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Science and Leadership.

SOME instruction in science is now provided at most of the secondary schools in Great Britain. Such instruction, in the case of the boys' schools, usually takes the form of an introduction to chemistry and physics, while in girls' schools botany and chemistry are frequently the only branches of science taught. For various reasons, which have so often been the subject of reference in these columns that they need not be repeated now, those pupils who show any aptitude for science are mostly led for the last two years at school to tread the path of specialisation on their journey to the universities. They arrive at the universities embryo chemists, physicists, or botanists, where they are hatched out as full-fledged specialists destined to act as guides to others along the same narrow paths, or to apply their specialised knowledge to industry or in one or other of the public services. Only the comparatively few forsake the paths of specialisation and find scope in leadership and control for the exercise of the particular qualities of mind engendered by the study of science.

The demand for early specialisation in science is as vicious in principle and as harmful in its effects as the demand for any form of early vocational training for the children of the less favoured classes of the community. The revolt against the old-fashioned classical education was successful because the teaching of the classics had become so specialised that the main object of the study was obscured. It encouraged the worst forms of pedantry: it was de-humanised. There is abundant evidence that the teaching of science is suffering from the same disease. The spirit of science, the systematic observation of facts, the conception of hypotheses, to be discarded if they cannot be verified over a complete range of observations, or enunciated as universal if they stand such test, the constant challenge to established precedents and authority, is apt to be obscured by a mass of technical trivialities which passes for scholarship. The influence of scientific discovery upon man's outlook and activities is too often ignored by teachers of science. They incline to look at their several subjects from the inside, and thus not only lose sight of the unity of purpose of the whole range of scientific study, but also fail to appreciate the important impacts of this study upon our common stock of ideas.

At the recent meeting of the Science Masters' Association, Prof. W. A. Bone opened a discussion on "Industrial Openings in Scientific Technology."

He reminded his audience that the profound change in conditions during the past twenty-five years had increased the need in every branch of industry for scientific control and direction, not only in the actual processes of manufacture but also over the whole range of activities precedent and subsequent to the production of finished goods. The nation that could think farthest ahead and adjust its system accordingly was the nation that would deserve success. It behoved us, therefore, as a nation, to ensure that our industrial leaders were men trained in scientific method and in modern scientific thought, who could foresee change and prepare for it. At least seven years' training was necessary, three years studying fundamental science subjects before graduation, to be followed by four years of specialisation.

Within the limits of the subject under discussion, it was obviously difficult for Prof. Bone to deal with the more general applications of the principles he enunciated for industry. This is a pity. As we have already suggested, the teaching of science in schools and most universities is vitiated by over-specialisation, with the resulting tendency to produce experts in the narrowest sense of the term. What is most needed at the present time is an appeal to the science masters in our schools to break with a bad tradition, and by broadening the basis of instruction in science, particularly by the inclusion of biological studies, to extend the mental horizon of their pupils. University teachers will then be the better enabled to equip science students for the responsibilities attaching to the most coveted positions, not only in industry and finance but also in the spheres of higher administration in State and local government services, the various colonial services, and even the judiciary.

Most of us will subscribe to the view that no person can be considered well educated who lacks the equipment to discern the principal forces which are operating to mould our environment. Undoubtedly some knowledge of science and some training in scientific method are essential for such discernment. For the control and direction of affairs, more than this general training is and should be required. It is doubtful whether anyone who lacks the capacity for independent and perspicacious inquiry should be entrusted with the cares of leadership. The field of research is sufficiently extensive to provide abundant opportunity for testing such capacity. It behoves us to follow some such procedure in choosing our leaders, rather than continue to leave it to chance circumstance to produce them.

To prevent misunderstanding, let us state definitely that it is not contended that the creative research workers of any country should be hampered by administrative duties. Such research workers are sufficiently rare to be given every form of encouragement to extend the bounds of knowledge. Their requirements are met by giving them all the facilities they need for their work, the greatest amount of freedom from external control, and freedom from pecuniary worries. It does not follow that we agree with the oft-repeated assertion that such men are unfit for administrative control. The success of Newton as Master of the Royal Mint is by no means the exception which proves the accepted rule. Our view is that no country can afford the luxury of diverting them from the pursuit of new knowledge and its dissemination. Their gift of vision is the world's greatest asset: their function is leadership in a supreme degree. Happy the community that is intellectually equipped to appreciate their genius and possesses the will to follow them.

It is the other types of research workers for whom we consider more varied and abundant opportunities should be given for the exercise of their talents. They may be concerned with the critical examination of discoveries being made in a particular field of knowledge with the view of their application, or they may be engaged on what is embraced by the term 'development work.' But because of the existing prejudice in Great Britain against the so-called experts, they are rarely placed in a position to accept full responsibility for the execution of their ideas. Possibly this prejudice is more ingrained in the hierarchy of the Civil Service than elsewhere. Cases are on record where administrative officers have come to decisions on technical questions without even consulting the technical advisers of the department. It is repeatedly asserted in administrative circles that a man with intensive knowledge of a particular subject is incapable of unbiased judgment on any matter within its scope upon which there may be difference of opinion. Consequently, when a Royal Commission was appointed to inquire into the state of the coal industry, its members included no scientific authority. It is true that the Commission was assisted by a scientific assessor, but no actual member of the commission was competent to examine the scientific experts who gave evidence before it. We are assuming, of course, that finance and economics cannot be regarded as exact sciences.

Obviously there are historical reasons for the prejudice against the expert in the State service.

The prejudice, however, should be attributed to the expert's virtues rather than to his vices. The State machine is activated by bias—the bias of one or other of the political parties. The scientific expert who is faithful to his training must deal with facts objectively and not subjectively. Like the lawyer, it is his function to weigh evidence, but unlike the lawyer it is not his function to select only those facts which support his preconceived hypotheses. If the weight of evidence is against his hypotheses, he must find others. It is only natural that the politician, and the administrative head of a department who has to serve him, often to the extent of writing a memorandum demolishing all the arguments in a memorandum on the same subject which he had prepared a few months before under a different regime, should display a preference for the legalistically minded adviser. The scientific expert cannot be expected to be so accommodating.

Ethical considerations apart, let us assume that the present machinery of government is such that it demands for the smooth working of certain of its parts a type of administrative officer whose function is to serve as a buffer to lessen the shock of impact of impartial judgments on the political heads of the State machine. It does not follow that every part of the machine must be subject to the same control. The State has made itself progressively responsible for providing certain services, the efficient administration of which is entirely dependent upon the way our available resources of technical skill and scientific knowledge are utilised. It is farcical to pretend that they can best be utilised by those who are ignorant of those resources, any more than it is safe to assume that the ignorant will seek impartial advice or be unbiased in their judgments. We suggest that the present machinery of government is in need of overhaul. An attempt should be made to differentiate clearly between those departments whose principal functions are political, and those whose activities are governed solely by financial considerations. It is not denied that successful administration depends upon a knowledge of the administrative system, but we fail to understand why this knowledge cannot be acquired by those who have had the advantage of the broad training we suggest in the methods and principles of science.

As we have already said, many desirable changes in the teaching of science would be effected if the choice of career of science students were not so limited. Their predetermination to specialisation is bad for them and worse for the country which has built up the tradition. In the continental countries there is no such tradition. Men trained in science occupy the highest positions in the State and industry. This may account for the rapidity with which the scientific discoveries of our countrymen are applied to industry in Germany, and possibly afford an explanation for the slow development of the tropical possessions of Great Britain in comparison with the rapid development of those of the Dutch.

It is high time a survey were made of the positions for which candidates, in addition to that ill-defined quality—personality—should possess a sound knowledge of science. We can think of none where this knowledge would not be an advantage. It would lend reality to finance, to the direction of industry, to the administrative services, and even to politics. It would increase our respect for the law if the judges in the special courts dealing with technical matters were themselves able to differentiate between what is and what is not science. It would be worth while trying the experiment of appointing scientifically trained men as governors of our non-self-governing dependencies, instead of distinguished soldiers, sailors, or politicians. But it is unlikely that any such survey will be made until there are far more members of the House of Commons who have a knowledge of and abiding interest in science and faith in its methods. It would hasten the day if more teachers of science appreciated the social implications of their studies and led their students to realise that modern statecraft must be based upon a comprehensive study of the sciences.

The Clinician and Chemotherapy.

Principles and Practice of Chemotherapy: with Special Reference to the Specific and General Treatment of Syphilis. By Prof. John A. Kolmer. Pp. xvi + 1106. (Philadelphia and London: W. B. Saunders Co., 1926.) 55*s.* net.

HITHERTO most of the literature of chemotherapy has been written by chemists, or at least by investigators with a bias towards chemistry. It is wont to consist of descriptions, in series, of complex organic compounds contributed by the chemist, to which his biological colleagues, the pharmacologist and the parasitologist, add 'toxicities' and 'curative doses,' the latter being the minimum quantity of each substance found necessary to cure some particular infection induced experimentally in one of the lower animals. If the ratio between the two factors is favourable for any member of the series, that substance becomes a possible candidate for clinical trials, so that the clinician has the last word in deciding whether the work of his chemical and biological colleagues is

to have the chance of becoming a practical success. Such practical successes are rare, and are far more limited in their application than is generally believed, even by that restricted public which concerns itself with matters of scientific interest.

Fortunately, the contribution which chemotherapy makes to the welfare of humanity is not measured solely by these occasional therapeutical bull's-eyes, but by the steady growth of systematised knowledge of the mode of action of drugs, which its study inevitably ensures, and this accretion of knowledge is just as likely to come from clinical failures as from clinical successes, and perhaps even more from investigations which have no immediate practical end in view. The paucity of these successes is perhaps responsible for the suggestion now and then made that chemotherapy is not living up to the expectations that were formed regarding it when its greatest achievement, salvarsan, was introduced into medicine now nearly twenty years ago. Conferences of learned societies are often useful as a means of gauging current impressions, and it is noticeable that at the present time such conferences dealing directly or indirectly with therapeutics are often much more concerned with the contributions made by biology and bio-chemistry than with those attributable to the study of chemotherapy. There are fashions even in science and in medicine.

It is all to the good, therefore, that a clinician like Dr. Kolmer should have been inspired to produce at this juncture the book now under notice. It puts on record the clinician's view, generously tempered by that of the laboratory worker—for Dr. Kolmer has the good fortune to fulfil both functions—of the present position and future prospects of chemotherapy in relation to clinical medicine. Throughout the book, indifference to, or an intimate and extensive knowledge of, the chemistry of synthetic drugs appears to be assumed, for this side of the subject is left severely alone, only two graphic formulæ, those of salvarsan and neosalvarsan, being given in the whole book. Those interested in chemotherapy can, however, well afford to dispense with such details, which are readily obtainable elsewhere.

The author's preoccupation with the treatment of syphilis and the important position which this disease naturally takes in any exposition of clinical medicine based on chemotherapy, accounts for the large amount of space, more than 600 pages, devoted to it, and bio-chemists and biologists will welcome this full discussion, especially of the possible and probable reactions of anti-luetic drugs in the body.

Perhaps the most interesting section of the book is that concerned with the chemotherapy of bacterial and mycotic diseases. It is well known that in spite of unremitting work in this direction, especially in Germany, and more recently in the United States, very little progress has been made, and it is difficult to decide whether the workers who persist in such investigations are long-sighted optimists or merely misguided enthusiasts. Dr. Kolmer discusses the methods of investigation available and the pitfalls which beset even the most wary in drawing conclusions from the results of experiments in these cases. He then deals with such progress as has been achieved in the use of dyes for local and general infections, ethylhydrocupreine and its relatives in the treatment of pneumococcal and other bacterial diseases, and finally with the compounds of such metals as mercury, copper, arsenic, gold, etc., which have been the subject of so many forlorn hopes for the cure of tuberculosis. The section gives a fair and unbiased account of what has been done, and in view of the generally discouraging results, Dr. Kolmer takes a surprisingly cheerful view of the possibilities of chemotherapy even in these diseases.

The section on trypanosomal diseases is made the means of a very thorough discussion of trypanocidal tests, which have become so important a part of chemotherapeutical work and a subject to which Dr. Kolmer has himself made valuable contributions.

The other sections are neither so full nor so up-to-date as the three just alluded to. Experts on tropical diseases will scarcely regard 25 pages as adequate for the discussion of malaria, even if it has only recently become amenable to chemotherapeutical investigation, or 30 pages sufficient to describe all the work that has been done with surprisingly successful results in some cases, in "leishmaniasis, amebiasis, piroplasmosis, schistosomiasis, and other protozoan and metazoan diseases of man and the lower animals." It seems odd that kala azar, for example, can be dealt with without mention of the valuable work done by Dr. Napier in India in clinical trials of antimonial drugs, which has led to great improvements in treatment in the last few years. Medical men, in writing about the treatment of malaria, generally contrive to suggest that the supplies of cinchona bark are inadequate, or that the price of quinine is too high, and Dr. Kolmer is no exception to this rule. The fact is that for some years cinchona bark was over-produced, and if this had been

allowed to go on, many of the plantations would have gone out of existence. The planters in Java very wisely took steps to control output, just as British rubber-producing companies have had to reduce the output of rubber to avoid a similar catastrophe. To anyone who feels doubtful about the wisdom of such a course, the excellent address dealing with this subject which Sir Thomas Holland gave a short time ago to the Royal Society of Arts may be commended.

The book is very well produced, and contains few misprints or mistakes in chemical nomenclature; it can be cordially recommended to chemists and biologists concerned with chemotherapeutical work as affording the kind of information which is particularly difficult to obtain and collate, except by laborious search through medical literature. Dr. Kolmer not only provides this information, but also presents it with illuminating comments.

T. A. H.

Physics for Students.

(1) *Physics for Colleges.* By Prof. H. Horton Sheldon, Prof. C. V. Kent, Prof. Carl W. Miller, and Prof. Robert F. Paton. Pp. vi + 655. (London: Macmillan and Co., Ltd., 1927.) 16*s.* net.

(2) *The Elements of Physics.* By Prof. Alpheus W. Smith. Formerly published under the title of "The Elements of Applied Physics." Second edition. Pp. xviii + 660. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 17*s.* 6*d.* net.

(3) *Light.* By F. Bray. Pp. xii + 284 + 6 plates. (London: Edward Arnold and Co., n.d.) 6*s.*

(4) *Light.* By Vivian T. Saunders. Pp. vii + 320. (London: John Murray, 1927.) 6*s.* net.

(5) *Studies in Optics.* By Dr. A. A. Michelson. (The University of Chicago Science Series.) Pp. ix + 176 + 7 plates. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press, 1927.) 10*s.* net.

IN spite of the multitude of text-books on physical science, there always seems room for the ingenious author to produce a new volume. Amongst the problems he has to solve is included that of finding a method of so presenting his subject as to maintain the interest of the reader; for all educational experts are agreed that the power of remembering what is read depends upon the degree of interest that is aroused in the mind. The element of wonder may be excited in various ways, and the books noticed below serve to illustrate some of the methods which may be employed. Another difficult question which confronts the author is that of determining to what extent recent investigations and modern theories should be treated, and if they are adopted, to know at what point in the exposition the new material or method is to be introduced. For example, in a work on electricity, should the electron theory be made the basis of the treatment, or should it be discussed separately after developing the older theory? The answer to such a question must obviously depend on the purpose in view and on the class of reader for whom the book is intended.

(1) Under the editorship of Prof. Horton Sheldon, this text-book of "Physics for Colleges" has been compiled by four authors, each one of whom is engaged in teaching physics in an American university. Each author has been responsible for one section of the book, and has tried to make it a continued story. Thus, in the editor's section on heat and molecular physics, the kinetic theory underlies the whole, and everywhere explanations are based on this. In the same manner the electron theory underlies the section on electricity and magnetism, and wave motion underlies that on sound and light. "This not only unifies each section but it weaves modern physics into the structure of the book instead of leaving it as a mere appendage." It is noteworthy that the authors have been able to include chapters on modern radiation theory, quantum theory, and other modern developments; although the treatment of such subjects is necessarily somewhat slight, it is certainly desirable that the student who includes physics in his college course should be made familiar with recent theoretical and experimental work.

The editor, who has had experience of teaching classes containing hundreds of students, makes one remark which may be laid to heart by writers of text-books: "An attempt has been made at every turn to minimise those things which tend to influence the student to memorise, and to magnify those things which tend to induce him to use logical methods of thinking. Thus italics, bold-faced type, etc., have been avoided in the body of the text, as the student usually tries to memorise such portions of a book."

(2) In making a minor change in the title of his text-book, Prof. Alpheus Smith has not altered either the purpose or the method of the work. It is intended for students who are primarily interested in the practical applications of physics, and the author has been very successful in illustrating such applications to agriculture, engineering, physiology, and everyday life. The method employed has involved some curtailment in the number of

scientific facts recorded, and special stress has not been laid on the historical development of the subject. In the revised edition, additional paragraphs have been provided on sound and light, with illustrative material taken from architectural acoustics, audition and voice sounds, and from the physiological effects of light. Finally, a fifth part has been added giving in concise form a clear and interesting account of the brilliant discoveries and advances made in physics in recent years. The illustrations are numerous and, in general, excellent; in a few instances, however, photographs of apparatus show only the external appearance, and details of construction are lacking. Of special excellence are the photographs of sound waves produced by bullets or electric sparks.

(3) Mr. Bray's book on light was begun when the author was a science master at Clifton College, and was designed to satisfy the requirements of a general education and to enable a boy to pursue the study of light in a logical manner up to the modern developments of the wave theory. The author has been successful in his aim of producing a readable text-book, and he is to be commended for having devoted so much attention to the historical side, which, as he points out, provides a wide field of interest and fascinates both old and young.

The first chapter is an interesting historical survey of the science of optics, and the account given of the theories of light put forward by the early Greek philosophers is suggestive when the reader is already familiar with the most recent theories of radiation. More detailed history accompanies the accounts of the important principles laid down in each chapter, and five full-page plates give portraits of distinguished discoverers in optics. There are numerous diagrams, and also a large number of experimental verifications and determinations. The chapter on optical instruments is of special value, and we note that Schuster's method of focusing the telescope and collimator of a spectrometer is described.

Part II., which forms about one-third of the volume, is concerned with the development of the wave theory and is prefaced by an elementary treatment of simple harmonic motion and wave motion. The chapters on interference, diffraction, and polarisation are well written, and we find a brief reference to Bohr's theory of the origin of spectra in the last chapter. In view of recent progress, the statement that very little is known of the 'band spectrum' should be revised in a new edition.

(4) Mr. Saunders, of Uppingham, has written a text-book on light of somewhat similar character to that by Mr. Bray, for students who are following an elementary but formal course. It is intended to cover the ground required for the usual school examinations, but as it was not considered necessary to give detailed instructions concerning laboratory experiments, the scientific information given and the method of treatment are slightly more advanced than in Mr. Bray's book. For example, in the chapter on photometry we find descriptions of the selenium cell and the photo-electric cell which are receiving much attention in photometric laboratories. It may be pointed out that a photometer head of the Lummer Brodhun type was described by Prof. William Swan of St. Andrews thirty years before its invention in Germany.

It is a little misleading to say of the Gregorian telescope that "the telescope was never actually set up." James Gregory first described his reflecting telescope in "Optica Promota" (London, 1663) at the age of twenty-four. The attempt which he made to get a telescope from the London optician Reive was abandoned because the figure proved so bad. That versatile genius Robert Hooke constructed the first Gregorian telescope, which was presented to the Royal Society in February 1674. It is interesting to find that in the previous year the University of St. Andrews had commissioned "Mr. James Gregorie, professor of the Mathematical Sciences here to go to London, and there to provide so far as the money already received from our Benefactors will reach, such instruments and utensils as he with advice of other skilful persons shall judge most necessary and useful for the above mentioned design [for providing ane observatory]." As Gregory was a friend and correspondent of John Collins, the secretary to the Royal Society, it is more than probable that he met Hooke, the curator, during his visit to London, and discussed the telescope with him. Later, several Gregorian telescopes were made by Short, and one of these is now in the Natural Philosophy Department of the University of St. Andrews, marked James Short, Edinburgh, 1736. The same form was generally employed in the eighteenth century.

The latter part of the book is devoted to the wave theory of light, with descriptions in the last two chapters of electromagnetic radiations and spectral series. The chart from "Phases of Modern Science," showing the great range of electromagnetic waves, is reproduced, and an interesting elementary account is given of Bohr's theory of the hydrogen atom.

(5) Prof. A. A. Michelson, who was included in NATURE'S list of Scientific Worthies on Jan. 2, 1926, has done a valuable piece of work in giving a résumé, under the title "Studies in Optics," of his

own investigations on the subjects of interference, diffraction, and the determination of the velocity of light. His fertile mind, equipped with the necessary theoretical knowledge (derived largely from the work of the late Lord Rayleigh), seems to possess an almost uncanny power of translating ideas into practice. The book is based on the undulatory theory of light (the difficulties associated with the quantum theory being no more than hinted at), and it begins with a discussion of the interference of light waves and a description of the author's interferometer. Measurements of a small displacement made by this apparatus are from twenty to fifty times as accurate as the corresponding measurements by microscope or telescope. In the measurements of the standard metre in light-waves the accuracy may be expected to be of the order of one part in several million. The special case of interference known as diffraction is next discussed, and a word of praise must be given to the excellent photographs of diffraction patterns reproduced in the plates. The difficult problem of ruling large diffraction gratings has been attacked with marked success by Michelson, who applied interference methods to the measurement and correction of the errors of the dividing engine.

By the application of interference methods in astronomy it has been possible to measure not only the diameters of the satellites of Jupiter, but even the diameter of the red giant star Betelgeuse, which was found comparable with the diameter of the orbit of Mars. Experiments are still in progress at Mount Wilson Observatory to determine as accurately as possible the velocity of light, the value found from observations in 1926 being 299,796 kilometres per second. But it is probable that the negative result of the Michelson-Morley experiment will serve to perpetuate the fame of these experimenters even more than positive quantitative determinations. This zero result is the corner-stone of the theory of relativity, which is held by some to be incompatible with the existence of luminiferous ether. It is significant, however, that Michelson concludes his account of the theory by saying: "It is to be hoped that the theory may be reconciled with the existence of a medium, either by modifying the theory, or, more probably, by attributing the requisite properties to the aether; for example, allowing changes in its properties (dielectric constant, for instance) due to the presence of a gravitational field."

The University of Chicago is to be congratulated on this addition to its Science Series.

H. S. ALLEN.

The Constitution of Glass.

The Constitution of Glass: a Series of Papers reprinted from the Journal of the Society of Glass Technology. Edited by Dr. W. E. S. Turner. Pp. vii + 191. (Sheffield: Society of Glass Technology, 1927.) 7*s.* 6*d.*

IN May 1925 the Society of Glass Technology organised a general discussion to which papers on the nature and properties of glass were contributed by British, French, German, and American authorities. These papers have now been reprinted, with seven pages of "General Discussion on the Foregoing Papers," which are nine in number, since one additional paper appears to have been added to those contributed to the discussion. The volume also includes a paper on "The Viscous Properties of Glass," which was read at a meeting of the Society at the end of 1926, and a report on "The Structure and Constitution of Glass," by Dr. Rosenhain, prepared at the invitation of the Council under the Glass Research Association Trust Deed.

It is this last report that specially invites criticism, since, unlike the earlier papers in the present volume, it does not appear to have been read at a meeting of the Society for which it was prepared, and is therefore published without any accompanying discussion. This is an unfortunate limitation, since the theoretical views now advanced to explain the structure of glass and other amorphous solids gives the impression of having been devised (as indeed the author hints) in pre-War days, when the nucleus atom and the electronic origin of valency were alike unknown, and to have been brought only incompletely into conformity with the implications of these revolutionary doctrines.

