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British Chemical Abstracts.[1]

THE appearance of the first index volume, covering the whole of the abstracts in pure and applied chemistry issued during 1926 under the direction of the Bureau of Chemical Abstracts, is a notable achievement. Marking, as it does, the completion of the first period in what promises to be a valuable co-operative and unifying enterprise, it represents a definite British contribution to the armoury of chemical knowledge and research. So far as the fields of physical, inorganic and organic chemistry, biochemistry, and chemical technology are concerned, few investigations of real importance, few new facts or measurements, few patents of chemical processes, can have failed to be reported in the abstracts on which this index is based. Since the rate of advance in any branch of knowledge so largely depends on an adequate acquaintance with the experimental results and theoretical views which form the starting-point of any new research, the efficiency of the abstracting and indexing service is a matter which closely concerns every investigator, teacher, and student.

Since 1871 the Chemical Society has undertaken, on a systematic and extensive scale, the preparation and publication of abstracts of papers in pure physical, inorganic, organic, analytical, mineralogical, and biological chemistry; besides the annual indexes, collective indexes have been issued covering the periods 1841–72, 1873–82, 1883–92, 1893–1902, 1903–12, and 1913–22. The Society of Chemical Industry has similarly surveyed applied chemistry since 1882, and has published collective indexes for the periods 1882–1895 and 1896–1905.

Naturally, a considerable amount of material appeared in both publications, and from time to time tentative efforts were made in the direction of collaboration. Real co-ordination, however, was initiated only in 1924, when the Bureau of Chemical Abstracts, composed of four representatives from each of the two societies, was constituted with the object of securing, so far as might be possible, unification of the two sets of abstracts. Ever since the Bureau was established, Prof. J. C. Philip has acted as independent chairman, and the new organisation has also had the advantage of the advice, in an honorary capacity, of Mr. A. J. Greenaway, formerly editor of the *Journal of the Chemical Society*. The regular staff of the Bureau consists of an editor, Mr. T. F. Burton, supported

[1] British Chemical Abstracts issued by the Bureau of Chemical Abstracts. Index, 1926. Pp. 430. (London: Society of Chemical Industry.)

by eight specialist assistant editors, each in charge of an appropriate branch, and a large staff of abstractors, as well as an expert indexer. The publication as a whole, composed of two sections dealing with abstracts in pure and applied chemistry, is now known as "British Chemical Abstracts"—A and B, respectively.

At the outset, the possibility of co-operation with the American Chemical Society with the object of producing one chemical abstract publication in the English language was thoroughly explored, but progress in this direction proved to be impracticable. The Bureau then proceeded, with what patience and persuasiveness one can only surmise, to secure consent to a common format for the two sections of the abstracts, and a joint index. Thanks to the Chemical Society's action in giving up its well-known octavo format, agreement was reached in 1925 and the new scheme was initiated in January 1926. From that date onwards both A and B abstracts have been published—the former monthly, the latter fortnightly—in double column quarto, the overlap has been eliminated, and the A abstracts (pure chemistry) rearranged and paginated continuously, whilst the type and set up of the B abstracts (applied chemistry) have been brought into conformity with the A section. The first year of this new arrangement has now been completed by the publication of the index part, consisting of 430 pages. It has been necessary to adjust differences in the two systems of indexing previously employed, and to deal with some 50,000 index cards, so that the Bureau may be excused if the publication, which is to serve as a model, appears later than was hoped.

The index *qua* index requires little comment. It is based on the nomenclature and arrangement adopted by the Chemical Society; it includes a list of patents and a list of the journals abstracted; but not, unfortunately, a formula index, that expensive luxury.

In two respects, perhaps, the service offered to the chemist by "British Chemical Abstracts" is such as to merit his special attention. In the first place, it offers him abstracts which are admittedly second to none in accuracy; it is the policy of the Bureau that, so far as is practicable, the abstracts shall be prepared by abstractors and examined by editors who have specialised knowledge of the subject concerned. The degree of detail permitted in the abstracts depends to some extent on the accessibility of the original publication to British chemists, but every new substance is specifically mentioned. In the second place, promptness in the publication of abstracts is regarded as being of primary importance, and "British Chemical Abstracts," when compared with other similar publications, proves to have an excellent record in this matter.

According to the list at the end of the index, some 400 journals come directly or indirectly under the review of the Bureau's staff. It is of course financially impossible at present to spread the net so wide as does the corresponding American publication; moreover, it is doubtful whether much advantage would accrue from the inclusion of a large amount of ephemeral, borderline, and even non-chemical matter. A systematic survey of all possible sources of information is, however, made, and certainly there can be very little valuable information that escapes the attention of the Bureau and its staff. Much of the so-called borderline material is of course abstracted by other bodies—scientific and trade societies and research associations—the scope of which, although sufficient for their own purposes, is admittedly incomplete. It might conceivably be possible to secure some measure of effective co-ordination or co-operation between the Bureau and such organisations as would result in financial advantage as well as economy of effort on the part of the user. The Bureau would no doubt welcome constructive criticism, and give the most careful consideration to any suggestions calculated to enhance the value of its publications.

The Peoples of Sarawak.

Natural Man: a Record from Borneo. By Dr. Charles Hose. With a Preface by Prof. G. Elliot Smith. Pp. xvi + 284 + 60 plates. (London: Macmillan and Co., Ltd., 1926.) 30*s*. net.

THOSE who desire to gain some knowledge about the attractive inhabitants of Sarawak will find what they require in this interesting and informative book by Dr. Hose. All the information here given about the natives, and much besides, will be found in the "Pagan Tribes of Borneo," by Dr. C. Hose and Dr. W. McDougall. The serious student cannot afford to neglect the older work, but sufficient material will be found in the new book to satisfy most other readers. Owing to his long residence in the country, his intimate and sympathetic knowledge of most of the tribes, and his friendship with many individuals, Dr. Hose not only writes with authority, but also is able to handle his multitudinous facts with ease and to bring out the essential points of material

and social culture, besides giving a good insight into the mental and moral characteristics of the more important peoples. The value of the book is enhanced by the very numerous and beautiful photographs, which were mostly taken by the author and do really illustrate the text. A certain number, including two of the four coloured plates, appeared in the older work, but many are new and all are appropriate. There is a useful map of tribal distributions.

Dr. Hose deals at the beginning with Borneo when it was inhabited solely by hunters and collectors of jungle produce. Then cultivation (more particularly of rice), metal-working, the building of long-houses, and many other cultural elements were introduced; most of the aboriginal population assimilated these to a greater or lesser extent, and this congeries of tribes has beenn amed the Klemantans by Dr. Hose. Certain groups, however, persisted in the old way of life; these are the Punan and allied wanderers in the jungle. Later migrations of people with a similar culture, but more highly organised socially and possessing greater physical and mental virility, were those of the Kayan-Kenyah peoples, whose cultural affinities with tribes in northern Burma and in Assam have often been noted. These are the most advanced of the true Borneans, and it is with them that the book mostly deals; they appear to have entered Borneo from the south. The north was affected by the invasion of the Murut, who, Dr. Hose thinks, came from the Philippines or from Annam. They were not a water folk, and are supposed to have introduced terrace cultivation, the buffalo, and various distinctive weapons and customs; they do not use the blow-pipe. The last migration, which is estimated to have occurred less than 300 years ago, was that of the Iban, or 'Wanderers' (the so-called Sea-Dayaks), who under Malay leadership raided the north-west and penetrated up numerous rivers, a turbulent crowd glorying in head-hunting. There appears, however, to have been an earlier immigration of the same stock, but of gentle manners and more settled habit.

