conditions which promote maximum denaturation in subsequent storage have been found to be similar to those which promote maximum solubility ; for example, the rate of denaturation in frozen meat or fish is at a maximum at − 2° to − 3° C.

Prior to this recent work on protein denaturation, it was thought that the only factor influencing 'drip' from thawed-out frozen flesh and loss of quality during cold storage was the rate of freezing, which determined the number, size and position of the ice crystals. It is now clear that protein denaturation plays an important part, and is in addition the principal factor responsible for the 'dryness' and loss of quality of meats and fish preserved by freezing. Guided by this new knowledge, great progress is now being made in the fishing industry. Both quick freezing and subsequent holding at low temperatures are being employed in order to reduce denaturation to the greatest extent possible.

Life-Duration of Fruits

The preservation of fresh fruit presents an entirely different set of problems. In their discussion of these problems, Drs. F. Kidd and C. West stated that the fundamental issue is the question of life-duration and of the factors determining it. Analysis has shown that race, nutrition and environment are the principal determinants : and further, that the respiratory activity per cell unit of the crganism appears to be an integrated expression of the influence of these factors upon life-duration. The higher the pitch of activity, the shorter the life and vice versa. Death of the organisms after separation from the tree is not, however, simply due to exhaustion of sugar reserves. "If we may take a mechanical analogy,

the ageing and death of the fruit seems to be related rather to the wearing out of the machine by use than to the failure of its fuel reserves."

An interesting experiment described was one in which the life-duration of apples gathered at different stages of their growth from June onwards was determined. Maximum life-duration was exhibited by young fruits of about walnut size. Cell division had ceased in these fruits and the major enlargement by increase in cell size and storage of sugars had not taken place. It is at this stage that they exhibit minimum respiratory activity per cell unit.

Respiratory activity after gathering is subject to control by varying the temperature and the composition of the atmosphere. In either case, reciprocal effects on life-duration are obtained. The effects of oxygen and carbon dioxide concentration are new, and while still subject to analysis, have already been widely applied industrially in the fruit industry.

Composition of Fish Fats

A considerable amount of new ground has been broken recently in regard to the composition and physiology of fish fats. The position was reviewed, especially in the light of his own work at the Torry Research Station, by Dr. J. A. Lovern. As a class, fish fats are characterised by a greater number of individual fatty acids than are found in land animals: further, there are noticeable differences in the fats laid down by fresh-water and marine species. It appears that, in general, the peculiarities in the composition of fish fats can be traced back through the dietary chain from large carnivorous fishes to the vegetable feeding copepods. Curiously, however, in the case of the young salmon, its fat changes from the fresh-water type to the marine type while the fish is still in fresh water.

In laying down their fat reserves, there is, in the case of many fishes possessing more than one fat depot, a marked selectivity as between these depots. This selection appears to be governed by molecular size. In the mobilisation of fats for transference to the gonads, there is no evidence of selection as between depots, nor can evidence be obtained that the liver is active in desaturating fats as a preliminary to their oxidation, for in many cases the liver fats are found to be more saturated than the depot fats. F. K.

The Mendeléeff Centenary and Scientific Progress in the U.S.S.R.

AN international congress in honour of the hundredth anniversary of Mendeléeff's birth was held last September in Leningrad with a splendour appropriate to his importance as the greatest Russian man of science. The official list mentioned 'delegates' from many countries. As, however, the Russian Academy of Science had preferred to send personal invitations to scientific workers abroad instead of requesting societies and associations to send their representatives, we should more properly describe those who took part in the congress as guests. There were 26 foreign participators and about 300 official Russian delegates, besides some 1,400 unofficial Russians, who attended the lectures.

In planning the congress, the Russian Government set out not only to pay tribute to Mendeléeff's memory, but also to give the members an idea of the present-day position of Russian science and industry, so far as was possible within a fortnight. Therefore the lectures more or less closely connected with Mendeléeff and his work took place in the first part of the session. In connexion with it there followed inspections of scientific institutes in Leningrad, Moscow and Kharkov, and a visit to the industrial works at Dnjeproges.

The congress began on September 10 with a ceremonial inauguration in the former Taurian Palace in Leningrad, in the hall in which the Duma used to meet. It was specially impressive that welcome to those taking part was uttered not only by the president of the Academy and some high Soviet officials, but that at the end of the first meeting the platform was taken by twenty or thirty workmen in their working-clothes, whose speaker bid the congress welcome in the name of the engineers and chemical workers of Leningrad, and expressed their appreciation of Mendeléeff's life work for the industrial development of Russia. In consequence of the manner in which the invitations had been sent out, there were no addresses from foreign societies. Only the Royal Society of London, which had specially close relations with Mendeléeff, sent greetings by one of its fellows, Prof. J. W. McBain (Stanford University).

The first lectures were devoted to Mendeléeff's memory. In consideration of foreign delegates, some of the Russians spoke in French, or at least repeated from time to time the essential gist in a few sentences in French. Nevertheless, foreign visitors were mostly dependent on the printed synopses or the kindly translations of colleagues for their understanding of the Russian contributors, and therefore lost many details. Prof. Bajkov gave a description of Mendeléeff's scientific work. Prof. Ivanov dealt with Mendeléeff's

activities as president of the Institute of Weights and Measures.

Only on the second day did foreign representatives speak. After a lecture by Prof. Rožděstvenskij on spectra and their relation to the Periodic System, Prof. Paneth (London) dealt with Mendeléeff's views on the chemical elements as the ultimate basis of the science of chemistry, pointing out that he rejected to the end of his life the idea of their compound nature. Dr. Rumer spoke on quantum chemistry, Prof. Boldyrev on crystal structure and ionic radii; Prof. Lise Meitner (Berlin) lectured on atomic nuclei and the periodic system; Prof. W. Biltz (Hannover) gave a summary of his extensive researches on the volumes of chemical compounds in the solid state. On the third and the fourth days, lectures were given by the following: Prof. Fersmann, on the periodic system in geo-chemistry; Profs. Černiajev and Grünberg, on complex salts; Prof. Walden (Rostock), on electrolytes and solvents; Profs. Kurnakow and Stepanov, on Mendeléeff's theory of solutions; Prof. Zelinsky, on his contact theory; and Prof. Nametkin on his work on petroleum.

Opportunities to visit scientific institutions in Leningrad were afforded to delegates even before the official opening of the commemoration, during intervals between meetings, and on the fifth and sixth days of the congress. Even those acquainted with the literature concerning the intensive scientific work of their Russian colleagues were impressed by the extent of the investigations being carried on in the various institutes through which they were conducted—as, for example, the Radium Institute (directed by Profs. Vernadsky and Chlopin), the Institute of Chemical Physics (Prof. Semenoff) or the Institute of Technical Physics (Prof. Joffe). It would be very difficult to name any important modern problem in the sphere of physics or chemistry which is not being attacked by Russian scientific workers in friendly rivalry with their colleagues in Western countries; while the financial resources which are at their disposal for scientific purposes are in certain cases even better. The visitors' attention was directed with special pride to the number of pieces of apparatus made in Russia itself; it may be mentioned, for example, that complicated glass apparatus has been made almost exclusively of glass from Russian factories and manipulated by Russian glassblowers; and that the giant electromagnet on the ground floor of the Radium Institute, and the neighbouring high-tension apparatus (for the acceleration of charged particles by E. O. Lawrence's method) owe their construction and erection to Russian material and Russian electricians.

After the congress had lasted six days in Leningrad, the majority of those taking part accepted the Russian Government's invitation to visit Moscow, where the Karpov Institute formed a special centre of attraction. This Institute, called after its founder, is now housed in two large buildings, and the visitors were greatly interested to see the work on physical, colloidal and inorganic chemistry in the departments of Profs. Frumkin, A. Rabinowitsch, Kasarnowsky and Sirkin, and to talk to these workers. It was a happy thought of the directors of the congress to link with the inspection of several institutes informal lectures and colloquiums. In the Radium and the Chemical-Physics Institutes in Leningrad, in the Karpov Institute and in the "Scientists' House" in Moscow, several of those taking part in the congress made short reports on topical physico-chemical subjects, which were then thrown open to discussion. Besides those lecturers mentioned in the official programme, other members of the congress heard in this way were Profs. Hahn (Berlin), Hönigschmid (Munich), Stranski (Sofia), Centnerszwer (Warsaw), Palmaer (Stockholm), Bronsted (Copenhagen), Heyrovsky (Prague), Mark (Vienna) and Dr. and Mrs. Noddack (Berlin).

A somewhat reduced party then continued the journey to Kharkov and Dnjeproges. The Physical-Technical Institute in Kharkov, considerably smaller than the Karpov Institute, is directed by Prof. Leipunsky, and devotes its activities principally to low-temperature experiments and to atomic disruption. Indeed, this very modern sphere of research is already being tackled in several Russian institutes. We mentioned above that the Leningrad Radium Institute intends to use Lawrence's method, the Technical Physics Institute has already at work a high-frequency installation similar to that of Cockcroft and Walton at Cambridge, and in Kharkov Van De Graaff's method of electrostatic charging is being used. The visit to Kharkov was also of great interest for members of the congress because the incredibly intensive building activity, which in Leningrad and especially in Moscow (for example, the construction of an underground railway) often still impedes traffic and causes much dust, has already produced imposing results in Kharkov. The visit to the "House of Industry", an enormous block recalling sights of American towns, and the view from its fourteen story roof over the neighbouring quite recently developed town-quarter, with its fine offices and modern workmen's houses, will certainly be unforgettable for all who took part.

The most southerly point of the journey was reached in Dnjeproges. (Until recently the establishment was called Dnjepostroj, but as the last

syllable of this word designates a building in course of erection, the official name is now "Dnjeproges", a contraction for "Public Electricity Station on the Dnjepr".) Here is one of the greatest industrial installations in Europe; but the curved dam, almost 800 m. broad and 50 m. high, serves another purpose too. Above this point there were rapids in the Dnjepr which rendered shipping impossible, and many earlier projects for the regulation of the river were abandoned as impracticable. To-day the dam, in connexion with a system of locks, permits navigation from the Black Sea to Smolensk, a distance of nearly 1,400 miles; this is especially important for the transport upstream of benzine, and downwards of wood, apatite and flax.

The utilisation of the falls provides the Ukraine with cheap power. The installation is planned for nine generators each of 90,000 h.p.; six are already running. Here also the visitor is informed that the last two were not manufactured by the G.E.C. (Schenectady) but were built in Russia, apparently to exactly the same plan. The electrical power generated here, to amount to 600,000 kw. when the plant is in full working order, will be largely utilised in the neighbouring complex of industrial works (called Combine), which has sprung up in the course of recent years. (The population of Dnjeproges has already increased from 2,000 inhabitants in 1927 to 130,000.) The inspection of the works was especially interesting because here an attempt is being made to run parts of the plant as soon as possible without waiting for the completion of closely associated factories. Two blast furnaces of the largest size (each of 900 tons capacity), numerous electric furnaces for the manufacture of tool steel and iron alloys, and a bauxite plant for the electrolytic production of aluminium with a yearly production of 20,000 tons, are already at work. A sign of this uneven development in which the works find themselves at present is the mighty gas flame visible from afar at night, which burns from the coking plant; the utilisation of the gases and their by-products is of course under consideration, but operations had to be started before the works were complete.

Owing to the modern close relationship between chemistry and agriculture, it is easily understandable that the congress officials had also fitted into their programme an inspection of a collective farm (Kolkhoz) near Kharkov. Those present were naturally glad not only of an opportunity of seeing something of the typical Ukrainian landscape but also a model establishment. Nevertheless, they were aware that in this case they were not specialists and that the existence of a few particularly well-conducted community holdings gives no key to the results of general agricultural production—quite different from the inspection of Dnjeproges, where the functioning of this one powerful industrial centre naturally already means much for a great part of the U.S.S.R.

After returning to Kharkov, the members of the congress separated, all undoubtedly conscious of having experienced a very interesting time. The Russian Government had arranged that the delegates, so far as scientific sessions and visits permitted, should also have opportunities of visiting museums; congress membership cards procured free entry everywhere, even at times when the museums were officially closed. The Russian public were informed in detailed newspaper accounts of the course of the congress; at the same time were published papers on the history of the Periodic System (compiled by Prof. M. Bloch), a new edition of Mendeléeff's textbook, and the first volumes of a collected edition of his writings; and even special postage stamps, really artistically valuable, were printed, showing the portrait of Mendeléeff before a table of the Periodic System. In short, the Government manifested in every way its desire to give to the congress the mark of a great occasion, and thereby to express its respect for Mendeléeff the scholar and for science. In this sense it certainly intended the magnificent banquet given to nearly four hundred delegates in the Peterhof, the former country seat of the Czars near Leningrad, the decorated rooms, gilt statues and coloured fountains of which shone with a splendour which could scarcely have been greater in honour of any crowned head before the War.

Reverence for science—that was the special note of the congress. Among the Russian and foreign delegates were presumably supporters of the most varied political parties; under the unifying bonds of science they found themselves in complete harmony. The representatives of all countries emphasised in their speeches again and again the internationality of science—which would almost seem a commonplace if in recent years there had not occasionally been other manifestations. None the less, the memory of a great man is more honoured in the furtherance of his efforts than in speeches or commemorations. Everyone knows the kind of jubilee in which the name of the celebrity is mentioned in numberless eulogies but where very little of his spirit is to be felt. The most satisfactory thing about the Mendeléeff centenary celebrations in the U.S.S.R. was the impression that the powers that be are honouring Mendeléeff's legacy not only in words but also in deeds, through encouragement of science itself and of a technology and industries founded on scientific lines.

F. A. P.

Obituary

Prof. J. G. Gray

ENGINEERS and naval architects, and medical men and women, scattered over the world, who were students at the University of Glasgow at any time in the past thirty years, will find it difficult to realise that the energetic, youthful and cheery personality of Prof. James Gordon Gray is gone from the classrooms and laboratories in which his inspiration and enthusiasm for modern applied science were available in such abundance. He lectured to two classes on November 5, and collapsed suddenly, at home, on the next afternoon.

Prof. Gray was born at Glasgow in 1876; he was the second son of the late Prof. Andrew Gray, who succeeded Lord Kelvin in 1899 to the chair of natural philosophy at the University of Glasgow. A graduate in electrical engineering, Prof. Gray joined his father's staff in 1904, and gave him much assistance in the planning of the present Natural Philosophy Institute, opened by their Majesties the King and Queen in 1907. For several years he was senior assistant in natural philosophy, and lecturer in medical physics, and his unique experience in engineering and in medical physics led in 1920 to his appointment to the new chair of applied physics, founded through the generosity of Sir John Traill-Cargill, Bt., to take over the teaching of physics to all students of applied science.

At the time of his appointment, Prof. Gray was already well known for his scientific work. In his younger days he had carried out much research work on the magnetic properties of iron alloys and other alloys at liquid air temperatures and at temperatures near the Curie points of the alloys. Gradually he developed a special aptitude for designing gyroscopic apparatus to illustrate results obtained by Lord Kelvin and Prof. Andrew Gray, and finally he gave all his spare time to the theory and practice of gyroscopes. He was the inventor of motor gyroscopes and accessories, and of a large number of gyroscopic experiments that were of great educational value to his students, and of interest to thousands of others to whom he lectured all over Great Britain. His aim, frequently expressed, was to attain, by means of gyroscopes, real stability where only quasi-stability had been known before; and in this aim he was successful. During the War he co-operated with the Government in the development of appliances for use in aerial navigation and national defence, and spent much time in the air trying out the gear he had designed. Angular momentum and the laws it obeys were very real to him, and he had an uncanny faculty for designing elaborate gyroscopic devices that functioned correctly on first trial. Stabilisers for aeroplanes and for ships, artificial horizons, automatic steering devices, apparatus for blind flying, were all developed by him. He was the pioneer inventor of the magnetic inductor compass used by Col. Lindbergh in his Atlantic flight.

Prof. Gray was a member of the Institution of Electrical Engineers, and a fellow of the Royal Society of Edinburgh. He was joint author, with his father, of "A Treatise on Dynamics", revised by him three years ago; and he had published numerous scientific papers. His last work, entitled "Gyroscopic Pendulums", was completed a short time ago, and is now in the press; it consists of the Thomas Gray lectures, delivered by him this year before the Royal Society of Arts.

Prof. Gray's sudden death leaves a serious gap in the ranks of scientific workers, especially among those engaged on gyroscopic devices. He had a delightful personality, was genial in company, sympathetic to all in bereavement, and was loved by colleagues, staff and students. His students always referred to him affectionately, for his happy spirit quickly formed a bond of friendship between him and his audience, whether that audience were one of his own large university classes, or the members of one of the many scientific societies to which he lectured.

R. C. G.

Dr. S. K. Mukerji

We regret to announce that Dr. Sushil Kurmar Mukerji, reader in botany in the University of Lucknow, and honorary secretary of the Indian Botanical Society, died on August 5.