Thus we find that the crisp distinction between the 'electrovalent' structure of common salt and the 'bonded' structure of integral molecules, for which the quantum theory supplies such ample justification, is replaced by an amorphous conception of bonds of varying strength and varying length, uniting all the atoms in the mass, with little or no regard to the ordinary laws of chemical combination. This formless picture is rendered rather more confused by the fact that, although the relative constancy of length of the bonds between the atoms is scrapped, the fixity of angles is retained; but a final element of bewilderment is created by an assertion that, when an alkaline silicate is electrolysed, "rupture of bonds between an alkali metal and oxygen must have occurred,"

since the word " must " is surely too strong to use when postulating a rupture of bonds which the modern theory of ' complete ionisation ' supposes to be non-existent !

The general reader will welcome the reproduction of a paper on the equilibrium diagram of the soda-lime series of silicates, from the Geophysical Laboratory at Washington, and of a summarising paper on the structure of quartz by Sir William Bragg ; and chemists will add this volume to their shelves all the more readily because it is issued in the familiar format in which the *Journal of the Chemical Society* has appeared for more than half a century, and has therefore become by long usage an ideal for chemical publications when the financial assistance of the advertiser is not essential.

Our Bookshelf.

(1) *Applied Magnetism.* By Dr. T. F. Wall. Pp. 262. (London : Ernest Benn, Ltd., 1927.) 28*s.* net.

(2) *Einführung in die Elektrizitätslehre.* Von Prof. R. W. Pohl. Pp. vii + 256. (Berlin : Julius Springer, 1927.) 13·80 gold marks.

(1) DR. WALL gives a good general survey of the subject of applied magnetism and of the theoretical aspects of certain of the questions raised by recent developments of magnetic practice. The bulk of the work is devoted to the problem of obtaining practical control over the magnetic behaviour of the materials used in practical engineering work and to a description of the methods employed in testing the magnetic behaviour of such materials ; and the author's own work and experience enable him here to give a tolerably complete, if not always a critical, account of the present state of our empirical knowledge of a now very extensive subject. The treatment of the theoretical parts of the subject is less happy, being both incomplete and, in places, confused ; but as this side of the subject is still in a state of flux, this cannot be regarded as detracting seriously from the merits of an otherwise good book.

(2) This book, of a very different calibre from Dr. Wall's volume, is intended mainly as an introductory text-book of electricity and magnetism for students who are out for the ideas rather than their mathematical or technical development, and have to approach them experimentally. It covers the whole range of the subject from electrostatics and magnetostatics, through the usual ideas of current generation and flow, to electrodynamics, radio-activity, and electric waves, with all the thoroughness that is possible within the scope of its number of pages. The treatment is experimental throughout, each idea being derived from the result of an experiment, and suggesting further experiment, and so on throughout the whole subject ; but an excellent balance is maintained between the details of the experiments and the description of the facts which emerge from them. Altogether this is a delightful book, one of the most pleasant features of which is the large number of beautiful illustrations, diagrammatic and photographic, which adorn almost every page. G. H. L.

Properties and Testing of Magnetic Materials. By Thomas Spooner. Pp. xiv + 385. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1927.) 25*s.* net.

NEARLY every piece of electrical apparatus has, as Mr. Spooner points out, a magnetic circuit. In the majority of cases this circuit is the governing factor which decides the size, shape, weight, and cost of the apparatus ; a knowledge of its laws and the materials from which it may be constructed is therefore very desirable on both technical and economical grounds. Unfortunately, to those not already familiar with magnetic theory, the whole subject is somewhat repellent and irksome. The unlovely names of units and properties (which to the beginner appear far too numerous), the lack of uniformity among different authorities, and a feeling that the whole subject is not quite free from a tinge of empiricism, are among the probable reasons for this state of things. Anyone who feels like this will welcome Mr. Spooner's book.

The introduction gives the ordinary relations and formulæ of the magnetic circuit in very clear and convincing outline, and a useful comparative table of the various units of magnetic induction. The remainder of the first half of the book is a complete résumé of our present knowledge of the magnetic properties of commercial ferro-magnetic materials. The results of researches made by workers in many countries are given very fully, and these are discussed and compared with the author's own experiments. The book is therefore by no means a mere compilation. A very large amount of quantitative information is given—almost every page has a graph from which numerical values may easily be read off. The effects of composition, heat treatment, crystalline structure, etc., are shown, and problems introduced by modern high-frequency apparatus receive consideration.

The second part of the volume is devoted to a complete survey of the apparatus and methods of magnetic testing, with chapters on core losses in commercial machines and on magnetic analysis.

A. L. R.

A Manual of Automatic Telephony. By Charles W. Wilman. (Lockwood's Manuals.) Pp. vii + 223. (London : Crosby Lockwood and Son, 1927.) 7*s.* 6*d.* net.

THE average technical student finds great difficulty in mastering the theory of the working of automatic telephony. In our opinion, this is due to the fact that nearly every book on the subject begins at once by describing in detail some complete automatic system, and the student is lost in what appears to be a hopelessly complicated maze of circuits. Mr. Wilman has appreciated a beginner's difficulties, and so begins with a few simple general

considerations before describing the uses of the various devices used in practice. The diagrams given are very clear, all unnecessary details being omitted, and so the student will have little difficulty in seeing how an automatic system works.

Manual systems in the past have given satisfaction, but there are several advantages in connexion with automatic systems which make them more desirable. For example, connexions can be completed more quickly and can be released instantaneously. Errors due to incorrectly hearing a number are eliminated. There is a large saving in operators' salaries. A twenty-four hours' service can be given in every exchange, and so a large number of small exchanges can economically replace a large exchange. In countries where several languages are spoken, a call may be completed with equal facility whatever language the subscriber speaks. As for many years to come automatic and manual exchanges must exist side by side, the author devotes a chapter to explaining how they can be interconnected. We recommend this book to all readers who want to get an elementary knowledge of the working of an automatic system.

Some Famous Medical Trials. By Dr. Leonard A. Parry. Pp. x+326. (London: J. and A. Churchill, 1927.) 10*s.* 6*d.* net.

THIS entertaining work contains an account, from the time of Elizabeth to the present day, of thirty odd trials in which medical men figured, usually as defendants. The cases, which, as the author acknowledges in the preface, have not been arranged in any particular order, either chronological or alphabetical, have, with two exceptions from France and the United States respectively, been taken from the criminal annals of Great Britain. Ten cases in which the medical man was brought to trial for treason or other political offences contain nothing of scientific interest, and the same may be said of the crimes of violence, libel, and poisoning. The most instructive cases are those dealing with poisoning, the drugs chosen by the doctors for their victims being arsenic, aconite, hyosine, strychnine, and morphia. Among these may be cited the first case of poisoning by morphia, in which the evidence of Orfila, the celebrated Parisian toxicologist, was the cause of bringing the poisoner, Dr. Edmé Castaing, to the guillotine. Mention may also be made of an interesting chapter on the 'resurrection men,' dealing with the events which gave rise to the amendment of the law with regard to the supply of bodies for anatomical schools and the passing of the Anatomy Act.

Roman Britain. By Gordon Home. (Benn's Sixpenny Library, No. 4.) Pp. 80. (London: Ernest Benn, Ltd., 1927.) 6*d.*

MR. GORDON HOME'S account of "Roman Britain" in Messrs. Benn's attractive little "Sixpenny Library" is a model of concise popularisation. Apart from the many difficulties and obscurities which are involved in the study of the period of Roman occupation in Britain, the necessary concentration on technical details in the reports of excavations, and the lack of a comprehensive historical background, have militated against popular interest in this important element in the composition of the cultures of Britain. This is notwithstanding the fact that discoveries relating to the Roman occupation are more frequent and usually tell more than those of any other period of the early history of Great Britain. Mr. Home has provided exactly the background that is needed to promote such an interest. He tells a clear consecutive story in which, without shirking difficulties, he has given a reasonable interpretation, while avoiding controversial details which might confuse his readers as well as be irrelevant to his main purpose. The stress he lays on purely British culture and its gradual interpenetration by Roman influence, as well as the view taken of the state of the country at the close of the occupation, are useful correctives of popular misconception.

Adventures of Exploration, Book 6: North America. By Sir John Scott Keltie and Samuel Carter Gilmour. Pp. iv + 228. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., n.d.) 2*s.* 6*d.*

THE volume on North America, which is slightly larger than the earlier volumes, completes this admirable series. Some fifteen notable journeys have been retold without the omission of any important facts and illustrated by carefully chosen pictures from many sources. Each tale has a small sketch map to itself, which are excellent examples of clear maps, with no more names than are needed to follow the text. The voyage of Jacques Cartier begins the book, which goes on to tell among others of Champlain, La Salle, Hudson, Hearne, Mackenzie, Lewes and Clark, Franklin, Peary, Erichsen and Mikkelsen. It is not a complete history of North American exploration, and is not intended to be such, but it is an admirable sketch of the chief stages in the story, and is bound to quicken interest in geography.

The Diary of Henry Teonge, Chaplain on Board H.M.'s Ships Assistance, Bristol, and Royal Oak, 1675–1679. Transcribed from the original manuscript and edited, with an Introduction and Notes, by G. E. Manwaring. (The Broadway Travellers.) Pp. x+318+8 plates. (London: George Routledge and Sons, Ltd., 1927.) 12*s.* 6*d.* net.

WHEN Teonge's diary was first published in 1825, some doubt was cast on its authenticity. The disappearance of the manuscript made it difficult to answer the criticisms, but its rediscovery has now set all doubts at rest. The present edition has been produced from the original manuscript with modernised spelling and a number of notes. The author served as a chaplain in the Mediterranean. In addition to a vivid picture of life in the Navy in the seventeenth century, there are interesting accounts of inland journeys in Syria and Palestine. The book is beautifully produced and illustrated with a few contemporary drawings and engravings, but a track chart might well have been added.

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.*]

Earth Currents and Terrestrial Magnetism.

THE study of a monograph on earth currents by Dr. D. Stenquist,[1] telegraph engineer, published in 1925 in Stockholm, suggests that telegraphists have it in their power to add much to our knowledge. The early observations by W. H. Barlow and C. V. Walker showed that an intimate connexion exists in England between magnetic storms and disturbances in telegraph lines, and similar observations elsewhere showed this to be a general phenomenon. So much is this the case that the authorities of the Ebro Observatory, Tortosa, accept as their quiet days for the study of the regular diurnal variation of earth currents the international magnetic quiet days selected at De Bilt, provided their records for these days are complete. Further, Messrs. W. J. Peters and C. C. Ennis, of the Carnegie Institution of Washington, have shown that the Ebro earth current data exhibit in a similar way to magnetic data, and to a similar degree, what is known as the 27-day interval, representing, it is believed, the rotation period of the sun's equatorial surface.

Dr. Stenquist gives a variety of statistical data having an intimate bearing on the subject. In particular, attention may be directed to his Table I., p. 26 *l.c.*, giving a total of 53 dates between Nov. 1, 1906, and Oct. 31, 1909, on which a current of at least 15 milliamperes was observed in the central telegraph station at Stockholm. According to Stenquist, this is the smallest current causing serious telegraphic disturbance. As is now pretty generally known, yearly lists are issued from De Bilt giving for each day a magnetic character varying from 0·0 (very quiet) to 2·0 (very highly disturbed). These figures are based on returns from some 30 to 40 magnetic observatories in different parts of the earth. An analysis of these international character figures for the 36 months covered by Stenquist's table led to the following results :

A	2·0	1·9	1·8	1·7	1·6	1·5	1·4	1·3	1·2	1·1	1·0	<1·0
B	6	4	13	10	14	8	27	25	32	61	71	825
C	6	4	10	6	4	2	5	4	2	3	5	2

A is the international character figure ; *B* the total number of days having each specified character within the 3 years ; *C* the number of these days included in Stenquist's table. The two days on his list with characters less than 1·0 were Oct. 11, 1907, with 0·6, and Oct. 20, 1909, with 0·8. A high value of an earth current may persist for only a short time, while the magnetic character represents the day as a whole. A short portion of a day of character 1·0 *might* be more disturbed than any portion of another day of character 1·5. Thus it was not to be expected that all the days on Stenquist's list would have very high character figures.

What, however, is really significant is that the 23 days of the three years which had magnetic characters of 1·8 or more supplied 20 of the 53 days on Stenquist's list, while the 504 days with characters of 0·5 or less supplied none. It is obvious that if data such as Stenquist's were available for different parts of the world, especially if the directions of the lines in which the high currents prevailed were known, much might be learned as to the prevalence of outstanding earth currents in different regions. A day of high magnetic character is certain to have been highly disturbed magnetically all over the world. But in general the amplitude of disturbance is larger and rapid oscillatory changes are more in evidence in high than in low latitudes. Further, in high latitudes large disturbance is usually in evidence at the same time in all the magnetic elements, whereas in low latitudes disturbance is often mainly confined to the horizontal force. It is obviously important to know from actual observation what the corresponding facts are as regards earth currents.

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[1] "Étude des courants telluriques." Mémoires publiés par la direction générale des télégraphes de Suède.

Light and Sight.

IN the article, "Light and Sight," which appeared in NATURE of Jan. 21, Sir John Parsons accepts as evidence "that the human eye has become specially adapted to sunlight," "the fact that the brightest part of the spectrum, as seen by the light-adapted eye, coincides more or less accurately with the summit of the curve of radiant energy." The implication that the eye has developed in the direction of maximum efficiency as a converter of energy justifies careful examination of the suggestion.

The coincidence in question involves at least three quantities—the sensitiveness of the eye, the amount of solar radiation reaching the earth's surface, and a quantity which serves to define the quality of the radiation. In "the curve of radiant energy" to which Sir John Parsons alludes, the third quantity, the abscissa of a point on the curve, is presumably the wave-length of the light. It is not irrelevant to consider whether the coincidence would be maintained if some other variable were substituted for the wave-length, and, if it should not be maintained, whether special significance can properly be attached to the coincidence observed when this particular variable is adopted.

Physicists will probably have little hesitation in saying that if, in such a connexion, one variable is of greater significance than another, that variable is not the wave-length of the light, but its frequency. The widespread use of wave-lengths is attributable to the convenience, in the experimental analysis of light, of employing apparatus which can be effectively calibrated by measurements of length alone, rather than to any theoretical advantages consequent on this usage. If now we substitute frequency for wave-length, the brightest part of the spectrum on the new basis will suffer a small change, but the highest point of the new energy curve (at least if we may regard the sun as a 'black' body) will lie well outside the limits of the visible spectrum. To me this fact appears conclusive evidence that the utilisation of the greatest possible amount of energy is not the factor which has led the human eye to utilise the particular spectral region to which we find it sensitive, and that the coincidence referred to is fortuitous.

An alternative suggestion may be offered. Many readers of NATURE will recall Prof. R. W. Wood's remarkable landscape photographs taken, some with infra-red light only, and others with ultra-violet light only. The former are notable for the strength of the reflections from directly illuminated surfaces and the blackness of the shadows ; the latter for want of contrast amounting almost to general fog. These effects are due to properties inherent in the

light itself; they are not manufactured by the photographic plates. Corresponding effects would be present were vision excited by these radiations. It is not unreasonable to suppose that any appreciable extension of the visible spectrum at the short wave-length end would impair rather than improve the clarity of the pictures we should perceive. On the other hand, we may suppose that, under more primitive conditions, life would have been rendered more precarious by the increased difficulty of observing enemies lurking in shadows, had there been any considerable shift of the mode towards longer wave-lengths.

There is another coincidence mentioned in the article which may conceivably be accidental. This is the correspondence between the diameters of the retinal cones at their bases and the resolving power of the eye. We may note in passing that close agreement between these lengths would tend to discredit the theory which refers the limit of resolution to the fineness of retinal structures, rather than support it. At least three successive cones must be involved, on this view, in the resolution of two near point images, the total energy falling on the middle cone being appreciably less than that received by either of the outer cones. If we consider curves giving the energy distribution in the diffraction pattern of two sources when resolution is just possible, such as those given by the late Lord Rayleigh, we can readily appreciate that a decided fall in intensity at the centre of the pattern from the peak values is not inconsistent with the reception by the central cone of greater total energy than by each of the outer cones on which the most brilliant parts of the image are formed.

The chief reasons, however, for hesitation in accepting this theory are, on one hand, that it is unnecessary to seek for any explanation of a limit of this angular magnitude in the structure of the retina, for it is imposed by the wave-length of the light to which the eye is sensitive in conjunction with the diameter of the pupil; and on the other hand, that experiments in which this physical limitation does not arise yield figures which suggest that the eye possesses powers of discrimination much more refined than these coarser features of the retinal structure would lead us to expect. Illustrations of these finer ocular powers are afforded by the appreciation of form, the ability to set two straight lines to form a continuous line,[1] and the judgment of distance in binocular vision. Various explanations of these effects may be offered, but the observations at least entitle us to suspend judgment on the relevancy of this coincidence until more rigorous experiments enable us to discriminate between various views in the light of fuller knowledge.

T. SMITH.

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Jan. 24.

I WAS aware of the highly speculative nature of the explanation of the apparent coincidence of the brightest part of the spectrum with the summit of the curve of radiant energy, plotted with wave-lengths as abscissæ, and I fully appreciate the validity of Mr. T. Smith's arguments. It is essentially a physical problem, and I am glad that my rash statement has aroused the attention of a physicist.

On the other hand, I dealt somewhat at length in my lectures with the problems of the *minimum separabile* and contour discrimination. I came to the conclusion that while the facts relating to the former were not inconsistent with a purely physical explanation, those relating to the latter could not thus be explained at present, but were at least rendered intelligible by physiological and psychological interpretations.

These considerations emphasise the complexity of visual phenomena, and the necessity for the co-operation of physicists, physiologists, and psychologists in their elucidation. Mr. Smith's letter is a welcome indication of the increasing interest which physicists are displaying in the physiological implications of their researches. J. HERBERT PARSONS.

[1] See "The Unaided Eye," by J. W. French. *Trans. Opt. Soc.*, **21**, 127; 1919–20.

The Excitation of Spectra by High Frequency Oscillations.

IN a recent letter to NATURE (Nov. 19, p. 726), Mr. J. R. Clarke gives a brief account of some experiments he has made on the excitation of various spectra in mercury vapour. The wording of his note suggests that he attributes the phenomenon cited to the relative shortness of the wave-length of his oscillating system (300 metres). The apparatus he uses is no other than the ordinary one of electrodeless discharge of which the spectroscopic interest has been clearly shown by Prof. E. Bloch and M. L. Bloch (*Journal de Physique*, **4**, 333; 1923), whose first experiments were made with mercury in the absence of air, which is useless and even derogatory to obtaining pure spectra. This method has often been used since by these authors and others, most frequently, it is true, with damped oscillations, but M. Balasse recently employed undamped waves of about 155-880 metres (*Comptes rendus*, 1005; 1927) for the excitation of spectra of alkali metals. It may therefore be said that the method described is not merely full of promise, but also that it has already realised all these expectations.

Like the other kinds of discharges, the electrodeless discharge more or less weakens certain lines and strengthens others: in this way, in the case of mercury, the long list of arc lines given by the above-mentioned authors does not show a single line of the *mp* series, of which the strongest lines are, moreover, infra-red and red. This fact, found also by Mr. Clarke, is to be attributed to the kind of discharge employed and not to the shortness of the wave-length.

I have been studying for some time in this laboratory the emission of mercury vapour under the action of very much higher frequency waves, the period of which reaches the order of magnitude of the duration of life of the excited states of the atom. I have ascertained that a $\lambda = 1{\cdot}90$ m. oscillator, of very feeble power (20 watts max.), produces an exceedingly brilliant electrodeless discharge in a slightly warmed quartz tube which has been exhausted with great care and sealed after a drop of mercury has been introduced by distillation. The luminous efficiency of this mode of excitation seems to be very high. This tube also lights along Lecher's wires at the maxima of the electric field. I obtained ordinary electrodeless arc spectra, with one or two enhanced lines, the feeble power of the oscillator not enabling me to obtain more. The line 2537 seems to be relatively very strong, but, up to now, I have not observed in these spectra any effect that could be attributed to the shortness of the wave-length. Besides, it is to be noticed that this mode of excitation seems to be extremely sensitive to the presence of organic impurities: a tube with aluminium electrodes which has been carelessly

exhausted, although sufficiently so to give only the green fluorescence of glass when connected to an induction coil, emits close to the oscillator a bluish glow, containing the characteristic bands of carbon impurities and hydroxyl.

For the moment, I have given up the use of these 1·90 m. waves and have built a 5-10 metre wave-length oscillator (about 80 watts), in order to see how the growing pressure of the mercury vapour modifies the spectra obtained. I use either the electrodeless discharge or a discharge with only one electrode (in a different apparatus). In the latter case, in a suitable apparatus, permanently evacuated and provided with a liquid air trap, this projects a glow the length of which may attain 40 cm. The pressure of the mercury vapour is varied by heating the mercury, and the degree of excitation by varying the distance between the electrode and the oscillator. I obtain in this way spectra which depend on the pressure and degree of excitation, and the one-electrode discharge does not give results quite identical with those of the electrodeless discharge. At 80°-90°, for example, the former does not clearly reveal the unclassified lines which Mr. Clarke mentions, except perhaps the line 2540. This fact is peculiarly striking for the line 3984·1; this line shows itself very feebly even in long exposures, though it is strong in the ordinary arc. The unclassified lines are found, however, in the electrodeless discharge. In the one-electrode discharge, the glow is observable in the region where the mercury condenses: it is violet; I was unable to discern any impurity, but found that the red lines 6234·35, 6123·46, and 6072·64 were strong in this light. The spectrum of the whole of the glow, taken longitudinally, shows a strengthening of the series $1P - mD$ and $1P - mS$; this is a pressure, and not a wave-length effect. At a higher temperature (110°-120°) and feeble excitation, I get a green glow which shows the Lord Rayleigh and Volkringer spectra (*Proc. Roy. Soc.*, A, 114; 1927. *Comptes rendus*, 1927, *passim*). I am continuing the study of the development of these spectra at increasing pressure, but, at the above-mentioned temperature, I find in this glow the yellow line 5790·6 ($1P - 2D$), and the violet line 4347 ($1P - 3D$), which does not agree with Mr. Clarke's observations: he only saw the triplets *s* and *d*. Mr. Clarke, however, does not say what was the pressure of mercury vapour in his experiment.

Briefly, the method described by Mr. Clarke is the well-known one of the separation of spectra by the electrodeless discharge. I am trying to see if this and the one-electrode method, used with very short wave-lengths (1·90 metres and 5-10 metres), give new results. Up to now, I have not noticed any modification in the emitted wave-lengths, which was to be expected, and the relative alterations in the intensity of the lines are effects of pressure or strength of excitation, and not to be attributed to the shortness of the wave-length used.

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The Formation of Citric Acid by *Aspergillus niger*.

IN two recent publications (*Jour. Chem. Soc.*, 200, 3044; 1927) we have presented results which are in agreement with the assumption that the conversion of glucose to citric acid by *Aspergillus niger* proceeds according to the scheme: glucose ⟶ gluconic acid ⟶ saccharic acid ⟶ citric acid.