The great resources of Borneo attracted the Chinese more than a thousand years ago, and at intervals they claimed a partial suzerainty. Before the Mohammedan Malays became dominant in Brunei it was a Bisayan kingdom under Buddhist sovereigns. Indo-Javanese influence made itself felt, more especially in the west, of which traces still persist. Pigafetta in 1521 was the first European to visit Borneo, and various abortive attempts to settle in the island were made by Europeans in the seventeenth century. The Dutch eventually established themselves in the south, and in 1839 the brilliant and adventurous James Brooke arrived on the north coast and shortly afterwards became Rajah of Sarawak. He instituted a policy of administration than which nothing could be better for the local conditions; this has been successfully followed by Rajah Sir Charles Brooke and the present Rajah, Sir Charles Vyner Brooke. The policy has always been to interfere as little as possible with native custom and belief, but necessarily life and property had to be made secure. As an example of the care for the people, it may be noted that many years before the rubber boom of 1910–11, Para rubber seeds had been imported and the natives were encouraged

FIG. 1.—Iban women dancing with the heads of enemies at a festival. (From "Natural Man.")

to plant rubber for their own profit. The Rajah caused notices to be published that the natives were at full liberty to appropriate forest lands for this purpose, which would remain their property so long as they took care of the trees and worked the rubber properly. He also ordered that no sales of rubber plantations should be effected without the approval of the Government, and thus prevented exploitation by outsiders.

The administration of subject races, more particularly those in Africa, is a topic which is now being widely discussed. The method adopted in Papua has proved most excellent for peoples of very backward culture, and that employed in Sarawak is as admirable for somewhat more advanced peoples. A. C. HADDON.

The Chemistry of Plant Activities.

Photosynthesis. By H. A. Spoehr. (American Chemical Society Monograph Series, No. 29.) Pp. 393. (New York: The Chemical Catalog Co., Inc., 1926.) 6.50 dollars.

ALTHOUGH not actively engaged as a teacher, the author has done a considerable service to education in writing a book on photosynthesis as he understands it. The educational value of this book, however, lies not only in the actual information it gives on what may be called the more descriptive physiological aspects of the phenomenon, but also on the broadness of outlook displayed in the treatment of the whole subject. With commendable thoroughness the author has put a very liberal interpretation upon the word 'photosynthesis,' and has drawn into his purview a number of aspects which might perhaps scarcely have been expected to have received the careful consideration which he has given them. Thus the cosmic and economic aspects of the problem are dealt with at considerable length, and are amplified and illustrated by numerical data which contribute materially to a proper appreciation of their significance; likewise the purely chemical and physical aspects are dealt with in a very lucid and thorough manner. It is by adopting this very comprehensive attitude towards the subject that the author points the way to future progress, for the reader will realise that many gaps in our knowledge of chemistry and physics need to be filled before there can be much hope of a better understanding of the process of assimilation of carbon by green plants.

The book is divided into seven chapters which are, in effect, complete monographs of the various aspects of the question with which they deal, being supplied with continual references to original literature. From the point of view of the teacher or the advanced student, this is altogether excellent, since the book may be confidently relied upon to present a complete account of our present knowledge of the subject concerned. To the less experienced student this wealth of information may perhaps be a little embarrassing, more particularly as the author has an occasional tendency to break away from a subject and to return to it again later, which makes it necessary for the student to connect the various pieces together before he can get the continuous story.

The opening chapter, entitled "The Origin of Organic Matter and the Cosmical Function of Green Plants," is one of particular interest. There is probably no other book in which such a complete account of this aspect of the subject is to be found; the author has here collected together a mass of data with regard to solar radiation and the disposal by the leaf of the solar energy incident upon it, and illustrates it graphically in a very convincing manner. Here also will be found a comprehensive discussion of the solubility of carbon dioxide in fresh and sea water and its significance to aquatic plants, as well as a discussion of the economic aspects of the utilisation of the solar energy stored by the products of photosynthesis. Many of the data furnished in this very interesting chapter are culled from American sources which, though possibly easily accessible, are not familiar to the average reader.

The second chapter deals with "The Nature of Photosynthesis as Determined by Observations of Gas Interchange and the Formation of Organic Matter." This is by far the longest chapter in the book, and is the one which will appeal more particularly to the plant physiologist. Describing first the path of the gaseous interchange at the surface of the leaf and the work of Brown and Escombe, the author passes on to a consideration of the carbon dioxide content of the soil atmosphere and of natural waters. After carefully distinguishing between the terms 'photosynthetic' and 'respiratory quotient,' he introduces the principle of limiting factors. In discussing the effect of light he wisely administers a much-needed warning to those who may still be in need of it—and, sad to say, there are still a good many—in the following words: ". . . there is no sense in considering the photosynthetic activity in different coloured light without at the same time determining the energy relations of the light employed."

Attention is also directed to the fact that "the method of measuring the rate of photosynthesis by the appearance of starch in the leaf cannot be considered as being very accurate," since the formation of starch is itself not dependent upon the presence of light. He also administers the *coup de grâce* to one other much-cherished idea by the statement that "there is apparently no relation between photosynthetic efficiency and the absorption bands of chlorophyll." After dealing successively with each of the various limiting factors in detail, the chapter is brought to a close with an account of the more recent work of Plaetzer, Harder, and Warburg on the 'compensation point,' that is to say, the light intensity at which the respiratory and photosynthetic activities compensate each other.

In Chapter iii., entitled "The Products of Photosynthesis," the author gives a fairly exhaustive description of the occurrence and character of such carbohydrates as are found in the leaf, and may therefore be regarded as being, at any rate potentially, primary products of photosynthesis, and on these grounds excludes from this description such substances as trehalose, raffinose, melicitose, etc. Here also will be found a good summary of the vexed question of what is the first product of photosynthesis. The succeeding chapter gives a very clear account of the methods of measuring photosynthetic activity.

In Chapter v. the author sets forth in characteristically thorough manner the various hypotheses regarding the steps in photosynthesis. He says of Baeyer's theory that "it is a good suggestion of a possible mechanism of photosynthesis," but of recent work purporting to support the formaldehyde theory he says: "Condensing formaldehyde with strong alkalies or through the action of ultra-violet light and obtaining a great mixture of substances of which only a small per cent is in many cases hexose sugar, will, even to the most optimistic chemist, appear as a rather far cry to the method by means of which the plant forms glucose."

Chapter vi., on the energy relations in photosynthesis, contains a valuable summary of all the more recent work on this difficult subject, while Chapter vii. gives a fairly detailed but well-summarised account of the methods of isolating the various leaf pigments, including the separation of chlorophyll-*a* and -*b*; there is also a section devoted to the chloroplast.

There is a considerable number of misprints, more particularly of plant names, one of the most peculiar distortions being that of Heleodea for Elodea on p. 85. The book provides, however, most interesting and inspiring reading; it is impartially critical, and frequently indicates the direction in which further work is desirable. The author has produced a work for which teachers both of plant physiology and of chemistry should be very grateful.

The Future of Magnetism.

Magnetism and Atomic Structure. By Dr. Edmund C. Stoner. Pp. xiii + 371. (London: Methuen and Co., Ltd., 1926.) 18*s*. net.

IT is probably recognised by every one that the main interest in physics of to-day lies in the study of the atom. Much of the information with regard to the atom has been obtained by studying spectra; chemistry, magnetism, X-ray scattering, etc., play only a subsidiary part. We must admit, however, that our spectroscopic material is now more or less exhausted, and that we must look for fresh sources of information.

Much may be said in support of the opinion that magnetism will open a new way by which to approach the study of the structure of the atom. The atom is essentially an electromagnetic system which consists of a positively charged nucleus with negative electrons revolving round it. If the atomic number of the atom is given with its nuclear charge, and if the electrons arrange themselves round the nucleus in a definite way, then this arrangement of the electrons practically fixes all physical and chemical properties of the given element.