We are indebted to an obituary by Dr. B. Sahni in *Current Science* of September for the following particulars of Dr. Mukerji's career. Born in 1896 at Nawgong in Central India, S. K. Mukerji was educated at Allahabad, graduated bachelor from Muir College, and master from Canning College, Lucknow. He was later appointed to the staff of the last-mentioned College, and on the inauguration of the University of Lucknow, he became demonstrator in botany, then lecturer, and, in 1927, reader.

Dr. Mukerji came into contact with many English botanists when he was preparing a thesis on the ecology of dog's mercury (*Mercurialis perennis*) for the degree of D.Sc. in London between 1925 and 1927. Prof. F. W. Oliver and Prof. E. J. Salisbury introduced him to a study of the soil relations of plants. He was elected a fellow of the Linnean Society, and became a member of the Sectional Committee for Botany and Forestry of the British Association at its Leeds meeting.

Since 1927, Dr. Mukerji has been studying the flora of the country round Lucknow, and also had a wide sphere of more general interests connected with the University there. At the time of his death, he was working on the fossil plants collected by the Yale University expedition to the Karakorum Mountains.

We regret to announce the following deaths:

Prof. James Mark Baldwin, author of the "Dictionary of Philosophy and Psychology" and other works, on November 8, aged seventy-three years.

Prof. Karl von Linde, known for his work on refrigeration and the liquefaction of gases, on November 17, aged ninety-two years.

News and Views

Prof. H. C. Urey

IT is announced that the Nobel Prize for chemistry for 1934 has been awarded to Prof. H. C. Urey, of Columbia University, New York. Prof. Urey was responsible for the search for a heavier isotope of hydrogen, and for its detection by means of its spectrum. This heavier isotope, of mass about double that of the ordinary hydrogen atom, has since been obtained in the form of its oxide, 'heavy water', in a pure condition, and several other compounds, for example, an ammonia in which the three hydrogen atoms are replaced by heavy hydrogen. The new element has been called deuterium, and has been the subject of intensive investigation during the last two years. Unlike the isotopes of heavier elements, its properties differ in a marked and interesting way from those of ordinary hydrogen, and apart from its intrinsic interest, deuterium has already been put to several uses as an implement of research in various fields of chemistry and physics. Just as the discovery of the element radium by Mme. Curie, a chemist, opened out a new physics, so it may be expected that the discovery of deuterium by the present Nobel laureate in chemistry will have important consequences for physics as well as chemistry.

Robert A. C. Godwin-Austen (1808–84)

NOVEMBER 25 is the fiftieth anniversary of the death of Robert Godwin-Austen (whose name was originally Austen, afterwards changed to Godwin-Austen). Godwin-Austen was prominent in the ranks of the early British geologists, and a notable and constant contributor to geological science. He was born in 1808, and died at Shalford House, Guildford, at the age of seventy-six years. Austen's interest in geology had been stimulated whilst at the University of Oxford, where he had been a pupil of Buckland. He joined the Geological Society of London in 1830 (the year of publication of Lyell's "Principles of Geology"), when Sedgwick was its president, and read his first geological paper at Somerset House entitled, "An Account of the Raised Beach, near Hope's Nose, in Devonshire, and upon recent Disturbances in that Neighbourhood" on November 19, 1834. Austen was then residing at Ogwell House, near Newton Abbot, and this paper was the forerunner of pioneer field work in Devonshire, and a close association with De La Beche. The latter recorded that in the district extending from Dartmouth to Chudleigh he was principally indebted, as regards this part of the Geological Survey Map of Devon, to Austen; Phillips mentioned the "splendid series of fossils . . . fruit of the personal exertions of Mr. Austen". Further observations on south-east Devonshire were embodied in a classic paper covering the years 1834–40. Certain inferences respecting the Coal Measures were detailed in the paper "On the possible Extension of the Coal-measures beneath the south-eastern part of England" (1856). Godwin-Austen was awarded the Wollaston medal of the Geological Society in 1862, and referred to as "pre-eminently the physical geographer of bygone periods". In later years he resided at Shalford, Guildford, and there were consequent changes in his geological studies in a new area. Godwin-Austen was elected a fellow of the Royal Society in 1849.

David Douglas, 1798–1834

A BOTANICAL collector and explorer in many British territories, David Douglas, the Scottish naturalist, was born at Scone, near Perth, in 1798, and of humble parentage. To his zealous efforts are due the introduction into England from time to time of numbers of new trees, shrubs, and herbaceous plants, comprising hundreds of species. Much valuable information, in addition, was derived from him respecting the characteristics of the lands (some hitherto unexplored) that he visited. Douglas in early life began a seven years' gardening apprenticeship with the Earl of Mansfield, at Scone. On its completion, he worked at the Botanic Garden, Glasgow, where his abilities attracted the notice of Dr. W. J. Hooker, then professor of botany in the University of Glasgow, who took him as companion in journeys through the Western Highlands. In 1823, Hooker recommended Douglas to the Royal Horticultural Society of London, for botanical exploration work in North America, and under the Society's auspices he pursued this mission until the year 1827. Various and successive travels followed down to 1833. From California he penetrated northward into Russian America (Alaska) in one of these. Early in 1834, Douglas was at San Francisco and thence he embarked for the Sandwich Islands; in May of that year, he wrote home to Capt. Sabine giving accounts of journeys to the summits of the mountains and volcanoes. In November 1834 news reached England that on July 12, previously, Douglas had lost his life in an unfrequented track through the attack of a bullock. A monument exists at Honolulu recalling the fatality and Douglas's services to science.

Long Heads and Broad Heads in Germany

IT has always been a disconcerting fact to those who uphold the Nordic origin of German nationality that the predominant shape of head in the population is broad and flat, rather than of the long narrow Nordic form demanded by the favoured theory of racial origin. Various attempts have been made to explain away the anomaly; while some critics have not hesitated to say that the official figures of head measurements of the population were 'edited' before publication to eliminate the undue proportion of broad heads. Certainly Prof. F. G. Parsons, who measured German prisoners of war, found that they showed a greater breadth by several points than the figures accepted by German anthropologists as representing the German type of head. Some who admit the discrepancy invoke the Mendelian theory of

inheritance and regard the broad head as a dominant masking the long-headed Nordic element. A new theory has been put forward, or rather an old theory revived, in Germany, making the shape of the head fortuitous and eliminating its significance for the Nordic theory. Prof. Kruse of Leipzig, according to the *Times* of November 19, argues that the shape of the head depends upon whether babies are laid on soft or hard pillows. On soft pillows they lie on their backs and hence, he maintains, although originally long-headed, come to have broad heads as they grow. A broad head, therefore, is no disproof of Nordic ancestry. In the middle of the sixteenth century, Vesalius noted the difference between the rounded head of the Turk and the broad flat head of the German. The former he explained as due to the swathing of the head and the action of the midwife, and attributed the latter to the fact that German babies slept on their backs in their cradles, while the Belgians, sleeping on their sides, had longer heads. It is interesting to note that in Dürer's representations of German peasants at about the same date, the broad flat head is very marked.

Academic Assistance Council

LORD RUTHERFORD'S progress report of the Academic Assistance Council in a letter to the *Times* of November 16 is a statement in which the whole academic body of Great Britain may take legitimate pride. The Council, indeed, has not accomplished everything it would have wished; but its efforts nevertheless have effected much. Of the German scholars and men of science displaced since April 1933, Lord Rutherford says that 200 have found permanent places and 325 have been provided with temporary facilities for continuing their research outside Germany. In other words "at least two thirds of the whole number who were justified in looking to continue their scientific work have been assisted to remain in the academic world". Emergency grants have been given when needed and are still being given to 71 scholars and men of science while they are seeking posts. This is a remarkable achievement for an undertaking which was initiated in a period in which the whole world, and more especially the two countries which might be relied upon to respond generously to such an appeal, namely, Great Britain and the United States, were in a state of economic depression without a parallel. The need for effort, however, still remains, for the funds available for meeting present commitments will be exhausted in July 1935. Further, while Lord Rutherford is in a position to state that the work of the Council has now attained a basis of international co-operation, this announcement, unfortunately, coincides with a report of the financial collapse of national committees on the Continent.

LORD RUTHERFORD goes on to outline a further objective. The size and nature of the problem with which the Council has had to deal hitherto is now definitely known; and it is proposed to add to the functions of the Council the formation of a trust for creating a number of research fellowships which will be available for scholars and men of science of special distinction, who are debarred from carrying on their work in virtue of their race, religion or political opinions. These fellowships will be awarded irrespective of nationality. It will be remembered that, although the work of the Academic Assistance Council has necessarily been directed to the alleviation of the difficulties of those who have suffered through the political situation in Germany, the purpose of those by whom the Council was founded is to assist any, of whatever nationality, who might be dispossessed on such grounds. The same principle will be applied in the award of the proposed research fellowships. Already Lord Rutherford has been able to announce the prospect of a contribution from America which will provide for 36 research fellowships tenable for a period of three years in any of the universities within the British dominions. This generous offer will no doubt stimulate other contributions. Should the proposal of the Council come to full fruition on a pan-national basis, it will confer upon it a unique position as a permanent international rallying point for the defence of academic freedom—a consummation eminently to be desired in the present trend of world conditions.

University Education

IN his inaugural address to the Royal Statistical Society on November 20, the president, Prof. Major Greenwood, discussed the "Recent History and Function of University Education". Speaking of the statistical changes in the proportion of males in England and Wales who have entered upon a university course since 1801, Prof. Greenwood estimated that at the beginning of the nineteenth century, when Oxford and Cambridge were the only English universities, about one-half per cent of males had a university education, a very slightly larger proportion at the middle of the nineteenth century and now about 2 per cent. In Germany, before the Nazi regime, it was estimated that not more than 3 per cent of university students came from working class families. It is unlikely that the proportion is more than 10 per cent in England and Wales. An author writing in the first volume of the Society's *Journal* estimated that the universities of Great Britain had a total revenue in 1831 of £800,000 per annum; in 1931–32 their total income was £5,874,778, of which more than £2,000,000 came from Parliamentary grants.

THE renaissance of English university education which began rather more than eighty years ago led to a discussion of the functions of a university to which Cardinal Newman, Mark Pattison and Walter Bagehot all contributed; their views, however different the expressions, were essentially similar, namely, that higher education in its highest and best sense implied segregation; "a university should be situated," said Pattison, "like the poet's garden, 'Not wholly in the busy world, nor quite beyond it'." Prof. Valentine has recently shown that in universities now, even among scholarship entrants, a sensible proportion (in the modern provincial universities) fail

to reach honours standard. Mr. Abraham Flexner also has recently criticised the intellectual standards of British and American universities. The question accordingly arises whether the standard of intellectual selection should be maintained or even raised, or whether a wider conception of the function of a university should be entertained. Prof. Greenwood stressed the new factor of increasing leisure, and referred to the serious dangers to political freedom arising from an uneducated democracy to which the Bishop of Winchester has recently directed attention. The value of education from the hedonistic point of view has been insufficiently emphasised; while the ideal of Newman and Pattison cannot be realised in a great city, an even nobler ideal might be entertained. "In a great city what one loses in intimacy may be compensated by a gain of continuity. I think of the *universitas* of a *studium generale* in London as not restricted to the enrolled teachers and matriculated students, but as comprising the *universitas* of men and women to whom study and research can bring happiness and recreation."

The Electron in Industry

A RESEARCH and Development Lecture, arranged by the Royal Institution and the British Science Guild, was given by Mr. Clifford C. Paterson, director of the Research Laboratories of the General Electric Company, Wembley, on November 21, at the Royal Institution. After the work of J. J. Thomson, electricity could be thought of in terms of the individual electron, its habits and affinities. One of the two main reasons for the practical usefulness of electricity is its ease of control. The other is its transportability. It is in the direction of the control of electricity that the free electron has of late given the engineer new and extraordinary powers. The secret of the revolution is that electricity can now be freed from conductors. A stream of free electrons, whether in a vacuum or a gas, can be manipulated with such facility that the electricity can be increased or decreased at the rate of millions of times a second, or alternatively as slowly as desired, and no limit is set to the amount of energy which can be so controlled. It was the object of the first part of the lecture to explain and to demonstrate why these extremely rapid actions of the electrons are wanted. So much of what the eye sees and the ear hears consists, if analysed, of extremely rapid happenings. The eye and the ear are unconscious of these high-speed fluctuations and vibrations although sensitive to them. In order that these very rapid oscillations and variations may be faithfully reproduced and transmitted it is necessary to make exact electrical copies of them. This is done by suitably controlling a stream of free electrons.

THE two principal electron liberator devices discussed by Mr. Paterson were the thermionic valve and the photoelectric cell. To illustrate the potentialities of these, he demonstrated experimentally how the mechanical movements of a needle on a gramophone record can be converted into electrical pulses; then impressed on to the current in a luminous discharge lamp and changed to light pulses; the beam of light carrying exactly equivalent modulations can be passed across a room and reconverted by a photocell into electrical pulses. These again can be amplified and, by a loud speaker, reconverted into sound waves in the air. The free electron is also being used in new ways in the art of electric lighting. The many coloured luminous discharge tubes used for display purposes in the streets have led the way to more brilliant and more efficient light sources. Some of these give much more light for the electricity consumed than existing filament lamps. The effects are the result of high-speed encounters between free electrons and the gas atoms in the tubes, at speeds up to six million miles an hour. Electricity which is liberated from the metals, which in the older engineering restrained it, is having industrial applications of the highest importance.

Fuel Research

FUEL research was discussed by Sir Harry McGowan, who succeeds Sir William Larke as president of the Institute of Fuel, in his presidential address on November 12. Experience, he said, has taught him the vital connexion between research of all varieties and commercial and financial prosperity, whether it is applied to the improvement of present methods of working an existing process, to the production of an entirely new commodity as an alternative or substitute for one now in use, to the safety of those who labour in industry, or to an examination of the demands of the consumer. Research in one industry cannot ignore the results of research in others, for all economic facts are intimately connected, and a change in any part of the economic structure inevitably induces changes in other parts. Our national fuel asset is coal, and our original industrial monopoly was based upon the introduction of steam power and the development of railways. Development, though world-wide, has not, however, been uniform; it has a ragged front, and new knowledge is continually changing relative national positions. Sir Harry McGowan referred to the domestic use of raw coal, which is still preferred to smokeless semi-coke by the ladies who command the household and value a cheerful flame above the more economical and healthy use of coal. More propaganda and technical research are needed to bring home to the public what coal can do in the home. Sir Harry mentioned that whole suburbs of cities in France are heated by a high-pressure hot water ring main based on coal, and that an astonishing economy in fuel has been achieved. On the other hand, the industrial users of coal base their demands on specific requirements as to effective heat value. Sorting and grading are usual, and much better coal than was previously thought obtainable has been brought on the market.

POWDERED coal, continued Sir Harry McGowan in his presidential address, is comparatively a newcomer into the power field. It speedily affords a high temperature, permitting rapid adjustment to varying load (such as a sudden demand for electricity

on a winter's day), and thus provides a bulwark to the coal industry against the further invasion of oil. Colloidal fuel, a fine suspension of coal in oil, has not achieved the success which it appears to deserve. It is important for us to discover whether this lack of success is inherent, or whether it is due to some minor technical defect which can be overcome by research. A Diesel engine using powdered fuel might easily go a long way towards restoring the disproportionate consumption of oil as against coal. As regards coke, Sir Harry McGowan raised the question whether the amount of money spent on research on coke is proportionate to the tremendous turnover in the industry. He sees no reason why gas and electricity should not progress side by side as friendly rivals in a field of enterprise which will lead to an enormous net increase in the use of coal. Unlike electricity, gas is storable, and a national gas grid might fulfil many useful functions without injuring the interests of electricity. The difficulties are legal and financial, rather than technical. Sir Harry referred also to the large-scale research on the production of oil from coal; the subject has proved to be so big that nothing less than international action has been sufficient for full development. Turning to means for promoting research, he suggested that the fuel industry might proceed by prize or by levy. He asked, for example, what would happen if a prize of £100,000 were offered for a ship to be driven alternately by coal and oil, whichever is cheap in a given port. On the other hand, the coal industry is well acquainted with the levy principle; a farthing a ton would provide £250,000 a year, which could be entrusted to a Fuel Development Committee for allocation between technical research, market research and propaganda.

Avebury

AN impressive view of the great stone monument of Avebury as the outstanding relic of prehistoric Britain was given by Mr. H. St. George Gray at the Society of Antiquaries on November 15, when he described the results of the excavations carried out by a committee of the British Association between 1908 and 1922. This was the first occasion on which these excavations, which were confined mainly to the southern side of the fosse, have been described comprehensively as a whole. The area of the site, according to the estimate accepted by Mr. Gray, is 28½ acres, and the imposing vallum and fosse are in circumference four times the size of the fosse at Stonehenge. Unfortunately, according to Mr. Gray's estimate, 95 per cent of the sarsen upright monoliths have disappeared. The present excavation at Avebury was originally one of a series of excavations of the rude stone monuments of Britain undertaken by the British Association committee with the view of ascertaining their age. According to the evidence obtained at Avebury, there can be little doubt that this site belongs to the period of transition between the neolithic and bronze ages. No trace of metal was found in the lower levels of the fosse, and the tools of stone, antler and bone, picks, shovels, rakes and hammers, are such as may be regarded as characteristic of a stone age industry. The pottery supports this, being of the 'Peterborough' type. The occurrence of this type of pottery in the lower levels at Avebury bears out the evidence of dating obtained by Mr. Alexander Keiller nearby in his work of exploring and restoring Kennet Avenue (see NATURE, Oct. 13, p. 566).