It was suggested by Franzen and Schmitt (*Berichte der Deutschen Chem. Ges.*, **58**, 222; 1925) that the precursor of the citric acid of plants is β-γ-diketoadipic acid, arising from saccharic acid by loss of water. They showed that the ester of the diketo-acid is easily converted to citric acid by alkali hydroxide, a transformation of the benzilic acid type:

$$\mathrm{COOH \cdot CHOH \cdot CHOH \cdot CHOH \cdot CHOH \cdot COOH} \longrightarrow \quad -2H_2O$$

$$\mathrm{COOH \cdot CH_2 \cdot CO \cdot CO \cdot CH_2 \cdot COOH} \longrightarrow \quad +H_2O$$

$$\mathrm{COOH \cdot CH_2 \cdot \overset{\displaystyle OH}{\overset{|}{C}} \cdot CH_2 \cdot COOH}$$

$$\mathrm{\overset{|}{COOH}}$$

This observation strongly supports their view, but apart from the recognition of diacetyl $CH_3 \cdot CO \cdot CO \cdot CH_3$ (a decarboxylation product of diketoadipic acid) in ethereal oils, no further evidence has been adduced in favour of the participation of the diketo-acid in citric acid synthesis either by higher plants or by moulds.

Owing to the instability of diketoadipic acid, experiments on its behaviour to *A. niger* are not yet completed. Meanwhile, it appeared probable that useful indications on this point could be obtained by studying the growth of the mould on adipic acid. One of us (T. K. W.) has shown that *A. niger* readily oxidises certain fatty acids in the β-position, and therefore might be expected to convert adipic acid to the β-γ-diketo-derivative:

$$\mathrm{COOH \cdot CH_2 \cdot CH_2 \cdot CH_2 \cdot CH_2 \cdot COOH} \longrightarrow$$
$$\mathrm{COOH \cdot CH_2 \cdot CO \cdot CO \cdot CH_2 \cdot COOH.}$$

If the mould is capable of effecting a 'benzilic-transformation' the production of citric acid might then be expected. This has now been demonstrated. Potassium citrate has been isolated from cultures of *A. niger* on the potassium hydrogen salt of adipic acid, and on potassium muconate,

$$\mathrm{COOK \cdot CH : CH \cdot CH : CH \cdot COOK,}$$

and characterised as the tri-*p*-nitrobenzyl ester in each case. In the adipic acid experiment thallous citrate was also prepared and analysed. The muconic acid may give rise to citric acid by addition of two molecules of water forming β-γ-dihydroxyadipic acid,

$$\mathrm{COOH \cdot CH_2 \cdot CHOH \cdot CHOH \cdot CH_2 \cdot COOH,}$$

which on oxidation could yield the diketo-acid and finally citric acid. The conversion of fumaric and crotonic acids in the presence of liver tissue to malic and β-hydroxybutyric acids (Dakin, "Oxidations and Reductions in the Animal Body," pp. 49-50) indicates the biological possibility of this suggestion.

The conceivable formation of citric acid from muconic acid by addition of four hydroxyl groups and formation of saccharic acid receives less support from the biological side. Further work is in progress which, it is hoped, may enable the mechanism of citric acid formation from carbohydrates and organic acids to be definitely elucidated.

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Extension of the Irregular Doublet Law.

RECENT work in this laboratory has shown that the irregular doublet law, first discovered in 1920 by G. Hertz in the X-ray region, and since then extended by Millikan and Bowen for the optical region, is capable of much wider application. Millikan and Bowen have applied the law for the prediction and identification of spectra of atoms which are stripped

to one or two valency electrons by vacuum discharge, and in the case of higher valence elements, for inner transition lines. But the law can be applied for the prediction of spectra of elements with a larger number of valency electrons giving rise to complicated spectra. The extension of the law in its most general form can be thus enunciated :

If we compare the spectra of a group of successive elements which are reduced by electric discharge to the same electronic constitution (for example, C, N^+, O^{++}, Fl^{+++}, N^{+4}), then frequencies of corresponding lines arising out of a transition in which the total quantum number remains unchanged will form an arithmetic progression.

The law can be very easily illustrated with the atomic chart given by one of the authors (*Phys. Zs.*, p. 470 ; 1927).

$$\begin{array}{ccccc} K_1 & & & & \\ 2 & & & & \\ & L_1 & L_2 & & \\ & 2 & 1 & & \\ & & M_1 & M_2 & M_3 \\ & & [1] & \longrightarrow (1) & \longrightarrow (1) \end{array}$$

In this chart, horizontal transitions refer to $\Delta n = 0$. Thus taking C, N^+, O^{++} . . . we find that the origin of all possible groups of lines can be visualised as follows :

$$\underset{(M_1 \longrightarrow M_2)}{L_2L_2 \longrightarrow L_2M_1} \longrightarrow \underset{(M_2 \longrightarrow M_3)}{L_2M_2} \longrightarrow L_2M_3$$

Now the corresponding lines of the successive elements arising out of the transitions

$L_2M_1 \longrightarrow L_2M_2$, that is, $({}^3P, {}^1P) - \begin{pmatrix} {}^3D, & {}^3\bar{P}, & {}^2S \\ {}^1D, & {}^1\bar{P}, & {}^1S \end{pmatrix}$ lines,

and

$L_2M_2 \longrightarrow L_2M_3$, that is, $\begin{pmatrix} {}^3D, & {}^3\bar{P}, & {}^3S \\ {}^1D, & {}^1\bar{P} & {}^1S \end{pmatrix} - \begin{pmatrix} {}^3F & {}^3\bar{D} & {}^3P \\ {}^1F & {}^1\bar{D} & {}^1P \end{pmatrix}$

will form arithmetic progressions.

Application of this law can be extended to all other complicated spectra.

It follows that if the spectra of two elements, preferably successive, of any group be known, it becomes quite easy to predict the spectra of the remaining elements.

In the group just mentioned, namely, C, N^+, O^{++} . . . the spectra of N^+ has been completely elucidated by Fowler and Freeman, and that of O^{++} is nearing completion thanks to the work of Mihul. (Mihul's levels are wrongly given, though his multiplets are correct. They can be easily reshuffled and correctly fitted to Hund's theory). We can then predict the spectra of C, which is still unknown. Then $L_2(M_1 \longrightarrow M_2)$, as well as $L_2(M_2 - M_3)$ lines which are next in intensity to the fundamental $L_2L_2 \longrightarrow L_2M_1$ $({}^3P, {}^1\bar{D}\ {}^1\bar{S}) - ({}^3\bar{P}, {}^1\bar{P})$ lines are found to be beyond 8000 A.

In a similar way, spectra of all groups can be predicted and correctly located.

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Jan. 11.

The Scattering of Wireless Waves.

OBSERVATIONS made during the past year have brought to light a new factor which plays a very considerable part in wireless transmission on short waves, say between 14 and 50 metres. This factor is a very pronounced scattering of the wireless waves from the upper regions of the atmosphere or Heaviside layer.

The existence of this scattering has been brought to light by the use of various types of direction-finding apparatus. The results obtained by the use of these indicate that the energy received at distances beyond the reach of the direct ray, say greater than 100 km., is either partially or wholly scattered. The scattering effect is most marked within the 'skip distance.' As is now well known, the main rays from a short wave transmitter find their target at distances greater than about 200 to 500 miles, these distances depending on the wave-length, season, and time of the day. It is found that the intervening region (between the range of the direct ray and the end of the skip distance) is almost wholly illuminated by scattered radiation, which, being more or less isotropic, gives no indication of direction. Precautions have been taken to eliminate the reflected wave polarised with its electric force horizontal, which on the longer wave direction finders is responsible for directional errors and absence of bearing. The effects observed, therefore, on the short waves cannot be due to this cause.

During the summer months the scattered radiation appears to be more or less isotropic, but recently we have found evidence of anisotropic scattering, which suggests that it is akin to the scattering of light from the sky, so that it is probably partly or wholly polarised in a direction perpendicular to the direction of the incident ray.

Even at long distances the main ray appears to be associated with some scattering estimated to be 1/6 to 1/10 of the amplitude of the main signal. This scattering is a factor on all waves between 14 and 50 metres. The range above this has not been thoroughly investigated, and there appears to be no evidence of scattering in the longer wave band used for broadcasting.

These facts might indicate that the scattering follows Lord Rayleigh's law, increasing as the fourth power of the frequency, except that there is not sufficient numerical evidence to show that it varies in this manner between 50 and 14 metres. Indeed casual observation might indicate that there was very little variation of the scattering ratio in this range.

On the other hand, it may indicate that the mesh of the scattering structure is small compared with lengths of 300-400 metres, but is large compared with 50 metres.

Whatever other conclusions we may draw from this evidence, it seems certain that the Heaviside layer is by no means a uniformly ionised region, but is very patchy, and there is some evidence of the existence of clouds which are small in dimensions compared with the shortest wave-length, that is, 14 metres.

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Chelmsford, Feb. 3.

New Edition of Willard Gibbs's Works and Proposed Commentary.

IN 1906 the writings of Willard Gibbs were printed in a collected edition of two volumes entitled "The Scientific Papers of J. Willard Gibbs." Vol. 1 contained all of his papers on thermodynamics, and Vol. 2 the remainder of his published writings with the exception of the book "Elementary Principles in Statistical Mechanics," which had been published only five years earlier and was at that time still available. At the present time both Vol. 1 of the "Scientific Papers" and the volume on statistical mechanics are out of print.

In connexion with a movement started last winter to establish at Yale University a memorial in honour

of Willard Gibbs, provision has been made, through the generosity of a donor who prefers to remain anonymous, for a new and complete edition of Willard Gibbs's writings. This will consist of either two or three volumes, well printed and bound, and will be sold at a very moderate price to encourage a wide distribution. It will probably be published during 1928.

In addition to this reprinting of the original text of Gibbs's works, it is proposed to publish, at some later date, a volume or volumes designed to aid the reader to bridge the well-recognised gap between Gibbs's theorems on one hand, and the actual experimental data of the chemist and physicist on the other. This supplementary material, to be written by competent authorities in the several fields, would aim (*a*) to explain the philosophical background of Gibbs's method; (*b*) to amplify the treatment of points of special difficulty; (*c*) to discuss the evaluation of Gibbs's functions in terms of directly measurable quantities; and (*d*) to furnish a variety of illustrative examples from the literature now available. Such treatment is most needed in the case of the thermodynamic papers, but the plan may be extended to cover Gibbs's writings on other subjects if it seems expedient. The financial support of the undertaking has been liberally provided for, and suitable honoraria will be paid to the authors of the new material.

The undersigned committee, appointed to study this plan, earnestly solicits suggestions and comments from all persons interested, especially with respect to any or all of the following questions:

1. Which of the aims outlined above are the most important?
2. How should the subject matter be subdivided into parts which can be handled by a single author?
3. What persons, irrespective of nationality, are best fitted by ability and training to undertake these different parts?

Letters containing suggestions or criticisms will be welcomed, and may be addressed to the Gibbs Committee, Sterling Chemistry Laboratory, New Haven, Conn.

JOHN JOHNSTON.
WILLIAM F. G. SWANN.
RALPH G. VAN NAME, Chairman.

Yale University,
New Haven, Conn.

Use of Diffraction Effects in Measurements of Stellar Photographs.

THE central area of the image of a star in stellar photographs consists of a cluster of silver granules disposed radially in rapidly decreasing numbers, so that the circular or nearly circular boundary is ill defined. This want of definition is necessarily responsible for a large part of the probable error in the microscopical measurements of the star's co-ordinates.

The images of the brightest stars in some photographs, however, may be observed to be accompanied by radial 'rays,' which proceed outwards from both ends of a diameter of the disc as a narrow band gradually terminating in a vanishingly thin line. These effects are well known to be due to diffraction, and it appears that this occasional defect in the image might be purposely produced and used to increase the accuracy of measurement.

If a thin wire be stretched across the aperture of the object glass of the telescope, a star image when observed with an eyepiece will be crossed by a series of narrow spectra at right angles to the direction of the wire, and presumably the central line of this narrow band of interrupted light passes through the point of maximum intensity in the star image. The closer the wire is to the eyepiece the shorter the spectra become, and finally they vanish when the wire coincides with the image. The same narrow band of light is produced when the wire is placed outside the telescope between the object glass and source.

The effect is not altered by moving the wire in a direction perpendicular to the optic axis, and is still apparent when the wire is just within the boundary of the refracted bundle of light; and therefore the presence of other wires parallel to the first only increases the amount of light diffracted into the narrow band of spectra.

It is obvious that if two gratings be constructed of parallel thin wires and crossed at right angles, the images of stars photographed through them will be crossed by two narrow lines at right angles to one another.

It is conceivable that the micrometer wires of the reading microscope may be set with smaller probable error on the central line of these narrow bands than on the centre of the ill-defined star image itself. It is also possible that the presence of a binary will be more readily perceived by the doubling of the bands than by observation of the confused disc itself, but I have not been able to try this yet. I shall be grateful if any astronomer can inform me if this method has been used for the purposes of measurement.

It may be noted that if a wire or a couple of parallel wires be placed between the object glass and eyepiece of a microscope, the focus of a star-image can be more readily determined than by observation of the ringed disc alone. The very fine narrow band of diffracted light crossing the centre of the disc passes more rapidly in and out of focus than can be observed with the central spot of the disc itself.

ALAN POLLARD.

Imperial College of Science, London,
Feb. 3.

Altered Character in the White-faced Spanish Fowl.

A RUMOUR gained currency last year that the old white-faced Spanish fowl, made classical by Darwin's experiments, was extinct. This is not so—a cock won the first prize in the "any other variety" class at the last Crystal Palace Poultry Show—but it is now very rare. Thus it seems to me worth mentioning that its characteristic points have undergone a great additional development since Darwin's time. The ear-lobes were then already large, fully continuous with the similar white skin of the face, and confluent with the throat-skin behind the wattles, but they did not hang down so far as those. By the 'seventies they did so, in some specimens at any rate, but still retained their character as ear-lobes. This has now been entirely lost; they form but the lateral portions of a great white bib or horizontal dewlap, which extends an inch or two below the wattles, the throat-skin having been much developed in the downward direction also.

It is obvious that this alteration must have been effected by selection within the breed, as no outcross could have been used, no other breed having the white face. Thus we have here one structure definitely changed into another by selection of small variations in about half a century. The cock above mentioned is figured in *Poultry* for Dec. 30, 1927.

F. FINN.

c/o Grindlay and Co.,
54 Parliament Street, S.W.1,
Feb. 5.

A New 18-inch Cœlostat.

FOR investigations of the sun it is usual to employ spectrographs of considerable weight and length, which it would obviously be impracticable to mount on an equatorial telescope. The plan generally adopted is to place the apparatus in a room where it can be firmly fixed and kept at a constant temperature, and to direct the solar image into it by means of a mirror.

Various instruments have been devised for reflecting the light from a celestial object in a given direction, such as the siderostat and the Foucault and Stoney heliostats, which are arranged to give a double motion to a plane mirror. These all suffer from the defect that they rotate the image and are therefore not suitable for solar work.

The cœlostat is, however, free from these defects. It consists simply of a plane mirror in a metal cell to which are fixed two pivots or trunnions at opposite sides and exactly in line with each other, so that the mirror is rotatable about an axis parallel to its upper plane silvered surface. This axis has to be set truly parallel to the earth's axis, and the mirror is rotated by clockwork at the rate of once in 48 hours in a direction opposite to that of the earth's rotation. If then we look at a star reflected in the mirror, the image will appear to stand still, because the forward motion of the star is exactly counteracted by the backward motion of the mirror, remembering that the reflected ray always turns at twice the angular speed of the mirror. In order that the light can be sent in a convenient direction (usually either vertical or horizontal), it is necessary to place a second mirror in its path.

The following account is a description of a large instrument of this type with an 18-inch plane mirror, which has recently been made for the Commonwealth Solar Observatory at Canberra, New South Wales, by Sir Howard Grubb, Parsons and Co., of Newcastle-on-Tyne.

This cœlostat possesses a number of interesting features. For example, the mirror is made of Pyrex glass, and the driving clock is perpetually wound by a small electric motor. Both the quick and slow motions to the mirror are operated electrically from a distance by suitable magnets and a reversible motor. The complete apparatus weighs 480 lb. It will be mounted with its second mirror of 18 inches aperture on a rotatable carriage at the top of a building, and the beam will pass vertically downwards through a 12-inch objective and thence will be reflected by a 10-inch mirror into a horizontal spectrograph.

A complete cœlostat, therefore, will consist of a mirror mounted in bearings, with some arrangement by which the inclination of its axis to the horizon can be set exactly equal to the latitude of the observatory. There will also be a clock, similar to the driving clock of an equatorial telescope, which may, or may not, be on the same base. It is more compact if all the parts are mounted together, but the vibration of a clock, especially if electrically wound, is often difficult to overcome. It must be possible to increase or reduce the angular speed of the mirror from a distance by a very small amount for guiding while taking a photograph; and means must also be provided for moving the mirror quickly when making the preliminary rough setting. In the present instrument the quick setting is performed by a small motor with an auxiliary worm and wormwheel, mounted on the mirror spindle and rotating with it; thus the rough adjustment can be very conveniently performed by the operator from the slit end of the spectrograph.

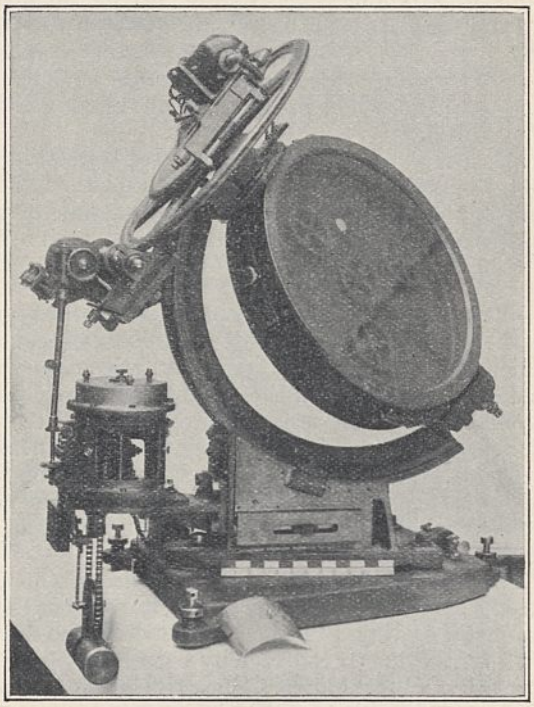

FIG. 1.—View of cœlostat from east side.

THE MIRROR.

The mirror is $18\frac{3}{4}$ inches in diameter and 3 inches thick, weighing about 72 lb., and silvered on the optically worked upper surface. The material chosen was Pyrex glass, made by the Corning Glass Co. of New York. The advantage of Pyrex over common glass is mainly its low coefficient of expansion. When a cœlostat is used in sunlight, the upper surface expands and forces the whole mirror to adopt a somewhat convex shape, which not only produces a marked change of focus, but also introduces astigmatism into the image. An additional advantage of this glass is found in the polishing process, because the heat generated by the polisher does not produce so much change of shape as is the case with ordinary glass. It is more difficult to grind than hard crown, but takes a very fine polish.

The mirror cell consists of a circular cast-iron box, with about $\frac{1}{2}$-inch clearance all round and below the mirror. The glass rests on three brass discs,

4 inches in diameter, mounted by ball and socket on the ends of three levelling screws. This ensures that the mirror will rest rigidly and firmly in the cell. To prevent any lateral movement, the mirror is held by eight equidistant pads about 2 inches square, mounted in pairs on pivoted rockers outside the cell. The two lower rockers, which bear the weight of the mirror disc, are solid and turn on fixed pivots; but the upper rockers consist simply of flat steel springs adjusted by milled screws. After lowering the mirror into place, a gunmetal retaining ring is screwed on the top of the cell and the glass is pushed up into contact with this ring by the three levelling screws. A fourth central screw is also provided which is made sufficiently long to lift the whole mirror right out of the cell for re-silvering.

Massive pivots $1\frac{3}{8}$ inch diameter are bolted to this cell at opposite sides in such a way that the axis of rotation lies accurately parallel to the plane of the upper reflecting face of the mirror.

The Mounting.

The mirror pivots pass through gunmetal bearings at the extremities of a heavy semi-circular casting, which is clamped to a cradle on the main case casting. By loosening this clamp, the whole semi-circular frame can be moved round to alter the inclination of the mirror-axis to suit different latitudes. The thrust due to the weight of the mirror is taken by a ball at the lower end of the axis. Provision is made for a small adjustment in azimuth.

The main wormwheel, or driving circle, which is strung on the upper pivot of the mirror box, is a gunmetal casting 19 inches in diameter, and is cut with 720 teeth. It is driven by a steel worm having a period of four minutes. The drive from the clock (one turn in six seconds), is transmitted to the driving screw by bevel and worm gearing through a vertical shaft the length of which can be varied to suit different latitudes. With the clock mounted on the base, and the large wormwheel of the present instrument, the latitude can only be adjusted over a few degrees, but if the clock were mounted independently a range of from 65° N. to 65° S. could be obtained.

The Slow Motions.

Between the clock and the main worm there is inserted an arrangement of gears for providing slow motions to the mirror. The clock shaft rotates once in six seconds, and the vertical shaft rotates at the same speed; after this the system is broken in two places, and at each break is inserted one of Sir Howard Grubb's well-known differential epicyclic gears (Fig. 2). So long as this gear is left free, it will rotate with the shaft and the whole will go round as one unit. By means of an electro-magnet, a small brake can be applied to the disc carrying the planet wheel, and then the clock will turn one of the large gears; this turns the planet about its own spindle, and the planet in its turn drives the other large gear. The numbers of teeth on these gears are 92 and 90; thus on applying the brake an acceleration of about 2 per cent. is obtained. A corresponding deceleration results if the brake is applied to the second (reversed) epicycle. These slow motions are for guiding, on account of the constantly varying refraction of the atmosphere. Pressing a key for three seconds will produce a change in the direction of the reflected ray of 1″.

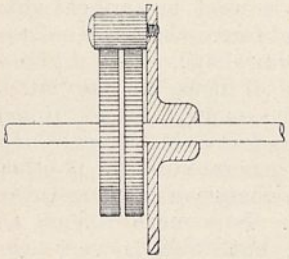

FIG. 2.—Sir Howard Grubb's differential epicyclic gear.

The Clock.

The clock is a distinctly novel arrangement and works extremely well. It is primarily a weight-driven clock with friction governor worked by an endless chain on Huygens' principle, so that the clock may be wound by an electric motor without the necessity of any maintaining power (Fig. 3).

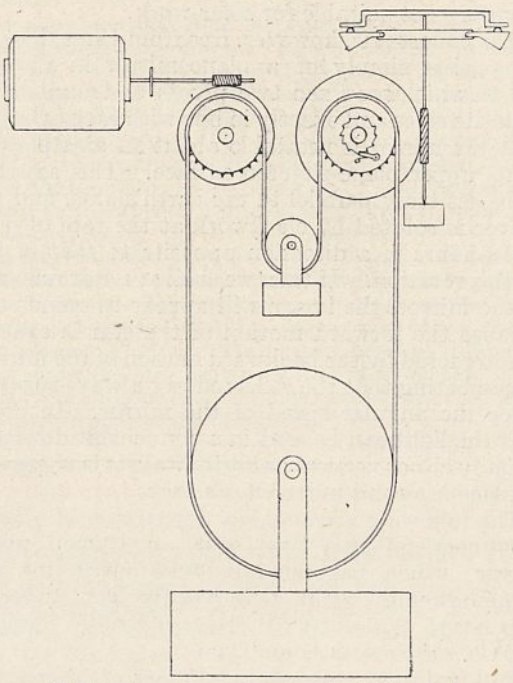

FIG. 3.—General arrangement of the driving clock.

The chain passes over two sprocket wheels, one on the motor winding shaft, and the other on the main clock shaft. On the latter is also a worm-wheel which drives the governor through a reversed worm arrangement. The governor spindle is vertical, and rests on a ball-bearing race to take the thrust of the reversed worm. There are four hinged governor weights which rise up by centrifugal force until the pads on their upper surfaces rub against a brass ring, and the friction then suffices to keep the clock running at a fixed speed. The speed can, however, be altered by an adjusting screw which lowers or raises the whole spindle, and thus allows more or less movement for the governor-weights.