The magnetic field is probably the only practical weapon by means of which we may hope to change the motion and arrangement of the electrons in the atom, and thus influence all the physical and chemical properties of the atom. In only a very few cases at the present time do we find that the influence of the magnetic field on the properties of the atom is noticed. This is because the influence of the available fields is too weak to produce a marked change in the properties of the atom, and our present methods of magnetic research are not sufficiently refined to study them. The most easily observed magnetic phenomenon is the Zeeman effect, and this has a tremendous influence on the present theory of the structure of the atom.

It is possible that the difficulty of experimenting in magnetism, and the small amount of trustworthy experimental work done, account for the fact that magnetism has been somewhat neglected. During

the last few years, however, a considerable amount of research has taken place, and new methods of approaching the subject have been developed, and we now have to recognise a marked advance in magnetism.

It is on this account that we have to welcome Dr. Stoner's book, especially as it attempts to give an account of our present knowledge of theoretical and experimental magnetism from the point of view of its relation to the structure of the atom.

The task of writing such a book, the counterpart of which has not before been published in any language, is indeed difficult; and in his preface Dr. Stoner himself admits the difficulty. The material which an author of a book on magnetism has at his disposal is very large, but the great amount of contradiction in experimental as well as in theoretical work makes the problem of selection very considerable.

In his preface Dr. Stoner states, "Prominence is given to the work which is thought to be of most important and lasting value," and the difficulty of selection may be illustrated by the following example. In Chapter xii. (p. 273, para. 4), Glaser's experiments are described at length, and in Chapter xv. they are well discussed. A few weeks before Dr. Stoner's book appeared, however, Glaser's experiments were repeated by Lehrer by a more refined method (*Z. für P.*, vol. 37), and it was shown that the increase of atomic diamagnetic susceptibility at low pressures in diamagnetic gases, as observed by Glaser, is almost certainly due to experimental error. This example is given, not to criticise Dr. Stoner's work, but simply to illustrate the difficulty of his undertaking.

On the whole, we must agree with Dr. Stoner's choice and with the manner in which he has put together the material at his disposal. The experimental and theoretical parts of the book are well divided; it is free from heavy mathematics; the subject is well brought up-to-date, and the references which follow each chapter are very valuable.

Dr. Stoner also gives a brief account of electrodynamics, the quantum theory, and other work which has been done on the structure of the atom, so as to enable the unprepared reader to follow the main subject of the book. We scarcely consider that such a brief account is sufficient to impart the preliminary knowledge necessary to follow the subject of the book—it can be regarded only as a means of recalling certain facts with regard to electrodynamics and the quantum theory to the mind of the reader who is already acquainted with them. It is doubtful whether it is really advisable to include this account in the book.

In general, the book is of more use to the experimentalist than to the theoretical research student. A close study of it reveals one or two slips and misunderstandings, but none of a very serious nature. Attention may be directed to one of these, and that is on p. 196, where Dr. Stoner makes some calculations on the gyromagnetic effect. In this connexion the equations (9·2) are wrong, as the author puts the sign of equality between two expressions which cannot be equal. On the following page he himself suggests that this may be 'wholly wrong,' and so it is.

It is probable that as magnetism attracts more and more attention, and as its importance in the study of the atom increases, we shall soon have more books published on this subject. Dr. Stoner's book is, however, the first on this subject, and we welcome it as a very good commencement and as an important contribution to our present literature on magnetism. P. KAPITZA.

The Educational Ladder.

Social Progress and Educational Waste: being a Study of the 'Free-Place' and Scholarship System. By Kenneth Lindsay. Pp. vii+215. (Studies in Economics and Political Science, No. 88.) (London: George Routledge and Sons, Ltd., 1926.) 7*s.* 6*d.* net.

MR. KENNETH LINDSAY, who was Labour candidate at a recent parliamentary election in Oxford, has written a very instructive study of the adequacy of the provision made for scholars to pass upwards from the elementary school to higher places of education, and the use made of it. He quotes with justifiable scepticism Lord Birkenhead's recent dictum that "the number of scholarships from the elementary to the secondary school is not limited, awards being made to all children who show capacity to profit"; and examines the actual facts carefully in four or five selected districts—London, Oxfordshire, Warrington, Wallasey, with a shorter account of Bradford.

The book is an interesting illustration of the fact that, however small and technical the point of departure may be, if the argument is pursued faithfully, a survey of all the connected fields is gained. This is especially true of sociology, and Mr. Kenneth Lindsay, by his thoroughness and acuteness, manages to give us a fairly complete sociological picture of London and some of the other places simply by following the record of the

scholars proceeding from the elementary to the secondary schools in the area.

The main conclusions may be very briefly summarised. The ladder of which Lord Birkenhead spoke affects at most 20 per cent. of the elementary school population; 80 per cent. go no further in their scholastic education. It also appears quite clearly that the minority who do pass on are mainly from the lower middle class of clerks and small traders, and that their children by their continued education are enabled to remain or rise a little higher in the same class. Individual cases are mentioned of the sons of manual workers who become professors or civil servants, but it is abundantly proved that the mass of the workers are untouched by the secondary system. The root of the difficulty is poverty. Even if more secondary and central schools were provided, the need of the parents for their children's earnings would prevent any large number taking advantage of them.

To Mr. Kenneth Lindsay this fact points to a much more generous subvention from the State towards the maintenance of scholars: he indicates his own belief in an all-round allowance to parents. From the educational point of view the book will incline most of us to the solution just advocated in the Report of the Consultative Committee on Adolescent Education, namely, the gradual raising of the universal school age to fifteen years as economic conditions permit, that is, concentrating more on the improvement of the education of all than on a large immediate increase either in secondary schools or in scholarships. F. S. M.

Our Bookshelf.

The Work of the Royal Engineers in the European War, 1914–1918. Compiled by Col. G. H. Addison. Published by the Secretary, Institution of Royal Engineers, Chatham. Miscellaneous. Pp. iii + 372 + 100 plates. (Chatham: W. and J. Mackay and Co., Ltd., 1927.) 20*s*.

THIS volume, the last of the series prepared by Col. Addison to illustrate the manifold activities of the corps of Royal Engineers during the recent European War, covers a wide range of activities. It shows in what manner the corps rose from 1569 officers and 23,521 other ranks (including Territorials) in August 1914 to 11,830 officers and 225,540 other ranks in August 1918. The mere list of units included in 1918 shows what the developments in warfare had brought under the control of the corps: water boring, sound ranging, tunnelling, gas and anti-gas methods, meteorology, land drainage, forestry, laundry, cinema and camouflage were amongst the many which the engineer-in-chief had to organise and supply with stores.

The subject of most general interest in this volume is the account of the camouflage service. Once again we see the shattered tree near Burnt Farm, and we learn that Colonel Solomon drew its bark from the King's Park at Windsor. It is not without some amusement that we note that for purposes of R.E. the artists in the Camouflage section were rated as painters and the sculptors as plasterers. From the chapter on the organisation of engineer intelligence and information emerges the somewhat startling fact that none of the maps supplied to the Army by the French staff recorded the existence of the unfinished Canal du Nord.

The chapters on concrete defences, on forward communications (duckboard tracks, decauville, mule tracks, plank roads, etc.) and on machinery, workshops (with the wonderful list of articles manufactured by the R.E. during the War), and electricity have their own special interest and might serve as a very useful text-book for engineers engaged in pioneer work in the outposts of civilisation. The concluding chapters on searchlights, inundations (our own and the enemy's), and training schools help further to illustrate the magnitude of the whole task of organising the engineering services required in the War and the success with which the task was accomplished.

Practical Organic and Bio-Chemistry. By Prof. R. H. A. Plimmer. New edition. Pp. x + 568. (London: Longmans, Green and Co., Ltd., 1926.) 21*s*. net.