Augusta Treverorum

EXCAVATIONS in the Altbach Valley, near Treves, on the site of the Roman city of Augusta Treverorum, which had been intermitted for a period owing to a lack of funds, are now to be resumed under the continued direction of Prof. Loeschke. The excavation of an area which is so rich in antiquities as to have been termed the German Delphi has now been in progress for ten years. In addition to an amphitheatre which ranks among the most remarkable monuments of Roman antiquity, the site has revealed a wealth of archæological material covering a period extending from the stone age to the middle ages, as well as settlements which range from prehistoric to late Roman and Frankish times. The large number of shrines, altars and other cult objects which have been found indicate that this area was held in special veneration from very early times and continued to be an important centre of pagan religious worship down to the conversion of the Empire to Christianity. According to a dispatch in the *Times* of November 16, it is proposed to transform the area into a vast open-air museum, containing reconstructions of the most important monuments of each period. This is to form an integral part of the town-plan of Trier, and will be approached by a Via Archæologica running through the city and embodying in its course the most important of the city monuments, such as the cathedral and the palace of the Electors. This plan will take ten years to complete.

Control of Traffic by Light Signals

THE earliest light signals for controlling traffic were operated manually by the police. The next type were operated on a 'fixed-time' basis by purely mechanical devices. A later development is to link up a number of local fixed-time controllers with a master controller so that the indications all along a main traffic route bear a definite relationship to one another, with the object of maintaining a steady flow of traffic. An important example of this type is installed in Oxford Street, London. The latest and most popular types of signals are those which are operated by the passing vehicles themselves. There are two systems of this type in general use, and both use a detector mat placed in the roadway. In one system, the compression of the mat actuates an electro-pneumatic contact box placed in the pavement and only responds when the vehicle is approaching the crossing. A vehicle 'parking' on the mat has no effect on the signal. Suspended signals, which are fairly common abroad, divert the attention of the driver from the road level, and the drivers of modern saloon cars have difficulty in seeing them. The British signals are sometimes criticised because,

unlike the 'clock-face' or 'Chinese-lantern' type of signal used frequently in Switzerland and Germany, they give no indication of the length of time that the red or green indication has to remain. They are objectionable as they induce many drivers to accelerate to high speeds in order to pass the signals before they change. The uncertainty of the time of change in the usual type forces the driver to go slowly and this leads to safety. It is probable that vehicle-actuated signals will come into general use in England, and this would make 'clock-face' signals with their fixed time sequence of events practically impossible. An illustrated article on "Traffic Light Control Systems" appears in *Electrical Industries* of November 15.

Additions to British Museum Collections

SEVERAL interesting additions to the archæological and ethnographical collections of the British Museum have been made recently. Among them is a fine totem pole from the Nass River, British Columbia, which is figured and described in the *British Museum Quarterly*, 9, No. 1. The pole was acquired by purchase through Dr. Marius Barbeau, who has collected the legends attached to it. It is about 25 ft. high and originally was surmounted by an eagle, now lost. The figures represented from the top downwards are the 'Geebelk', a fabulous monster with wings and human face, but with a beak instead of a nose, an eagle, a large beaver with a small one on its back, and a sea-monster known as 'the man underneath'. From information obtained locally, this appears to be one of the oldest totem poles on the Nass and one of the finest. Another notable addition to the Department of Ethnography is a series of ancient Peruvian textiles from pre-Spanish cemeteries at Nasca, presented by Mr. Henry van den Bergh. They are excellent examples of the polychrome weaving practised by the coastal tribes, the colours being red, yellow, green and black. They may be dated roughly as belonging to the period 200 B.C. to 200 A.D. Adequate examples of the textile art of this area and period had not previously been acquired by the Museum.

Finsbury Technical College and the Central Institution

IN a recent number of the journal of the old students of the City and Guilds (Engineering) College, the *Central*, is a characteristic article by Prof. H. E. Armstrong on "The Beginnings of Finsbury and the Central". Finsbury Technical College in Leonard Street and the Central Institution in South Kensington were both the outcome of the formation in 1877 of the City and Guilds of London Institute for the Advancement of Technical Education, and Prof. Armstrong's article will be read with interest by all those who have been connected with those institutions or the many notable men who held office in them. With Prof. Armstrong at Finsbury were Ayrton and Perry, "the Japanese twins". "We were three of the rankest radicals ever brought together, dissatisfied with the narrow formal teaching then given, each of us with clear-cut constructive ideas for its practical improvement. We were bent on developing a rational experimental course of instruction, suited as we thought, to the coming needs of students who were to enter industry". So writes Prof. Armstrong, who after a short time was, with Ayrton, appointed to the Central Institution, where he had as colleagues Henrici and Unwin, who "were both dead set in their ideas, and took no special interest in developing method". "The 'Finsbury Spirit' never descended upon the Central Institution and other colleges set up to rival it and some day Leonard Street will figure upon the map as a small oasis in the midst of a great London educational desert". A sketch of the history of Finsbury College was given in the *Central* of July 1933.

Map of the Roman Empire

WE have received from the Ordnance Survey the Aberdeen sheet of the International Map of the Roman Empire on the scale of 1 to 1,000,000. The sheet covers the greater part of Scotland north of the Firth of Forth. Heights are shown by layer colours of two tints of green and three of brown. Spot heights in metres give actual altitudes; there are no contour lines. Modern names are confined to those of water features, and they are printed in blue. Roman features and place-names, which are of course few on this sheet, appear in black. Tribes are named in red. Forts, temporary camps and signal stations are differentiated. There is only one Roman road. Scales and index to adjoining sheets appear in the margin. The sheet is a beautifully clear piece of colour printing.

Protection against X-Rays and Radium

THE British X-Ray and Radium Protection Committee has recently issued a fourth revised report. It includes recommendations on the working hours for whole-time X-ray and radium workers. In addition to formulating precautions that should be observed by these workers, the report also deals with the safe use and storage of inflammable films, the safe use of electromedical apparatus, and precautions to be observed in the application of ultra-violet treatment and to ensure proper dosage. The Protection Committee will welcome suggestions or information which might tend to improve its scheme of protection outlined. Copies of the report may be had on application to the Secretaries, 32 Welbeck Street, W.1, or to the Director, National Physical Laboratory, Teddington, Middlesex.

Exhibition of International Architecture

ON November 30 H.R.H. the Princess Royal is to open an Exhibition of International Architecture at the new headquarters of the Royal Institute of British Architects in Portland Place, the inauguration ceremony of which was performed by the King and Queen early this month. The Exhibition will be the first of its kind ever held, and will provide a comprehensive panorama of modern building and planning. It will be divided into ten sections, illustrative of the whole of modern life. There will be, for example, a section devoted to planning for pleasure, containing

examples of modern road-houses, inns, theatres, cinemas and so on. Other sections will deal with planning for health, for dwellings, for commerce, for transport and for religion.

Announcements

MR. THOMAS ROWATT has been appointed director of the Royal Scottish Museum, Edinburgh, in succession to the late Mr. E. Ward.

DR. JAMES DAVIDSON, lecturer in the Department of Pathology in the University of Edinburgh, has been appointed officer in charge of the scientific laboratory which is to be instituted at the Metropolitan Police College at Hendon. Dr. Davidson's main function will be to assist in the investigation of criminal cases, to give instruction in scientific methods of crime detection to students at the College and at Peel House and to other members of the force, and to undertake research work.

THE following have been elected as officers of the Cambridge Philosophical Society for 1934–35 : *President*, Prof. J. Barcroft ; *Vice-Presidents*, Profs. E. K. Rideal, A. Hutchinson, and E. D. Adrian ; *Treasurer*, Mr. F. A. Potts ; *Secretaries*, Mr. F. P. White, Dr. J. D. Cockcroft, Dr. H. H. Thomas ; *New Members of Council*, Prof. G. H. Hardy, Dr. E. G. Holmes, Dr. M. Born.

THE following appointments have recently been made by the Secretary of State for the Colonies :— Mr. H. K. Ashby, to be agricultural officer, Malaya ; Mr. L. L. Carrington, to be agricultural officer, Jamaica ; Mr. J. Cook, to be agricultural officer, Malaya ; Mr. W. A. Gordon, to be assistant conservator of forests, Gold Coast ; Mr. A. K. F. Nicol, to be assistant conservator of forests, Nigeria ; Mr. D. F. Stewart, to be inspector of plants and produce, Gold Coast ; Mr. R. J. M. Swynnerton, to be agricultural assistant, Tanganyika Territory ; Mr. H. Gillman (agricultural assistant), to be district agricultural officer, Tanganyika Territory ; Mr. J. P. Maule (late superintendent of agriculture, Nigeria), to be manager, Government Stock Farm, Cyprus ; Mr. A. E. Moss (inspector of plants and produce), to be agricultural superintendent, Gold Coast.

WE have received an advance copy of a programme of the second annual exhibition of microscopes, conducted by Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C. The exhibition is to be held at the Central Hall, Westminster, S.W.1, during the week commencing December 10 from 2.30 p.m. daily, and admission is free. About one hundred microscopes will be arranged to display specimens illustrating pond life, botany, biology, pathology, bacteriology, petrology, metallurgy, Nature study and other types of study and research. There will also be a number of lantern lectures and cinematograph displays on the use of the microscope for various purposes.

IT is proposed to hold annually at the London School of Hygiene and Tropical Medicine a two-day conference in order that medical officers in industry on leave from the tropics may be able to meet and exchange views on the problems peculiar to their particular industries and to the areas where they are practising. The main subject for discussion will be the prevention of disease, for example, control of malaria and epidemic diseases in the tropics ; water supplies ; sewage and refuse disposal ; housing ; the keeping of records ; and hygiene generally. The conference each year will be held in July ; further information can be obtained from the Organising Secretary, Ross Institute of Tropical Hygiene, London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), London, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A junior scientific officer in the William Froude Laboratory of the National Physical Laboratory, Teddington, Middlesex—The Director (Nov. 26). An assistant engineer in the Roads Department of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, London, S.W.1 (Nov. 26). A technical research assistant in blast furnace investigation in the British Iron and Steel Federation—The Secretary, Iron and Steel Industrial Research Council, Caxton House, Tothill Street, Westminster, S.W.1 (Nov. 27). A vice-principal of the Coventry Municipal Technical College—The Director of Education, Council House, Coventry (Nov. 30). A scientific officer in the Department of Scientific and Industrial Research—The Establishment Secretary, 16, Old Queen Street, Westminster, S.W.1 (Nov. 30). A geologist in the Department of Industry and Commerce—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (Nov. 30). A physicist in the Sheffield Radium Centre—The Secretary, Sheffield Radium Centre, Royal Infirmary, Sheffield, 6 (Dec. 1). A superintendent of commercial horticulture under the Middlesex County Council—The Secretary to the Education Committee, 10 Great George Street, Westminster, S.W.1 (Dec. 7). Lecturers in chemistry, land surveying and zoology in the University of Cape Town—Secretary to the High Commissioner for the Union of South Africa, Trafalgar Square, London (Dec. 12). A chemist in the Archæological Museum, Palestine—The Director of Recruitment (Colonial Service), 2, Richmond Terrace, Whitehall, London, S.W.1 (Jan. 1). A technical assistant secretary of the Institution of Gas Engineers—The Secretary, 28, Grosvenor Gardens, London, S.W.1. An abstractor of scientific and technical literature for the British Cotton Industry Research Association —Director of Research, Shirley Institute, Didsbury, Manchester. Two engineer sub-lieutenants in the Royal Indian Navy—The Secretary, Military Department, India Office, Whitehall, S.W.1. An assistant to the Advisory Economist at the Midland Agricultural College—The Principal, Sutton Bonington, Loughborough.

ERRATUM.—In NATURE of November 17, p. 770, col. 1, lines 14–15, for "Sir William Herschel" read "Sir John Herschel".

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.*]

Electric Deflection of Cosmic Ultra-Radiation

FOR the purpose of an analysis of the cosmic ultra-radiation I have succeeded in deflecting the radiation by strong electric fields. This method is considerably more convenient for the investigation of cosmic ultra-radiation than the use of magnetic fields. The following gives the results obtained with fields of 700 volts and 70,000 volts per centimetre.

Four Geiger-Müller tube-counters of 35 cm. length and 2·7 cm. diameter are placed vertically one above the other, the axes in the east-west direction. The distances apart of their axes are: 6·0 cm. from the first to the second, 140·0 cm. from the second to the third, and 36·0 cm. from the third to the fourth. A plate condenser of 2·8 cm. plate distance, 40 cm. broad and 121 cm. long stands symmetrically between the second and the third tube. The counters are arranged to work in the usual coincidence method adopted for cosmic rays. The absorption in the whole apparatus is equivalent to 1·0 cm. of lead; over the apparatus there are also two covers of reinforced concrete and the roof of the building. The fourth and lowest tube-counter can be displaced to each side.

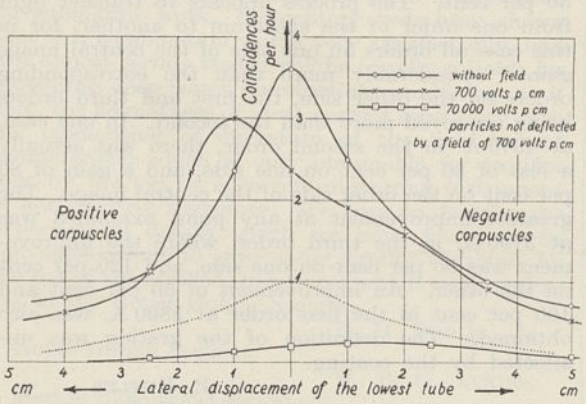

FIG. 1.

The uppermost curve in Fig. 1, giving the coincidences per hour, is then found without a field. At a field of 700 volts per centimetre in the condenser, 1 cm. deflection corresponds to particles of 1×10^7 electron volts. In this case we obtain more positive than negative corpuscles, if we take the difference between this curve and the curve indicating the non- or less-deflected particles. The latter form a similar curve to that without a field, with about 1·0 coincidence an hour in the centre. (Deflection $\leqslant 0{\cdot}5$ mm. corresponds to particles $\geqslant 5 \times 10^8$ e. volts, dotted curve in the figure.) At 70,000 volts per centimetre, there are more negative than positive corpuscles of 1–2 cm. deflection (1 cm. corresponds to $1{\cdot}0 \times 10^9$ e. volts). Without a field the mean statistical error of the measured points is 5 per cent, at 700 volts per centimetre it is 10 per cent and at 70,000 volts per centimetre it is 30 per cent; accidental coincidences have no effect.

I presume that the deflected particles observed with a field of 700 volts per centimetre correspond to the 'shower' particles, whilst the particles observed with a field of 70,000 volts per centimetre are chiefly primary corpuscles. The measurements are being continued with different fields in order to make an exact analysis of the radiation.

I wish to express my thanks to Prof. E. Regener for his kind help, and to the W. G. Kerckhoff Stiftung, Bad Nauheim, for providing funds for obtaining the condenser and the tube-counter in 1933, after preliminary work had been done since 1932.

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Oct. 30.

Use of the Centrifuge in Determining the Density of Small Crystals

THE accurate measurement of crystal density has recently acquired increased importance, since it is necessary to know this quantity in order to use X-ray methods for determining the molecular weights of unknown chemical substances. But the usual crystallographic methods of density measurement, using the specific gravity bottle or flotation of the crystals under gravity in liquids of known density, cannot easily be made to give accurate results where only small quantities of very finely crystalline material are available. We have therefore recently applied the centrifuge in the second of these two methods to hasten the settling of floating crystals, just as the centrifuge is used by biologists in the measurement of the densities of living cells.

The density determination even of minute crystals can then be made a very rapid process. In our experiments a small quantity of the substance under examination (about 0·05 mgm. or less) was introduced into a suitable liquid in a small test tube and all air bubbles removed from the liquid and crystals by evacuation in a vacuum desiccator. The test tube was then placed in a centrifuge and spun for 1–2 min. at a speed of 2,000–4,000 rev. per min. According to whether the crystals sank or rose under the centrifugal force, heavier or lighter liquids were then added to the tube and the process repeated until finally a liquid was obtained in which no movement of the crystal could be observed. At this point the density of the liquid is that of the crystals. The limits of experimental accuracy could very easily be followed by slightly changing the density of the liquid on either side of the mean until the crystals began definitely to rise or sink.