The endless chain also supports two weights, of which the main lower one weighs 11 lb., while the

small upper one of ½ lb. simply serves to keep the chain taut. The up-and-down movement of the main weight operates a small rheostat controlling the speed of the winding motor, so that as the weight rises it introduces more resistance, thus slowing the motor until a balance is obtained. The weight then floats almost stationary, and the motor winds at the same rate as the clock unwinds. A second rheostat is also fitted, so that the motor speed may be approximately adjusted when the instrument is installed.

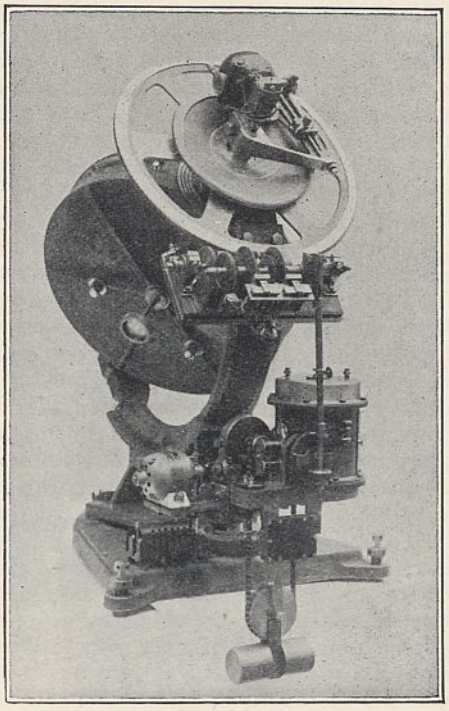

FIG. 4.—Arrangement of clock, gearplate, and driving circle.

When the motor is switched off, the main weight continues to fall and the little weight rises until ultimately it will reach the top of its travel and stop abruptly. In order to prevent damage, due to the great inertia of the governor, a ratchet is incorporated in the clock sprocket to allow the governor to run on freely.

The motor armature was carefully balanced by the makers, and as an extra precaution against vibration, the whole motor is mounted on thick pads of Sorbo rubber and the drive is transmitted through a thin flexible coupling.

To ensure the utmost accuracy in the rate of the mirror, the speed is further controlled by a pendulum, using the 'Russell' type of control. Just before the main spindle leaves the clock, a friction clutch is inserted that will slip if anything obstructs the free movement of the spindle. Round the edge of this clutch is a series of six pins which travel past at the rate of one per second, and a steel pawl is so placed that it catches one of these pins and holds it stationary until the pawl is drawn clear by an electro-magnet operated by a pendulum of an accurate clock. In this way the motion is held momentarily until released by the controlling pendulum at the end of each second. It is, of course, necessary to run the cœlostat clock a trifle fast in order that this control should be effective. The arrangement of these various mechanisms is clearly shown in Fig. 4.

THE ELECTRIC QUICK MOTION.

This is a great convenience in setting the mirror from a distance into the correct position at the commencement of observation. To avoid having to unmesh the driving worm, the main wormwheel is loose on the mirror shaft, but the drive is transmitted through a small auxiliary worm and wormwheel which can be turned by an electric motor also mounted on the spindle. In the ordinary way the whole arrangement, including its motor, turns with the mirror once in two days; but when the quick motion is required, this auxiliary motor is started up and the mirror shaft then rotates, independently of the main wormwheel, at the rate of one turn in about two minutes. The motor is, of course, reversible from the distant control switch, and the current is led to it through four slip-rings and wipers. The worm drive for this quick motion can be thrown out of gear when it is desired to turn the mirror by hand.

The Suez Canal in Relation to the Marine Faunas of the Mediterranean and Red Seas.[1]

THE marine faunas of the Mediterranean and Red Seas differed so widely from one another before the opening of the Suez Canal that in many groups, if a species was found in one sea, it was almost certain that it did not occur in the other. Since then there have been a few Red Sea crustaceans found all over the Mediterranean, and a swimming crab is being commercially fished along the North Egyptian coast, where also the Red Sea pearl oyster is common. The intermingling of the two faunas being clearly an object of great interest, the Royal Society provided the requisite funds for the Cambridge Expedition, the first reports of which are now before us. The leader of the expedition was Mr. (now Prof.) H. Munro Fox, who for several summer vacations had worked at the Suez end of the canal, and with him were associated Mr. Robert Gurney, Mr. V. C. Robinson, and Mr. D. N. Twist. Help was also given by the directors of the Orient Line, and the expedition received an unstinted, generous, and most practical welcome from the Suez Canal Company and the Egyptian Government.

Along the line of the Suez Canal are limestones of Cretaceous and early Eocene ages, the arm of the Mediterranean that extended down what is now the Red Sea only coming into existence in the

[1] Cambridge Expedition to the Suez Canal, 1924. (London: *Transactions of the Zoological Society*, 1926. Part I.

Miocene, when the whole area was peopled from the Mediterranean. In the Middle Pliocene a connexion was formed that allowed an invasion of Indian Ocean animals. How and when exactly the Isthmus of Suez was built is not known, but in the Pleistocene there was a freshwater lake over part of what is now the Isthmus, this containing a series of molluscs of species many still living in the Upper Nile.

It was at this period that the fauna of the Gulf of Suez assumed its almost completely Indian Ocean facies, and the fact that it did so is remarkable enough and by itself quite sufficient to make desirable the present study. The Bitter Lakes were once an arm of the Red Sea, the top of which periodically was isolated and dried up, giving alternate layers of salt and sand. The Pharaohs dug a canal connecting the Bitter Lakes and so the Gulf of Suez to the Nile, and this continued more or less open until the eighth century. It was not a traffic route, as the terminal ports were in Egypt itself, and so differs scientifically from the present canal, the connexion being through a long stretch of fresh water, without unbroken journeys by means of which animals attached to ships could pass from one to another area.

The scientific results of the expedition can only appear gradually as groups of animals are worked out. The Bitter Lakes have increased in depth by nearly three metres, owing to salt solution, since the canal was opened, but the maximum density of their surface waters is only 1037—bottom 1042 = salinity 1·053—as compared with average densities of about 1027 and 1031 in the Port Said and Suez Roads respectively. At Lake Timsah the density varies from 1006 to 1036, and in places fresh water overlies the sea water, each containing its own organisms. The fauna and flora of the canal are poor, probably due to dredging and the churning up of the water by ships, since piles and mooring buoys show abundant growths. The bottom of the Bitter Lakes is covered, over the salt bed, by black mud devoid of macroscopic life, but the shore regions show a fauna and flora richer in numbers of species and individuals than similar areas at either end of the canal. Rather unexpectedly, there is no sign of stunting or deformity except in the Foraminifera, some organisms showing markedly increased size.

Clearly, to-day salinity is no barrier to migration, to the swimming, crawling, or carrying of adult organisms between our seas, but it may have been in the past, since the density of the Bitter Lakes in 1869 was 1123,—and it may still be to forms only distributable by delicate larvæ or eggs peculiarly subject to changes of osmotic pressure. The amount of hindrance by reason of high temperatures is small, but more data are required. Tugs, coal barges, etc., dirtied by organic growth, are frequently changed over from the terminal ports and are helpful. Currents deduced by Prof. Fox from density observations show that Bitter Lake water, as affected by Red Sea tides, is carried from October to July nearly to Port Said, and Mediterranean water to beyond Lake Timsah in August and September. Of 12 groups of organisms there are found in the Canal 83 Mediterranean and 234 Red Sea species, but we must await further lists and analyse these into areas, while the breeding dates are all important in respect to currents.

Scientifically, periodic investigations of the Suez Canal flora and fauna should have been made in the past in respect to which there are no data such as are now required. The expedition under discussion has collected all there were and given a definite basis upon which future science can work. It cannot, however, be deemed to have completed its task until its members pay a further visit to the canal to study the conditions from July to September, the months of heat and of northerly currents, one member in advance to collect data on breeding in the previous quarter.

Obituary.

PROF. J. FIBIGER.

IT is a tribute to the perennial fascination of the cancer problem that Johannes Fibiger, whose sudden and unexpected death on Jan. 30, at the age of sixty years, is deplored by the medical profession of the world, only became known to the wider medical and lay public through his contribution to its solution. It is eloquent of the importance and value of his work that his death has evoked world-wide tributes to his memory.

Fibiger was appointed professor of pathology in the University of Copenhagen in 1900, and until 1913 was known only to pathologists through his careful work on tuberculosis. In 1913 the accidental discovery of cancer of the stomach in rats associated with the presence of nematode worms in the actual substance of the growth, started him on the intricate and arduous investigation which led to the discovery of the first successful method of experimental cancer production. The magnitude of this achievement is seen in the great expansion to which it has led, in the study of neoplastic growth. The tar cancer work of Yamagiwa, Itchikawa, and Tsutsui was directly inspired by it, and Fibiger himself was quick to discern the experimental advantages of the chemical method, his own researches in the subject doing much to establish it in the forefront of the means at our disposal for probing the caustive factors in malignant disease. Even more directly the offspring of Fibiger's genial discovery, is the method of sarcoma induction in the liver of the rat by the larvæ of *Tænia crassicollis*, worked out by Bullock and Curtiss. The production in animals of X-ray, paraffin, and arsenic cancer easily followed as an extension of the avenues of attack opened by Fibiger.

The substitution of exact experiment in the place of more or less nebulous speculation, to which the discussion of cancer etiology was previously restricted, is now acknowledged by all serious students of the cancer problem as the most precious

and enduring consequence of Fibiger's discoveries. Their permanent value will inscribe his name beside that of Virchow, on whose theory of chronic irritation it has placed the crown of experimental verification.

The recent award to him of the Nobel Prize in Medicine was welcomed by Fibiger's friends and admirers throughout the world. In 1926 he was made Rector of his University, a post which he filled with dignity and distinction. His unfailing personal courtesy and energy were proof even against the tedium of international conventions, and in his addresses, as in his published work, he combined brilliance with accuracy, sanity and restraint with enthusiasm. J. A. MURRAY.

MR. J. E. HARTING.

MR. JAMES EDMUND HARTING, who died on Jan. 16, was the son of a Roman Catholic solicitor and was born in 1844 in Chelsea. He was educated at Downside College and, after taking his B.A. at the University of London, he joined his father's firm and practised for some years as a solicitor. Always attracted to natural history, he continued his observations of Nature, more especially of bird-life, in and around London, and one of his earliest papers, "A list of Waders that have appeared at Kingsbury Reservoir in 1863," appeared in the *Zoologist* for that year. From this time onwards, Nature articles from his pen appeared regularly in the *Field*, the *Sussex Zoologist*, the *Middlesex Zoologist*, and in many other journals, but the great majority were written for the *Zoologist*, and in 1877 he became the editor of this journal, a position he retained until 1896. From 1871 he was naturalist editor of the *Field*, and later shooting editor also. On the opening of the Natural History Museum at South Kensington he was appointed to form the zoological library, and the zeal and energy with which he worked is attested by the magnificent collection of books now in the Museum available for reference.

Among the more important of the many books written by Harting were "The Birds of Middlesex" (1866); "The Ornithology of Shakespeare" (1871); "A Handbook of British Birds" (1872), of which he brought out a new and revised edition in 1901; in 1875 he edited an edition of White's "Natural History of Selborne"; "British Extinct Animals" (1880); "The Birds of Hampstead" (1889); and "Bibliotheca Accipitraria" (1891), this last being perhaps the most valuable of all his works. In addition, however, to the above-mentioned works of a more or less scientific character, he wrote many books indirectly connected with ornithology, such as "Ostriches and Ostrich Farming" (1879) and "British Game Birds and Game Laws" (1912).

As a writer, Harting had the knack of making his subjects interesting even when they appealed only to a small circle of readers, whilst his popular and semi-popular books and articles showed a wealth of knowledge and accurate observation of Nature, recorded with a charm that disarmed even those who disagreed with his deductions. From a scientific point of view, Harting was, unfortunately, so conservative that modern methods annoyed and irritated him. In consequence, he often refused to accept facts which, in his heart of hearts, he knew to be true, or arguments which he knew to be irrefutable. Nevertheless, his recent death leaves the scientific world the poorer, whilst the Nature-lover loses a writer who, whatever he wrote, was always well worth reading.

MR. GEORGE MUIRHEAD, successively factor on large estates in Berwickshire and on the Earl of Aberdeen's properties in Aberdeenshire, and for the last quarter of a century Commissioner on the Scottish estates of the Duke of Richmond and Gordon, had exceptional opportunities for studying the natural history of Scotland in very diverse regions. He made the most of these, and for long had been well known throughout the country on account of the particular interest he showed in bird life, in the artificial rearing of salmon and trout, and in floriculture. More than twenty years ago Mr. Muirhead conducted a series of experiments on the rearing of salmon fry in salt-water ponds near the estuary of the Spey, and succeeded in rearing fry, received from the hatcheries at Gordon Castle, through the smolt to the grilse stage. His most important work was his "Birds of Berwickshire," the two volumes of which, published in 1889 and 1895, comprise much more than the ordinary local fauna, since they include readable accounts of the past history and of the legendary lore of the species found in the county. A few years ago the University of Aberdeen recognised the merit of his work by granting him the degree of LL.D. He died on Jan. 29 at the ripe age of eighty-two years, and is survived by his widow, the eldest daughter of the late Lord Sempill.

WE regret to announce the following deaths:

Prof. P. Carmody, Director of Agriculture and Government Analyst, Trinidad, on Feb. 10, aged seventy-one years.

Dr. R. S. Holway, emeritus professor of physical geography at the University of California, on Dec. 2, aged seventy years.

Dr. W. L. Johannsen, professor of plant physiology in the University of Copenhagen and a foreign member of the Swedish and of the Austrian Academies of Sciences, on Nov. 11.

Mr. Richard Kearton, author of several popular books on natural history, and associated with his brother, Mr. Cherry Kearton, in the kinematography of wild animals, on Feb. 8, aged sixty-six years.

Colonel J. P. Koch, Chief of the Danish Military Air Service, who had taken part in many exploring expeditions in Greenland, on Jan. 13.

Prof. Otto Krug, Director of the Agricultural Experimental Station and Public Institute for the Examination of Foodstuffs at Speyer, on Dec. 25, aged sixty-four years.

Prof. Ludwig Milch, Director of the Institute of Mineralogy and Petrology at the University of Breslau, on Jan. 5, aged sixty years.

The Right Hon. the Earl of Oxford and Asquith, F.R.S., on Feb. 15, aged seventy-five years.

News and Views.

THE funeral of Prof. H. A. Lorentz, which took place at Haarlem on Thursday, Feb. 10, afforded a striking tribute to the honour and esteem in which he was held by all sections of his countrymen. Representatives of the King and Queen, the Government, and municipalities were present, and the funeral procession passed through the streets of Haarlem along a special route, which was lined with people. Not only were the universities and scientific institutions of Holland strongly represented, but there were also representatives of foreign academies, including Prof. P. Langevin, Mme. Curie, Prof. A. Einstein, Prof. J. Verschaffelt, and Sir Ernest Rutherford, the latter representing the Royal Society of London. An eloquent eulogium on Prof. Lorentz was delivered at the graveside by Prof. Ehrenfest, successor of Prof. Lorentz in the chair of theoretical physics in the University of Leyden, and was followed by short addresses by Sir Ernest Rutherford, Prof. Langevin and Prof. Einstein. In these speeches, emphasis was laid not only on the magnitude of his contributions to science both by his teaching and investigations, but also on his fine personality and character and the strong influence for good he had exerted in international scientific affairs.

CONSTERNATION has been aroused by the proposal to build a beet-sugar factory on the banks of the River Wye near Hereford, which would discharge several million gallons of putrescible effluent daily into this fine and valuable salmon river during the sugar season. Judging by the disastrous effect which this effluent has had upon other rivers, the anxiety is well justified, for they have been depleted of oxygen and coated with sewage fungus for many miles below the point of discharge. While the provision of factories and employment can only be viewed with satisfaction, particularly by the Minister of Agriculture and Fisheries in his former capacity, the pollution of one of our finest and most beautiful salmon rivers can only be viewed with dismay, particularly by the Minister of Agriculture and Fisheries in his latter capacity. Up to the present time it has been found impracticable to render the effluent non-putrescible at a reasonable cost owing to its large volume. Research concerning possible methods of treatment has been recently inaugurated under the auspices of the Department of Scientific and Industrial Research, and is, we understand, in active progress at Rothamstead. Upon the successful issue of these investigations, rendered difficult since the cost of treatment must be small, rests the possibility of working sugar factories on clear rivers, such as the Wye, without destroying not only the fishing but also, and to a marked extent, the amenities of the riverside. In common with all who desire both increased employment and the preservation of our rivers, as such and not as sewers, we wish good hunting to the small band of workers who are attacking this problem.

IN 1926 a copy of Barrow's "Euclidis Elementorum libri XV." (1655) was sold by auction for five shillings. It proved to be Newton's own copy and to be full of his notes. In the Newton memorial volume, prepared under the auspices of the Mathematical Association and published last year (Bell and Sons, Ltd.), the conjecture was hazarded (p. 170) that this was the only relic left of Newton's Cambridge library of at least 2000 volumes. Now comes the startling news that Col. de Villamil has unearthed from a private house in Gloucestershire, where they have been lying for the last two centuries, at least a third of the missing volumes, and that they include some of the books from which Newton must have reaped his early acquaintance with the subject he was to adorn. A short account of the find is given in the *Morning Post* for Feb. 8. The treasure trove includes classical texts, works on alchemy and the chemistry of the day, and on religious topics. Many of them are autograph presentation copies, contain his own signature, and show by copious annotations every sign of having been closely studied.

AMONG the mathematical works which Col. de Villamil has found are Newton's own copy of the "Principia," corrected in preparation for the second edition, to be edited by Roger Cotes; the "English Euclid" mentioned in Brewster's "Life" (i. p. 22), probably Barrow's edition of 1660; Seth Ward's "Idea Trigonometriæ demonstratæ (in usum juventutis Oxoniensis") (1654); Norwood's "Trigonometrie, or the Doctrine of Triangles" (8th edition, 1685); and what is described as Descartes' "Philosophy." Another interesting item is Newton's own Greek-Latin lexicon (1650), bought, according to the fly-leaf, on Mar. 26, 1661, for sixpence. Some of the books belonged to Barrow, *e.g.* his Greek Testament (1653), and his presentation copy of Stillingfleet's "Discourse on Idolatry," etc. A further and detailed account of the contents of this unexpected—or should we say, long-expected—find will be awaited with impatience. Meanwhile Col. de Villamil, who is old enough to have learned his Euclid from Oliver Byrne's coloured diagrams, must be warmly congratulated on the good fortune which has brought in his way so striking a discovery.

A MERRY combat has been raging around the subject of evolution since Sir Arthur Keith restated the case at the Leeds meeting of the British Association. Trumpets which have lain silent for years are blazing forth challenges to science, and weapons old and rusty with disuse are being burnished for the fray. We are not surprised, knowing something of the strength of fundamentalist feeling which lay dormant in Great Britain, hoping and waiting for the gradual overthrow of Darwinism. But what is surprising is the progress which the doctrine of evolution has made in the meantime even in the quarters which now challenge the sequel. Take the article on "Truth and Error in the Doctrine of Evolution" by Dr. J. A. Fleming, in the January issue of the *Nineteenth Century*. Dr. Fleming is a distinguished electrical engineer and, as a matter of course, knows a great

deal about recent developments in physical science. He is prepared, therefore, to accept the findings of the astronomers and physicists, and admits the evolutionary development of, say, the solar system. But he clearly knows a great deal less about the discoveries of biological science, and, perhaps as a consequence, is not prepared to accept the findings of the biologists. Yet when he reaches the greatest stumbling-block of all, the position of man, even he admits that "as regards bodily structure [the human race] is unquestionably closely allied to the animal races, and especially to the higher mammalia." His main difficulty in accepting evolution lies in the high qualities of man, which seem to cut him off as a being apart from the animal world, but here his misstatement of the facts is patent. All the existing races of mankind he regards as possessing the *same* marvellous qualities. Gradings, essential to the evolutionary view, are ignored, and the lowly Fuegans are (presumably) bracketed with the highest Caucasians. Had the author followed the course which he himself proposes, of endeavouring to trace the characteristics of finished humanity backwards to their simpler manifestations, he would have found a diminishing series through the Iron and Bronze Ages, to the neolithic and various palæolithic stages, which might have suggested that the series did not end there.

THESE are not the points to which Sir Arthur Keith has given prominence in his rejoinder, "Evolution and its Modern Critics" in the February issue of the *Nineteenth Century*. Both Dr. Fleming and another critic, Mr. G. H. Bonner, argue that the intelligent perception of orderliness and plan in Nature implies an intelligent planner. It is the old story of Paley's argument from design, the watch and the watch-maker, the contrivance which could not exist without a contriver; an argument which, seemingly invincible, "was yet in less than a generation replaced in class-rooms, laboratories, and learned societies by that of Darwin." Paley forgot that even his watch had an evolution, and Darwin's argument succeeded because "he produced such a prodigious number of facts which could not be explained if special and instant creation was true, but which fell into place and assumed a rational order if the doctrine of evolution were valid in the world of living things." The human thigh-bone shows as clear evidence of architectural skill as Paley's watch, yet the internal struts carrying just the proper strains in the proper places are built by cells acting in response to the physical forces which play upon them. Architect and mason are one. "There is no duality of function in living matter." The critics are loth to surrender the uniqueness of the human 'soul': they say, a man is not his body; it is the soul, manifesting in a physical body in order to unfold, that is man. But the intricate manifestation "as we medical men know it, depends solely upon the brain"; the human soul is "the inward response and outward manifestation which is given by every living human brain."

THE Lewis Evans Collection at Oxford has recently received several very valuable gifts. One of these, the great silver microscope of George III., has already been referred to in our columns (Feb. 11, p. 226). Now the great Companies of the City of London have materially increased the fund for the collection, originally started with £1000 from the Goldsmiths' Company, on condition that the University devote to the collection the necessary accommodation in the Old Ashmolean Museum, and make such other arrangements for its future maintenance, care, and display as will enable the gift to be secured to Oxford, and available for study. In making these additions to the Lewis Evans Fund the subscribing Companies were greatly influenced by the very close relationship between the ancient museum of John Tradescant in Lambeth and the Old Ashmolean at Oxford. Both were science museums. Ashmole's museum was the child of *Museum Tradescantianum*, with a rich share of the parental qualities, and a richer endowment of the family heirlooms. Until the recent revival of the old Museum its scientific origin was forgotten, being obscured by the growth of the art and archæological side, while the original scientific treasures of the seventeenth century were relegated to the cellars of the University. Yet, as has been aptly said, "Tradescant's Museum was for the London of the 17th century what the British Museum plus the Imperial Institute plus Kew is for London of the 20th century."

THE Old Ashmolean was opened in 1683, wholly as a scientific institution. At present one-third only is available for scientific purposes, for its original laboratories are being used for the storage of Bodleian books, while a second third is used for completing Dr. Murray's "New English Dictionary." The plans for a great extension (or a great reduction) of the University Library give ground for hope that accommodation for both books and the dictionary staff may be found elsewhere than in a building which is now the oldest building in Britain that was specially built for the study and teaching of natural science. Contributions to the endowment fund, such as those from the City Companies, for which the University has recently recorded a decree of thanks, will materially aid objects which have the sympathy of all interested in the history of science in Great Britain.