THE need for a new (the third) edition of this book is in itself an indication of the appreciation of the public to which it is addressed. The author in revising his work, in addition to making numerous changes of detail, has again to some extent modified its scope. The book has been made more theoretical and less practical and at the same time more elementary.

We greatly regret this decision on the part of the author. Instead of developing into a valuable aid to laboratory practice in general biochemistry, the book is gradually becoming unequal in its treatment of various branches of the subject and overweighted with theoretical matter, much of which is too condensed (*e.g.* the anthoxanthins, the terpenes, and the alkaloids) to be of value for the class of students for which the main bulk of the book is intended.

Considered as a text-book for medical students, however, the book preserves the qualities which it has always possessed, and the sections on proteins, colloids, and digestion may all be cited as characteristic examples of the mode of treatment.

If, however, its virtues have been retained, so have some of its vices. The author still omits all reference to hydrogen ion concentration, its determination and its influence on biochemical phenomena. This constitutes a very serious, and in our opinion inexcusable, defect from which the book suffers throughout. The student, medical or other, who relies upon this work will find himself in this respect deprived not only of a general point of view of the greatest utility, but also of much

valuable information, and will be greatly hampered if he should attempt to enlarge his ideas by reading current biochemical literature.

A large amount of new information has been incorporated into the text; thus glutathione, thyroxine *à la* Harington, and the irradiation of cholesterol are all included. On the other hand, oxidation-reduction potentials and the bacterial production of acetone and butyl alcohol from starch seem not to be mentioned. A. H.

Home Fires without Smoke: a Handbook on the Prevention of Domestic Smoke. Edited by Cyril Elliott and Marion FitzGerald. Pp. xvi + 59. (London: Ernest Benn, Ltd., 1926.) 3*s.* 6*d.* net.

THIS small book is of the popular type setting forth in simple language the existing methods available for preventing domestic smoke. There is a useful foreword by Sir Napier Shaw, and four chapters by different authors. Solid fuels are dealt with by Dr. M. Fishenden, gas by Mr. F. W. Goodenough, electricity by Major F. H. Masters, and the general housewife's problem by Miss Bushell and Miss Gordon. The book should help those desirous of knowing what they can do to eliminate domestic smoke.

Dr. Fishenden is a strong advocate of coke as a fuel for continuous use. Mr. Goodenough gives a very clear review of the possibilities of gas. He directs attention to a point not sufficiently realised when comparing the cost of gas for domestic use with that of solid fuel, that is, the saving of the time of the housewife. The case for electric heating and cooking is naturally supported strongly by Major Masters; he makes a good deal of the efficiency with which electricity is converted into heat and utilised, but no stress is laid on the necessity first to convert coal into electricity, with a heavy loss in the process. In his foreword, Sir Napier Shaw emphasises the scale of the smoke problem, a point often forgotten. Referring to the possibility of substituting gas and soft coke for the large amount of coal burned each year in domestic fires, he directs attention to the problem of disposing of the gas if sufficient coal were treated.

It is stated by Mr. Goodenough (p. 18) that gas "is probably available to something like 95 % of the population of these islands," and, on the same page, that "some forty million tons of coal are still burned in British dwelling-houses every year." These two statements taken together show that the disposal of the gas would be a real difficulty.

The book is not provided with an index, although a fairly complete list of contents is given.

J. S. OWENS.

Les physiciens hollandais et la méthode expérimentale en France au XVIII^e siècle. Par Prof. Pierre Brunet. Pp. ii + 153. (Paris: Albert Blanchard, 1926.) 14 francs.

THE legacy of Newton and his contemporaries of the seventeenth century has often been described. This was the century, too, that saw science organised through its societies on rational lines that at the same time made possible international relationship and collaboration on a scale hitherto impossible. The excellent volume before us deals with the handling of this legacy by the continental physicists of the eighteenth century. It is perhaps insufficiently realised that international relationship has affected the progress of science almost as often as it has the progress of peoples; and the historian of science who is concerned with the development of the broader aspects of his subject is confronted with continual illustrations of this. The French Descartes lived his scientific life in Holland; Huyghens was a Dutch philosopher who worked in France and visited England; 'S Gravesande, of Leyden, was a member of the delegation of 1715 sent to England to congratulate George I. on his accession. Desaguliers was a Dutch philosopher who was educated in England. Here are but a few of the ingredients of international relationships in science. The eighteenth century was notable for the rise of the Dutch experimental school of physicists, and the story of the development of the experimental method in Holland, and of its influence on the mathematical methods of the French school, is dealt with by Prof. Brunet with a sympathy, a penetration, and an understanding that has resulted in a volume of unique value to all students of the history of science.

I. B. H.

Mongrel Virginians: The Win Tribe. By A. H. Estabrook and I. E. McDougle. Pp. 205 + 2 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 13*s.* 6*d.* net.

THIS study of a group of Indian-white-negro crosses is a sociological and eugenic study of a group which has lived in the same locality in Virginia for more than a hundred years. It originated from a white-Indian union, with later introductions of 'mean-white' and negro strains. The group consists of about five hundred individuals in an area approximately eight miles long by four miles broad. They are mostly living on the land. The original white family, judging from its social and economic position, was probably above the average. The descendants are almost without exception below the low white in average ability.

One hundred and forty-five pages of the book are taken up with a history of the individuals so far as it has been possible to recover it, and this is followed by certain deductions from the data as to fecundity, consanguinity, legitimacy, and the like. As a sociological record this material has value; but as a scientific study it leaves much to be desired. The fact that a large number of the females have been prostitutes, and that white men from outside have resorted, and continue to resort, to the area, introduces an element of uncertainty into the data. Further, it is to be regretted that advantage has not been taken of such a promising opportunity to examine on anthropological and genetic lines such exceptional material for the study of a number of problems relating to heredity, inter-breeding, and racial crossing.

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.*]

Transmutation of Elements.

PROF. A. SMITS, in a letter in NATURE of Jan. 2, 1926, announced the possibility of transmuting lead into thallium and mercury. In the December number of *Zeits. f. Elektrochem.* these experiments are described in more detail by Smits and Karssen. They used a quartz tube, furnished with two steel electrodes with carbon points, which dip down into the liquid lead. The amount of lead used is about 900 grams, which is kept liquid in a side tube all the time. When an experiment is performed, the tube is tipped and the lead is brought over into the main tube. The arc which is burning between two inner surfaces of lead is either continuous or intermittent, the main consideration being to obtain as high a current density as possible. The first method gave strong spectroscopic evidence of mercury and thallium after 10 hours' burning at ±35 amp. The second is the so-called sparking method, in which a current of 60-100 amp. can pass through the tube at the make of the arc, that is, when the tube is short-circuited through the liquid lead. Here all the mercury lines, even the very weak ones, were present after 9¼ hours' sparking.

I have been trying to check this work of Smits and Karssen, using a tube of similar construction, the dimensions, however, being smaller, as the amount of lead used was only 180-200 gm., and the bore of the tube where the arc was burning was $\frac{3}{8}$ in. The sparking method was first tried with an evacuated tube for 14 hours, with a current in the short-circuited tube of 60-75 amp., plus 21¼ hours with 80-90 amp. The lead was found to be pure by spectroscopic examination before the run started, and the spectra throughout the experiment, mostly photographed at 5-hour intervals, showed no mercury or thallium lines.