So far we have used this method to determine the density of the following five crystals: vitamin B_1 hydrochloride, supplied by Prof. Peters, and the hydrocarbons '$C_{21}H_{16}$', '$C_{25}H_{24}$', '$C_{26}H_{26}$', '$C_{27}H_{28}$', obtained by selenium dehydrogenation of cholic acid, cholesterol, ergosterol and phytosterols respectively and given us by Prof. Ruzicka. The density of vitamin B_1 HCl, which is water soluble, was measured in a mixture of bromonaphthalene and xylene. The hydrocarbons were soluble in organic solvents and here aqueous sugar solutions proved most satisfactory. To overcome difficulties due to the high surface tension of water, the hydrocarbons were first introduced into a drop of sodium taurocholeate solution which was

then made up to the approximately correct density with the sugar solution. Owing to the high viscosity of the sugar solutions, it was found necessary to increase the centrifuge period to 5–7 minutes in the neighbourhood of the neutral point, but the high viscosity has also the advantage of lessening the danger of convection currents disturbing the equilibrium during the slowing down of the centrifuge.

The table below shows the values of the densities observed and the molecular weights deduced in certain cases from these and previously obtained X-ray measurements.

TABLE 1.

Substance	Density	Molecular Wt. Obs.	Molecular Wt. Calc.
Vitamin B_1 HCl	1·403 ± 0·003	351 ± 8	
$C_{21}H_{16}$	1·244 ± 0·002		
$C_{23}H_{24}$	1·195 ± 0·003	327 ± 7	324
$C_{26}H_{26}$	1·158 ± 0·003	341 ± 5	338
$C_{27}H_{28}$	1·135 ± 0·002		

Further work is in progress to increase the accuracy of the X-ray measurements of these compounds.

We have to thank Prof. R. C. Peters and Prof. R. Robinson for permitting one of us to use centrifuges in the Department of Biochemistry and Dyson Perrins Laboratory, Oxford.

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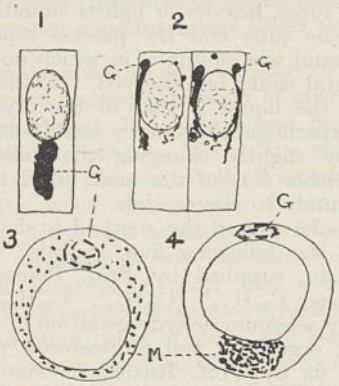
Use of the Ultra-Centrifuge for Studying the Golgi Apparatus

IN some recent work[1] it has been shown that the Golgi apparatus of the uterine gland cells of the guinea pig passes centripetally when pieces of uterus are centrifuged 400,000 times gravity by the ultra-centrifuge of J. W. Beams. This effect is shown in Figs. 1 and 2; in Fig. 1 the control Golgi apparatus lies as a dark mass towards the lumen of the gland. When centrifuged, the material of the Golgi apparatus passes up as streamers between the nucleus and the cell wall to the upper region, apparently being lighter than the surrounding cytoplasm.



Recently we have extended this work to the spermatocytes of *Helix*. These were studied intravitally by Platner[2] and others about the year 1885, and have been the subject of several monographs in recent years. As in many other types of cells, both Golgi apparatus and mitochondria are visible in the living cells. The control cell is shown in Fig. 3, the centrifuged cell in Fig. 4. In many cases complete separation of the two categories of cytoplasmic inclusions is effected.

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J. A. MULIYIL.
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Oct. 27.

[1] Beams and King, *Anat. Record*, 1934.
[2] Platner, *Arch. mikr. Anat.*, **25**, 1885.

Aluminium Coating of Gratings

DR. SPENCER JONES, the Astronomer Royal, in a recent article[1] on the use of aluminium for coating glass reflecting mirrors, has dealt with its application to astronomy. We have recently carried out, at the Solar Physics Observatory, Cambridge, some tests on the behaviour of a speculum-metal grating which had been kindly coated for us with aluminium by the process of evaporation by Mr. C. H. Walker, of Metropolitan-Vickers Electrical Co., Ltd. The tests were made with a laboratory spectrograph with a calibrated wedge over the slit; photographic plates were cut into half and the two halves were exposed under identical conditions before and after the grating had been coated, and were developed in pairs together. The plates were examined with the observatory recording microphotometer.

In substantial agreement with Strong[2] we found a greater improvement in the shorter wave-lengths, and an average increase in the reflectivity of about 50 per cent. The process appears to transfer light from one order of the spectrum to another, for in this case all orders on one side of the central image gained considerably more than the corresponding orders on the other side, the first and third orders being improved more than the second. In one case, at 4870 A. in the second order, there was actually a loss of 30 per cent on one side, and a gain of 80 per cent on the other side of the central image. The greatest improvement at any point examined was at 3700 A. in the third order, where the improvement was 50 per cent on one side, and 120 per cent on the other. An improvement of 50 per cent and 100 per cent in the first order at 3800 A. was also obtained. The definition of the grating was unaffected by the coating.

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F. J. M. STRATTON.

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Oct. 31.

[1] NATURE, **134**, 522, Oct. 6, 1934.
[2] *Pub. Ast. Soc. Pac.*, **46**, 25; 1934.

Measurement of the Current Generated by a Rectifier Photoelectric Cell

CAMPBELL and Freeth[1] have described a method of measuring the current generated by a rectifier cell in such a way as to reduce greatly the disturbing effect of the internal leakage which occurs in these cells. This varies with temperature and intensity of illumination and may cause large curvature of the light-current characteristic in strong light. This method consists in the insertion of a variable external source of potential, obtained from a potentiometer

arrangement, in series with the cell and the galvanometer or micro-ammeter, M, used for measuring the current, and the connexion of a second galvanometer, G, directly across the terminals of the cell. The potentiometer is adjusted until a zero reading of G is obtained. M then measures the current, and the absence of potential difference between the cell terminals greatly reduces leakage currents, though small internal potential differences may occur between the back plate and parts of the front conducting film, which cannot be at the same potential throughout owing to its appreciable resistance.

We have found the following very slight modification of this circuit to be eminently suitable for measuring illuminations ranging from full sunlight to a small fraction of a metre candle. We employ as a source of potential a standard potentiometer of known resistance, and replace the micro-ammeter, M, by a known resistance, R, which may conveniently be varied from 100 ohms for full sunlight up to 100,000 ohms for very weak light. If a sufficiently sensitive null point indicator is available, R may with advantage be increased still further, thus giving an enormous range of sensitivity. Since there is no potential differences across the cell and null point detector, G, their resistances make no difference, and the current is immediately deducible from the setting of the potentiometer and the value of R. We must, of course, ensure that the contacts of the potentiometer, which is itself used in an unbalanced condition, are in good order, and correct for the potentiometer resistances when finding the current.

For work at sea, where the motion of our small ship precludes the use of a sensitive galvanometer, G may be replaced by the interrupter amplifier telephone combination which we have always used for submarine work. Laboratory tests have shown that this combination works very satisfactorily, and it is almost certain that it will be equally suitable for measuring deep water illumination, combining, as it does, the advantages of great current sensitivity with the moderation of curvature of the light-current characteristic which is only obtainable for rectifier cells by the use of a current-measuring instrument of low effective resistance. We hope to describe the experimental details which we have found to be convenient, and to give some results obtained by the use of the method, in a paper which we are offering to the Royal Dublin Society.

H. H. POOLE.

Royal Dublin Society.

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Oct. 30.

[1] *J. Sci. Instru.*, **11**, No. 4, April 1934.

Raman Spectra of Decahydro- and Tetrahydro-Naphthalene

THE Raman spectra of decahydro- and tetrahydronaphthalene have been studied by me with the view of recording the faint lines and assigning the frequencies correctly. These liquids were studied previously by G. B. Bonino and P. Cella[1], who reported a large number of lines for each of these substances. Whenever a substance has a large number of Raman lines, and if no suitable filter is used to cut off the light of the 4046 group of lines of the mercury arc, and only one strong mercury line is used as the exciting line, for example, the 4358·8 A. mercury line, there is always the possibility of wrong assignment. Hence, in the case of such substances it is desirable to use a suitable filter to cut off the 4046 group of mercury lines. After trying several filters one after another, I found ultimately a filter of *m*-dinitrobenzene dissolved in suitable proportions in benzene to be very efficient in weakening considerably the 4046 region of the mercury arc. This filter had previously been used very successfully by R. Bär[2], using carbon tetrachloride as the scattering liquid.

In the present investigations I have taken two spectrograms using tetralin, one with a quinine sulphate filter which only partially weakened the 4046 region, and the other with a filter of *m*-dinitrobenzene dissolved in benzene. The latter filter weakened considerably the light of the 4046 region and more of the shorter wave-length radiations. A comparison of the two plates, and also a consideration of the relative intensities of the lines on each plate, gave the origin of each Raman line. In the use of dekalin I have obtained one spectrogram using the latter filter. I have subjected the liquids to repeated distillation and have used only the middle portion of the distillate and taken special care to make the liquids dust-free.

Bonino and Cella[3] have reported altogether 41 lines in the case of tetralin. Thirty-eight of these lines have been observed on my plate and they agree remarkably well with their results.

In addition, I have been able to obtain on my plate twelve new lines not recorded before, at wave-numbers: 19892, 19998, 21833, 21864, 22239, 22715, 23100, 23203, 23814, 24001, 24371 and 24446. In the case of dekalin, Bonino and Cella reported 16 Raman lines as due to 4358 A. excitation. I obtained all these lines on my *m*-dinitrobenzene in benzene filter plate. The agreement here is also very close. In addition, dekalin has given seventeen new frequencies on my plate at wave-numbers 19702, 19761, 20046, 21588, 21665, 21881, 22005, 22495, 22562, 22586, 22614, 22644, 22765, 22784, 23082, 23098 and 23173.

On my plates, tetralin and dekalin each show three anti-Stokes lines not previously recorded, at wave-numbers 162, 265, 1433, and 596, 494 and 407 cm.$^{-1}$ respectively.

Tetralin shows a large number of Raman lines owing to the presence of the aromatic ring and the carbon hydrogen linking in addition to the aromatic linking C=C in its molecule. As reported by Bonino and Cella, it shows one line at 3046 cm.$^{-1}$ characteristic of the aromatic carbon hydrogen linking, and another at 1582 cm.$^{-1}$ of the aromatic linking C=C. Five other lines which are present in the naphthalene spectrum and are due to the CH groups have been obtained at frequencies 1376, 1283, 1174 and 1037, 582 and 511 cm.$^{-1}$ and they confirm the previous authors' results; but the sixth line at 938 (0) cm.$^{-1}$ reported by them was observed on none of my plates. Two other new frequencies obtained by me are at 2940 and 699 cm.$^{-1}$. They are both present in the cyclohexane spectrum as has been reported by P. Krishnamurti[4]. The former is characteristic of the carbon hydrogen linking in the : CH_2 group. The latter has been reported to be present as a very weak line in benzene at 694 cm.$^{-1}$ by S. Bagwantam[5], which, he reports, agrees remarkably well with a strong infra-red absorption found by Coblentz[6] at 694 wave-numbers.

Dekalin shows three frequencies at 2922, 2892 and 2855 cm.$^{-1}$, only two of which were previously reported by Bonino and Cella, characteristic of the carbon hydrogen linking in the : CH_2 group and also one at 1447 cm.$^{-1}$ as reported by these authors. They are all present in the cyclo-hexane spectrum also reported by P. Krishnamurti. Six other lines which are present both in the cyclo-hexane and naphthalene spectra[7] have been obtained at 1362, 1256, 1166, 1024, 991 and 596 cm.$^{-1}$, and they also confirmed the previous authors' results.

Among the other new unrecorded frequencies given by dekalin are three weak lines at 2658, 443 and 376 cm.$^{-1}$, all of which are present in the cyclo-hexane spectrum according to P. Krishnamurti.

A full report of these investigations will be published shortly.

I am indebted to Sir C. V. Raman, in whose laboratory at Calcutta these investigations were carried on until I left Calcutta early in January 1933. During the past year, while working in Prof. O. W. Richardson's laboratory, King's College, I have been permitted by him to use the microphotometer, and by Dr. W. E. Williams to use the comparator, in measurements of Raman lines. It is through these facilities that I am now able to give the results of my investigation.

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Oct. 15.

[1] *Rendiconti Reale Accad. Roma*, **13**, 784; 1931. Also, *Atti. Accad. Lincei*, **15**, 572–576; April 3, 1932.
[2] *Helv. Phys. Acta*, **5**, 174; 1932.
[3] Loc. cit.
[4] *Ind. J. Phys.*, **6**, 543; 1932.
[5] *Ind. J. Phys.*, **5**, 515; 1930.
[6] "Investigations of Infra-red Spectra". Carnegie Inst. (1905).
[7] R. Bär, NATURE, **124**, 692, Nov. 2, 1929.

Magnetic Properties of Organic Vapours

VERY little work has so far been done on the magnetic susceptibilities of organic vapours. Vaidyanathan's[1] experiments indicate that in the case of some liquids, such as benzene, carbon disulphide, pentane and hexane, there is considerable divergence between the liquid and vapour values. Sivaramakrishnan's[2] careful measurements by a new method[3] developed in this laboratory also gave a similar result in the case of benzene (a molar susceptibility of $79{\cdot}6 \times 10^{-6}$ for the vapour and $54{\cdot}6 \times 10^{-6}$ for the liquid).

In a recent note[4], we pointed out that these apparent differences were due to the fact that in the calculation of the molar susceptibility of the vapours, it was assumed that the vapours obeyed Boyle's law and that the susceptibility of 22·41 litres of the saturated vapour at N.T.P. would give the molar susceptibility. This assumption is obviously untenable. The correct method after determining the volume susceptibility of the vapour would be to calculate the specific susceptibility of the vapour, knowing the density of the vapour (available from the tables) at the specified temperature and pressure. We can thence calculate the molar susceptibility.

As an example, for benzene Vaidyanathan gives the molar susceptibility (in -10^{-6} units) for the liquid as 56, while his (uncorrected) values for the vapour, by two methods, are 83 and 74. When the results are recalculated by the above method, the values become 64·5 and 59·3; and Sivaramakrishnan's value (79·6) becomes 57·1.

For other organic vapours for which calculations have been made (details will be published elsewhere) the corrected molar susceptibilities agree equally well with the values for the liquid state. The only exception is carbon disulphide, for which the corrected molar susceptibility is still more than 30 per cent greater than in the liquid state; but here more accurate data are desirable, particularly in view of the fact that Vaidyanathan's results, by two different methods, differ by as much as 20 per cent.

It follows from the foregoing considerations that the calculated values of the molecular susceptibility depend on the accuracy of the density data. It seems to be desirable in new measurements to determine the density of the vapours directly along with the magnetic values.

In a recent letter in these pages, Jaanus and Shur[5] have mentioned that the difference of the magnetic susceptibility in the liquid and vapour states was mainly due to some mistake in the experimental work. We take this opportunity to point out that the differences are due mainly to certain untenable assumptions made in the calculations and not to experimental inaccuracies.

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Aug. 29.

[1] *Ind. J. Phys.*, **2**, 135; 1927.
[2] *Annamalai Univ. J.*, **3**, 48; 1934.
[3] *Proc. Phys. Soc.*, **46**, 318; 1934.
[4] *Current Science*, **2**, 475; 1934.
[5] NATURE, **134**, 101, July 21, 1934.

Parasitism of *Rhizoctonia lamellifera*, Small

IN the years preceding 1929, much controversy existed regarding the parasitism of the group of fungi known collectively as *Rhizoctonia bataticola*. The differences of opinion held by various sections of workers, and postulated principally by Small, Gadd and Briton-Jones, were largely attributable to the use of the one specific name *bataticola* for what now appears to be a relatively large group of sclerotium-forming fungi. Papers published by Ashby[1] in 1927 and Haigh[2] in 1930 showed that *R. bataticola* was a polymorphic fungus possessing a pycnidial stage, *Macrophoma phaseoli*, and was apparently distinct from two other forms which Haigh styled strain *A* and strain *B*. In 1933, I showed[3] that strain *A* was physiologically and morphologically distinct from both strain *B* and *M. phaseoli*, and suggested that it should be designated by Small's original binomial *R. lamellifera*. The question of parasitism I did not touch upon.

For the past eight years I have been experimenting with the object of producing infection in young plants by various strains of these fungi, but until a year ago was unable to obtain any certain results with *R. lamellifera*. Last year, however, by growing grapefruit seedlings on certain agar media under aseptic conditions and inoculating with a grapefruit strain of *R. lamellifera*, I obtained 100 per cent 'kill' in 24 plants after 9 weeks. Control plants on sterile agar and on media inoculated with (*a*) *M. phaseoli* and (*b*) a saprophytic *Phyllosticta* sp. remained green until after the agar had dried out—a matter of six months.

Infection was observed to begin at the root tip and proceed along the translucent roots for several inches, when the plants began to wilt. Soon afterwards, the fungus, growing on the surface of the medium, attacked the seedling at the 'collar', and very soon invaded the whole of the stem and leaves, causing the plant to die rapidly. A contributory factor appears to be water shortage.