THE announcement in the *Times* of Jan. 9 that Dr. Hans Merensky had found artesian water in the gneiss formation of Namaqualand is important, if borne out by experience. The vegetation of this region is mostly fed by the sea-mists that drift in, and is singularly beautiful. At dawn the rolling downs in the Sand Veld become white, yellow or blue in patches acres in extent, as the sun touches the buds of the flowers interspersed among the grass; while in the Harde Veld, where the rock appears at the surface, the Mesembrianthemums afford a rich pasture for sheep. The curse of the country, however, is the want of water, so that the whole region lies idle until the rare showers fill the water-holes and valleys. The recent discovery of diamond gravels along the coast has made the finding of water imperative, as it would be useless for the Government to proclaim the

fields open for prospecting if there is no water for the people who would flock in, in the hope of making their fortunes.

THE Namaqualand gneiss is banded, with occasional slips of schist, which are metamorphosed sediments caught in the folds. It is a possible theory that the gneiss itself is the mashed-up sediments that have become entirely altered under extreme metamorphism. In the rock-shaft at the Kimberley Mine at 2520 ft. there were the ordinary shales and grits; at 3520 ft. the schists were riddled with a network of dykes of pegmatite; it was hoped to see the transition into a continuous mass of gneiss at the next level, but unfortunately the Blue Ground came to the end, and it was never cut. If this has been the history of the vast area of gneiss as a whole, it is quite conceivable that certain beds were more resistant to metamorphism, such as bands of quartzite, which, in the folding, would form impervious layers, and so help to constitute artesian basins in which subterranean water could be stored.

WE are reminded in the seventh annual report of the (British) Electrical (and Allied Industries) Research Association, known as E.R.A., that the problem before Great Britain is to provide a means which will enable its population of nearly fifty million persons to live and prosper. For about four-fifths of their food and for a large fraction of the raw materials of industry, the inhabitants of these islands depend on supplies from overseas. These supplies can only be obtained if the manufacturing industries in the country are able to carry on export trade in future with greater efficiency than the rest of the world. This is not done by lowering wages or increasing working hours. Commercial skill and organisation alone cannot succeed. It can only be done by research. Every stage in the production of the finished article must be done as efficiently as possible. Physical researches of the greatest difficulty have continually to be made, and these make the greatest demands on our physical knowledge and our manual skill. It has been found necessary to modify some of the conclusions previously arrived at. The method of finding the temperature rise in buried electric cables needs modification; this is probably due to the fact that the thermal properties of the soil round the cable are not accurately known, and this subject is being investigated. Special attention is being given to high voltage and high frequency work, and satisfactory progress is being made. The researches conducted by Prof. Callender on the properties of steam have been most successful. They are not only of importance in connexion with the design of steam turbines and boilers, but are also of value to the scientific worker. The expenditure of E.R.A. has now been extended from £16,000 per annum to £24,000 per annum, and the Association looks forward confidently to manufacturers and electric supply companies for support. Sir John F. C. Snell, chairman of the Electricity Commission, has been elected president for the ensuing year.

SIR WILLIAM BRAGG delivered a further lecture "From Faraday's Notebooks" at the Royal Institution on Feb. 9. When water lies in a pool on a vibrating support, quivering motions often appear on its surface; and sometimes the extreme regularity of their arrangement produces an exceedingly beautiful effect. Faraday carried out a number of experiments on these 'crispations,' as he called them. They are found on the surface of the water in a finger bowl when the wet finger is rubbed round the edge; or, as Faraday observed, in the small quantities of rain-water that may lie on the objects in a cart which is rattling over the pavement. Their explanation brings in some interesting points of physical science, for their form depends on the properties of the liquid on which they occur, and they have been used as the basis of a method for measuring liquid surface-tensions. Faraday also observed, when on a visit to Hastings, the curious ridges that form on the water lying in thin layers on the wet sand when the wind blows over the beach, and he pointed out that the ridges are parallel to the direction of the wind; that is, at right angles to the ripples that a wind produces in the ordinary way. These, too, he tried to explain on the same principles that he applied to his crispations. He thought that he saw a similar effect in the ridges that appear upon a water surface when the end of a vibrating iron bar is just dipped into the water; the ridges radiate outwards in approximately straight lines from the end of the bar. Curiously enough, he tried to use this effect as an analogy which would help him to understand how a vibrating body in the ether would cause the emission of rays of light. He proved that the water ridges are due to oscillations of the water at right angles to the ridges, and suggested that there was a similarity to the transverse vibrations which Fresnel had considered to be characteristic of the propagation of light.

THE Post Office is to be congratulated on the completion of the long-deferred underground electric railway in London for the conveyance of letters and parcels. It will appreciably contribute to the reduction of surface street traffic. The tube connects the Paddington District Post Office with the Eastern District Post Office. The total length of the railway as at present constructed is 6½ miles. It is the first permanent 2-foot-gauge railway in Great Britain. The minimum diameter of the tunnel between the stations is seven feet, and it accommodates a single track. The operation of the driverless trains is entirely automatic. When a train is standing at a platform ready to be loaded an operator inserts a plug, and a panel which describes where the train is going is illuminated. When the train has been loaded, the foreman operates a switch which lights a green light in the control cabin and a red light on the platform indicator. The switchman then pulls the lever appropriate to the route, starting the train and extinguishing the other lights. The electrical power required for the trains is purchased from two London supply companies and is supplied at 11,000 volts three-phase. It is then converted down in two operations to 440 volts direct current. A train passing through a station does not require to be

watched by the switchman, as he can always see its exact position by looking at the illuminated diagram in the control cabin of the station. The trains consist of two or three steel motor wagons, each of which is capable of carrying half a ton. It is possible to dispatch a second train from one station before the arrival of the first train at the next station.

ON Thursday morning, Feb. 9, Mr. Baird succeeded in sending from his laboratory the first glimmerings of images of persons in London to a room in a suburb of New York. The transmission was sent by a telephone wire from London to the radio transmitter at Purley, and from there was broadcast to New York. The waves that produced the pictures were detected by the loud irregular humming noise they produced in a telephone. The pattern of a man's head moving in a human way was clearly seen, but it sometimes faded away. This fading was attributed to interference from short-wave stations in Paris and Mexico City. A picture of a woman's head moving in a natural way was also transmitted. The receiving apparatus used in this experiment was a comparatively simple device. It comprised only a system of rotating shutters controlled by a small electric motor, the source of light being a discharge tube. Mr. Baird attributes the imperfections of the images to atmospherics and fading, and says that they could have been very considerably improved by using a higher-powered transmitter at Purley. The experiment proves that the trans-Atlantic transmission of living pictures is possible, and it indicates some of the difficulties that have to be overcome.

SIDKY PASHA'S proposal to the Chamber in Cairo that all royal mummies at present being exhibited in the Cairo Museum or elsewhere in Egypt should be returned to their tombs and reinterred in their sarcophagi, will no doubt commend itself to a certain section of Egyptian opinion for reasons which, perhaps, need not be too closely examined. His views, as explained to the *Times* correspondent and published in the issue of Feb. 8, are from certain points of view unexceptionable, if not entirely convincing. The analogy he draws from the fact that great men of more modern periods are not exposed to view though they were of less importance than the Pharaohs in their day, is somewhat irrelevant. In arguing that scientific requirements alone could justify the continued exposure of the bodies, and that these have long been satisfied, Sidky Pasha assumes that further discovery is no longer possible to future generations of anatomists and archæologists—an assumption as great as the statement that those who now look at these mummies in the Museum are inspired by nothing but a vulgar curiosity. If this were true, it would involve sad implications for those who seek to popularise our museums. The appeal to sentiment in the argument that this is an attempt to comply with the religious ideas of the ancient Egyptians and to meet the requirements of the dignity of Egypt, will add weight to a proposal which it might be difficult to take seriously if it were not a real danger to the future study of ancient Egypt, and if it had not already been applied in the case of Tutankhamen.

PRINCIPAL A. P. LAURIE, of the Heriot-Watt College, Edinburgh, and professor of chemistry at the Royal Academy of Arts, and Mr. Noel Heaton, have been elected honorary associates of the Royal Institute of British Architects.

IT is announced in *Chemistry and Industry* that the Perkin medal for 1927 has been presented to Dr. Irving Langmuir, assistant director of the research laboratory of the General Electric Company, Schenectady. The medal is awarded each year by the American Section of the Society of Chemical Industry to the chemist who, in the opinion of a committee representing the Section, the American Chemical Society, the Société de Chimie Industrielle, and the American Electrochemical Society, has rendered the greatest service to American chemistry.

THE following officers and new members of Council of the Royal Astronomical Society have been elected: *President:* Rev. T. E. R. Phillips; *Vice-Presidents:* Prof. A. S. Eddington, Prof. Alfred Fowler, Dr. J. W. L. Glaisher, Lieut.-Col. F. J. M. Stratton; *Treasurer:* Dr. E. B. Knobel; *Secretaries:* Dr. John Jackson, Dr. H. Knox-Shaw; *Foreign Secretary:* Prof. H. H. Turner; *New Members of Council:* Prof. S. Chapman, Sir Frank Dyson, Mr. W. M. H. Greaves, Dr. Gerald Merton, Prof. E. A. Milne.

AT the recent annual meeting of the Botanical Society of America, the following were elected corresponding members: Abbé G. Bresadola; Prof. S. Ikeno, professor of botany in the Imperial University, Tokyo; Prof. C. H. Ostenfeld, formerly Keeper of the Botanical Museum, Copenhagen; Prof. O. Rosenberg, professor of botany in the Högskola, Stockholm; Prof. R. von Wettstein, director of the Botanical Garden and Botanical Institute, Vienna. Officers of the Society were elected as follows: President, Prof. A. H. Reginald Buller, of the University of Manitoba; Vice-President, Prof. Irving W. Bailey, of Harvard University.

DR. J. PHILLIPS, whose important botanical work in connexion with the indigenous forest trees of South Africa, carried out at the Knysna Forest Research Station in South Africa, has been referred to from time to time in our columns, has accepted an appointment in the new Research Station to be inaugurated in Tanganyika. It is much to be hoped that the South African Government will find it possible to carry on the important and interesting work to which Dr. Phillips devoted so much energy and perseverance, and which is so fraught with interesting possibilities whilst being of considerable importance to the Forestry Department.

AN American expedition to Nicholas Land, north of Cape Chelyuskin, is announced in a *Daily Science News Bulletin*, issued by Science Service, Washington. This is the Arctic land discovered in 1913 by Com. B. A. Vilkitski and partially explored by him in the following year. Since then it has apparently not been

visited. The expedition is to sail in the *Morrissey* under Capt. R. A. Bartlett, and will be mainly concerned with the collection of material for the American Museum of Natural History. No indication is so far given of the date of sailing or the route to be taken.

THE title of the *Amateur Aquarist and Reptilian Review* is being changed to the *Aquarist and Pond Keeper*, for it is intended that, besides the usual inhabitants of aquaria and ponds, the journal shall also deal with the mammals and birds which affect these directly or indirectly, either as enemies or friends. The present number (Winter 1927), the last of the old series, includes many short articles of interest to aquarium owners. These are chiefly about fishes, but there are also notes on miscellaneous subjects, such as lizards, snails, and fresh-water plants.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A part-time demonstrator in chemistry at Birkbeck College—The Secretary, Birkbeck College, Breams Buildings, Fetter Lane, E.C.4 (Feb. 21). A technical assistant in the Department of Fisheries, Irish Free State—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin, C.2 (Feb. 24). A mycologist to the Department of Agriculture, Tasmania—The Agent-General for Tasmania, Australia House, Strand, W.C.2 (Feb. 29). A woman staff lecturer and demonstrator in the Department of Physics of Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (Mar. 14). A professor of biochemistry at the London School of Hygiene and Tropical Medicine—The Academic Registrar, University of London, South Kensington, S.W.7 (April 12). Male cartographers in the Hydrographic Department of the Admiralty—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (return of application forms, May 24). A research worker with metallurgical training, in the Research Laboratories of the General Electric Company, Ltd.—The Director, Research Laboratories, G. E. Company, Ltd., Wembley. A junior veterinary surgeon in the Department of Agriculture, Southern Rhodesia—The Secretary, High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2. A director of agricultural research and of experiments and demonstrations in the application of fertilisers, and a director of fertilised propaganda, under the Chilean Nitrate Committee—The Chilean Nitrate Committee, Friars House, New Broad Street, E.C.2. A head of the Department of Biology of Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield.

Our Astronomical Column.

FIXING THE DATE OF EASTER.—A new Bill, entitled the Stabilisation of Easter Bill, 1928, is being introduced as a private member's bill in the House of Commons by Capt. Bourne and is down for a second reading on Feb. 17. The Bill, which is to regulate the date of Easter Day and other days depending thereon, provides that "Easter-day shall, in the calendar year next but one after the commencement of this Act and in all subsequent years, be the first Sunday after the second Saturday in April."

THE TOTAL ECLIPSE OF AUGUST 31, 1932.—This is the only total eclipse in the next eight years that is visible in an easily accessible region. A recent *Daily Science News Bulletin*, issued by Science Service, Washington, gives the particulars about it that have been calculated by Dr. L. J. Comrie of the *Nautical Almanac* Office. The eclipse is total in eastern Canada and the north-eastern corner of the United States ; it occurs at 3.30 P.M., height of sun 30°, duration of totality 100 seconds, width of totality track 100 miles ; the central line runs from Pierreville, Quebec, to Biddeford, Maine. The southern limit of totality runs from Montreal to Salem, Mass. ; the northern limit from St. Jean des Chaillons, Quebec, to Richmond, Maine. The central line passes over the White Mountains. Three Rivers and Sherbrooke in Quebec, Portland in Maine, and Portsmouth in New Hampshire are all suggested as suitable stations. Montreal is too near the edge of the track, except perhaps for some investigations of a special character. Boston is very close to the track, but just outside it. It will be remembered what enthusiasm was excited in America by the eclipse of January 1925. That of 1932 crosses a region not much less populous ; it comes at a better time of the year and the sun is higher, so still more successful results may be hoped for.

This is a return after two Saroses of the eclipse of 1896, Norway, Novaya Zemlya, Japan ; and after one Saros of that of 1914 (Sweden and Russia) ; the eclipse is nearing its end in the Saros cycle, and 1932 is the last occasion on which it will be visible under favourable conditions in accessible regions.

THE SUN'S ROTATION AND THE RELATIVITY SHIFT OF SPECTRAL LINES.—A paper by Mr. J. Evershed dealing with "The Solar Rotation and the Einstein Displacement derived from Measures of the *H* and *K* Lines in Prominences" is published in *Mon. Not. Roy. Ast. Soc.*, Dec. 1927. It is well known that, at the photospheric level of sunspots, the sun's angular rate of rotation diminishes from the equator towards each pole. Spectroscopic observations of the Doppler effect made by Adams in 1908 indicated that the angular speed of rotation also increases from the photosphere outwards through the chromosphere. In 1925, Evershed published his results obtained from spectroscopic observations of prominences, which gave the unexpected value at the sun's equator of nearly 17° for the daily sidereal rotation as compared with 14½° at the level of the photosphere (visual observations of sunspots).

The present paper, which confirms and extends Mr. Evershed's earlier results, is based on data derived from 200 spectra of prominences photographed last year at Pitch Hill, Surrey. For purposes of measurement, a comparison spectrum of the iron arc was used instead of the spectrum of the centre of the sun's disc as employed earlier. From a discussion of class *A* of spectrograms (those in which the lines were narrow, well-defined, or otherwise undistorted by radial motions of eruptive prominences) a first approximation of the mean shift of the spectral lines, *H* and *K*, in prominences is given as +0·0109 A., the predicted relativity shift at 28″ above the sun's surface being +0·0081 A. The outstanding difference is discussed. The paper also contains an account of Mr. Evershed's apparatus which he has installed in his underground observatory at Pitch Hill.

Research Items.

THE EARLY RACES OF AMERICA.—Dr. Etienne B. Renaud has published in the *University of Colorado Studies*, vol. 16, pt. 1, the results of an examination of two small series of skulls, one from La Plata (Colorado) and one from Cañon del Muerto (Arizona), and a comparison with other skulls from the south-west United States and from South America. The skeletal material in question is of the highest importance, not only because examples are few, but also because of its relation to the results which are now emerging from the study of the archæology of the area on scientific lines. The skulls belong to the second of the three phases in culture into which archæologists are differentiating the Indian civilisation of the south-western area of North America. These are, first, the earliest nomadic population, of which practically nothing is known, representing a late palæolithic stage; secondly, the basket-makers, representing the mesolithic culture; and, thirdly, the pueblo cliff-dwellers, a full neolithic phase, whom the Spaniards disturbed in their normal development. Of the two latter, the basket-makers were a dolichocephalic people with undeformed head, the pueblos a brachycephalic people who deformed artificially the back of the head. The two series of skulls under review belong to the basket-makers, and, apart from certain local variations, agree sufficiently in their ten characteristics here examined to warrant their being regarded as of the same race—a race which further comparison with other skeletal material reveals as a common south-western type for which as an ethnical and cultural entity the name basket-maker is suggested provisionally. The significance of this conclusion is enhanced when it is shown that this type is sufficiently cognate to warrant inclusion with the Lagoa Santo group of South America, for which Dr. Rivet and others have suggested a kinship with Melanesia and Papua—a kinship for which Dr. Rivet has argued further on linguistic grounds.

A MAGDALENIAN SITE IN THE DORDOGNE.—Excavations in La Grotte Bâtie (Crozo-Bastido) at Saint-Sosy (Lot), on the right bank of the Dordogne, are described in *L'Anthropologie*, vol. 37, Nos. 5-6, by M. Armand Viré and l'Abbé Clement Teuliere, by whom the investigations were carried out. The cave or rock shelter is situated 10 metres above a path which runs precariously along a cornice on the cliff face at an altitude of 135 metres, the height of the Dordogne at this point being 105 metres. A low wall of unknown purpose has at some time been erected at the entrance. Hence the name. The remains here described were found in the lowest of four strata, which at the centre of the cave reached a minimum depth of 1·50 metres. They include teeth and bones of reindeer which had been used as food, and a number of objects made from the antler, including a series of harpoons, mostly fragmentary or incomplete, one of them, fairly flat, resembling an Azilian type without hole. A number of bone needles were found, of which six had eyes. There were also a few piercers, but none intact. Several engravings on bone were found, of which the finest was a well-engraved horse's head showing part of the neck and chest. A shaped object with an eye on each side may be a fish or serpent. The stone implements were exclusively of flint, of varied coloration, but only rarely patinated. Scrapers and burins predominated, with scraper-burins and flakes *à dos abattu* of all sizes. One implement in particular is interesting in its resemblance to Aurignacian or early Solutrean forms. The evidence of the remains in general, but especially the harpoons, points to an Upper Magdalenian date.

OCEANIC ANGLER-FISHES.—The British Museum (Natural History) has added to its collection of post-cards two sets, each of five cards, representing some of the oceanic angler fish, mostly collected by Dr. John Schmidt, and described by Mr. C. Tate Regan (Series 1 and 2, Set M3 and M4). These are printed from beautiful drawings made by W. P. C. Tenison and are extremely interesting. The first series depicts some of the remarkable free-swimming forms, all of which are females, the males, illustrated in the second series, being parasitic on the females. These oceanic anglers are some of the most wonderful of all fishes, having the first ray of the dorsal fin modified into a lure. They live near the bottom in the deep sea where there is little or no light, the body being a uniform black colour and the lure luminous to attract the fishes on which they feed. Most of them are quite small, the female of the Atlantic *Melanocetus Johnsoni* being only 3 in. long, but it is so extremely voracious that it is sometimes found extended with fishes many times its own size. *Photocorynus spiniceps* is 2½ in. long, the male, attached to the top of its head above the right eye, being only ⅛ in. On the other hand, we have *Ceratias holboelli* trawled off Iceland, 42 in. long, the two males attached to the abdomen being a little more than 3 in. The ceratioids are unique amongst vertebrates in having the dwarf males, which actually fuse with the skin of the females, and are unlike all other animals in having the male nourished by the female's blood system.

THE POLAR FILAMENT OF THE SPORE OF NOSEMA.—K. Ohshima (*Annot. Zool. Jap.*, vol. 11, No. 3, 1927) has investigated the polar filament of the spore of *Nosema bombycis*. The extrusion of the filament was brought about by placing the spore in hydrogen peroxide solution, but the action was too rapid to permit determination of the method of extrusion, *i.e.* whether by eversion of the filament (as in the case of nematocysts) or by shooting out the filament from the extremity of the spore. The addition of 5 per cent. to 10 per cent. salt solution decreased the rate of extrusion, and the author was able to observe that the contents of the filament issue from its tip as soon as extrusion is accomplished and form a spherical droplet 3μ to 6μ in diameter. The substance of the droplet is colloidal and strongly adhesive, so that it fixes the spore to the slide. The filament is a long, fine tube of even diameter, and the author concludes that its extrusion is not due to a process of eversion. Spores examined in the digestive fluid from silkworms discharged their viscous contents from their respective filaments. The viscous material no doubt serves to fix the filament to the digestive epithelium. The digestive fluid was found to dissolve the filament in from two to five seconds. A further account is promised of the nature of the enzyme in the digestive fluid and of the nature of the proventricular fluid of the silkworm moth which causes extrusion of the polar filament but does not dissolve it. The author suggests that the viscous material discharged from the spore weakens the digestive epithelial cells and produces a condition more favourable for infection.

A NEW PARASITIC GASTROPOD.—S. Hirase describes (*Annot. Zool. Jap.*, vol. 11, No. 2, 1927) a new parasitic gastropod—*Sacculus okai*, n. g., n. sp., found in

colonies imbedded in gall-like swellings of the test of tunicates in the north-western Pacific. 19 examples were found in one swelling in *Ascidia prunum* and 11 in *Boltenia ovifera*. Each of the gastropods is globular in form and about 3 mm. long and 2 mm. broad, and lies free in the lumen which communicates with the exterior by a small slit-like opening in the test. A brief account of the anatomy of Sacculus is given and the genus is placed in the Tænioglossa, though the presence of a well-developed proboscis and a bipectinate osphradium distinguish it from the other members of the sub-order. The radula is not reduced, and there is a monopectinate ctenidium with a well-developed osphradium.

NEW VARIETIES OF HOPS.—A large number of new varieties of hops have recently been raised in the Experimental Hop Garden at Wye College, and established at the East Malling Research Station. Some of the recent work, which was carried out under the auspices of the Institute of Brewing Research Scheme, is summarised by Prof. E. S. Salmon in the *Journal of the Institute of Brewing*, **33**, 488; 1927. The 112 varieties tested included new and commercial types, of which 74 cropped at the rate of at least 20 cwt. to the acre, whilst one of the former yielded 32¾ cwt. to the acre. Although in all the early, mid-season, and late classes certain new varieties had higher preservative properties than any of the commercial varieties tested, the panel of experts which judged the hops favoured certain of the latter in preference to any of the former. Comparison with the results of previous seasons, however, have shown that one new mid-season variety is gradually being regarded more favourably by the judges, and as it has high preservative properties, hopes are expressed that it will ultimately prove of value. Excellent results have been obtained in brewing trials with certain of the new varieties which have been under observation for from five to nine years. The paper also contains the scheme of manuring employed, together with notes on the diseases of the hop (cf. NATURE, **117**, 67; 1926).