After a breakdown of this tube, a new run was started with new lead which, however, on very good spectrograms, showed slight traces of mercury and thallium. This time the arc was burning in $\frac{1}{5}$-$\frac{1}{7}$ of an atmosphere of nitrogen. First, an experiment with continuous current was performed for 25 hours, with current densities from 15 amp. to 25 amp., the latter value being maintained for 10 hours at about 38 volts. No appreciable change in the intensity of the mercury and thallium lines could be detected. The sparking method was again tried with nitrogen filling, without changing the construction of the tube or touching the lead. No mechanical devices were necessary, since the arc under a certain pressure and with a certain amount of lead present, will make and break itself as soon as the lead surfaces are brought to contact. This way of sparking should be very effective, as the arc runs through all stages of burning. After a 10 hours' run with 65 amp. to 95 amp. was performed, the scheme of connexions was changed, putting a condenser across the terminals, and a big inductance in series with the tube to protect the generator against transients. The current in the arc was now increased to 120 amp. short-circuited, and was about 60 amp. when the arc broke. With this arrangement a 12 hours' run was performed, but no increase in the strength of the mercury or thallium lines could be detected. The actual burning time of arc was a little less than half the time, and the number of contacts ranged around one a second. On increasing the current up to 150 amp., the tube broke after 2½ hours' run.

As will be seen, the currents compare with, and even exceed, those used by Smits and Karssen, and as the dimensions of the tube are smaller the actual current densities are higher. On account of the smaller amounts of lead used, the expected products of transmutation should be more easily detected, but in spite of these two favourable conditions no transmutation could be found.

It is the author's intention also to try out the second method by which Smits and Karssen claim to get positive results, namely, high potential discharges between lead electrodes in carbon disulphide.

L. THOMASSEN.

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The Floods at Memphis.

THE news of the dangerous floods at Memphis, Tennessee, inevitably invites a comparison with its Egyptian namesake. The modern town was laid out in 1819 (soon after the evacuation of the surrounding territory by the Chickasaw Indians) by three men, John Overton, Andrew Jackson, and James Winchester, who gave it the name of the most ancient of the great capitals of Egypt because of the similarity in the geographical positions of the two sites. They realised that the American site enjoyed an advantageous position at the head of the navigable waters of the Mississippi, and from that they doubtless hoped—and time has amply justified their hope—to derive the great commercial future for their new city which a like position at the apex of the Nile Delta had secured for Egyptian Memphis throughout a period of three thousand years.

It seems possible, however, that the founders of the town had forgotten the implicit warning of Herodotus, who made his headquarters at Memphis when he visited Egypt in the latter half of the fifth century B.C. Speaking of the foundation of that city in the dim beginnings of Egyptian history, he tells us (as the priests had told him) how the river had originally flowed right under the western cliffs—as it might be the Chickasaw Bluffs in Tennessee—and how, in order to secure a larger area of low-lying irrigable land, the reigning king dammed the Nile and turned it into the middle of the valley between the two desert ranges, and then let it rejoin its bed at the apex of the Delta. He goes on to say that "to this day" (his day) the point at which the river was thus bent out of its old course was guarded by the Persians—then ruling Egypt—"with the greatest care," and was strengthened every year. "*For if the river were to burst out at this place, and pour over the mound* (i.e. *the dam*), *there would be danger of Memphis being completely overwhelmed by flood.*"

We have no exact information as to the nature of the defences thus so carefully manned by the Persians, though we may feel tolerably certain that they consisted simply in the earth banks which are almost as old in conception as the Nile mud itself and are still to be seen throughout the length of Egypt to-day. But the Greek historian's account has been verified and very happily supplemented by modern excavation. Herodotus tells us of a "camp of the Foreigners." Sir Flinders Petrie, who dug at Memphis for several years before the War, guessed that this referred to the mixed levies of the Persians; and in his first season's work he struck a building which, as he had calculated, turned out to be this very camp. It lay on the south-east edge of the

town, precisely where we should expect to find the "army of occupation" whose main business was to secure the city from flood. Memphis was at this time the commercial centre of Egypt as well as being its capital, and it was natural that the Persians should keep a strong armed force in this outpost of their empire. The size and heterogeneous nature of this force is attested by large numbers of small terra-cotta figures representing men of all nations, from the Scythians on the north-west to a Mongolian type coming from farther India, thus indicating the extreme limits of the Persian sway. The Egyptian, we know, was from the earliest times fond of caricature, and these figurines, though showing the influence of the Greek artists then fashionable in Egypt, are definitely the work of native craftsmen. An interesting feature is the absence of women among the foreign types, although *Egyptian* women occur fairly frequently. The explanation is clear enough. Memphis had become for a time the Cologne of Egypt—if one may be permitted the anachronism—and the army of occupation, consisting of units many of whom were thousands of miles from their native lands and who doubtless despaired of seeing their own homes again, followed the natural course and took wives from among the native women. That these should in their turn become a butt for the jesting hands of their fellow-countrymen is not surprising. Thus to the bald remarks of the ancient historian archæology has added such convincing details as these models of the very soldiers, whose 'foreign service' for a considerable period was the comparatively 'light fatigue' of patrolling and repairing the dams of Memphis.

Such a strict watch was still kept up at every Nile flood until a few years ago, when the irrigation works of the British engineers put the water under more perfect control, and thus practically removed the danger from flooding. Centuries of experience of the vagaries of the Nile floods, and perhaps a cautious instinct inherited from those earliest days of human occupation of the Nile valley, when every acre of cultivable land had to be won from Nature with great hardship and risk, must have made the Egyptians more than usually careful of their dykes. At all events it is interesting to note that throughout the five millennia of its history, during which we frequently hear of looting and partial destruction by conquering armies, there is no record, so far as I am aware, of the flooding of the town of Memphis. Yet its modern namesake, although advantageously situated on the hills forty feet above the river, and in spite of all the resources of modern science, is suffering this grievous calamity little more than a century after its foundation.

S. R. K. GLANVILLE.

Biological Fact and Theory.

TEMPTING though it is to deal with Prof. Huxley's personal references to myself and others, as they have no bearing upon the argument, I would return to my protest against his dogmatic statements about doubtful matters.

Among "the fundamentals of genetics to date" (NATURE, Mar. 5, p. 350) Prof. Huxley gives "the proof that the chromosomes carry the genes, and that the genes are arranged in linear order," and "the individuality of the chromosomes." The 'genes' are of course the factors of Mendelian heredity. I think I am right in saying that they are assumed to be small particles arranged in regular order in the chromosomes, each representing a particular character. Also it is apparently assumed that *all* characters are represented by genes.

Now the usual mode of distribution of the chromosomes between dividing cells before fertilisation, provides a perfect mechanism for the distribution of the 'genes' according to the 'Neo-Mendelian' theory, but this mode of distribution is not universal in connexion with fertilisation, as I have already pointed out (NATURE, Jan. 29, p. 161). The continuous individuality of the chromosomes from generation to generation of cells and whole organisms may be a fact in some cases, but is very doubtful in others. They appear only during the process of mitosis in most organisms. Several investigators of repute (*e.g.* Child, *Biol. Bull.*, vols. 12, 13, 1907; vol. 18, 1910; vol. 21, 1911) claim that amitosis occurs among the cells destined to produce gametes. Personally, I think there is some other explanation than amitosis for these appearances, but until this and the other points to which I have referred are demonstrated, the individuality of the chromosomes must remain as an attractive working hypothesis.

While in breeding experiments certain groups of characters do appear in the individuals of consecutive generations in the Mendelian manner, the great majority of characters are common to all the individuals of a race or even many races, and any such mechanism as is provided by the chromosomes for the distribution of Mendelian characters would prove an obstacle were these common characters represented by unit factors arranged in regular lines in the chromosomes. Moreover, certain breeding experiments suggest that similar characters (*e.g.* colour) may blend when races geographically widely separated are crossed, but segregate in the case of local variants (Prout and Bacot, *Proc. Roy. Soc.*, B, vol. 81, 1909; *Entomologist's Record*, 15 and 16, 1906; *Trans. Entomol. Soc. Lond.*, 1906; *Proc.*, 1907). Blending of such important characters as the number of the vertebræ occurs in crosses between *Salmo salar*, *trutta* and *fario*. The progeny are fertile and there is apparently no segregation (Walker, "Hereditary Characters," 1910). "Very frequently, if not always, the character that has once been crossed has been affected by its opposite with which it was mated and whose place it has taken in the hybrid," and "Everywhere unit characters are changed by hybridism" (Davenport, "Inheritance in Poultry," p. 80, 1906). Many other instances might be cited.