Preliminary histological examination suggests that the fungus advances along the vascular system of the young root and does not penetrate the cortex except to form sclerotia.

Confirmatory evidence of parasitism under specialised conditions was obtained in later experiments.

There appears to be no authentic record of *R. lamellifera*, as distinct from members of the *bataticola* group, killing living plants, and as a number of workers have recently turned their attention to this group of fungi, it might be well if my experimental results were made known pending the publication of a full paper.

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Sept. 29.

[1] *Trans. Brit. Myc. Soc.*, **12**, 141; 1927.
[2] *Ann. Roy. Bot. Gard. Peradeniya*, **11**, 3; 1930.
[3] *Proc. Rhodesia Sci. Assoc.*, **33**, 65; 1933.

Bursting of Cell by Polarised Sunlight

AT a meeting of the Biochemical Society in November 1925, I read a paper on the "Hydrolysis of Starch in the Guard-Cells of the Leaf by Polarized Light". This work has since been amplified and confirmed, and some of the results were shown at a meeting of the Linnean Society in April 1933.

FIG. 1. Burst guard-cell after exposure to polarised sunlight.

In all these cases, diffused skylight, polarised by passage through a Nicol's prism, was used. As the Nicol cuts off a large proportion of the light, the illumination was comparatively weak. Recently, however, direct *sunlight* has been employed.

A young and healthy hyacinth plant was placed in a sunny window for two or three hours to allow the plastids of the stomata to form their full starch content. A Nicol's prism was then placed in front of a small portion of the leaf, which thus received *polarised sunlight*, the part covered by the cork rim of the Nicol being in comparative darkness and the rest of the leaf in strong sunlight. The results were most striking. Whereas in the earlier experiments with feeble illumination, the starch gradually hydrolysed to a reducing substance and the stomata opened and remained open, with this bright polarised sunlight the guard-cells burst and the contents were ejected to a distance, often as great as the long diameter of the stoma (Fig. 1). Staining with iodine showed that the starch had completely disappeared. The rapidly increased turgor, due to the hydrolysis, had ruptured the cell-wall. The guard-cells in the portion in darkness and in ordinary sunlight showed good starch content.

It was interesting to note that the maximum effect occurred along lines parallel to the length of the leaf. As the leaves of monocotyledons are slightly ridged, the stomata along some lines would receive fuller light than along others, owing to the difference in tilt of the surface.

Next spring it is hoped to make systematic experiments to determine the minimum time and intensity necessary to produce this violent explosion of the cell.

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Sheep Sweat a Factor in Blowfly Attack of Sheep

BLOWFLY attack of sheep is associated with bacterial activity in the wool. The part of the body most commonly attacked is the breech, which is the portion of the fleece most subjected to wetting; other parts of the body may be attacked if they are kept wet.

'Body strike' or fly attack on the wither, back or loin, is usually associated with excessive rains and humid conditions generally. Under these conditions, bacteria develop in the wool and produce what is known as 'weather stain'. If flies are prevalent, a certain proportion of the sheep exhibiting stain are struck. In field observations which we have made on weather stain and body strike, we have been able to study the conditions contributed by the sheep which predispose it to fly attack. The links in the chain of evidence are as follows :—

1. We have shown that there is a relation between yolk colour and susceptibility to weather stain and body strike; susceptibility increases with increase in intensity of yolk colour from white to yellow.

2. We have produced evidence for considering yellow yolk to be identical with 'golden colouration' of Rimington and Stewart[1].

3. On the evidence of Rimington and Stewart confirmed by Sutton[2], yolk colour is an index of sweat content.

We must conclude, therefore, that there is a relation between sweat content and susceptibility to weather stain and body strike.

Seddon, Belschner and Mulhearn[3] have shown that excessive wrinkliness of the breech is a factor which predisposes sheep to crutch strike. Bull[4] has shown further that in the skin folds of the crutch the "sweat glands are large, dilated and show hyperplasia of the lining epithelium". The wool yolk in folds is more

yellow than is wool on the crest of wrinkles and on Rimington and Stewart's analysis contains a high proportion of sweat. We have concluded, therefore, that sweat is probably a factor in crutch strikes as well as in body strikes.

Our evidence and conclusions are being published in detail in Pamphlet No. 48 of the Committee of the Council for Scientific and Industrial Research.

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Canberra, F.C.T., Australia.

[1] Rimington, C., and Stewart, A. M., *Proc. Roy. Soc.*, B, **110**, (B 765), 75–91; 1932.
[2] Sutton, W. G., *J. Text. Instit.*, **24**, 341–350; 1933.
[3] Seddon, H. R., Belschner, H. G., and Mulhearn, C. R., *Sci. Bull.* No. 37. Dept. Agr., N.S.W. 42 pp.; 1931.
[4] Bull, L. B., *Aust. Vet. J.*, **7** (4), 143–148; 1931.

Inland Water Survey

I HAVE read with interest the leading article on inland water survey in NATURE of October 27 and the comments on Mr. Alan Chorlton's letter in NATURE of November 10, and Prof. W. S. Boulton's letter in the issue of November 17.

It is becoming more clear that there is considerable opinion in favour of keeping the administrative hand in the position to control survey; and that undoubtedly means the subservience of the machinery of pure survey to the immediate requirements of regional committees and the like. This is where confusing results come in.

Prof. W. S. Boulton has, like many others, unfortunately, considered only water supply, whereas there are other water interests which are more dependent on water survey. It seems to be forgotten that the case for the independence of water survey is considered to be proved by the Inland Water Survey Committee of the British Association. It would be a great disaster if the next move towards a central water authority only resurrected the chaos of records, inquiries and the like which has characterised the past.

Undoubtedly, the dual aspect, which Prof. Boulton mentions, must be kept in mind, and this aspect is present in land survey organisation. The Ordnance Survey is under the Ministry of Agriculture and Fisheries, and it has been called upon for, and carried out, the boundaries of the catchment board authorities. There has been no step to follow up this piece of national survey by national water survey of rivers. Every water interest will have to take its part in the observational and record side of water; but it is imperative that there shall be a central survey authority for direction and supervision.

Looking at the matter from the point of view of efficient survey, it seems to be more important than ever that survey should be freed from the opposing interests of Ministries, first of all; and the Joint Committee of the British Association and Institution of Civil Engineers has stated fairly clearly the type of administrative control which might guide the activities of the water survey authority, and it has also put in a few lines what is the general scope of water survey.

Various views will undoubtedly be expressed by many people interested in the subject, but surely the views of those who have worked intimately at this problem for the last two years should receive the most careful consideration and even some practical development. The alternative is undoubtedly the easy course of placing the water survey authority under the Ministry of Health; but the danger is obvious. It seems impossible that this Ministry will be able to cut the interests of pure survey out of the hands of those who go very far to determine the actions of the Ministry. When the Admiralty and Ordnance surveys were founded, conditions were different from those now existing; and it may be doubted if a Ministry would now be regarded as the most suitable body to maintain those surveys or to create either water or air survey on equally efficient and economic lines.

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Diffusion of Gases through Metals

THE rate of diffusion of gases through metals has been found to be approximately proportional to the square root of the gas pressure, and is generally represented by the equation $D=K.\sqrt{P}$. Borelius and Lindblom[1] made accurate determinations of the rate of diffusion of hydrogen through various metals and found their results were more nearly represented by the empirical equation $D=K\ (\sqrt{P}-\sqrt{P_t})$ where P_t was a threshold value of pressure below which no diffusion took place.

We have measured the rate of diffusion of hydrogen through copper, nickel, iron and molybdenum and nitrogen through molybdenum. We confirm the departure from the square root law at low pressures, but not the existence of a definite threshold value of pressure. At low pressures the rate of diffusion falls off, becoming progressively less than would be expected from the square root law. It appears to us that the effect of adsorption on diffusion has been neglected, and that if this is taken into account the experimental results can be satisfactorily explained. Diffusion must be preceded by adsorption on the surface, and the rate of diffusion must be proportional to the amount of gas adsorbed. Diffusion measurements are not generally made under conditions where a complete unimolecular layer is adsorbed, so that with each increase in pressure a larger fraction of the surface becomes covered. This factor may be included in the diffusion equation by introducing the Langmuir isotherm $\theta=\frac{ab\,P}{1+aP}$ where θ is the fraction of the surface covered by adsorbed molecules. The diffusion equation then becomes $D=K\ (\frac{abP}{1+aP})\ \sqrt{P}$, which satisfactorily represents our experimental results.

We have also checked this equation by inserting the adsorption constants obtained from Gauger and Taylor's[2] isotherms for hydrogen and nickel, plotting the curve, and extrapolating the sensibly straight part until it intercepts the pressure axis. The value of pressure obtained in this way is in close agreement with the so-called threshold value found by Borelius and Lindblom for the same system.

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Research Laboratories,
General Electric Co., Ltd.,
Wembley.
Oct. 29.

[1] *Ann. Phy.*, **82**, 201; 1927.
[2] *J. Amer. Chem. Soc.*, **45**, 924; 1923.

Research Items

Physical Characters of a Scottish Bishop. The skeletal remains of Bishop James Kennedy, born about 1408, and bishop of St. Andrews from 1440 until 1468, when he died, have been studied from the anthropological point of view by Dr. David Waterston, professor of anatomy in the University of St. Andrews (*Trans. Roy. Soc. Edinburgh*, **58**, Pt. 1, No. 4). Although very little is known of the personal life of the bishop, he was undoubtedly one of the more prominent figures in an obscure period of Scottish history. Not only does this examination of his remains serve to throw light on the physical characters of the dominant classes in Scotland at that period, but it also provides material for a comparison with the physical characters of Robert the Bruce, whose skull has been the subject of anthropological investigation, and from whom Kennedy was descended through his mother. Dr. Waterston's examination was made possible by restorations in the chapel of the United College of St. Salvator and St. Leonard in 1930 which led to the opening of the tomb; but the remains, it is known, had been exposed on previous occasions, while the present interment dates only from 1863. There is, however, no doubt of their authenticity. They indicate a stature of 173·5 cm. (5 ft. 8 in.–5 ft. 6 in.), broad shoulders and powerful muscles. In fact, they are those of a person who had led a life of physical activity. The arms were a little longer than usual, and a functional development of the muscle on the right ulna suggests the habitual pursuit of some activity, such as fencing. The skeletal evidence of right-handedness is confirmed by the asymmetrical endocranial cast of the brain. The heart had been removed after death for separate interment. There was evidence of rheumatoid arthritis. The cranial and facial skeleton was nearly, but not quite, complete. The cranium was dome-shaped with full and rounded outline, the facial skeleton well-developed and powerful, with prominent zygomatic bones, strong mandible and prominent chin. The length-breadth index is 78·8. The skull closely resembles the typical Scottish skull as defined by Sir William Turner; but it presents some marked and interesting differences from that of Robert Bruce.

Pygmies and Bushmen. The problem of the relationship of the African pygmies and the Bushmen of South Africa has once more been raised by Dr. Walter Hirschberg, who briefly reviews the theories which have been put forward from time to time and makes certain suggestions of his own in *Africa* (vol. 7, No. 4). The theory of racial affinity has been supported by, among others, Schweinfurth, von Luschan, E. Fischer and P. W. Schmidt, and opposed by Sir Harry Johnston, P. Poutrin and R. Pöch. Schapera regards them as divergent specialised branches of a small variety of Negro. Other investigators have pointed to remnant peoples of East Africa, such as the Ndorobo, Elgunono and Doko, among whom traces of Bushman-like population are conspicuous, the reasons given being predominantly linguistic, though somatically the resemblance is to the Hottentot. To-day, the pygmies and Bushmen represent two highly specialised cultures and racial types. Their economic pursuits appear to be definitely determined by environment and cannot be taken as proving or disproving affinity. Bushman culture consists of a variety of elements, one of which may well have originated from pygmy culture; but this by no means justifies using it as a proof of relationship. Divergences in the two cultures outweigh resemblances. A fundamental difference seems the inevitable conclusion. One element of Bushman culture which points to East Africa is the resemblance in the bow and arrow to that in use among the Kindiga. Another clue lies in the prehistoric relations that can be traced to East Africa in the Wilton, Smithfield and kitchen-midden cultures, which extend so far as Kenya and Uganda. Failing skeletal remains, the existence of a Bushman people cannot be established beyond the confines of South Africa. Neither Bushmen nor Pygmies are a uniform race and any relationship between them is highly improbable. Present-day Bushman culture is probably the product of a long period of development in that area.

Life-History of *Idiacanthus fasciola*. Dr. William Beebe has a fund of interesting information to offer on this peculiar fish ("Deep-Sea Fishes of the Bermuda Oceanographic Expeditions. Family Idiacanthidæ." *Zoologica. Sci. Contrib. New York Zool. Soc.*, **16**, No. 4, March 1934). Most of the fish hitherto classified under the genus *Stylophthalmus* have proved to be the larvæ of *Idiacanthus*, which have enormously long-stalked eyes, the character being very specialised and correlated with many primitive conditions of teeth and skeleton. The change into sessile-eyed post-larvæ is by absorption of the optic nerve and the drawing down and coiling up of the cartilage stalk, followed by its inclusion into the anterior part of the eye socket, its complete covering with epithelium and final absorption. The males are very small and larvoid, without teeth, pelvic fin or barbel, but with a long caudal fin, bones slightly or not at all ossified, of simple larvoid shapes and relative positions. The digestive apparatus is atrophied after the post-larval stage, and the testicle is precocious in development. There is a large post-orbital cheek light corresponding to a very small one in the female. The author suggests that they are probably parasitic, the female doing the seeking. They are more numerous than the females, and have very weak swimming powers. The female is well adapted for swallowing large food, having an apparatus allowing a very great distension of the entire throat, and powerful teeth, the food being fishes of various kinds. *Idiacanthus* belongs to the sub-order Stomiatoidea and the family Idiacanthidæ, and there is only one genus known. All the Bermuda specimens belong to one species, *Idiacanthus fasciola*, including specimens hitherto referred to the family Stylophthalmidæ.

Development of the Tusser Caterpillar. S. Saito (*J. Fac. Agr., Hokkaido Imp. Univ.*, **33**, Pt. 4; 1934) directs attention to the tusser worm, *Antheraea pernyi*, as a particularly favourable subject for the study of the development of a silk-spinning lepidopteran. The egg is 3–4 mm. in the longer and about 3 mm. in the shorter transverse diameter. Each female moth lays about 240 eggs. The author has employed about 25,000 eggs in this investigation. When the egg is fixed in Allen's modification of Bouin's fluid, the egg-shell or chorion becomes separated from the egg by a space which permits removal of the chorion by means of needles. The author first examined the development of the superficial features of the embryo,

and then studied the internal changes by means of serial sections. The thickened ventral plate, differentiated from the blastoderm, develops elevations at its four corners, the two anterior ones form the cephalic lobes and the two posterior ones the caudal lobes. Between the cephalic and caudal lobes is an unsegmented region from which a segment is first constricted off at its anterior end, and afterwards other segments are marked off one after another from before backwards, until 16 segments are produced of which three are cephalic, three thoracic and the remaining ten are abdominal. Each segment has a pair of appendages, but those of the first, second, seventh, eighth, ninth and tenth abdominal segments disappear, while those on the other segments become transformed into the limbs characteristic of the body regions to which they belong. The paper is illustrated by five plates.

Annelids from the Dutch East Indies. A collection of polychætes and Hirudinea from the Dutch East Indies is described by H. Augener in *Treubia*, **14**, No. 2, 1933. These belong to the Zoological Museum in Buitenzorg, Java, and several interesting points are noted. Young were found on the bristles of *Amphinome rostrata* from two localities. Several species of polychætes are common to these regions and to European seas, including such well-known British forms as *Odontosyllis fulgurans* and *O. gibba* (distinguished by their luminescent properties and found in their pelagic stages), *Branchiomma vesiculosum* and *Nereis* (*Platynereis*) *dumerili*. The last-named, which is usually marine, occurred in water of low salinity in a small island off Java, and *Lycastis ranauënsis*, a fresh-water nereid from Sumatra, is also recorded from Java. 29 species belonging to 10 families, and 21 genera are dealt with in this work.

Seasonal Nitrogen Cycles in Fruit Trees. A useful paper by Dr. D. V. Karmarkar (*J. Pom. Hort. Sci.*, **12**, No. 3, Oct. 1934) traces the seasonal changes in moisture and nitrogen contents of apple trees, and changes several empirical beliefs into demonstrated facts. It has been found that the water content of the wood and bark rises through the periods of bud swelling to a maximum in June. Young leaves have high water content, and so have leaves during defoliation. Neither of the cultural treatments mentioned in the title of the paper, namely, grass plus annual spring nitrate, or arable without nitrogenous fertiliser, seemed to have any appreciable effect on the times of seasonal changes in water or nitrogen contents. Well-defined changes occur in the amounts of total soluble materials, total nitrogen, protein and non-protein nitrogen, and in the various fractions of the latter. The results show that, in general, trees grown on arable land have a higher turnover of nitrogen than trees grown on grass, and many more conclusions are set forth in detail. Dr. T. Wallace, of Long Ashton Research Station, has prepared the actual account of the work under review, whilst Mr. J. O. Jones made several of the nitrogen determinations after Dr. Karmarkar left for India.