SEASONAL CHANGES IN CONIFER LEAVES.—Several observers have recorded the disappearance of starch and the increase of sugars in leaves of evergreens during the winter season. The special interest of these changes lies in the possible protective action against frost. By increasing sugar concentration by 'feeding,' Lidforss succeeded in rendering glass-house plants resistant to a temperature of − 7° C., and claims that sugar prevents the precipitation of the proteins on freezing. He explains the well-known phenomenon of death from frost in spring of the leaves on the sun side of trees such as Abies, as due to earlier regeneration of starch, and the resulting lessening of the sugar content on the sun side. Prof. J. Doyle and Miss Phyllis Clinch have now taken the problem further and published (*Proc. Royal Irish Acad.*, vol. 37, B, No. 26) the results of some investigations on seasonal changes in conifer leaves with reference to enzymes and starch formation. Their observations on the autumnal disappearance and spring regeneration of starch lead them to conclude that these phenomena cannot be related to assimilation or environment changes, and that the starch-sugar equilibrium is determined in winter by protoplasmic change. They take exception to the claim of Chapman (see *Biochem. Jour.*, vol. 18, No. 6, p. 1388) that three enzymes at least—amylase, dextrinase, and maltase—must be present before starch formation can go on, and consider his experimental data insufficient to support his conclusions. Maltase seems absent from *Tsuga Albertiana*, which also lacks dextrinase and probably amylase in winter. Maltase seems also to be absent from *Pinus parviflora* in winter. The presence of amylase in winter is also doubtful in *Pinus larizio*. Yet in all these cases starch can be formed either naturally in summer or by artificially increasing the sugar concentration in winter.

TIME OF APPLICATION OF SPRAYS FOR FRUIT TREES.—Modern work on the control of pests and diseases of fruit trees lays emphasis on the importance of applying the spray fluids at a particular stage in the plant's development. A recommendation for 'spring' or 'winter' treatment is no longer considered a close enough definition. H. R. Briton-Jones and A. H. Lees, realising the inadequacy of verbal instructions for describing the necessary stages, have published a paper (*Jour. Min. Agric.*, **34**, p. 814) with numerous photographs of various types of commonly grown fruit trees in the condition when spraying will be most effective. The successive stages illustrated are roughly classified as dormant, swelling, bursting, green-flower, and pre-flowering respectively. Information concerning the various pests which may be successfully dealt with at the various stages depicted, and the most suitable type of spray for use in each case is given, and cautions are included where treatment at any stage may be useless or dangerous. Such work in achieving better standardised methods must ensure a greater degree of reliability in the employment of spray fluids, and consequently extend their use to the benefit of fruit growers.

MOVEMENTS OF THE NORTHUMBRIAN FAULT BLOCK.—The tectonic conceptions of Argand have been applied with conspicuous success to the structures of the Northumbrian fault block by Mr. H. C. Versey (*Proc. Yorkshire Geol. Soc.*, pp. 1-16, 1927). He considers the block to be a fractured *pli de fond* of Hercynian orogeny. The effect of the uplift was to develop a saddle-shaped structure in the rigid substratum, as a result of which the thin covering of carboniferous rocks was folded into small *plis de couverture*. The most northerly of these folds trends to the north-east across Teesdale and Weardale, and appears to be related genetically to the thickening of the Whin Sill. The latter is thus regarded by Mr. Versey as being locally phacolithic in its mode of emplacement. The fault block acted as a horst to the folds produced in the deposits of the Pendle trough to the south. Thus various types of virgations are exemplified in the fold-lines between the rigid areas of the Northumbrian and Midland blocks. The tectonic interpretation of the region is thought to be in good accord with the characters of the Permian rocks east and west of the block, but it should be pointed out that totally different views have recently been expressed by Mr. J. S. Turner (*Proc. Geol. Assoc.*, pp. 339-374, 1927). Both writers appeal to the composition and distribution of the Brockrams in support of their respective readings. Prof. Holmes's discovery of a pebble of Whin Sill rock in the upper Brockram near Appleby, recorded briefly in Gilligan's "Geology of Appleby," is, however, strongly in favour of the validity of Mr. Versey's conclusions.

MAGNETIC DETECTION OF MINERALS.—The economic applications of geophysical science are rapidly growing in importance, and recently led to the publication, for a time, of a *Zeitschrift für angewandte Geophysik*. An interesting account of magnetic methods of investigation of underlying minerals is contained in a lecture by Dr. L. Palazzo, published in the *Memoria d. Pont. Accad. d. Scienze—I nuovi Lincei*, Ser. 2, vol. 10, pp. 271-308, 1927. The various instruments

devised for such purposes are described and illustrated, with their mode of employment. A brief account is given of the theory of local magnetic disturbance by magnetic masses below ground, and various researches on actual disturbed regions, at Kursk in Siberia, and in certain parts of Italy, are described.

THE STEREOSCOPE IN AIR SURVEY.—The need for the use of the stereoscope in plotting surveys from air photographs is now recognised and makes the publication of a simple explanation of the process most opportune. "The Stereoscopic Examination of Air Photographs," by Lieut. M. Hotine, forms No. 4 of the Professional Papers of the Air Survey Committee (London: H.M. Stationery Office. 3*s.* 6*d.*). This small volume begins with an explanation of the principles underlying stereoscopic measurement, and goes on to explain machine plotting and to describe the topographical stereoscope. A final chapter on stereoscopic training and testing should also prove valuable.

ELECTRICAL RESISTANCE MEASUREMENTS.—When an electromotive force E applied to a circuit drives a current I through it and I is proportional to R, so that in the equation $E = RI$, the resistance R of the circuit is a constant, the quotients E/I and dE/dI have the same value R, while if R is not a constant but varies with I, the second quotient has the value $R + I(dR/dI)$, and has generally been called the 'differential resistance' of the circuit. In the December issue of the *Journal of the Franklin Institute*, Mr. H. Nakamoura, of the Research Laboratory of the Tokyo Electric Company, shows that some of the methods of measurement of resistance in common use determine the ordinary resistance and some the differential resistance.

THE CRITICAL POTENTIALS OF TUNGSTEN.—The erratic records usually obtained of the secondary emission of electrons from metals bombarded by cathode rays have been shown by H. E. Krefft to be connected with the presence of adsorbed films of gas. His experiments, which are described in the *Annalen der Physik* (vol. 84, p. 639), were made with a tube built entirely of metal and glass, in which a vacuum of 10^{-8} mm. mercury could be maintained, containing a tungsten target which could be heated to 1500° C. by radiation from an auxiliary filament. At the higher temperatures the breaks in the secondary emission curves were reproducible, and ratios of the secondary current to the primary current were obtained which were consistent to less than one per cent., under favourable conditions. At lower temperatures, and in general when gas was known to be present, new breaks appeared; and finally, when the gas-content became relatively large, the curves were smooth. The main critical potentials agree well with those found by Prof. O. W. Richardson and Dr. Chalklin from the study of soft X-rays, but one persistent break at about 16 volts has had to be attributed to ionisation of molecular oxygen, from which it appears impossible to free the metal, even above 1000° C.

A POLARISATION COLOUR SCHEME.—A useful miniature booklet for the waistcoat pocket has been issued by Messrs. James Swift and Son, Ltd., entitled "Polarisation Colour Scale." The contents have been drawn up as an aid to mineralogists by Drs. W. R. Jones and A. Brammall. On the inside of the cardboard cover is given a table of the birefringencies of seventy-eight mineral crystals, and two polarisation colour scales (in colour, a very good attempt at reproduction of the natural colours), one for crossed Nicols and the other for parallel Nicols, each for the first four orders of spectra. In the four little pages of text, explanations are given of the practical meaning of birefringence and of the numerical scale-values attached to the colours, and instructions are detailed for using the scale to determine the thickness of rock-sections and the birefringence of mineral crystals, either in rock-sections or in mounted grains. The method recommended for finding the thickness of a rock-slice is, first, to select some familiar colourless mineral of low birefringence, such as quartz (birefringence 0·009), represented in the slice by numerous sections; then, to evaluate in $\mu\mu$ the highest interference colour given by these sections, by reference to the scale; for thickness = (interference colour value)/(birefringence × 1000). The thickness thus given (in microns) can then be used to determine the birefringence of an unknown mineral; for the birefringence = (interference colour value)/(thickness × 1000). If the mineral be itself a naturally coloured one, allowance must obviously be made for the modification this causes in the polarisation colours.

MOLECULAR STRUCTURE IN SOLUTION.—Various physical properties of solutions of cobalt chloride with increasing hydrochloric acid content and of hydrochloric acid alone have been determined by O. R. Howell in an attempt to investigate the change of state of the cobalt atom with increasing concentration of acid. The November number of the *Journal of the Chemical Society* contains conductivity values for such solutions, and the conclusions drawn from these results are in agreement with those obtained from previous work on other properties. As acid is added to a cobalt chloride solution, the red colour changes to blue, owing to the cobalt atom being forced out of association with six molecules of water, $Co(H_2O)_6$, in order to unite with four atoms of chlorine, $CoCl_4''$. Hill and Howell, in 1924, showed that in blue compounds the cobalt atom is surrounded by four other atoms or groups, whereas when it is surrounded by six atoms the compound is red. Howell points out that these facts can be utilised to predict, to a certain extent, the crystal structure not only of compounds containing cobalt but also of those in which a metallic atom can be replaced by cobalt. Several predictions made in this way (for example, with zinc and magnesium orthosilicates) have been verified by determination of the crystal structure.

IONISATION AND CHEMICAL CHANGE DURING SLOW COMBUSTION.—The work of Dixon and others has shown that before the main combustion of a gaseous mixture occurs, there is an induction period during which slow combustion proceeds. Bennett and Mardles, in the *Journal of the Chemical Society* for December, have attempted to investigate the nature of the changes occurring during this period. They found that in the case of a system containing liquid drops (*e.g.* *n*-hexane and air) more ionisation took place and a considerably lower temperature was required for spontaneous ignition than with the corresponding vapour mixture. It is questionable whether ionisation accompanies all gaseous reactions, but ionisation was detected with various systems, although it did not occur below the temperature of initial oxidation. During the period of slow combustion, the main changes appear to be due to thermionic emission followed by the formation of centres of chemical change around the liberated ions. The presence of various 'antiknocks' (*e.g.* lead tetraethyl, iron carbonyl) causes a decrease in electron emission and in the initial chemical change, thereby delaying spontaneous ignition and also lowering the temperature at which slow combustion begins.

Insulin and Carbohydrate Metabolism.

ALTHOUGH the main outline of the action of insulin on the metabolism of carbohydrate is now fairly clear, the actual details of the chemical transformations occurring in the synthesis and combustion of sugar in the body are still only known in part. The view that insulin transforms glucose into some reactive form, although still maintained by some investigators, has not been confirmed by others. Either there is a failure to find any change in the rotation of the glucose under the influence of muscle tissue and insulin (A. B. Anderson and A. Carruthers, *Biochem. Jour.*, vol. 20, p. 556; 1926), or discrepancies between the polarimetric and copper reduction values of the extracts examined are considered to be explicable rather on the basis of the presence of other optically active or reducing substances in addition to the glucose (H. F. Holden, *ibid.*, p. 263, and G. S. Lund and C. G. L. Wolf, *ibid.*, p. 259). Anderson and Carruthers have also found that the polarimetric value of dialysates or extracts of blood varies according to the reaction of the solution at the time of estimation.

It appears certain that phosphorus plays an essential part in the utilisation of glucose; and the formation of a hexosephosphate may be regarded as an essential link in the chain, probably both to synthesis and degradation. An exception, however, appears to be provided by blood, the corpuscles of which break down, *in vitro*, glucose into lactic acid, without the intervention of the phosphorus molecule (J. T. Irving, *ibid.*, p. 1320). The reduction in the blood-sugar under the action of insulin is always accompanied by a parallel reduction in the inorganic phosphorus, which, however, is later excreted from the body, any hexosephosphate formed not being stored but rapidly broken down again.

The development of convulsions when the blood-sugar has fallen to a low level, and their abolition by the administration of glucose, has provided a useful means of investigating further the details of carbohydrate metabolism by observing what compounds have the same favourable effect as glucose. The convulsions appear to be caused by disturbances in equilibrium, the symptoms being similar to those observed after unilateral labyrinth extirpation or other lesion to the vestibular apparatus (W. Russell Brain, *Quart. Jour. Exp. Physiol.*, vol. 16, p. 43; 1926). Thus the animal (rabbit) holds its head rotated to one side, and the whole body may be rotated on the pelvis. Later, rolling movements occur towards the side to which the head is rotated, sometimes also to the opposite side. On the other hand, the preliminary symptoms of apprehensiveness and shying at the movement of an observer suggest a heightened irritability of the whole of the central nervous system, which perhaps one might suggest to be correlated with the fall in the sugar of the blood.

The brain, and presumably also the rest of the nervous system, depends for its glucose upon that brought to it in the blood; although reducing substances are present in the brain tissue, they appear to consist chiefly of creatinine and pentoses (Barbara E. and E. G. Holmes, *Biochem. Jour.*, vol. 19, p. 492; 1925; and vol. 20, p. 595; 1926). These authors, in their investigations into the metabolism of the brain, have found that this tissue forms lactic acid from glucose in the absence of oxygen, and that the acid is removed if oxygen is afterwards admitted. Examination of rabbit's brains *post mortem* shows that they contain lactic acid, the amount of which does not increase on anaerobic incubation unless glucose is also present. From their series of experiments, the conclusion may be drawn that the amount of lactic acid found in the brain *post mortem* depends on the level of the blood-sugar at the time of death, and is roughly proportional to it: thus it is increased following the administration of an anæsthetic and decreased after an injection of insulin. It bears no relationship to the reducing substances in the brain, which, as we have seen, are not glucose, or apparently to the glycogen, which remains remarkably constant after a variety of experimental procedures, such as depancreatisation or the injection of a convulsive dose of insulin.

The formation of lactic acid from the blood glucose must be a highly active process, since it appears to be complete in the few minutes elapsing between death of the animal and removal and cooling of the brain: in the rabbit the amount found is of the order 0·1 gm. per cent. Insulin has no direct effect on the lactic acid metabolism of the brain, but influences it solely by producing hypoglycæmia: moreover, following depancreatisation, the brain can convert both blood and added glucose to lactic acid under anaerobic conditions and remove it again in the presence of oxygen, and to the same degree as a normal brain (*ibid.*, vol. 19, p. 492; 1925, and p. 836; vol. 20, p. 1196; 1926; and vol. 21, p. 412; 1927).

It appears, then, that insulin plays no part in the conversion of glucose to lactic acid and the subsequent removal of the latter in the brain as in skeletal muscle, but the work throws no light on why hypoglycæmia should produce convulsions: the lactic acid in the brain tissue itself is reduced when the blood-sugar falls, but, following the convulsions, the blood lactic acid increases, owing to the escape into the circulation of some of the acid set free during the violent muscular movements.

Since Herring, Irvine, and Macleod investigated the remedial effect of various sugars upon insulin convulsions (*Biochem. Jour.*, vol. 18, p. 1023; 1924), numerous other investigators have studied the same problem, using a variety of sugars or their possible metabolites in the hope of discovering some of the stages through which carbohydrates pass in their metabolism in the body. Recovery has been produced by the administration of glucal (Winter) and dihydroxyacetone (Kermack, Lambie and Slater, Laufberger, Hewitt and Reeves, Markowitz and Campbell, etc.), whilst the following compounds have been found to be inactive: glucosan and desoxyglucose (Winter), methyl glyoxal, lactic acid, glycerol, sodium citrate and pyruvate, and rhamnose (Lambie and co-workers), hexosedi- or mono-phosphate (Marks and Morgan), glyceric aldehyde (Hewitt and Reeves), and glucosone (Hynd) (L. B. Winter, *Biochem. Jour.*, vol. 20, p. 668; 1926; and vol. 21, p. 54; 1927; W. O. Kermack, C. G. Lambie, and R. H. Slater, *ibid.*, vol. 20, p. 486, and vol. 21, p. 40; Lambie and Frances A. Redhead, *ibid.*, vol. 21, p. 549; H. P. Marks and W. T. J. Morgan, *ibid.*, vol. 21, p. 530; V. Laufberger, *Publ. de la Faculté de Médecine*, Brno, Czechoslovakia, vol. 4, p. 1; 1926; J. A. Hewitt and H. G. Reeves, *Lancet*, vol. 2, p. 703; 1926; J. Markowitz and W. R. Campbell, *Am. J. Physiol.*, vol. 80, p. 548; 1927; A. Hynd, *Proc. Roy. Soc.*, vol. 101, B, p. 244; 1927).

Various points of interest emerge from this work. Glucal is presumably effective owing to the similarity of the molecule to that of glucose. More interest attaches to the place of dihydroxyacetone in carbohydrate metabolism. Laufberger has shown that its behaviour in the body is the same as that of glucose (*Pub. de la Faculté de Médecine*, Brno, Czechoslovakia,

vol. 2, p. 83; 1923–24), and Lambie and his co-workers have adduced evidence indicating that it acts by being directly oxidised and not by being converted into glucose first: in which case they suggest that the reaction which is facilitated in the organism by insulin, and fails to proceed satisfactorily in the diabetic, is the transformation of glucose into dihydroxyacetone. Thus they have found that in the decerebrate eviscerated preparation, the latter will not maintain the blood-glucose at a constant level when infused, nor does it accumulate in the blood, the inference being that it is immediately oxidised: in other experiments its administration has failed to give so marked a rise in the blood-sugar as that of glucose itself: it raises the respiratory quotient and increases the metabolism more quickly and to a greater extent than glucose: and the fall in the inorganic phosphate of the blood parallels the intensity of the metabolic change, so that it appears that dihydroxyacetone causes a more rapid formation of the phosphoric acid ester than glucose.

These authors suggest that the reactions which occur may be similar to those postulated, from theoretical considerations, by A. L. Raymond (*Proc. Nat. Acad. Sci.*, vol. 11, p. 622; 1925). Glucose reacts with phosphoric acid to form a hexosemonophosphoric ester, which then splits into a molecule of triose and one of triosephosphate: two molecules of the latter condense to form a hexose diphosphate, which is hydrolysed back to hexose and inorganic phosphate. The triose may be dihydroxyacetone itself or closely related to it. In a further discussion, Lambie points out that lævulose, like dihydroxyacetone, is both more easily oxidised and a better glycogen former than glucose, yet only glucose can be obtained from glycogen on hydrolysis: it is therefore possible that dihydroxyacetone may be a common intermediary between lævulose and glucose and glycogen. Lævulose, however, does not cause recovery from insulin hypoglycæmia so readily as glucose or dihydroxyacetone: possibly it may be converted into the latter without the aid of insulin, being more closely related to it than glucose. In insulin hypoglycæmia, however, the conversion of glucose into dihydroxyacetone under the influence of the excess of insulin might be even more rapid than the transformation of lævulose, so that glucose would be more effective in causing recovery than the latter.

This hypothesis of the mechanism of action of insulin and of the rôle of dihydroxyacetone in metabolism has, however, been controverted by Markovitz and Campbell, who maintain that this compound is not a normal metabolite of glucose, but must be converted into the latter by the liver before the body can make use of it, and adduce experimental evidence in support of this view. The ultimate decision between these two views must be withheld until further work, which will be awaited with interest, has been carried out on the rôle of dihydroxyacetone in carbohydrate metabolism.

In conclusion, attention may be directed to some interesting observations which may possibly lead to a satisfactory explanation of the cause of insulin convulsions. Mention has been made of the fact that methylglyoxal cannot produce recovery from them: Lambie and his co-workers have also noticed that after an injection of this compound, glucose or dihydroxyacetone may also be ineffective: in other words, methylglyoxal appears to exert some toxic action on the animal. Hynd has gone even further, and observed that an injection of glucosone (a body closely related to glucose from which methylglyoxal might possibly be derived) produces a condition similar to insulin hypoglycæmia, which, however, differs from the latter in that glucose cannot bring about recovery. He suggests that insulin may cause the production of glucosone from glucose in the body.

These observations suggest that the convulsions are caused by some intermediary metabolite in the combustion of glucose: it appears reasonable to suppose that this compound is always being formed in small quantities in the body, but is immediately further broken down. Following an injection of insulin, the amount produced is considerably increased and the oxidising mechanism fails to keep pace with this increased production, so that the compound set free in the body is enabled to exert its toxic effects. In this connexion the work of Dakin and Dudley may be recalled: they found that most tissues contained an enzyme, glyoxalase, which was capable of converting methylglyoxal into lactic acid. However, the relationship between the curative effect of an injection of glucose or dihydroxyacetone upon insulin convulsions, and the possible presence of glucosone or methylglyoxal in excess as their direct cause, appears to require further investigation before one of the different hypotheses outlined above can be considered definitely established.

Marine Biology in Ceylonese Waters.

DETAILS of the marine biological research carried out by the Ceylon Government are contained in the Administration Report of the Government Marine Biologist for 1926. (Part 4: Education, Science, and Art (F), by Dr. Joseph Pearson. Pp. F29. Colombo: Government Record Office. 65 cents.) In this report there is an account by Mr. A. H. Malpas, the assistant marine biologist, on the present state of the pearl oyster, the window-pane oyster, and the chank (a gastropod, *Turbinella pyrum*, Linn.) fisheries. It would appear that there is no likelihood of a large pearl oyster fishery for at least four years, whereas an experimental fishery on the lines advocated by Dr. J. Pearson, the marine biologist, may be held in 1928. The essence of the new system is the elimination of the sale of oysters to the public, by which means all the pearls would come into the hands of the Government.

The window-pane oyster fishery at Lake Tamblegam in 1926 was very successful. Although the Government received a revenue of only Rs.18,000.0 for two million oysters, it is stated that the lessee's returns from the fishery were between one and two lakhs of rupees, but the sum was more probably nearer Rs.50,000.0. There is a curious anomaly in the control of the chank fishery in the Palk Strait. On the Indian side the fishery is under the control of the Madras Fisheries Department, and hence the Government made a net profit of Rs.46,367.0.0 in 1922–23 on 466,540 chanks. On the Ceylon side chank fishing is open to all comers, and the only revenue that accrues to Government is that derived from the export duty. In 1923, the Ceylon Government made a profit of Rs.12,065.0 on 2,419,786 chanks. From these figures it is clear that although the Ceylon chank fishery is about five times as large as the Madras fishery, yet its value as a Ceylon Government asset is almost negligible.

A considerable amount of fisheries research has been carried out by Mr. A. H. Malpas and Mr. M. Gomez. It is very gratifying to note that, as a direct outcome of the trawling experiments carried out by the Government Marine Biology Department, a company has been registered in Colombo to modernise

the local fishing industry. There is every hope that this new enterprise for commercial exploitation of Ceylon waters will be successful. The part of the report that should interest every Ceylonese is that entitled 'Miscellaneous.' Under this heading, the author states that a sum of Rs.8,048,297.0 was collected in 1925 as import duty on dried fish goods. Hence any step that could be taken towards the organisation or the development of local curing should be encouraged. Towards this aim some useful experiments have been carried out, and so far with great success.

Work on fresh-water fishes has been mainly carried out by Mr. P. E. P. Deraniyagala, the second assistant marine biologist. He has commenced on an atlas of fresh-water fishes of Ceylon, which it is hoped will be useful to both laymen and naturalists. In addition to this he records that a fish, *Lutianus rivulatus*, locally known as *Baddau*, has an inshore migration lasting for a few weeks in May, and suggests that it spawns in deep water far from land.

The marine superintendent, Lieutenant-Commander E. L. Pawsey, is making some useful investigations to locate the exact position of the pearl banks, beacons, etc., as the existing charts are found to be almost useless.

The Marine Biology Department of the Ceylon Government should be congratulated on the amount of useful work it is carrying out towards the development of the resources of the country.

University and Educational Intelligence.

OXFORD.—The honorary degree of Master of Arts has been conferred on Mrs. Florence Joy Weldon, widow of the late Dr. W. F. R. Weldon, professor of zoology, who had recently received the thanks of the University for her gifts of pictures.

Owing to need for further space in Dr. Lee's department of inorganic chemistry required by workers engaged on research in physical chemistry, a special research room is to be added at a cost not exceeding £2800 from the Government grant.