The theory seems to me the most probable which requires least in the way of assumption. That recent variations are transmitted in the Mendelian manner; that they are always tending to blend more and more if they are preserved from generation to generation; and that racial characters, derived originally from individual variations, are produced through the general potentialities of the cell for development within definitely restricted limits, seems to me to require less in the way of assumption and to agree more easily with known facts than what is now put forward as the "Neo-Mendelian Chromosome Theory."

That the chromosomes are concerned in the transmission of the potentialities for developing Mendelian characters is an attractive and probably useful working hypothesis, and so long as Prof. Huxley and "the whole body of those engaged upon genetical research" treat this and the other hypotheses involved as useful "conceptions and theories" (as he now calls them, NATURE, April 30, p. 639) and not as 'laws' and proven facts, no one can complain.

"If therefore the Reader expects from me any infallible deductions, or certainty of *Axioms*, I am to say for myself, that these stronger Works of Wit and Imagination are above my weak Abilities. Wherever he finds that I have ventur'd at any small

Conjectures, at the causes of things I have observed, I beseech him to look upon them only as *doubtful Problems*, and *uncertain Ghesses*, and not as unquestionable Conclusions, or matters of unconfutable Science" (Robert Hooke, *Micrographia*, 1665 (Preface)).

CHARLES WALKER.

The University of Liverpool,
May 4.

The Coat of Sheep.

THE letter under this title, by Prof. J. Cossar Ewart, in NATURE of Mar. 19, contains some observations so divergent from those we have made here that it seems desirable to contrast the two. He remarks: "From an investigation which has been in hand for some time on the structure of the fibre forming the coat of sheep, it has been ascertained that in sheep, as in man, the first coat consists entirely of simple pithless fine-wool fibres." In the course of investigations on South African sheep and wool, I have procured a fairly complete series of fœtuses of the Merino, blackhead Persian, Afrikander, and Karakul, as well as of the Angora goat; and in each case microscopic sections have been made of the different stages in the development of the hair and wool. In view of the statement that "the first coat consists entirely of simple pithless fine-wool fibres," a re-examination has been made of all this material.

Prior to the extrusion of any fibres, apart from the coarse stiff ones over the lips, eyelids, and tip of tail, the appearance of the fœtal skin in sections is much the same in all the types. The hair plugs vary much in depth within the dermis, and keratinisation first appears within the deeper and thicker follicles. Likewise the fibres from these are the first to reach the surface, and break through the outer cuticularised layer of the epidermis. For a short time after the extrusion only the tips are visible, and the degree of differentiation is so small that little distinction can be made between hair and wool. Later, when an external difference is apparent, the outer fibres are in every case the stronger and the inner are the finer. Moreover, in transverse sections of the skin the stronger fibres often reveal a medulla, while the fine fibres are solid. Fortunately, no uncertainty exists in the recognition of the medulla in sections, though its early stages are difficult in the extruded fibre. I have already shown (Duerden, J. E., and Ritchie, M. I. F., "Development of the Merino Wool Fibre," *S.A. Jour. Science*, vol. 21, 1924) that in the Merino it arises from the hair germ as a direct upward continuation of the basal layer of the epidermis, and its cells undergo keratinisation later than those of the cortex, cuticle, and inner root-sheath; stained in picro-carmine they are a brilliant red, surrounded by the clear yellow cortex.

On account of the evolutionary loss of most of the hairy fibres in such fine-woolled sheep as the Merino, and the feebleness of the medulla in those which remain, the distinction between hair and wool is not strongly marked. The blackhead fat-rumped Persian, now so plentifully farmed in South Africa for its superior mutton, however, has a covering altogether resembling that of wild sheep, namely, an outer hairy coat and an under woolly one; and it may therefore be taken as representative of the ancestral condition of all sheep. By the time differentiation of the fibres is established in the fœtus the coarse, hairy, medullated fibres are found to project much beyond the fine wool, and there can be no question of the coarser fibres having appeared first.

The long stiff fibres of the lips and eyelids remain for the most part non-medullated until towards the close of fœtal life when, with increasing diameter, a pith develops; so that these fibres, the first to protrude, are truly hair, not wool. The morphological value of a fibre can scarcely be estimated before its growth is completed.

The results may be summarised as follows. The coarse medullated hair of the sheep and the fine non-medullated wool appear on the fœtus at about the same time, the stronger fibres slightly in advance of the finer. In fine-woolled sheep the distinctions between the two sets of fibres are not pronounced in the early fœtus, and the entire coat may have a semblance of wool; but towards the end of fœtal life a medulla appears in the stronger fibres, thus marking them off as hair, and as representative of the ancestral outer hairy coat. In wild and coarse-woolled sheep the distinction between hair and wool is apparent much earlier, and the growth of the hair throughout is in advance of that of the wool.

J. E. DUERDEN.

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Chemical Formulæ of Mineral Compounds.

DURING the last decade I have accumulated some new facts which I believe are of fundamental significance. Certain theoretical considerations require that the chemical formulæ of *all* true mineral species composed of any of the first twenty-one elements of the periodic system should obey the following simple equation:

$$M = 2a + 8n,$$

where M is the molecular number (*i.e.* the total atomic number in the compound), a the number of atoms, excluding hydrogen, and n any integer.

My first notes, based on Dana's "Text-book of Mineralogy" (1912), recorded five exceptions to the above equation, disregarding four substances of organic origin. Later I verified that Dana (1922 edition) corrected the formulæ of aluminite and lazurite, leaving me with three exceptions only. Afterwards I obtained from other sources the corrected formula $(Na_2,Ca)O \cdot Al_2O_3 \cdot 5SiO_2 \cdot 10H_2O$ for faujasite and $CaMg_3(SiO_3)_4$ for tremolite, which left tavistockite as the sole exception for some time. Mellor's "Inorganic and Theoretical Chemistry" (1923) mentions the latter as $Al_2Ca_3(OH)_6(PO_4)_2$, which is in perfect harmony with my equation. Granting the correctness of this formula, my list of exceptions is now reduced to merely four organic minerals—whewellite, oxammite, mellite, and fichtelite. These, however, were expected and bear a theoretical significance which cannot be discussed here. I have been able to cover most of the remaining minerals by a modification of the above equation based on a new theory, the satisfactory completion of which involves difficulties which I hope to overcome.

L. W. TIBYRIÇÁ.

Caixa 1330,
São Paulo, Brazil,
Mar. 25.

MR. TIBYRIÇÁ'S formula, which amounts to the statement that $M - 2a$ is divisible by 8, may be interpreted in the following manner. Every atomic number of the elements from 2 (helium) to 21 (scandium) may be represented by the expression $2 + 8d + v$, where d is an integer from 0 to 2 and v an integer from 0 to 4, equal to the valency of the element. This is supposed to be due to the arrangement of the electrons in layers; the first complete layer consisting of two, the second and third of eight electrons each; the valency being an excess above or a deficit below a complete layer. The elements with $+v$ are often

described as positive, those with $-v$ as negative. In any compound of two atoms in which the atomic number of one contains $+v$, and that of the other contains $-v$, the total 'molecular number,' M, will be $2 \times 2 + 8(d + d')$, where d and d' may be the same or different. Similarly, in a compound containing a atoms, with the sum of the + valencies equal to that of the − valencies, the total molecular number will be $a \times 2 + 8(d + d' + \text{etc.})$, where $(d + d' + \text{etc.})$ is an integer n. This is Mr. Tibyriçá's formula. In minerals, which are compounds, consisting only of elements with numbers from 2 to 21, all combination is between elements with + valency (including for this purpose the tetrads) and those with − valency, and their valencies are all satisfied. The only exception of which I am aware is carbon monoxide, which undoubtedly exists in a natural state.