Rainfall Prediction in Northern Australia. In "Foreshadowing of Monsoonal Rain in Northern Australia" by H. M. Treloar (Bull. No. 18, 1934, Bureau of Meteorology, Melbourne) the problem of foreshadowing the seasonal rains of three Australian districts referred to as the Darwin, Pine Creek and Victoria River Downs districts is examined. These are regions where the rainfall is very markedly of the summer type, ninety per cent of the year's fall coming on an average in the five months, November–March. Of the three districts, that farthest south and most distant from the sea is one of importance in the rearing of cattle. Sir Gilbert Walker's method, in which purely statistical relationships have been found between the element to be predicted and other meteorological elements for some earlier period in distant regions, is used. The results take the form of a regression equation between departures from the normal of the various elements, and the efficacy of the formulæ can be gauged from the value of the multiple correlation coefficients, which for the three districts already mentioned amounted to 0·71, 0·51 and 0·57 respectively. A large part of this paper is occupied with a discussion of the best form in which to make the foreshadowing, the fundamental difficulty being that the amount of rain predicted in a given season will often, with correlation coefficients of the magnitude of these, differ greatly from the actual fall, and the method may be discredited in the opinion of practical farmers unconversant with statistical methods because of a single failure. The view is taken that Walker's recent system of restricting predictions to years when the departure from the normal indicated by the formula is above a certain limit does not meet the needs of many agriculturists and engineers concerned with water supply, and that it is better to give the foreshadowing in the form of 'odds' (say, 7 to 1) that the rainfall will be between certain specified limits.

The Siberian Meteor of June 30, 1908. The main phenomena of this great meteor have been described by Dr. F. J. W. Whipple in the *Quarterly Journal of the Royal Meteorological Society* (**56**, 287–304; 1930). Since that time, further details have been obtained from other sources, and these are summarised by Dr. Whipple in a recent paper in the same journal (**60**, 505–512; 1934). The unusual glows in the sky of northern Europe were observed during the nights of June 30–July 2. In Sweden they were so bright that good photographs could be taken at midnight on July 2, and in Scotland a photograph of Dornoch Cathedral was taken at the same time with an exposure of 90 seconds. There is no record of any observation of the glows in the south of Europe or in the United States. In Aberdeen, the unusual luminosity was seen within 22 hours after the fall of the meteor, a feature that it is difficult to explain, though the best interpretation, in Dr. Whipple's opinion, is that an air-current travelled over Siberia and northern Europe at a height of about 80 km. with a velocity of 200 km. per hour. The remarkable air-waves recorded by microbarographs at four stations in Great Britain were registered at nine other observatories, the most distant from the origin being Washington (8,910 km.) and also, by way of the antipodes, at Potsdam (34,920 km.). From the Irkutsk seismogram, it is deduced that the meteor fell at 0 h. 14 m. G.M.T. on June 20 at a point in lat. 60° 40′ N., long. 101° 57′ E. In estimating the velocity of the air-waves, the times at which the first trough arrived are used, and it is assumed that the trough started from the above point at 0 h. 16 m. The velocities obtained range between 313 and 322 km. per sec., with an average of 318 km. per sec.

Dielectrics. Parts 2 and 4 of vol. 17B of the *Journal of the Indian Institute of Science* contain communica-

tions from Messrs. Ramaswamy, Narayanaswami and Mowdawalla, of the Indian Institute, on the effects of magnetic fields and successive discharges on the dielectric constants, power factors and breakdown voltages of dielectrics. Solid dielectrics were tested between circular plate electrodes and fluids between spherical electrodes to which alternating electromotive forces up to 115 kilovolts could be applied by a transformer. Magnetic fields up to 18 kilogauss could be produced by a direct current electromagnet. The authors conclude from their measurements that the effects of the magnetic field on dielectric constants and power factors are very small in air and oil, but are appreciable on the power factors of papers and on both dielectric constants and power factors of glass and mica if the magnetic field is transverse to the electric field. The breakdown voltages of air, mineral oils and manilla paper are little affected by fields up to and exceeding 10 kilogauss, but are decreased 3–6 per cent for other papers and increased nearly 2 per cent for glass. Successive discharges up to about a thousand reduce the breakdown strength of dry mineral oils and raise those of moist oils to about 43 kilovolts per cm. and of benzene to about 35 kilovolts per cm.

Quenching of Resonance Radiation. O. S. Duffendack and J. S. Owens have discussed the quenching of mercury resonance radiation by the addition of other gases (*Phys. Rev.*, Sept. 1). The effect of temperature on the quenching was specially studied. A quartz cell containing mercury vapour and the quenching gas was illuminated by a mercury argon glow discharge. This constitutes a simplification of the ordinary technique, since the λ 2537 emission line is so narrow that no secondary resonance lamp is required. The temperature of the quartz cell was varied, the pressure of mercury vapour being held constant. The output of resonance radiation was measured by photographic photometry. The principal interest of the results lies in the temperature variation of the quenching, which allows interpretation in terms of the quenching mechanism. The quenching by hydrogen is practically independent of temperature, the quenching by carbon monoxide and nitrogen decreases with increasing temperature. In the former case, the mercury metastable state $2\ ^3P_0$ is not involved; in the latter case, the $2\ ^3P_1$ excited atoms are reduced to the metastable state by gas collisions, and this reverse process goes on with increasing frequency at higher temperatures. A mechanism is suggested for the former (hydrogen) quenching involving the dissociation of the hydrogen molecule, followed in some cases by the excitation of the mercury hydride molecule produced.

X-Ray Examination of Carbohydrate Acetates. The lattices of glucose and cellobiose were established in 1929 by Hengstenberg and Mark, who succeeded in obtaining crystals large enough and perfect enough for complete analysis. Zechmeister and Tóth in 1931 by means of the hydrolysis of cellulose prepared some of the higher cellodextrins, namely, cellohexaose, cellotetraose and cellotriose. G. J. Leuck and H. Mark have now (*J. Amer. Chem. Soc.*, **56**, 1959; 1934) attempted an X-ray examination of some of these higher sugars in the form of acetates, employing in some cases material prepared by Zechmeister and Tóth. The acetate of cellotriose was obtained in suitable crystals, and the acetates of glucose and cellobiose were also investigated. Crystallisation from 96 per cent alcohol was used, and a special technique for orienting the directions of groups of crystals was adopted. Monochromatic rays from copper ($\lambda = 1{\cdot}54$ A.) were used, and the densities determined by flotation in salt solution. The identity periods a, b and c (needle axis) were determined, and the numbers of molecules in the unit cell then calculated. The c values were practically the same, 5·65–5·7 A. The crystals of glucose penta-acetate are orthorhombic. The numbers of molecules in the unit cell for glucose penta-acetate, cellobiose octa-acetate and cellotriose undeca-acetate are 4, 2 and 2, respectively, only the first value being quite certainly established. The molecular chains in all three substances probably lie perpendicular to the needle axis. The authors make certain suggestions as to the spacings in relation to the cellulose molecule.

Unsaturated Acids in Animal Oils and Fats. It has been believed for many years that the body fats and oils of land animals are composed principally of glycerides of oleic, palmitic and stearic acids. Careful investigations have usually revealed the presence of small amounts of saturated acids of lower molecular weight than palmitic, as well as small amounts of linolic acid, $C_{18}H_{32}O_2$. Linolenic acid, $C_{18}H_{30}O_2$, is rarely found and originates in the diet. Arachidonic acid, $C_{20}H_{32}O_2$, has been found in some fats, and it seems possible that highly unsaturated fatty acids, with four or more double bonds, might occur rather generally in animal fats and oils. J. B. Brown and C. C. Sheldon (*J. Amer. Chem. Soc.*, **56**, 2149; 1934) have examined twelve specimens of fowl oils and four of animal fats by a method depending on the fact that highly unsaturated acids or their methyl esters, on bromination in cold ether, yield characteristic insoluble polybromides. The results showed that linolenic acid was present in some specimens of goose oil and probably in turkey oil. Eight other specimens of avian oils contained small amounts of highly unsaturated acid, mostly arachidonic. The four specimens of animal fats (lamb, veal, reindeer and beef tallows) contained traces of highly unsaturated acids other than arachidonic.

Fermi's Differential Equation. Fermi's differential equation is of considerable importance in atomic physics. (The differential equation is $x^{1/2}\frac{d^2y}{dx^2} = y^{3/2}$. A solution is needed such that $y = 1$ when $x = 0$, and $y = 0$ when $x = \infty$.) Unfortunately, no simple general solution can be obtained, and since the equation has a singularity at the origin, it is difficult to apply the usual methods of numerical approximation, so special investigations are necessary. Fermi himself initiated this work, and Sommerfeld has given the asymptotic expansion of certain integrals of the equation. A systematic study of the whole problem, with full analytical rigour and an estimation of the upper limits of the possible errors, has now been made by C. Miranda (Reale Accademia d'Italia, *Memorie della classe di scienze fisiche, matematiche e naturali*, 5, 1934), at the institute for the applications of the calculus, under the direction of Prof. Picone. The paper explains some general theorems established by the director of the institute, which give solutions of differential equations, valid even at singular points, in the form of rapidly convergent series. These theorems are then applied to Fermi's equation, and the results are given by means of graphs and several pages of numerical tables.

The Scott Polar Research Institute

THE new building of the Scott Polar Research Institute, Cambridge, was opened on November 16 by the Chancellor of the University, Mr. Stanley Baldwin, in the presence of a distinguished company. In a pamphlet distributed at the opening, the history and aims of the Institute are outlined. The Chancellor also made it clear in his speech on Friday that the building has the twofold object of doing honour to the name of a great polar explorer, and being also a centre of information for those yet to come. The building was therefore designed by Sir Herbert Baker with these two objects in view, and has succeeded in attaining both of them.

The history of the Institute is, briefly, as follows. A balance of £12,000 remained after the War from the Mansion House Fund subscribed in 1913 in answer to Capt. Scott's last message. A first grant of £6,000 was made from this fund in 1920 to establish a polar research institute at Cambridge, and in 1925 the whole trust fund was handed over to the University. £6,000 was set aside as a building fund, and the Institute began its work on an income of £300 a year. In 1931, the Pilgrim Trust made a grant of £4,000 to the building fund and later the trustees of the British Museum gave £2,000 for a publication fund. The whole scheme owes its inception and completion to the unremitting labours of Prof. F. Debenham, director of the Institute, who was a member of Scott's last expedition to the Antarctic.

The present building is of three stories, the uppermost an attic floor with dormer windows behind a balustrade. The front door is flanked by two very large windows to the vestibule and is surmounted by a bronze bust of Capt. Scott, executed by Lady Hilton Young. On a frieze which forms part of the upper stone balustrade are the words QUÆSIVIT ARCANA POLI VIDET DEI, an epitaph which is singularly apt for one who sought so diligently the scientific, as well as the geographical, secrets of the Antarctic, and in doing so found a glorious death; an end, which, as Mr. Baldwin pointed out in his speech, was like the failure of Sir Richard Grenville in his last fight, in that it was more lasting than a success.

In the forecourt there is a symbolic statue given by the same artist, to the memory of the five men of the Pole party. It is in the form of a youth standing with head thrown back, and is one of the best of Lady Young's symbolic designs. On the pediment are the words LUX PERPETUA LUCEAT EIS, and indeed a light everlasting will shine on the memory of Dr. Edward Adrian Wilson, Capt. L. E. G. Oates, Lieut. H. R. Bowers, and Petty Officer Edgar Evans, as on that of their leader.

On the keystones over the large windows are symbolic representations of a polar bear and an Emperor penguin feeding its chick, by Mr. Charles Wheeler. For this carving the late Sir Louis Baron gave £100.

The vestibule consists of a chamber with two high domes painted by Mr. MacDonald Gill with maps of the polar regions. These paintings were the gift of an anonymous donor, and attracted a great deal of interest from those who inspected the building at the time of the opening. They are not only topographically correct in a general sense, but also contain a great deal of historical detail in the form of pictures of famous ships, in their proper localities. Below each map is a ring of names of explorers famous for the great discoveries they made and the extent of their additions to the maps encircled by their names.

The ground floor is taken up by a museum of polar equipment, which includes exhibits of both practical and historical interest. Thus sledges, dog-harness, polar clothing, and Eskimo kayaks are in close proximity to relics from the time of Sir Martin Frobisher, including some from the Parry, Franklin and more recent expeditions. The director and his assistant have each a small room on this floor.

On the first floor there are two research rooms and a library, designed with special care by the architect, with oak parquet flooring and oak furnishings. Adjacent to the library is the map room, also carried out in oak; these two rooms will be spacious enough for their purpose for a very long time to come.

The second, or attic, floor has been most ingeniously designed to give a long gallery for the pictorial side of the collections. The walls are panelled with three-ply African mahogany and are hung with water-colours by Dr. E. A. Wilson. Display cupboards, after a design borrowed from Sir Sydney Cockerell of the Fitzwilliam Museum, further increase the space available for hanging sketches and pictures. In cabinets and lockers on this floor are kept the already very large collection of photographs and other illustrations of past expeditions.

The Polar Research Institute would not justify its name were it nothing more than a depository of things polar, and its real activities are possibly not evident to the passing visitor. The first duty of the Institute is to keep in touch with all investigations made in, or concerning, the polar regions. It does this by maintaining a large correspondence with people interested in polar matters in Great Britain and other countries. It is satisfactory to record that an increasing number of the visitors are more or less directly concerned with expeditions going or returning.

A second duty is to provide facilities for those wishing either to organise an expedition or to work out the results of one which has returned. In the past eight years there has been a constant use of these facilities, beginning with the temporary residence of Mr. V. Douglas to work out the geological results of Sir Ernest Shackleton's *Quest* Expedition. The Institute does not organise expeditions itself, nor is it concerned only with those from Great Britain; many of the requests for information come from overseas.

A third activity of growing importance is the publication of the *Polar Record* in January and July of each year. By means of the large correspondence referred to above, by reference to press-cutting volumes which are kept up to date, and with the assistance of many well-wishers, it has become a publication unique in character. Each number consists briefly of a review of all major events in the polar regions for the previous six months, and in addition to this it usually contains an authoritative article on some subject of topical interest. Its circulation is growing rapidly and it has proved a very useful means of spreading interest in the work of the Institute. Nevertheless it is still, owing to scarcity of funds, unable to illustrate its pages with plates and maps in the style the subject merits, nor is the size to which the journal is limited sufficient to include long articles or reviews of books.

Industrial and National Aspects of Technical Education

THE discussion at Aberdeen on September 11 arranged by the Department of Industrial Co-operation of Section F (Economic Science and Statistics) and Section L (Educational Science) of the British Association, on the planning of a national policy of technical education and industrial recruitment, followed very appropriately Mr. H. T. Tizard's presidential address to Section L and a subsequent discussion in that section on the development of post-primary education during the present century. Mr. Tizard had referred particularly to the way in which the lack of co-operation or understanding between some branches of industry and the universities regarding the character of a university training is liable to lead to engineering graduates, for example, finding themselves in blind alleys or to definite unemployment, as among the biologists. While there can be no two opinions about the folly of a policy of encouraging young men of good ability to spend long years in specialised study, only to find at the end that there is no demand for their services or that the posts offer inadequate prospects, this has been the experience of many science graduates during the past fifteen years. If, however, Mr. Tizard's suggestion that the supply should be deliberately kept short of the demand is not altogether acceptable to industry, the alternative is to attempt some definite planning of technical education both quantitatively and qualitatively in relation to industrial recruitment.

The discussion on this question, while exploring a number of important aspects, was rather disappointing as a definite contribution to the solution of the problem. For this the meagre interest taken in the discussion by industry as a whole may have been responsible, in spite of the valuable contributions of Mr. A. P. M. Fleming and Mr. W. Rintoul. The discussion was opened on the administrative side by a paper by Mr. J. W. Bispham, which surveyed particularly the functions of the technical school and also discussed the effect of raising the school-leaving age, which he considers is inevitable in the near future. The emphasis which was laid on the hardship frequently caused to students, as well as the unwise duplication of equipment, etc., through the sectional treatment of technical education where overlapping or contiguous areas are concerned, indicates the need for national planning of educational facilities. Local rivalries or prejudices are above all out of place in determining educational policy. Equally important is a much closer contact between industrial and educational authorities.

Mr. G. W. Thomson's survey of the position of technical education in Scotland was an important contribution from much the same point of view, but laid considerable stress on the social aspects of the problem. These include the relation of technical education to actual employment, and the dangers of exclusive vocational training. A much larger place for the teaching of English in all technical education was claimed, partly because of its cultural value and as a corrective to the narrow stratification of industrial society, but partly also because of its power to encourage the initiative and originality of thought and expression which industrial conditions often tend to repress. Mr. Thomson also directed attention to the neglect of apprenticeship and to the value of closer correlation between educational authorities and those responsible for the conduct of industry in extending the provisions for part-time study in day classes.