Preparations are being made for an expedition this year to the south-west coast of Greenland under the leadership of Dr. T. G. Longstaff, and a grant of £50 has been voted thereto by Congregation. The main purpose will be the study of the ecology of the Arctic fauna and flora in that region. Similar expeditions were undertaken by members of the University in 1921 to Spitsbergen, and in 1923 and 1924.

MR. F. G. TRYHORN, lecturer in physical chemistry in the University of Sheffield, has been appointed professor of chemistry in University College, Hull.

DR. R. K. BUTCHART, lecturer in mathematics in the University of St. Andrews (University College, Dundee), has been appointed to the chair of mathematics at Raffles College, Singapore.

THE trustees of the Mary Ewart fund are offering a travelling scholarship, value £200, for one year, to past and present students of Somerville College, Oxford. Particulars may be obtained from Mrs. T. H. Green, 56 Woodstock Road, Oxford.

APPLICATIONS for the Government Grant for scientific investigations, in connexion with the Royal Society, must be received on a prescribed form by the Clerk to the Government Grant Committee, Royal Society, Burlington House, W.1, by, at latest, Mar. 31.

AN examination for the following scholarships offered by the Household and Social Science Department of King's College for Women, Campden Hill Road, W.8, will be held on May 10: the "Carl Meyer," value £80, and tenable for three years; the "Minor College," value £40, and tenable for three years. Particulars may be obtained from the Secretary of the College.

EXAMINATIONS for the award of Tate and Morgan scholarships in engineering, science, domestic science, hygiene, and art, at Battersea Polytechnic for the session 1928–29, will be held on Tuesday, June 12, and succeeding days. The scholarships vary in value from £20 to £30 per annum with free tuition, and are tenable for two or three years. The latest day of entry is April 21.

AN excursion for geographers and other workers in open-air sciences, starting on July 27, is being arranged for field-work in southern Spain and in the Rif. The party will stay first at Algeciras, and then at Tangier. An attempt will be made at comparative regional surveys of the northern and southern boundary areas of the Straits of Gibraltar. Particulars may be obtained by sending a 2d. stamp to Mr. Valentine Davis, Cheshire County Training College, Crewe.

THE Ella Sachs Platz Foundation for the Advancement of Scientific Investigation is inviting applications for grants in aid of research. Preference is given to research in medicine and surgery or branches of science bearing on these subjects, and particularly to work on any single problem. In previous years, the general subject of chronic nephritis has received support, and, in a lesser degree, internal secretion and injection. Last year, twenty-four grants were made, seventeen of them being to workers outside the United States. Applications must reach Dr. Joseph C. Aub, Massachusetts General Hospital, Boston 14, Massachusetts, before May 15.

"THE Quality of the Educational Process" is the title of a comparative study of education in the United States, England, France, and Germany, undertaken by Dr. W. S. Learned for the Carnegie Foundation for the Advancement of Teaching and published in the Foundation's recent annual report. Dr. Learned is concerned to reveal the defects in his own country's systems and to show how they may be remedied by applying the lessons of the hard-won experience of European nations. In three important respects he finds the European systems superior to the American. The general foundation is laid compactly in a single sequence including nearly the entire adolescent period and, as a consequence of this thorough preparation, the student's general education continues inevitably after he has embarked on his more advanced and vocational studies. Secondly, the principle of continuity in the main threads of the educational material is respected, long periods of work being adjusted to clearly defined aims, the material being constantly revised from advancing points of view, and the student's attention being kept fixed upon the quality of his thinking rather than on merely getting through set tasks. Thirdly, the final, usually external, examination at the end of each considerable stretch of work invigorates the whole process, constituting not merely a satisfactory test of intellectual power but also an indispensable instrument wherewith to develop it. With these three merits—compact foundation, continuity of subject matter, and judicious use of examinations—are contrasted the corresponding defects of the American system. Specially noteworthy is the praise bestowed on the place assigned in Europe to examinations. This paper, and a previous paper by the same author on secondary education in the United States and in Europe, are published separately as *Bulletin* No. 20 of the Foundation.

Calendar of Customs and Festivals.

February 20.

COLLOP MONDAY : also, sometimes, Shrove Monday. The period of merrymaking and feasting before Shrove Tuesday and the beginning of Lent known as Shrove Tide or Carnival, as the latter name is intended to suggest, bade farewell to meat before the entry upon the Lenten or spring fast. In the north of England this survived in the custom of eating collops (slices of bacon or salted meat) with eggs as one of the dishes at dinner on the Monday before Ash Wednesday.

February 21.

SHROVE TUESDAY. The day for the confession of sins or shriving, also the day on which the merry-making of carnival culminates. In England Shrove Tuesday was a holiday and occasion of merrymaking both before and after the Reformation. The summons to confession was by the ringing of a bell, which continued to be rung after the Reformation but was known as the Pancake Bell. In England the eating of pancakes and the tossing of the pancake in Westminster School are now practically the only survival of the Shrove Tuesday feast and its ritual.

As a holiday Shrove Tuesday was especially associated with the freedom of the apprentices and workers, who jealously guarded their privileges of "doing what they list." They also joined in the customary activity in searching out and carting women of ill fame and their male companions at this time. The licence permitted to the 'prentices may be compared with the privileges allowed school children in some parts of Scotland on this day, which are similar to those permitted at Candlemas. At Bromfield, in Cumberland, the scholars of the Free School used to bar out the schoolmaster for three days. The articles of capitulation specified the times of study and play in the coming year, and stipulated the immediate playing of certain games—a cock-fight and a football match.

Cock-fighting, one of the most popular of the amusements of Shrove Tuesday in England, was also practised in Scotland, especially by schoolboys. Cock-throwing or baiting (sometimes hen baiting) was also widely practised, when sticks were thrown at a cock tethered to the ground. Sometimes two metal cocks were used in a game in which missiles of lead were thrown at the cocks by opponents, each standing behind his own bird. Cock-throwing has been explained as an expression of the hostility of Saxon and Dane, or of our enmity with the French, but the cock is almost certainly a substitute for a human victim.

In Wales such hens as did not lay eggs before Shrove Tuesday were thrashed by a man with a flail, who received for his pains any hen which he killed.

Football was an important feature of the Shrovetide observance, and in nearly every town or village the streets were the scene of a vigorous and sometimes violent game. The contest was usually between two wards of the same town, or two towns or villages. In so far as it was a ritual observance, judged by analogy, it represents the struggle between winter and spring.

At Ludlow the contest took the form of a tug-of-war, attended by the Mayor and corporation. In other localities, matches at battledore and shuttlecock, especially between men and women, were played.

A curious and significant custom is recorded in the *Gentleman's Magazine* in February 1779. The writer saw in a Kentish village a figure called a Holly Boy being burnt by boys. This had been made by the girls but stolen from them. In another part of the village the girls were burning an Ivy Girl which they had stolen from the boys. The representation of the two sexes warrants the inference that the figures originally represented the male and female principle in Nature. Similar male and female figures appear in the processions which are found on the Continent at this and other times of the year. Sir James Frazer gives a number of instances. In the case of the processions on or about Shrove Tuesday, the significant feature is that the human figure, which is the central object of the celebration, is either torn to pieces or burnt. Sometimes in the latter case the fertility of the crops in the coming season is prognosticated by the height of the flames. In this custom of 'burying the Carnival,' it may be taken that the lay figure is the surrogate of a human victim who represented the god of vegetation. Similarly, the *bœuf gras* of the *Mardi Gras* celebrations in France is the spirit of fertility in flocks and herds.

In Roman Catholic countries the celebration of Carnival has generally survived with greater vigour than in the Protestant. Certain features are crucial. It is a period of freedom or licence. Disguise is worn which, like the skins worn by those who took part in the Lupercalia, may be either a protection against evil spirits, or an attempt at assimilation to the deity. Finally, there is usually some personification, human or animal, around which the festival centres.

February 22.

ASH WEDNEDSAY. PULVER WEDNESDAY (*Dies Pulveris*). The opening day of the Lenten fast takes its name from the custom of marking each member of the congregation in church with the cross in ashes which have been blest by the priest. The ashes should be those of the palms used on Palm Sunday in the previous year. There is a reference to the practice in Anglo-Saxon times, but it was abandoned in England at the Reformation.

It is said that originally Lent did not begin until the following Sunday, but that Ash Wednesday and the succeeding days were incorporated in the observance to equalise it with the forty days' fast of Our Lord. It is, at least, true that after the solemn service of the day was over, the remainder was given up to merrymaking similar to that of Shrove Tuesday. Sometimes and in some places this included the procession, in which a figure was carried and afterwards destroyed. One such is recorded from Marseilles. Similarly, in England, Jack-a-Lent, a lay figure made from an old suit of clothes stuffed with straw, was carried in procession, pelted with sticks, and afterwards pulled to pieces.

In Germany it is said—the exact locality is not recorded—that the youths dragged the maidens, accompanied by a fiddler, in a cart until they reached some lake or river 'and there wash them favouredly.' Similarly, in England the Fool Plough, which formed part of the Ash Wednesday observances, and was drawn by youths while the girls sat on it, also ended its course in a pond—a piece of horse-play which had degenerated from a rain or fertility charm.

As usual on such occasions, children begged from door to door with an appropriate song, the custom being known as 'clacking,' from the fact that they carried pieces of wood which they clacked before the door, hoping to receive pieces of bacon for a feast. If they failed they stopped the keyhole with mud. It is also recorded that in the evening boys used to run along carrying firebrands and torches. In Dijon on the first Sunday in Lent, known as Firebrand Sunday, large bonfires were lit in the streets, a custom derived, it is said, from the practice of carrying lighted torches of straw to drive away 'badder' from the earth—in other words, evil spirits.

Societies and Academies.

LONDON.

Royal Society, Feb. 9.—O. W. Richardson: On the extraction of electrons from cold conductors in intense electric fields. The attraction of an electron by its mirror image in a conductor is treated as a Schrödinger wave problem. The sharpness of the photo-electric effect at a metal surface is accounted for. A formula is obtained for the field currents from cold conductors, which agrees well with the experimental data. The result implies that electrons are being generated at a rate proportional to $(\psi\bar{\psi})^{\frac{3}{2}}$.

R. H. Fowler: The restored electron theory of metals and thermionic formulæ. This note amplifies the recent work of Sommerfeld on the electronic theory of metals by applying his ideas to thermionic phenomena. The equilibrium state of an assembly consisting of a heated metal and an atmosphere of free electrons is calculated. It appears that the vapour pressure has twice the commonly accepted value owing to the two orientations of each electron. This result is then applied to the theory of thermionic emission, and gives values in excellent agreement with the best observations.

R. H. Fowler: The photo-electric threshold frequency and the thermionic work function. The old equation for the saturation current required assumptions for which there is no justification. Sommerfeld's theory of metals leads quite simply to the existence of a sharp photo-electric threshold frequency ν_0, and to the equality of this $h\nu_0$ with the thermionic work function χ. These points have been recently considered by O. W. Richardson, but in a more elaborate manner which appears capable of simplification.

P. A. M. Dirac: The quantum theory of the electron. In order to make the quantum theory, when applied to atomic structure, agree with observation, one has had to assign to each electron a spin and a magnetic moment. This is not necessary; agreement with observation can be obtained without arbitrary assumptions by a correct relativistic application of the general quantum theory to a point-charge electron. The Hamiltonian function on which the present theory is based is linear in the energy and momentum. The spinning electron model, applied in the previous non-relativistic way, is justifiable for many purposes. The motion of an electron in a central field of force is worked out, and the energy levels obtained are shown to be the same as those given by the model in the first approximation for a Coulomb law of force.

H. T. Flint and O. W. Richardson: On a minimum proper time, and its application to (1) the number of the chemical elements, (2) some uncertain relations. The existence of a minimum proper time h/m_0c^2 is deduced by a method which is independent of the assumptions about the metrics of space and time used previously. This leads to an upper limit $\left(\frac{n}{n+1}\right)^{\frac{1}{2}}c$, on the velocity of an electron in an atom in an orbit of total quantum number n. This involves an upper limit (97) on the atomic number of any chemical element and also an upper limit on the quantum number of an intranuclear orbit. This limit is a function of the atomic number of the nucleus.

H. Jeffreys: Some cases of instability of fluids. The problem of the instability in a liquid produced by heating below is rediscussed by a formally accurate method. Where the fluid is enclosed between two perfectly conducting solid boundaries, the honeycomb structure is not developed when the liquid is flowing, being replaced by a division into long strips. There is a formal analogy between this problem and G. I. Taylor's problem of the stability of liquid between two rotating cylinders. In atmospheric problems the earth's rotation will have a considerable effect in modifying the motions produced by excessive heating below; this will probably be in the direction of making the departures from the adiabatic gradient needed to cause instability greater than in the absence of rotation (though they will still be very small) and of confining the ascending currents to regions of smaller horizontal extent.

H. A. Wilson: The emission of light by flames containing sodium and the absorption of light by mercury vapour. It was shown by Gouy in 1879 that the intensity of the light from a sodium flame is proportional to the square root of the mass of sodium in the flame per square cm. of area, perpendicular to the direction of the light emitted. This result can be explained by assuming that the sodium atoms absorb and emit light like simple damped oscillators. The absorption of mercury resonance radiation by mercury vapour can be explained in the same way by assuming that the mercury atoms absorb the resonance radiation like simple damped oscillators.

C. N. Hinshelwood and H. W. Thompson: The kinetics of the combination of hydrogen and oxygen. An examination has been made by a static method of the combination of hydrogen and oxygen, at constant temperature and volume, from the region of purely catalytic surface reaction up as nearly as possible to the point of explosion. In the last fifty degrees of this range a reaction, approximately of the fourth order, comes into prominence; it is strongly autocatalysed by steam, and has a high temperature coefficient. The normal positive catalytic effect of the walls of the reaction chamber gives place to a negative effect, which may be due to the catalytic destruction of an autocatalyst for the main reaction, or the interruption of 'reaction-chains,' or to both causes. It is concluded that the reaction measured is the true gas reaction between hydrogen and oxygen.

E. T. Copson: On electrostatics in a gravitational field. Prof. Whittaker has recently discussed the effect, according to the general theory of relativity, of gravitation on electromagnetic phenomena. In particular, he has considered electrostatics in gravitational fields of two kinds, namely, those specified by the quasi-uniform metric and by Schwarzschild's metric. Algebraic expressions for the potential of an electron in these gravitational fields are now obtained by the use of Hadamard's theory of 'elementary solutions' of partial differential equations. The expression for the potential in the quasi-uniform field is the same as that obtained by Prof. Whittaker, who used entirely different methods.

W. R. Brode: The analysis of the absorption spectrum of cobalt chloride in concentrated hydrochloric acid. The principal absorption band, between 720 and 850 $\mu\mu$, consists of at least seven component bands. By different mathematical methods of analysis, the observed curve is resolved into seven similarly shaped components. There is a constant frequency difference between each of these components, and this frequency difference is the highest common factor of the frequencies of these component bands. There is apparently a definite relation between the odd and even numbered multiples or component bands and their relative intensities of absorption.

Society of Public Analysts, Jan. 11.—J. R. Nicholls: Determination of small quantities of benzoic acid and cinnamic acid, with some notes on the colorimetric determination of salicylic acid. The method of determining benzoic acid is based on its partial oxidation, in a constant proportion, to salicylic acid by means of hydrogen peroxide in the presence of ferric chloride,

and colorimetric determination of the salicylic acid under specified conditions. Cinnamic acid may be determined by first oxidising it quantitatively to benzoic acid.—**L. E. Campbell**: Report of the Preservatives Determination Committee of the Chemists of the Manufacturing Confectioners' Alliance and of the Food Manufacturers' Federation, on the determination of sulphur dioxide in foods. A normal procedure and an apparatus have been devised, and details of standard volumetric and gravimetric determinations are given, together with details of the treatment required in certain special cases, such as starch, gelatin, meats, dried fruits, etc.—**J. W. Black** and **B. J. W. Warren**: Notes on the effect of other reducing substances on the determination of SO_2. In some cases (*e.g.* glucose and gelatin) the interference of other reducing substances is negligible, but in others (nutmeg, mustard, ginger, etc.) it is considerable, and a time limit must therefore be set to the distillation period.—**H. R. Jensen**: (1) Rapid estimations of sulphites by alkaline liberation, or extraction, and titration. The sulphite content of certain products, such as glucose syrup and cornflour, may be satisfactorily determined by direct extraction followed by titration with iodine. (2) Barium sulphate losses in gravimetric estimations. Too low acid concentration favours adsorption of barium chloride; hence it is desirable to add the reagent in a very fine jet, and to have an excess to reduce the solubility of barium sulphate and the adsorption of alkaline sulphate.—**Osman Jones**: Determination of sulphur dioxide in sausages. On the addition of sulphite to sausages there is an immediate loss of sulphur dioxide, so that the amount found is invariably lower than that added. A method of vacuum distillation is described, which gives results agreeing well with those of the Committee's standard method.—**H. M. Mason** and **G. Walsh**: Note on the oxidation of sulphites by air. Carbon dioxide must be quite free from oxygen if used in a lengthy sulphite distillation. Removal of the adsorbed air from the foodstuff by the use of a vacuum before the heating will prevent oxidation losses, but good results are also obtained by extremely rapid heating and distillation.—**H. M. Mason**: Note on the titration of dilute sulphite solutions with standard iodine solutions. The low results obtained when sulphite solutions are titrated with iodine are due to oxidation and to the escape of sulphur dioxide set free by the hydriodic acid formed during the titration, the latter being responsible for 70 per cent. of the loss.—**A. W. Knapp** and **R. J. Phillips**: Determination of sulphur dioxide in fatty substances. In rancid fats free from sulphur dioxide, volumetric determinations show an apparent content of sulphur dioxide; hence only the gravimetric process should be used in such cases.

Royal Anthropological Institute, Jan. 17.—**R. Ruggles Gates**: A pedigree study of Amerindian crosses in Canada. Crosses between French and Indians began in Ontario about 1660. The present study concerns interrelated pedigrees extending through six generations from crosses involving Cree and Ojibway Indians on one hand and French, Scotch, and English on the other. Pedigrees and ancestry of many individuals of mixed blood were obtained, with photographs of persons having many different degrees of Indian blood. The inheritance of features was studied as well as eye-colour, skin colour, and hair characters. Individuals of three-sixteenths Indian ancestry were found having essentially blue eyes and at least one factor for skin pigmentation. It is concluded that the Indian probably has more than two factors for skin colour, and that certain of these factors are independent of certain factors for eye-colour. Independent segregation of genetic factors was found in several families. People with one-sixteenth Indian blood and distinct eye pigmentation showed the presence of an undilutable factor for skin colour. There is evidence that certain tribes probably have fewer factors for skin colour than others. This appears to be the first attempt to apply genetical pedigree methods to the study of the results of interracial crossing in man. There is abundant scope for the application of this method to anthropological crosses in many parts of the world.

Royal Meteorological Society, Jan. 18.—**Hugo Hergesell**: The observation of clouds, with special reference to the safety of aviation (*v.* NATURE, Jan. 28, p. 143).—**Sir Gilbert Walker**: World weather. Comparisons by graphical methods of variations of pressure, temperature, and rainfall have during the past half century brought to light a number of relationships between conditions at places separated by considerable distances; these have in recent years been studied systematically by taking 30 centres widely distributed over the earth and calculating by statistical methods the relationships between their seasonal values. It appears that there are three main oscillations or swayings: (1) the North Atlantic; (2) the North Pacific; and (3) the southern, affecting the Pacific and Indian Oceans. These relationships have obvious applications for seasonal forecasting.

Linnean Society, Jan. 19.—**C. V. B. Marquand**: The botanical collection made by Capt. F. Kingdon Ward in the Eastern Himalaya and Tibet in 1924–25. Capt. F. Kingdon Ward, travelling eastwards from Gyantse to Tsetang over unexplored ground, and crossing the Temo La to Tumbatse, entered the region in the neighbourhood of Lat. 29° 40′ N., Long. 95° E., where the most important part of the collection was made. A short distance east of Tumbatse a number of high passes over the eastern extremity of the Himalaya were traversed. On the highest of these passes, the Nam La, over a southern spur of the lofty Namcha Barwa at an altitude of 17,500 ft., a large number of alpines were collected. In Aug. 1924 an extensive collection was made around the Trasum Lake, and the Banda La, a pass over 18,800 ft., the most northerly point of the Expedition, was visited. Excluding the three genera Meconopsis, Rhododendron, and Primula, the collection comprises 446 species, including 54 new species as well as 26 new varieties. The genera most strongly represented, apart from the three above, are Saxifraga, Gentiana, and Pedicularis.—**F. W. Edwards**: Insect-collecting in the Southern Andes. The expedition described was a joint one arranged by the British Museum (Natural History) and the Bacteriological Institute of the National Department of Health of Argentina, its object being to make investigations regarding the mosquitoes and other bloodsucking flies of the Southern Andes, and to form a general collection of insects from the southern beech-forests. Two and a half months, October 1926 to January 1927, were devoted to collecting, most of the time being spent around Lake Nahuel Huapi, close to the western border of Argentina in latitude 41° S. From here the party worked their way across to the Chilean coast; the route taken was the regular one over the Perez Rosales Pass and across Lakes Nahuel Huapi, Frias, Todos los Santos, and Llanquihué, an ancient route which is now being increasingly used by tourists.

PARIS.

Academy of Sciences, Jan. 9.—**Pierre Termier**: The strata of the Aiguilles d'Arves between Lauteret

and Vallouise.—**Ch. Fabry**: A phenomenon which accompanies binocular vision when the two visual images are not combined into one.—**J. S. Townsend**: The theory of high-frequency currents through gases.—**B. Hostinsky**: The probabilities relative to repeated transformations.—**Hadamard**: Remarks on the preceding note.—**Julius Wolff**: On the series $\sum \frac{A_k}{z-a_k}$.—**P. Bessonoff**: Nearly periodic meromorph functions defined in the whole plane.—**P. Faton**: The movement of the perihelion of the planets.—**Wright**: A photograph of Jupiter, obtained at the Lick Observatory (California). The photographs were taken in approximately monochromatic light with the large 95 cm. Crossley reflector. In the first series the light had passed through a screen permitting the passage of only ultra-violet light of about λ3700: in the second series the screen is transparent only for rays about λ7600 in the extreme red. The photographs show great differences, the causes of which are discussed.—**L. Décombe**: The electrified spherical pellicules and the fine structure of the spectral lines.—**Paul Woog**: The extension of lubricants over solid surfaces.—**P. Schwartz**: A method of radioelectric direction finding applicable to geodesy. The radiogoniometric method described gives the position of emitting stations with a precision comparable with that obtained by optical methods.—**G. Colange**: The electrocapillary properties of mercury in contact with air. The capillary constant of mercury increases when it is electrified negatively and diminishes when it is positively electrified. There is a maximum capillary constant for mercury, which under the experimental conditions described corresponds to a negative potential of 15,000 to 20,000 volts.—**Marcel Dufour**: The refraction of a parallel light beam normal to a cylindrical lens.—**Pierre Brun** and **Jean Granier**: The dielectric properties of aqueous-alcoholic mixtures. Measurements of the dielectric capacity (high-frequency current, wave-length 50 metres) of isobutyl alcohol—ethyl alcohol—water and isoamyl alcohol—ethyl alcohol—water mixtures. The results are shown graphically. It is concluded that the Maxwell formula relating dielectric capacity and refractive index of organic liquids ($K=n^2$) should be replaced by $K=n^2+k_2$, in which k_2 is a variable, a function of the number of free hydroxyl ions in the solution.—**Mlle. Suzanne Veil**: The evolution of nickel sulphide and cobalt sulphide in the presence of water. The changes in the sulphides are followed by means of the changes in the magnetisation coefficient.—**F. Bourion** and **E. Rouyer**: Ebullioscopic determination of the molecular equilibria of resorcinol in aqueous solutions of calcium chloride.—**M. Tiffeneau** and **Mlle. Jeanne Lévy**: The comparative migratory aptitudes of acyclic radicals in the semipinacolic transposition of the phenyldialkylglycols. Their relations with the affinity capacities.—**Georges Brus**: The crystallised dihalogen derivatives of pinene.—**Paul Fallot**: The western termination of the Sierra de Cazorla (Andalusia).—**Henri Schoeller**: The stratigraphical characters of the Embrunais layer and of the outer edge of the Briançonnais layer to the north of the Pelvoux region.—**G. Mangenot**: The signification of the red crystals appearing, under the influence of cresyl blue, in the cells of certain algæ. The red crystals are the iodide of the oxonium derivative of cresyl blue, and indicate the presence of iodides. The distribution of iodides in algæ can be determined by means of this reagent.—**Bogdan Varitchak**: The nuclear evolution in *Ascoidea rubescens*.—**M. Bridel** and **P. Picard**: The primeveroside of salicylic acid.—**Maurice Fontaine**: The analogies existing between the effects of a tetanisation and those of a compression.—**M. Raymond-Hamet**: The action of chloralose on the sympathetic and parasympathetic.—**Jean Timon-David**: Contribution to the knowledge of the fats of insects: the butter from the insects parasitic on *Pistacia Terebinthus*. The aphides *Pemphigus utricularius* and other species of Pemphigus give about 20 per cent of their weight as a fat soluble in ether. The chemical constants of the fat are given.—**G. Lavier**: The prebasal vacuole of trypanosomes.—**Ch. Pérard**: A disease of the mackerel (*Scomber Scomber*) due to a myxosporidium, *Chloromyxum histolyticum*.—**Marage**: The nature of the deafness of Beethoven.