So far, the element hydrogen has been left out of consideration. Its atomic number, $2 + 8 \times 0 - 1 = 1$, satisfies the same conditions as do the other elements up to 21, but though it has a − valency of 1, it behaves as an element with + valency and combines with elements with − valency, instead of those with + valency; thus water or ice would not satisfy Mr. Tibyriçá's formula. For $M - 2a = 2 + 8 - 6 = 4$, which is obviously not divisible by 8 If the elements of an even number of molecules of water be present in a molecule and the other elements present satisfy the formula, the mineral as a whole will do so. But if only the elements of an odd number of molecules of water be present, it will not. Thus, if tavistockite have the formula $Al_2Ca_3(OH)_6(PO_4)_2$, Mr. Tibyriçá's formula would not apply. For $M = 234$ and $2a = 54$; so that $M - 2a = 234 - 54 = 180$, which is not divisible by 8. But it appears that in calculating the number of atoms, a, he does not include atoms of hydrogen, though he includes their atomic number in calculating M. Consequently for water $M - 2a = 2 + 8 - 2 = 8$; so that for minerals with an odd multiple of the elements of water, $M - 2a$ is still divisible by 8.

J. W. E.

Progressive Lightning.

I HAVE read with interest Prof. Boys's comments on the phenomena of "Progressive Lightning" in NATURE for Feb. 19 last. The object of this present note is to direct attention briefly to some considerations in connexion with that phenomenon which occurred to me after writing my note of Dec. 19, and do not appear to have been discussed so far as I know, and to clarify and supplement some points brought out by Prof. Boys.

At the outset I must say that I have made no especial studies of these phenomena, but have simply observed them as one interested in all Nature. The generally accepted explanation of the multiple flashes as progressive discharges through a channel rendered a better conductor by the preceding discharge, was seemingly so sound and reasonable that it was a profound surprise to note what appeared to be different behaviour of the near flashes. I would be glad to supplement my visual observations by photography, but that is impossible. I have more investigations in hand now than I can finish, and my experience has invariably been that even an apparently simple problem reveals so many by-paths and requires so many subsidiary investigations that it becomes a major one before a solution is reached—if ever.

Prof. Boys's observations of close-by multiple flashes seems to set at rest the question of the phenomena depending only upon distance, as my observations seem to indicate. He quite properly raises the point of a near flash blinding the eye to subsequent ones. In my own case this can scarcely be the explanation of the failure to observe multiplicity in the near-by flashes, because many of those very close were not seen directly but by their general illumination, which is not sufficiently blinding and would not prevent noting subsequent ones. Many were also observed in day time, when blinding is much less likely to occur. Certainly a negligible number of my observations could have been so affected.

After sending my former note another fact impressed me, namely, that the general glare accompanying distant flashes appears also to be of greater duration than those near by, about in the same ratio as the flashes themselves. This is very difficult to explain on almost any hypothesis. Ordinary refraction or reflection phenomena alone appear inadequate, as the great velocity of light would limit such effects to a negligible fraction of a second.

It may be urged that there will be a persistence of such phenomena so that the duration will appear sensible. There is no reason, however, that I can see, why such persistence of vision should be greater in distant than in near flashes.

While I feel some confidence in the reality of the difference between near and distant flashes observed here, I also feel that it should be confirmed by photographic observations before considering it as established, because of Prof. Boys's observations of multiplicity in near-by flashes and because of theoretical objections. I should hesitate to believe that there was any essential difference in such phenomena here and in England, for example, without further evidence.

I have considered only discharges of lightning to earth, because discharges between clouds seemed to present some anomalies.

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BEING essentially an experimentalist, I am of opinion that the subject of "Progressive Lightning" is one for experiment rather than discussion, and that the simple apparatus for causing two images to move at equal speeds upon the photographic plate but in opposite directions so as to obtain opposite aberrations, which I described in NATURE of Nov. 20 last, is likely to give direct information as to fact. Dr. Simpson has this now, and I am hoping that the experiment may be made also in America, where the method has attracted some attention.

C. V. BOYS.

Rotation of Dielectric Bodies in Electrostatic Fields.

REFERRING to the letters by the late Dr. S. W. Richardson and by Mr. G. L. Addenbrooke in NATURE of Feb. 12 and Mar. 12 respectively on the rotation of dielectric bodies in electrostatic fields, the following may be of interest.

We have recently observed that if the metallic points of a Hamilton reaction mill or 'electric whirl' are replaced by dry wooden points, the normal direction of rotation is reversed; that is to say, instead of rotating in a direction *opposite* to that toward which the points are directed, the mill with wooden points rotates in a direction the *same* as that toward which the points are directed. The cause of the rotation under these conditions must then be quite different from that when metallic (good conducting) points are used—where the explanation is that ions are produced in the immediate vicinity of the point by the process of ionisation by collision, those of *opposite* sign to the charge on the point are

immediately drawn into it, those of the *same* sign are repelled, and that the rotation is due to the mutual repulsion between the swarm of latter ions and the charge on the point.

It is interesting to note that a wet point (we used ordinary matches for points) will rotate in the normal direction at first, then, as it dries, decrease its speed, come to rest, and finally begin to rotate in the opposite direction.

Rectangular blocks of paraffin mounted non-symmetrically on the arms of the mill (two straight brass arms were used mounted on the head of an ordinary speedometer connected to one pole of a large Holtz machine, the other pole being connected to a plane wire netting suspended in a horizontal plane above the rotating arms and parallel to them) behaved in a similar manner to the dry matches, *i.e.* rotated in the direction toward which the greater part of the block protruded. In the dark in the latter case, extensive brushes could be seen on the arms near the paraffin, and there is no doubt that the action of the block is to form a non-symmetrical brush, which drives the arms much the same as the brush from a metallic point drives it. The brush, of course, is formed on the side of the block which protrudes least from the arm in the plane of rotation.

In the case of the matches the cause of the rotation is not so clear. Only a faint glow can be observed on the end of the match. It seems likely, however, that the action of the dry match is to disturb the faint (silent) discharge from the arms of the mill, retarding it on the side toward which the match protrudes, so that the major portion of the brush forms on the side of the arm opposite to the match and so drives the arm in the direction toward which the match extends. This point is still under investigation.

A. W. SIMON.
J. M. CAGE.

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Yolk Formation in some Arthropods.

THERE has recently been controversy between Harvey on one hand and Gatenby and Vishwa Nath on the other, as to the relationship of Golgi apparatus and mitochondria to yolk formation.

I have been myself engaged on this particular problem for the last year or so. A brief account of a portion of my work in collaboration with Dr. Vishwa Nath was published in NATURE of Nov. 6, 1926. I have since then worked out three more arthropod forms, namely, *Musca domestica*, Forficula and Porcellio. The relationship of yolk formation to the cell inclusions may be described as follows.

In Musca the nucleolus divides at a very early stage and the various nucleoli begin to fragment. These fragments soon escape into the cytoplasm but do not undergo any further fragmentation. Simultaneously with the escaping of these extrusions, a fuchsinophil yolk arises in masses all over the cytoplasm. In Scolopendra (Nath and Husain) a similar though not identical relation has been noticed between this yolk and the extrusions. In Forficula the fragmentation of the nucleolar extrusions has been followed in most eggs. In Porcellio, the nucleolus does not fragment at all, and it is interesting to note that there is no proteid yolk in this form.