This vigorous plea for the consideration of individual needs in the planning of a policy of technical education was supported by Principal J. Cameron Smail, who however differed as to the place of the teaching of English and cultural values, and deprecated the pushing of selected young people at fourteen or fifteen years of age, urging that a watch should be kept on the education of all young people up to the age of eighteen years. The most serious recent criticism of our system of technical education, that it has been planned too much in accordance with demands from below and not enough in response to requirements from above, was, however, scarcely noted in the discussion, even in the important paper by Mr. A. P. M. Fleming which preceded that by Mr. Thomson. This paper gave a comprehensive account of the methods of recruitment and training used by a large centralised industry, employing 10,000 workers, 3,000 of whom are staff grade, including 800 with technical qualifications. A deliberate attempt has been made in co-operation with educational institutions to effect a planned system of co-ordinating supply and demand, having regard to the influence of the trend of development in engineering plant and apparatus, types and methods of production and markets for new as well as for established engineering products. The scheme attempts to place a premium on ability, and to facilitate promotion of those possessing the requisite qualities from the lowest to the highest positions of responsibility.

In the selection of recruits for training, whether at the usual age of fourteen years for a seven-year apprenticeship system, or of the university trained staff, Mr. Fleming said that reliance is placed on the judgment of the trained staff familiar with this work rather than on vocational or intelligence tests. Attention was directed to the value of a year in the works before proceeding to a university, particularly in avoiding the possibility of a misfit, and also to the value of a cross-connexion between industrial and academic research. Curricula, too, need careful planning if the originality of the investigator is not to be suppressed. On the other hand, post-graduate work and travelling scholarships may well be deferred until some industrial experience has been acquired. Many students are unfit from the start for an industrial career, and in view of the careful practical training now given by some large organisations to their scientific staff, Mr. Fleming suggested that such training invites university recognition by the conferring of a higher degree on men who have pursued such a course in an organisation of accepted standing. The award of research scholarships and the like, enabling the recipient to pursue investigations in laboratories where the facilities are often much greater than in a university, is another way in which co-operation between industry and the universities might be extremely fruitful.

Mr. Fleming's outline not merely of actual achievements but also of some of the possibilities of co-ordination and planning in this field was the most important contribution from the industrial side. Mr. W. Rintoul's paper was limited to a discussion of technical education as applied to the training of

chemists for industry. Like Mr. Fleming, Mr. Rintoul laid a good deal of stress upon the training which supplements that given at the university. For the analyst, post-graduate training in general research or in chemical engineering, etc., is desirable. For the chemist in charge of plant, a two-year course in research or in chemical engineering might equally be desirable but it is highly important that this post-graduate training should be obtained in a university other than that in which he qualified, so as to widen his outlook as much as possible. On entering industry, a year or so should be given to analytical work.

Stressing the value of the knowledge acquired outside the university in such post-graduate work, Mr. Rintoul emphasised the continual necessity for the works chemist to keep himself in touch with developments by membership of scientific or industrial societies and attendance at their meetings. The suggestion of special leave for selected men for a refresher course after five years' service or more was akin to suggestions made by Mr. Fleming. Equally for the research chemist, Mr. Rintoul urged that post-graduate training should be carried out in a fresh university on account of the wider technique and experience thus acquired, as well as the greater stimulus given to originality by a change of environment. The training of the chemist for definitely commercial work is probably best completed after entering industry itself.

In most of the papers and in the discussion, full attention was directed to the social aspects involved in planning technical education and particularly the problems raised by mechanisation. Apart, however, from a very demonstrable consciousness that technical education must be regarded as a vital national matter and not a purely local one or the concern of industries by themselves, the discussion made little definite contribution to immediate progress, and the valuable suggestions made from the industrial side scarcely attracted the attention they deserved. None the less, the discussion of this subject at a British Association meeting should at least assist the formulation of a definite and adequate policy in which technical education is treated not as a thing apart, but in relation to those wide issues of juvenile unemployment, industrial efficiency and the raising of the school leaving age from which it cannot be divorced without danger to the community.

The Sanriku (Japan) Earthquake Seawaves of 1933

THE great earthquake that gave rise to these destructive seawaves occurred on March 3, 1933. As soon as the news of the disaster reached Tokyo, several members of the Earthquake Research Institute were sent to the districts principally affected. The chief points that they investigated were the highest levels reached by the *tunami* or seawaves, the areas of the regions inundated, the damage to houses, etc., and the relations between the effects of the waves and topographical conditions.

Several memoirs have already appeared and an abstract of one of them, by Messrs. Imamura and Kawase (NATURE, 133, 72–73; 1934), gives the main facts as regards the height of the waves and the loss of life and property. In March of the present year, or about a year after the earthquake, the reports of the observers have been published. They occupy a whole volume (Supplementary Vol. I) of the *Bulletin* of the Earthquake Research Institute. To have produced in so short a time a work of such value and interest, accompanied by such wealth of illustration, is a remarkable feat and one for which seismologists can scarcely be too grateful. The volume contains 521 pages and 251 plates. The first half consists of sixteen memoirs, thirteen of which are written in English and the rest in Japanese with abstracts in English. The second half contains the reports of the observers, which, except for a brief abstract of two pages and the titles of the plates, are written entirely in Japanese.

Besides these investigations, experiments are being made in the Institute laboratory in which, by means of models, the natural conditions are imitated as far as possible. They are still unfinished, but the final results, which will be published shortly by the Institute, can scarcely fail to throw light on the nature of earthquake seawaves.

The tide-tables show that the sea at the time of the earthquake was practically at mean sea-level. The heights reached by the waves were determined from the marks left by them on houses, trees and cliffs. As a rule, the heights reached in 1933 were slightly less than those in 1896, but some of them were considerable, the greatest being 94 ft. at Sirahama in Ryôri.

The propagation of the seawaves is studied by Prof. N. Miyabe (pp. 112–126). They were recorded by mareographs at eighteen stations in Japan, only one of which lies on the Japan Sea side. Unfortunately, the times at which the first waves arrived cannot always be determined with precision, and there may be errors of as much as five minutes in the estimates. Taking their probable values and using the formula $v=\sqrt{(gh)}$, Prof. Miyabe has drawn circles with the stations as centres, and radii equal to the distances the waves would travel in the intervals between the time of the earthquake and the times of arrival at the respective stations. These circles do not intersect in a point, but envelop one side of an area about 600 km. in length from north to south. Thus, it is possible that the displacement that gave rise to the seawaves may have been several hundred miles in length. The seawaves were also recorded by mareographs at Honolulu, San Francisco and Santa Monica (Cal.). The mareograms at Manila and Wellington (N.Z.) show no trace of the waves, perhaps on account of the disturbing effect of intermediate islands. Nor do those at Sydney and Melbourne record them with certainty. On the other hand, they are shown with considerable amplitude at Iquique in Chile, though that station is nearly 9,000 miles from the origin.

Mr. K. Musya describes in great detail the luminous phenomena observed with the seawaves (pp. 87–111). He classifies them according to the following types: the crest of the waves emitted dim continuous light (for Prof. Terada's explanation of this light, see NATURE, 133, 73; 1934); the surface of the sea glittered all over; the waves on the shore-line gave out bluish light; when the sea-water receded before the arrival of the great waves, the exposed sea-bed gave out blue light; a luminescent body like a meteor was seen; well-defined round luminous bodies were seen in an incoming wave; a round-shaped luminous body appeared above the sea; and bright light radiated from the sea.

C. DAVISON.

University and Educational Intelligence

CAMBRIDGE.—H. J. Bhabha, of Gonville and Caius College, has been elected to an Isaac Newton studentship, and C. G. Pendse, of Downing College, to an additional Isaac Newton studentship.

Applications for a John Lucas Walker studentship are invited and should be sent before December 1 to Prof. H. R. Dean at the Department of Pathology, to whom requests for further information regarding the Studentship may be addressed. This studentship will be tenable for such period and will be of such annual value not exceeding £200 as the professor of pathology with the approval of the managers may determine.

LONDON.—The Essex County Council has decided to make a grant of £33,000, payable over ten years, towards the erection of the new University buildings The Worshipful Company of Tallow Chandlers has made a donation towards the Ceremonial Hall to be built on the Bloomsbury site.

OXFORD.—On November 17, Dr. R. T. Gunther delivered a public lecture on contributions to science by early members of Balliol College. Names specially mentioned by him were John Evelyn, an early fellow of the Royal Society, and James Bradley, the discoverer of aberration and the first observer of lunar nutation. A tribute was paid to the memory of Henry Smith, a man of wide attainments and a really great mathematician, whose fame with the outside world fell far short of his actual abilities.

SHEFFIELD.—The following appointments have recently been made: Mr. A. J. Holland, to the Society of Glass Technology Research fellowship; Mr. Norman E. Densem, to a research fellowship in the Department of Glass Technology.

The Council has accepted an offer from the Society of Glass Technology of a research fellowship for a period of two years, of the value of £200 per annum.

THE American Association of Dental Schools, stimulated by the publication in 1926 of Dr. W. J. Gies's report to the Carnegie Foundation for the Advancement of Teaching on "Dental Education in the United States and Canada", appointed some three years ago a curriculum survey committee, and has lately adopted a series of recommendations presented by this committee at the Association's annual meeting held this year in Chicago. The recommendations have been published in an article by the committee's secretary in *School and Society* of August 18. They are in accordance with a tendency, said to be increasingly manifested in the United States, to regard dentistry as a health service, and they aim at giving effect to Dr. Gies's contention that the practice of dentistry "should be developed into the equivalent of an oral specialty of the practice of medicine". The objectives of the curriculum are declared to include competence in the "maintenance of oral health and the treatment of oral diseases . . . with understanding and appreciation of the relationships between oral and systematic conditions in health and disease". Two years of education in the liberal arts and sciences are to be required for admission to the dental school, which is to provide a four-year professional course. Having dealt with the subject of the undergraduate curriculum, the committee is proceeding to study methods of teaching, graduate instruction and the education of dental teachers, research workers and specialists.

Science News a Century Ago

Death of Johann Tobias Burg

On November 25, 1834, Johann Tobias Burg, the Austrian astronomer, died near Klagenfurt. Born in Vienna on December 24, 1766, Burg was educated under the Jesuits, and at an early age was admitted to the observatory at Vienna. In 1791, he was sent as a teacher to Klagenfurt, but in the following year, on the death of Hell, returned to the observatory. In 1798, the Institut de France offered a prize for the determination of the mean places of the apogee and ascending node of the lunar orbit, by means of at least 500 observations. Burg applied himself to this laborious task, employing no fewer than 3,232 observations in his calculations. Bouvard was his only competitor, and the judges, Lagrange, Laplace, Delambre, Legendre and Mechain divided the prize, awarding two thirds to Burg. Napoleon, however, aware of the importance of the work, doubled the value of the prize; while the Emperor of Austria decorated Burg with the Cross of Leopold. Burg continued to devote his attention to the study of the motion of the moon, publishing his results at Vienna and Berlin. Becoming deaf, he retired to a house in the country at Wiesena near Klagenfurt, where he died at the age of sixty-seven years.

Almanacs for 1935

The first almanac printed in England appeared in 1497. The almanac of Francis Moore (1657–1715 ?) dates from about 1700, the "Lady's Diary" appeared in 1705, the "Gentleman's Diary" in 1741 and the "Nautical Almanac" in 1767. A stamp duty had been imposed on almanacs in 1710, but this was abolished in August 1834, and in consequence of this there was a great increase in the number of almanacs published. The *Mechanics' Magazine* of November 29, 1834, devoted considerable space to a review of the many published almanacs for 1835, which were "mostly of such a quality as to be dear at any price". The "People's Almanac", the "British Diamond Almanac", the "British Calendar and Almanac" and "Marshall's Penny Almanac" all abounded in more or less inexcusable blunders. The writer of the article did not think people put so great a faith in "Partridge's Almanac" as that of Francis Moore, who with all his "old-fashioned nonsense continues to display an ardent devotion to all the best interests of humanity". The "Lady's" and "Gentleman's Diaries"—"old friends with new faces"—had original contributions to mathematical science, that in the "Gentleman's Diary" being a long and able article by W. S. B. Woolhouse "on the Fundamental Principles of the Differential and Integral Calculus and the Reasonings employed in their Application". Mr. Woolhouse, it was said, had presented the principles of the calculus "in as intelligible and popular form as possible and has succeeded to a degree which we scarcely imagined within the limits of attainment".

Societies and Academies

LONDON

Royal Society, November 15. A. R. MEETHAM and G. M. B. DOBSON: The vertical distribution of atmospheric ozone in high latitudes. Observations to determine the vertical distribution of the ozone in the atmosphere—similar to those recently made at Arosa—were carried out at Tromsø in May and June, 1934. They show that the average height of the ozone is very slightly lower at the higher latitude and indicate that at Tromsø the ozone is more concentrated in a region centred at a height of 21 km. above sea-level, whereas in Switzerland it is more uniformly distributed through the lower 30 km. of atmosphere. G. G. SHERRATT and E. GRIFFITHS: The determination of the specific heat of gases at high temperatures by the sound velocity method. The experiments recorded carry the determination of the specific heat of carbon monoxide by this method up to a temperature of 1800° C. By working with more than one frequency and correcting the data for the effect of frequency on the velocity of sound in the gas, the specific heat in the temperature range 1000°–1800° C. is found to be in good agreement with that deduced from spectroscopic data. Specific heats based on sound velocity measurements in various gases have not hitherto been found to be in accord, even at moderately high temperatures, with those obtained from spectroscopic data. The discrepancy is probably due to the use of a single frequency, for it is now known from practical and theoretical considerations that the velocity of sound in a gas is not necessarily independent of the frequency.

PARIS

Academy of Sciences, October 22 (*C.R.*, 199, 745–811). The president announced the deaths of Francis Gonnesiat, *Correspondant* for the Section of Astronomy, and of Santiago Ramon y Cajal, *Correspondant* for the Section of Anatomy and Zoology. ERNEST ESCLANGON: Notice on the work of F. Gonnessiat. MAURICE CAULLERY: Notice on the work of Santiago Ramon y Cajal. JULES DRACH: The logical integration of the equations of dynamics: central forces. JEAN TILHO: The possibility of the capture of the Logone, a tributary of Lake Tchad, by the Niger. The dangerous consequences to Tchad and the neighbouring regions of such a change of course of the River Logone are pointed out, and a comparison is made with the change of course of the River Mahajamba, in Madagascar, which occurred in February 1903. Possible precautionary measures are discussed. ANDRÉ BLONDEL: The utilisation of yellow glasses in the technique of lighthouses or aviation beacons. In spite of a reduction in the range, the use of yellow glasses has certain advantages for lighthouses, especially those in use at the entrances to ports. PAUL MONTEL: Some new limitations of the moduli of zeros of polynomials. H. EYRAUD: Some laws of errors analogous with systematic errors. SERGE FINIKOFF: The transformation of surfaces with the aid of ∞^2 quadrics having a contact of the second order with the surface and its transform. G. PÓLYA: The application of linear differential operations to series. GH. TH. GHEORGHIU: Metaspherical functions. CHARLES PLATRIER: The ballistic problem of Lagrange: the first median zone. JEAN MASCART: The grouping of the planetary perihelia. BERNARD LYOT: The polarisation of the minor planets. A new photographic method is described, giving results of much higher accuracy than is usual in photographic photometry. MLLES. RENÉE CANAVAGGIA and MARIE LOUISE FRIBOURG: The differential rotation of the currents of Ursa Major, Taurus and Scorpio. JEAN LOUIS DESTOUCHES: The axiomatic in the theory of photons of Louis de Broglie and superquantification. GASTON DUPOUY and CHARLES HAENNY: A new method of absolute measurement of the magnetisation coefficients and the magnetic susceptibilities of liquids. A modification of the Gouy cylinder method. A quartz rod is suspended in the liquid the magnetic properties of which are to be measured. The apparent susceptibility of the rod with respect to the liquid is determined, utilising the change of weight of the suspended rod; the susceptibility of the rod is determined separately and that of the liquid calculated. With a magnetic field of about 30,000 gauss and for solutions with a coefficient of magnetisation of the order of 10^{-5}, the force to be measured is more than 1 gm. and coefficients of magnetisation of the order of 10^{-9} can be determined. JEAN GENARD: The magnetic extinction of the fluorescence of the diatomic molecules of selenium. PIERRE AUGER and LOUIS LEPRINCE-RINGUET: The analysis of the cosmic radiation at high altitudes. Research carried out at the International Laboratory on the Jungfraujoch. JEAN AMIEL: Moist mixtures of chlorates and sulphur and some other reactions of moist chlorates. ALBERT PORTEVIN and E. HERZOG: Some conditions to be realised in tests on the corrosion of steels in a moist medium. Discussion of the causes of the difficulty in obtaining concordant measurements of corrosion. PIERRE CARRÉ and DAVID LIBERMANN: The preparation of veratryl chloride and the formation of the 9, 10-dihydroanthracene nucleus. OCTAVE BAILLY and JACQUES GAUMÉ: The migration of the phosphoric acid radical in the course of the hydrolysis of β-methylglycerophosphoric ester. The passage from the β- to the α-glycerophosphates. HENRY GAULT and JEAN BURKHARD: Ketolic condensations of acetoacetic ester with formaldehyde. GEORGES DEFLANDRE: The presence of conifer pollen (Abietineæ) in a flint from the chalk. Showers of pollen in the Cretaceous period. MAURICE QUENDIAC: A condition of the accumulation of tannin-bearing cells in chestnut wood. GUSTAVE GUITTONNEAU and RENÉ CHEVALIER: The calcophosphoric equilibria realised in cheeses. ADOLPHE LEPAPE and RENÉ TRANNOY: The fixation by plants of radium available to them in the soil. LUCIEN CHOPARD: The presence of a spermatophore in certain Orthoptera of the family of Phasmids. RAOUL M. MAY: The subcutaneous brephoplastic graft of the thyroid in the rat. MME. MARIE PHISALIX: The natural immunity of the hedgehog towards bee venom.