SYDNEY.

Linnean Society of New South Wales, Nov. 30.—**A. H. S. Lucas**: Notes on Australian marine algæ (No. 5). This paper contains (1) a list of the algæ collected at Michaelmas Cay, near Cairns, Qld., (2) Chlorophyceæ from Bowen, including records new for Australia, (3) a description of a new species of Codium, (4) notes on Caulerpa with a description of *C. Hedleyi*, (5) distributional notes on Fucoideæ, and (6) descriptions of two new species of Chondria.—**B. Bertram**: Mosquito control in the municipality of Lane Cove, New South Wales. The problem was to deal with *Culex fatigans*, breeding in natural waters polluted by house drainage. Oiling gave useful results, but channelling was equally satisfactory, more permanent, and likely to be less expensive. The widespread benefit felt from the treatment of certain creeks suggests that the range of flight of *C. fatigans* is greater than is usually supposed.—**Rev. H. M. R. Rupp**: A new Dendrobium from New South Wales and Queensland. The new species is allied to *D. Becklerii* and *D. Mortii* and occurs throughout the brushes among the foothills of Barrington Tops, N.S. Wales, and also at Tambourine Mt., S. Queensland.

VIENNA.

Academy of Sciences, Dec. 1.—**A. Müller** and **A. Sauerwald**: The behaviour of aluminium-triethyl under the influence of nickel catalyser at higher temperatures.

Dec. 9.—**K. Przibram**: The theory of the coloration of rock-salt by Becquerel rays; also remarks on the natural blue rock-salt. Pressure is supposed to be part cause of the colouring.—**E. Steinach, M. Dohrn, W. Schöller**, and **W. Hohlweg**: The biological actions of the female sexual hormone in aqueous form. A hormone oil containing extract of placenta has been prepared with a strength of 50,000 mouse-units per gram. The active substance is soluble in water to a solution of 500 mouse-units per cubic centimetre. Experiments have been made with albino guinea-pigs, making it easy to observe the reddening or hyperæmia of the mammæ. Marked effects have been produced in the early maturity of the mammæ and uterus in females which had been castrated when young. The effects of injecting water-soluble hormone are similar to the action of physiological hormone obtained by transplantation of ovary.—**E. Steinach**: Reactivation of the ovary and the whole female organism by the hormone method. Senile females of the rat are rejuvenated by the water-soluble hormone.

Dec. 15.—**K. Fritsch**: Observations on flower visiting insects in Styria, 1906.—**F. Frankl**: Topological relations of compact portions of Euclidean space to their components and application to the theory of prime ends. The results of Alexander's work on the Jordan-Brower theorem are extended.

Official Publications Received.

BRITISH.

Canterbury College (University of New Zealand). Records of the Canterbury Museum. Vol. 3, No. 2, 14th December. Pp. 83-149+plates 18-23. (Christchurch, N.Z.)

Publications of the South African Institute for Medical Research. No. 22: A Mosquito Survey of certain Parts of South Africa, with special reference to the Carriers of Malaria and their Control. (Part 1.) By Dr. Alexander Ingram and Botha de Meillon. Pp. 81+15 plates. (Johannesburg.)

Nyasaland Protectorate. Annual Report of the Department of Agriculture, 1926. Pp. 26. (Zomba: Government Printer.)

The Empire Marketing Board and the Home Producer. Pp. 12. (London: Empire Marketing Board.)

The Journal of the Quekett Microscopical Club. Edited by W. S. Warton. Ser. 2, Vol. 15, No. 93, November. Pp. x+289-374+xxx+xii. (London: Williams and Norgate, Ltd.) 3s. 6d. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 18, N.S., Nos. 43-47. 43: Comment on an Article by James Wilson on "The Maintenance Requirements of Cattle on different Rations and at different Rates of Production," with a Note on "Dynamic Action," by E. B. Forbes; 44: The Maintenance Requirements of Cattle, a reply to E. B. Forbes' Criticism, by James Wilson; 45: *Catenaria anguillulae* as a Parasite of the Ova of *Fasciola hepatica*, by Prof. J. Bayley Butler and J. J. C. Buckley; 46: Some Experiments on feeding Rats with Soya Beans and other Materials, by D. T. Barry and J. Freud; 47: The Formation of Vortices behind a Cylinder moving through a Fluid, by E. T. S. Walton. Pp. 495-534+plates 23-27. (Dublin: Royal Dublin Society; London: Williams and Norgate, Ltd.) 4s.

British Guiana: Combined Court, Annual Session, 1927. Report on the Preliminary Geological Survey of the Potaro-Ireng District of British Guiana. By Smith Bracewell. Pp. iii+60. (Georgetown, Demerara: Department of Lands and Mines.)

FOREIGN.

Annual Report of the Director, United States Coast and Geodetic Survey, to the Secretary of Commerce for the Fiscal Year ended June 30, 1927. Pp. iv+47+15 maps. (Washington, D.C.: Government Printing Office.) 50 cents.

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 394: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Md., in 1923 and 1924. By Daniel L. Hazard. Pp. ii+111+10 charts. (Washington, D.C.: Government Printing Office.) 20 cents.

Report of the Acting Secretary of the Smithsonian Institution for the Year ending June 30, 1927. (Publication 2923.) Pp. vi+131. (Washington, D.C.: Government Printing Office.)

Fifteenth Annual Report of the Secretary of Commerce, 1927. Pp. xlii+310. (Washington, D.C.: Government Printing Office.) 30 cents.

Treasury Department, United States Public Health Service. Studies on Oxidation-Reduction. 11: Potentiometric and Spectrophotometric Studies of Bindschedler's Green and Toluylene Blue. By Max Phillips, W. Mansfield Clark and Barnett Cohen. Pp. iii+36. 10 cents. 12: A Note on the Schardinger Reaction (in reply to Kodama). By W. Mansfield Clark, Barnett Cohen and M. X. Sullivan. Pp. ii+10. 5 cents. (Washington, D.C.: Government Printing Office.)

State of Connecticut. Public Document No. 24: Fiftieth Report of the Connecticut Agricultural Experiment Station, New Haven, Conn., for the Year 1926. Pp. xvii+599+18 plates+58T+3 plates+li. (New Haven, Conn.)

CATALOGUES.

Training Electrical Engineers. Pp. 32. (London: The Electrical Standardizing, Testing and Training Institution, Ltd.)

Catalogue of Botanical Books. (No. 157.) Pp. 56. (London: Dulau and Co., Ltd.)

Catalogue of Books and Journals bearing on the Mathematical, Physical and Chemical Sciences. (No. 301.) Pp. 74. (Cambridge: W. Heffer and Sons, Ltd.)

Diary of Societies.

SATURDAY, FEBRUARY 18.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—W. Maurice: Electric Mine Lamps and Better Lighting.—Prof. W. M. Thornton: A New Gas Detecting Miners' Electric Lamp.—High Candle-power Lamps will be exhibited and explained by H. Staples on behalf of Prof. R. V. Wheeler.—*Papers open for further discussion:*—Impressions of the Canadian Empire Mining Congress, by W. C. Carr.—Further Modifications of the Correlation of the Coal-seams of the Northumberland and Durham Coalfield, by Dr. W. Hopkins.

PHYSIOLOGICAL SOCIETY (in Department of Physiology, University, Manchester), at 3.—E. Boyland and A. D. Ritchie: The Adductor Muscles of Pecten.—Prof. A. V. Hill: Recent Myothermic Experiments.—F. W. Lamb and J. V. A. Simpson: Assessment of Schoolboys by Air Force Tests.—F. W. Lamb, E. D. Portman, and G. J. Woolham: Posture Deviations of the Arm and their Reversal.—A. N. Birkett and F. W. Lamb: Balance of Ocular Muscles in Normal Subjects.—C. E. Brunton: Respiratory Responses to Interruption of Breathing and to Inflation.—Dr. J. C. Bramwell and R. Ellis: (*a*) The Tidal Wave; (*b*) Some Observations on the Action of Amyl Nitrite.—J. G. Woolham: On Correlations between Pulse and Respiratory Tests.—Dr. G. A. Clark: Pituitrin and Blood-Sugar.—H. E. Magee and B. A. Southgate: A Method for Determining the Effect of Electrolytes in the Lumen of the Surviving Gut on its Movements. (Preliminary Communication.)—B. Finkleman: Vagus Inhibition in its Relation to Ions.—Dr. A. D. Macdonald and E. D. Portman: The Diuretic Principle of Pituitary Extracts.—E. D. McCrea and Dr. A. D. Macdonald: The Action of Drugs on Entogastric Pressure.—Dr. E. C. Eaves: Calcium, Iron, and Phosphorus in Normal and Some Abnormal Brains.—M. M. Croll: Alteration in Weight of the Brain and Some Other Tissues during Formalin Fixation.—H. D. Kay: The Organic Phosphorus of the Erythrocyte.—Prof. R. J. S. McDowall: Class Experiments in Leucocytosis.—I. Berembloom and Dr. B. A. McSwiney: Reaction of Adrenaline with Relation to the H-ion Concentration.—Demonstrations:—Light Production in a Marine Animal (Cypridina), by W. R. Amberson; Apparatus for the Observation and Photography of the Skin Capillaries in Man, by G. L. Brown and F. W. Lamb; An Optical Sphygmograph, by Dr. J. C. Bramwell; Records of Sounds, by Dr. J. C. Bramwell and F. W. Lamb; The Action of Pituitary Extracts on Isolated Blood-Vessels, by E. D. Portman and Dr. A. D. Macdonald; Calcium and Vagus Threshold, by B. Finkleman; Histological Preparations showing the Innervation of Different Parts of the Human and Rabbit's Pituitary, by M. M. Croll; A New Drop-Recorder, by O. Inchley.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. C. Colles: Musical London from the Restoration to Handel (1660-1759) (III.).

SOCIETY OF SUPERINTENDENTS OF TUBERCULOSIS INSTITUTIONS (at 122 Harley Street), at 3.—Dr. A. N. Robertson: Open-air Treatment and Meteorological Conditions.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB (in Departments of Electricity and Comparative Anatomy, Oxford University), at 8.15.—Annual Exhibition.

MONDAY, FEBRUARY 20.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—E. B. Bailey: Schist Geology: Braemar, Glen Cluny, and Glen Shee.—Dr. H. H. Read: Highland Schists of Middle Deeside.—C. N. Kemp: The X-ray Examination of Coal Sections (Preliminary Note).—*To be read by title only:*—Dr. E. Henderson: An X-ray Examination of Saturated Dicarboxylic Acids and Amides of the Fatty Acid Series.—W. L. Ferrar: General Derivatives and Integrals.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Prof. T. G. Pinches: The Influence of the Mythology and Heathen Practices of the Canaanites upon the Hebrews.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Pathological Specimens in the Museum.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.30.—Informal Discussion on The Relative Importance of Sales, Design, and Works Organisation in Engineering.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—L. Emanueli and others: Discussion on 132,000-volt Cables.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.30.—Dr. S. Z. de Ferranti: Electricity in the Service of Man (Faraday Lecture).

RAILWAY CLUB (25 Tothill Street, S.W.1), at 7.30.—Annual General Meeting.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Prof. A. P. Laurie: Stone Preservation and Decay.

ROYAL SOCIETY OF ARTS, at 8.—Dr. H. Gough: Fatigue Phenomena, with special reference to Single Crystals (Cantor Lectures) (2).

CHEMICAL INDUSTRY CLUB, at 8.—Dr. F. C. Shrubsall: Mental Deficiency.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—G. Watkins: The Cambridge Expedition to Edge Island.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section).—Dr. F. L. Usher and others: Discussion on The Phenomenon of Wetting and its Industrial Significance.

TUESDAY, FEBRUARY 21.

ROYAL DUBLIN SOCIETY (in Science Room, Ball's Bridge, Dublin), at 4.15.—Rev. H. C. Browne: Stereoscopic Notes.—Dr. J. H. J. Poole: The Measurement of the Current flowing through a Photo-electric Cell by means of a Neon Lamp.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. S. Huxley: The Behaviour of Animals (1).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Dr. T. H. C. Stevenson: The Vital Statistics of Wealth and Poverty.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Hon. Ivor Montague: Exhibition of Photographs of the Moscow Zoological Gardens.—G. C. Robson: Observations on the Oviposition of Octopus.—Prof. D. M. S. Watson: On Some Points in the Structure of Palæoniscid and Allied Fish.—Oldfield Thomas: The Delacour Exploration of French Indo-China Mammals. II. On Mammals collected during the Winter of 1926-27.—S. Maulik: New Chrysomelid Beetles from India, with a Note on the Scales of Coleoptera.

INSTITUTION OF CIVIL ENGINEERS, at 6.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—L. W. Chubb: Our Common Lands: The Story of their Preservation.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—A. Page: Address.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at College of Technology, Manchester), at 7. Dr. S. Z. de Farranti: Electricity in the Service of Man (Faraday Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—C. E. Kayser: A Comparison of the Norman Doorways of Yorkshire, Norfolk, and Gloucestershire.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—C. R. F. Engelbach: Works Re-organisation to Increase Production.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (jointly with Institution of Post Office Electrical Engineers—Scottish East Centre) (at Freemasons' Hall, Edinburgh), at 7.30—E. H. Shaughnessy: The Rugby Radio Station.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. R. M. Brown: Fatigue of Metals: Some Effects of Cold Drawing on the Strength and Endurance of Mild Steel.

WEDNESDAY, FEBRUARY 22.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—Dr. H. P. Bayon: The Pathology of Certain Avian Diseases compared with that of Analogous Morbid Conditions in Man and Animals.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Investigations into the Surgical Diseases of the Salivary Glands, including their Pathology and Treatment.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. C. A. Matley: The Pre-Cambrian Complex and Associated Rocks of South-Western Lleyn (Carnarvonshire).

BIRKBECK COLLEGE PHYSICAL SOCIETY, at 6.—Prof. E. V. Appleton: The Influence of the Earth's Magnetic Field on Wireless Transmission (Distinguished Visitors' Address).

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institute of Chemistry) (at 39 Elmbank Crescent, Glasgow), at 7.—J. H. Hawley: Some Aspects of Toxicology.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section), at 7.30.—F. H. Carr: The Methods Employed in the Preparation of Unstable Substances.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—A. Page: Address.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (at Glasgow University), at 7.30.—Prof. R. A. Berry: Chemistry in Relation to the Science and Practice of Agriculture.

SOCIETY OF CHEMICAL INDUSTRY (Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—Annual Meeting.

ROYAL SOCIETY OF ARTS, at 8.—Dr. H. R. Hall: The Excavations at Ur from 1919 to 1926.

EUGENICS SOCIETY (at Linnean Society), at 8.—Dr. C. P. Blacker and Mrs. Marjorie Farrer: Birth Control: When is it Justified?

FOLK-LORE SOCIETY (at University College), at 8.—Annual Meeting.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London, 11 Chandos Street, W.1), at 8.30.—Dr. G. V. Anrep: Conditioned Reflexes and Experimental Neuroses.

THURSDAY, FEBRUARY 23.

ROYAL SOCIETY, at 4.30.—Sir Leonard Rogers: The Yearly Variations in Plague in India in Relation to Climate: Forecasting Epidemics.—Dr. W. S. Patton and E. Hindle: The North Chinese Species of the Genus Phlebotomus.—H. Eltringham: On the Production of Silk by Species of the Genus Hilara, Meig. (Diptera), with an Appendix.—A. H. Hamm: On the Epigamic Behaviour of *Hilara Maura*, Fab., and two Allied Species.—Dr. H. M. Leake: Agricultural Value of Rainfall in the Tropics.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. F. Ll. Griffith: Nubia in Antiquity and in the Middle Ages (1).

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

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Mrs. Stella Churchill: Sunlight in its Effect upon the Development and Growth of Children.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—T. N. Riley and T. R. Scott: Insulating Oils for High-Voltage Cables.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre, Dublin) (at Trinity College, Dublin), at 7.45.—T. J. Monaghan: A Review of the Present Position of Wireless Telegraphy.

CHEMICAL SOCIETY, at 8.—Prof. A. Fowler: Spectra and Atoms (Lecture).

FRIDAY, FEBRUARY 24.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—W. H. J. Childs: Some Methods of Estimating the Intensities of Spectral Lines.—Prof. P. W. Burbidge and N. S. Alexander: On Electrical Methods of Hygrometry.—L. Hartshorn: On Constants of Thermionic Valves.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—W. D. Newcomb: The Relationship between Peptic Ulceration and Gastric Carcinoma.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (as Central Hall, Westminster), at 5.30.—S. V. Goodall: Admiralty Floating Docks.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle-upon-Tyne), at 6.—G. U. L. Sartoris and K. Watson: The Michell Crankless Engine.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section) (jointly with Students' Sections of Institutions of Civil and Mechanical Engineers) (at Institution of Electrical Engineers), at 6.15.—F. C. Dain: Salesmanship and its Application to Engineering.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Exhibition of Industrial Kinematograph Films.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—C. H. Faris: The Applications of Electro-chemical Deposits of Metals to Engineering.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. R. Miller: Some Public Health Aspects of Juvenile Rheumatism.—Dr. J. T. Clarke: The Pathogenesis of Rheumatic Fever in its Climatological Relationship to a Possible Insect Carrier.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB (in Department of Biochemistry and Physiology, Oxford), at 8.15.—Dr. A. E. Dunstan: Lecture.

ROYAL SOCIETY OF MEDICINE (Disease in Children and Surgery Sections), at 8.30.—Special Discussion on Chronic Appendicitis in Children. Dr. Robert Hutchison (Children); A. J. Walton (Surgery).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. G. Gordon: The Lives of Authors.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea).—N. H. Hartshorne: The Electronic Theory of Chemical Combination.

CHEMICAL INDUSTRY CLUB.

SATURDAY, FEBRUARY 25.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—Dr. R. J. Perring: Miners' Nystagmus.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—C. Dodgson: The Life and Work of Albrecht Dürer (1).

PUBLIC LECTURES.

SATURDAY, FEBRUARY 18.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray Amulets and Magical Figures of the Ancient Egyptians.

MONDAY, FEBRUARY 20.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—A. Bridges: Sugar Beet Costs.

GRESHAM COLLEGE, at 7.30.—G. P. Bailey: Modern Science and Daily Life: Chemistry in Industry.

LEEDS UNIVERSITY, at 8.—Dr. Ll. Wynn Jones: Recent Advances in Experimental Psychology: Analysis of Typical Results with special reference to Experiments on Cognition.

TUESDAY, FEBRUARY 21.

GRESHAM COLLEGE, at 6.—A. R. Hinks: The Foundations of Astronomy. (Succeeding Lectures on Feb. 22, 23, and 24.)

THEOSOPHICAL WORLD UNIVERSITY CENTRE (153 Brompton Road, S.W.3), at 6.—Prof. E. Marcault: Principles of Race-Psychology. (Succeeding Lectures on Feb. 28, Mar. 6, 13, and 20.)

WEDNESDAY, FEBRUARY 22.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.30—Dr. J. E. W. Macfall: Some Aspects of Legal Live Birth.

THURSDAY, FEBRUARY 23.

BRITISH MEDICAL ASSOCIATION (Tavistock Square, W.C.1), at 5.15.—Sir W. Heaton Hamer: Epidemiology in England during the last Hundred Years. Part 2. The Return to the Hippocratic Method (Chadwick Lecture).

LEEDS UNIVERSITY, at 8—Dr. D. R. Fox: The Development of Public Education in the United States.

FRIDAY, FEBRUARY 24.

KING'S COLLEGE, at 5.30.—C. J. Gadd: Ur in the Time of Abraham.

THEOSOPHICAL WORLD UNIVERSITY (at Friends' House, Euston Road), at 5.30.—Prof. E. Marcault: Psychology of Man's Evolution. (Succeeding Lectures on Mar. 2, 9, and 16.)

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Dr. W. F. Bewley: The Cultivation of the Tomato.

SATURDAY, FEBRUARY 25.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. Edith Durham: Primitive Life in South-East Europe.

CONFERENCES.

FEBRUARY 21–24.

CARBONISATION CONFERENCE (in Birmingham and Midland Institute and Queen's College, Birmingham).

Tuesday, February 21 (in Birmingham and Midland Institute).
At 10.30 A.M.—
W. J. A. Butterfield: The General Scope of the Gas Industry.
T. Hardie; Some Phases of Modern Practice in Gas Manufacture.
T. Hardie: Presidential Address to the Southern Association of Gas Engineers and Managers.
M. Barash and T. C. Finlayson: Continuous Vertical Retorts.
N. J. Bowater: Vertical Intermittent Chamber Ovens for Gas Manufacture.
R. H. Ruthven: Intermittent Vertical Chambers.

Wednesday, February 22 (in Birmingham and Midland Institute).
At 10 A.M.—
C. P. Finn and R. Ray: The General Scope of the Coke Oven Industry.
G. J. Greenfield and G. H. Harrison: Modern Coke Oven Practice.
E. C. Evans: Coke Research and the Steel Industry.

Thursday, February 23 (in Birmingham and Midland Institute).
At 2.30—
T. F. E. Rhead: Steaming in Vertical Retorts.
A. T. Green: Gas Works Refractories.
Dr. A. Parker: Gas Works Effluents.

Friday, February 24 (in Queen's College).
At 10 A.M.—
Sir Arthur Duckham: The Handling, Preparation, and Utilisation of Gas Works Coke.
J. Roberts: Blending in the Gas and Coke Oven Industries.
At 2.15—
F. S. Sinnatt: A General Review of Low Temperature Carbonisation.

FEBRUARY 24 AND 25.

ASSOCIATION OF TECHNICAL INSTITUTIONS (Annual Meeting) (at Stationers' Hall).
Principal G. H. Austin: Commercial Education.
Principal S. Carter: Suitable Courses in Commerce for Small Institutions.
T. P. Bennett: The Technical Training of the Architect.
Principal F. E. Drury: Technical Education for the Building Trades.
F. W. Roberts: Technical Education for the Boot and Shoe Industry.