CRACOW

Polish Academy of Science and Letters, October 8. S. ZAREMBA: A general theorem relating to partial differential equations of the second order, linear and of the hyperbolic type. S. PIOTROWSKI: The variable stars 355, 1933 Herculis and 354, 1933 Ophiuchi. The elements of these stars have been determined from 67 observations of 355 and 59 of 354. W. JACYNA: Theorem of the preliminary choice of the arbitrary functions in the equation of state in thermodynamics. W. JACYNA, J. DEREWJAKIN, A. OBNORSKY

and T. PARFENTJEW: The equation of state of helium in the medium region of temperature. N. N. MALOV: The influence of the wave-length of high-frequency electric fields on their mortal action. Remarks on a recent communication of W. Szymanowski on the same subject. K. DZIEWONSKI: A simplified method of mercurisation and degradation of the polycarboxylic aromatic acids. When the acids or their anhydrides are heated with mercuric oxide and water at 150°–180° C. under a pressure of 10–15 atmospheres, one carboxyl group is removed; at higher temperatures (200° C.) all the carboxyl groups are removed. K. DZIEWONSKI and Cz. DRAGAN: A new method of synthesis of compounds of the type of the 1-alkyl-2-hydroxynaphthalenes. K. WODZICKI: The presence of the right oviduct in the domestic duck. The author proves that a Müllerian duct appears in 90 per cent of the domestic ducks examined. J. ZACWILICHOWSKI: Researches on the innervation and the sensorial organs of the wing of *Tipula paludosa*. R. J. WOJTUSIAK: The faculty in the tortoise of distinguishing form, direction and dimensions of an object.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 3). A. MARKOV: Isotopy of compact entities in Euclidian spaces. N. MUSCHELISHVILI: New problem in the theory of elasticity. P. NOVIKOV: The separability of analytic entities. B. GERASIMOVITCH: The absolute magnitude of *Be*-stars. G. KRUTKOV: A special case of Brownian rotation movement. D. PANOV: The approximate determination of the centre of flexure for a symmetrical section. A. BELIAJEV and J. CHARITON: Transmission of detonations in a vacuum. N. ZELINSKIJ: Transformation of pentamethylene cycles with broken ring into the carbohydrates of the paraffin series by contact with platinum in the presence of hydrogen. P. LAZAREV and A. GAMBURCEVA: Variations in the peripheral visual adaptation during eight months. P. LAZAREV and A. DUBINSKAJA: Changes in the visual adaptation caused by cerebral disturbance. S. GAMBURCEVA: A graphical method for studying the curves of adaptation in peripheral vision. M. LOBASHOV and F. SMIRNOV: The nature of the action of chemical agents on mutational process in *Drosophila melanogaster*. (2) The effect of ammonia on the occurrence of lethal translocations of genes. H. FRIESEN: Further investigations on the artificial production of crossing-over in the males of *Drosophila*. D. SCHWARTZ: Hypertetraploid tobacco resulting from interspecific hybridisation. K. MIRIMANIAN: Congelation in Armenia. A. EBERZIN: Age of the conglomerates of Cape Pitzunda (Caucasus). A. FORMOZOV: Competition between species. Mutual relations between the squirrel (*Sciurus vulgaris*, L.), the crossbill (*Loxia curvirostra*, L.) and the great spotted woodpecker (*Dryobates major*, L.). N. NASONOV: The formation of cartilage *in vitro* in the axolotl.

ROME

Royal National Academy of the Lincei, June 17. F. SEVERI: The rational involutions on a surface as equivalence series: their virtual Jacobian groups (2). G. ABETTI: The variability of the period of rotation of the sun. The relatively high values obtained prior to 1912 by the spectroscopic method for the velocity of rotation of the sun are probably subject to systematic error. Since then, the variations in the results have been small (1·93–1·97 kilometres per second for the linear velocity at the equator) and might easily be caused by accidental or systematic error in the observations. L. LOMBARDI and E. BOTTANI: Investigations on the distribution of the continuous current in a homogeneous conductor subjected to the influence of a permanent magnetic field (2). The experiments described were made with the object of testing Weber's discovery of the non-uniform distribution of continuous current in a homogeneous conductor in a magnetic field. The results obtained support the theoretical considerations advanced in the authors' earlier note, and indicate that, apart from small deformations which the internal equipotential surfaces and the lines of current may undergo as a result of the Hall effect, Weber's phenomenon is non-existent. C. SEVERINI: Double series of orthogonal and normal functions (1). L. TOSCANO: The integration of recurrent linear and homogeneous successions of the second order (1). E. BORTOLOTTI: General views on Vitali's calculus and its extensions (2). L. CAMPEDELLI: Further considerations on the calculation of the Zeuthen-Segre invariant for an algebraic surface. P. LIBOIS: A class of quadruple planes. M. RENATA FABBRI: Poinsot's cones in a particular rotation of heavy solids. G. GARGÌA: Laws of Einsteinian planetary movement. GIULIO BEMPORAD: Variations of the eccentricity in the orbits of binary systems. D. FAGGIANI: The time of circonsonance (acoustic reverberation) in chambers with apertures. D. GIGANTE: The limit of resistance of the pigeon to insulin. Under normal conditions the pigeon is endowed with an insulin resistance higher than that of any other bird yet examined.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 461–494, Aug. 15, 1934). A. M. SKELLETT: Proposal of a method of observing the solar corona without an eclipse. The scanning disc technique of television is suggested. The image of the sky around the sun's disc might be scanned in a spiral path round the sun starting from a limb, and the resultant current from a photoelectric cell passed through electrical filters to eliminate the direct current component (due to skylight and telescope glare) and the low frequency components (due to radial progression), leaving high frequency components due to corona and 'poor seeing'. The image re-constructed from the filtered current would show the corona without skylight glare and could be observed directly or photographically. The method has been tested in the laboratory. CLYDE E. KEELER and W. E. CASTLE: The influence of pregnancy upon the titre of immune (blood-group) antibodies in the rabbit. The titre falls during pregnancy and rises sharply after parturition. It is possibly caused by absorption by the embryo of some substance in the maternal blood necessary for the production of antibodies. M. STANLEY LIVINGSTON, MALCOLM C. HENDERSON and ERNEST O. LAWRENCE: Radioactivity artificially induced by neutron bombardment. Following up Fermi's results, various elements were submitted to a stream of neutrons produced by exposing them to beryllium bombarded by deutons. The induced activity of calcium fluoride has a half-life of about 10 sec. Silver seems to show two decay periods of half-life 154 ± 10 sec. and 26 ± 4 sec. respectively, possibly connected with the

presence of two silver isotopes. For aluminium the decay period is $9{\cdot}5 \pm 0{\cdot}5$ min. and for copper about 7 min. The observed radiations in each case are of electronic mass and for silver and aluminium are electrons. Estimates have been made of the activity induced by a given number of neutrons and of the energy of the radiation emitted. CHARLES HAIG : The spectral sensibility of *Avena*. The bases and tips of young oat shoots respectively were exposed to monochromatic light. The tip responses show a maximum at λ 4800 ; base responses show no maximum in the visible spectrum but possibly one in the ultra-violet. This confirms the earlier suggestion of separate photoreceptor systems. FOLKE SKOOG and KENNETH V. THIMANN : Further experiments on the inhibition of the development of lateral buds by growth hormone. The view that this inhibition is due to high concentration of growth hormone preventing its production by a given tissue is re-stated. Inhibition is complete without increase in stem length or thickness. Further, crystalline preparations of growth substance are as effective for decapitated pea plants as natural preparations of the same concentration of growth substance, showing that impurities are not involved. ALFRED J. MARIA : The potential of a positive mass and the weight function of Wiener. NATHAN KAPLAN : V_3 in R_6.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Sunday, November 25

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. C. Hinton : "Some Fossil and Living Mammals".*

Monday, November 26

BRITISH MUSEUM (NATURAL HISTORY), at 5.30—(at Imperial College of Science, Exhibition Road, South Kensington, London, S.W.7).—Dr. R. M. Craig : "The Geology and Scenery of the Hebrides" (Swiney Lectures on Geology. Succeeding lectures on November 28, 30, December 3, 5, 7, 10, 12, 14, 17, 19 and 21).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Ivan T. Sanderson : "The Mamfe Basin, Cameroons".

Wednesday, November 28

BRITISH SCIENCE GUILD, at 4.30—(at the Goldsmith's Hall, Foster Lane, London, E.C.2).—Prof. J. B. S. Haldane : "Human Biology and its Applications" (Norman Lockyer Lecture).

Friday, November 30

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS, at 5.30—(at the Royal Society of Arts, John Street, Adelphi, W.C.2).—A. Keiller : "Excavations (1934) on the Course of the Megalithic Avenue leading from Overton Hill to Avebury, Wilts., commonly known as the West Kennet Avenue".*

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—L. St. L. Pendred : "A Survey of Ships and Engines" (Thomas Lowe Gray Lecture).

ARMOURERS AND BRASIERS' COMPANY, at 8—(at the Royal School of Mines, South Kensington, S.W.7).—Prof. F. C. Thompson : "The Deformation of Metals" (succeeding lectures on December 7 and 14).*

ROYAL INSTITUTION, at 9.—Sir Josiah Stamp : "The Roosevelt Plan".

Official Publications Received

GREAT BRITAIN AND IRELAND

Technical Publications of the International Tin Research and Development Council. Series A, No. 2 : Tin-Iron Alloy in Tinplate, with Notes on some Imperfections. By W. E. Hoare. Pp. 253–264. (London : International Tin Research and Development Council.)

Medical Research Council. Special Report Series, No. 197 : Medical Uses of Radium—Summary of Reports from Research Centres for 1933. Pp. 40. (London : H.M. Stationery Office.) 9*d*. net.

Economic Advisory Council : Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1933. Survey prepared by B. P. Uvarov. Pp. 66. (London : H.M. Stationery Office.) 2*s*. net.

Air Ministry : Aeronautical Research Committee : Reports and Memoranda. No. 1454 (Ae. Tech. 606) : Interferometer for Recording Turbulent Flow. By L. F. G. Simmons and C. Salter. Pp. 3+4 plates. 9*d*. net. No. 1597 (T. 3451e, part) : Pressure Exploration over an Aerofoil that completely spans a Wind Tunnel. By W. L. Cowley and G. A. McMillan. Pp. 13+3 plates. 9*d*. net. (London : H.M. Stationery Office.)

The Zoological Society of Scotland. Popular Official Guide to the Scottish Zoological Park. By T. H. Gillespie. Tenth edition. Pp. 116. (Edinburgh.) 1*s*.

The Coventry Libraries. Report of the Committee on the Year's Work, together with the Fourth Annual Report of the Museum for the Year ended 31st March 1934. Pp. ii+30. (Coventry : Gulson (Central) Library.)

The Imperial Forestry Institute : University of Oxford. Tenth Annual Report, 1933–1934, and Prospectus. Pp. 36. (Oxford.)

County Council of the West Riding of Yorkshire : Education Committee. Report on the Examination for County Minor Scholarships, 1934. Pp. 38. (Wakefield : County Hall.)

Board of Education : Science Museum. Rubber Exhibition (November 1934–April 1935) : a Brief Account of the History of Rubber from its Source to the Finished Product, and a Descriptive Catalogue of the Exhibits. Compiled by the Rubber Growers' Association. Pp. 44+4 plates. (London : H.M. Stationery Office.) 6*d*. net.

Committee of the Privy Council for the Organisation and Development of Agricultural Research. Report of the Agricultural Research Council for the period July 1931–30th September 1933. (Cmd. 4718.) Pp. v+205. (London : H.M. Stationery Office.) 3*s*. net.

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Eleventh Conference held at Somerville College, Oxford, September 21st to 24th, 1934. Pp. 109. (London : Association of Special Libraries and Information Bureaux.) 5*s*.

East African Agricultural Research Station, Amani. Sixth Annual Report, 1933–34. Pp. 48. (London : H.M. Stationery Office.) 1*s*. net.

Hastings Natural History Society. Report and Balance Sheet for the Session 1933–34, Council, Rules and New Members. Pp. 8. (St. Leonards : Hon. Secretary, 23 Charles Road.)

OTHER COUNTRIES

U.S. Department of Agriculture. Miscellaneous Publication No. 192 : A Review of the Patents and Literature on the Manufacture of Potassium Nitrate with Notes on its Occurrence and Uses. By Colin W. Whittaker and Frank O. Lundstrom. Pp. 54. 5 cents. Circular No. 320 : Report on a Preliminary Field Survey of the so-called "Alkali Disease" of Livestock. By Kurt W. Franke, T. D. Rice, A. G. Johnson and H. W. Schoening. Pp. 10. 5 cents. (Washington, D.C. : Government Printing Office.)

Ministero dei Lavori pubblici, Consiglio Superiore : Servizio Idrografico. Le precipitazioni atmosferiche in Italia, nel decennio 1921–1930. Per Prof. Filippo Eredia. (Pubblicazione N. 16.) Pp. xiv+320+31 plates. (Roma : Istituto Poligrafico della Stato.) 50 lire.

International Institute of Agriculture. Coffee in 1931 and 1932 : Economic and Technical Aspects. Pp. 231. (Rome : International Institute of Agriculture.) 20 lire.

Ministry of Agriculture, Egypt : Technical and Scientific Service. Bulletin No. 131 : Citrus Gummosis in Egypt. By Dr. Ahmed Siragel-Din. Pp. ii+44+14 plates. 5 P.T. Bulletin No. 136 : Latent Hæmoprotozoal Infections Intercurrent and Recidivous Diseases ; Observations and Researches on the Comparative Pathology. By Prof. Dr. M. Carpano. Translated from the Italian by E. Talarewitch. Pp. 17+9 plates. 3 P.T. Bulletin No. 137 : Sur les piroplasmoses des carnassiers et sur un nouveau piroplasme des Vélins (*Babesiella felis* chez le Puma : *Felis concor*). Par Prof. Dr. M. Carpano. Traduit de l'italien par Elliot J. Moreno. Pp. 20+6 plates. 3 P.T. Bulletin No. 139 : Contributions to a Knowledge of the White Flies (Aleurodidæ) of Egypt, 2. By Prof. Dr. H. Priesner and Mahmoud Hosny. Pp. 21. 3 P.T. Supplement to Bulletin No. 140 : A Supplement containing Illustrations relating to Bulletin on Fowl-Plague in Egypt, written by Dr. Ahmad Mohammed Rachad. 8 plates. 15 mills. Bulletin No. 141 : Water-Table Effects. 1 : The Gumming and Death of Plum Trees. By Dr. A. Fikry. Pp. ii+35+12 plates. 5 P.T. Bulletin No. 142 : Control of Barley Diseases. 1 : Closed Smut. By G. Howard Jones. Pp. ii+19+8 plates. 3 P.T. Bulletin No. 147 : Pasteurella in Animals and their Inter-Classification. By I. Abu Bakr Khalifa. Pp. 36. 5 P.T. (Cairo : Government Press.)

CATALOGUES

The Gaede Series of High Vacuum Pumps. (Special List No. 21.) Pp. 26. (London : W. Edwards and Co.)

A Catalogue of Books and Periodicals on Natural History, including Zoology, Geology and Palæontology. (No. 495.) Pp. 160. (London: Bernard Quaritch, Ltd.)

Anthropology and Folklore, Archæology and Ethnography : a Catalogue of New and Secondhand Books. (Catalogue No. 574.) Pp. 42. Selected List of Publishers' Remainders. (Catalogue No. 579.) Pp. 24. (London : Francis Edwards, Ltd.)

Catalogue of Books on Chemistry (Organic, Inorganic, Physical). Pp. 20. Catalogue of Books on Applied Chemistry. Pp. 26. (London : H. K. Lewis and Co., Ltd.)