In all three cases both the Golgi apparatus and mitochondria have been observed. The latter are always granular and never filamentous. They are seen to divide but never swell up into yolk of any kind. The Golgi apparatus is seen as a juxta-nuclear mass in the younger eggs of all forms. It is always in the form of dots and dashes and never discoid. It does not arise *de novo* in the cytoplasm but is formed by the multiplication of the pre-existing Golgi elements. In Forficula and Porcellio, free fat arises directly by a metamorphosis of the Golgi apparatus. In Musca the latter never swells up, and in correlation with that it is interesting to note that there is no fatty yolk in this form.

A detailed account will be published later.

MIAN TASDIQUE HUSAIN.

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Government College,
Lahore (Punjab),
April 11.

Soft X-ray Spectra.

ALTHOUGH much general information of soft X-ray spectra can be obtained by photoelectric methods, there is an urgent need for its direct spectroscopic confirmation. Dauvillier (*Jour. de Phys. et le Rad.*, **8**, 1; 1927) has recently photographed some lines of boron, carbon, oxygen, and thorium between 25 Å.U. and 125 Å.U. by refined methods of crystal spectrometry. Spectra in this region can also be obtained from a concave glass grating if it be mounted at a sufficiently large angle of incidence.

Using the anticathode of an X-ray tube as a source of radiation, I have, by this method, obtained photographs of some fifteen lines between 40 Å.U. and 200 Å.U. Their interpretation requires some care, since, in general, the same lines appear whatever the nature of the anticathode. The K line of carbon (44 Å.U.) is present on all plates, though in varying intensity, due presumably to the destruction of residual vapours in the tube. The L lines of carbon and the K and L lines of oxygen and nitrogen fall outside the region covered by these experiments; as possible causes of the observed spectra there remain strontium, barium, and platinum deposited from the filament on the cold anticathode. Perhaps the most prominent of the lines which have so far been fitted into the scheme of X-ray levels is the $M_{I,II}$ doublet of strontium ($\lambda = 159$, 160·1 Å.U.). A few lines appearing faintly on the photographs seem to be due to the anticathode itself—lines associated with the M levels in the case of zinc, copper, and iron.

A curious feature of the spectrum of aluminium is the presence of a kind of band, with a sharp limit at 166·6 Å.U., shading off towards longer wave-lengths. It appears to be not without structure, though this cannot be definitely asserted until further experiments have been performed.

It is worth mentioning that spectra in this region can also be obtained from a grating of speculum metal, though with considerable difficulty; and that Schumann plates are at least fifty times as sensitive as X-ray plates, even though they are treated with a fluorescent oil.

T. H. OSGOOD.

Ryerson Physical Laboratory,
University of Chicago, April 11.

Consideration of Six Cases in Zoological Nomenclature.

THE Secretary of the International Commission on Zoological Nomenclature has the honour to invite attention of the zoological profession to the fact that application for 'suspension of the rules' has been made in the six following cases:

I. *Odontaspis* Agassiz to be retained with *Carcharias taurus* Rafinesque as type.

II. *Eulamia* Gill to be retained for *Carcharias* Mueller and Henle (not Rafinesque, 1810).

III. *Carcharodon* Mueller and Henle, 1838, to be retained.

Cases I., II., and III. would involve treating Rafinesque's Caretteri (April 1810) and his Indice (May 1810) as two parts of one and the same paper.

The rigid enforcement of the rules would retain *Carcharias* vice *Odontaspis*, *Eulamia* vice *Carcharhinus*, and *Carcharhinus* vice *Carcharodon*.

IV. In *Aëtobatus*, *Raja* (*Aëtobatus*) *vulgaris* to be understood as *Raja aquila*, for which it was obviously intended. This replaces *Myliobatis* Cuvier and leaves *Stoasodon* for *narinari*.

V. Suppression of "Synoptisches Verzeichnis . . . der Baikalflohkrebse" in *Bull. Internat. Acad. Pol. Sci. et Let.*, 1926, pp. 1-77, from nomenclatorial consideration. Examples of generic names used: *Siemienkiewicziechinogammarus*, *Cancelloidokytodermogammarus*, *Lovenіnuskytodermogammarus*, *Parapallaseakytodermogammarus*.

VI. *Lithostrotion striatum* Fleming, 1828, to be declared genotype of *Lithostrotion*, in place of *L. floriforme* designated by Edwards and Haine, 1851.

Zoologists interested in these cases are cordially invited to communicate their views to the Commission not later than Jan. 1, 1928. C. W. STILES.
(Secretary.)

U.S. Public Health Service,
Washington, D.C.

Odours and Visual Imagery.

THE relative inhibition of cortical brain functions and the progress of uncritical activities, such as imagery, during the initial and terminal phases of sleep (cf. NATURE, Aug. 7, Sept. 11, and Oct. 30, 1926), may find a parallel in certain cases of visual imagery induced by odours. The following illustration may be of interest. A small bottle containing methyl salicylate was associated consciously and deliberately with a number of circumstances in which some experiments had been carried out three or four years ago. On withdrawal of the stopper, the odour induced a visual image of a medical practitioner in a bedroom, merging into the image of a table with a tumbler of water and a spoon. Afterwards, the image, or images, were found to be as blended as the content of a dream, since the room, the doctor, and the table, had to be referred to widely separated times and places. *Litera odorata manet.*

The similarity between such a smell association and dream phenomena calls to mind the argument put forward by Dr. Halliday (*Glasgow Med. Jour.*, Mar. 1926) as to the correspondence between verbal aphasia conditioned by deterioration of the neopallium and the natural aphasia as regards names for smells, due to the absence of higher integrating levels in the archi-pallium.

The above considerations, together with numerous records of smell associations, reinforce a suggestion (*Brit. Med. Jour.*, 1922, i. p. 904) that odours should be used in psycho-analytical practice. In the treatment of neuroses on analytic lines, the overcoming of a high resistance in certain patients by means of images recalled by olfactory stimuli has been found recently to be of some considerable practical value.

J. H. KENNETH.

The Homestead, Clynder,
Dumbartonshire, May 3.

Effect of Temperature on the Refractive Index of Rocksalt.

WE are writing to direct attention to a source of error which may occur in spectroscopic investigation of the infra-red region of the spectrum. On reviewing the literature in which experimental work in this region is reported, we find that usually no note is made of the temperature of the prism at the time when the experiment is being conducted. In the course of investigations which we have been carrying on for some time on the absorption of gases in the near infra-red, we have had occasion to observe the important effect of temperature on the refractive indices of rocksalt and fluorite. Thus, a variation of 5° in the working temperature would result in a difference of so much as 0·075μ (about 180 wave numbers) in certain parts of the near infra-red.

The commonly adopted practice of accepting the 4·4μ emission band of carbon dioxide, or the quartz reflection bands, as bench marks is misleading unless combined with suitable temperature corrections of the prism used. It is our intention in the near future to deal with these matters fully and to describe the procedure we adopt to ensure greater accuracy in the determination of infra-red bands with prism apparatus.

R. ROBERTSON.
J. J. FOX.

Government Laboratory,
Clement's Inn Passage,
Strand, London, W.C.2, May 17.

The Industrial Revolution.

MISS BUER, in NATURE of May 7, p. 671, is, I think, under a wrong impression in stating that the use of Newcomen's engine (in England) was not widespread. Statistics are not available, but in 1769, John Smeaton obtained a list of 99 engines that had been erected in the Newcastle-upon-Tyne district alone. Pryce, in "Mineralogia Cornubiensis," 1778, gives the figure for Cornwall as 60 at that date. We have to reflect that the materials of one such engine might cost £1000, and its annual upkeep £200.

Nor is there any evidence that the engine "was frequently abandoned owing to the wasteful consumption of fuel." The engine was only applicable to pumping, and its largest sphere of usefulness was at collieries, where fuel consumption was scarcely a consideration at all. An engine was abandoned or transferred when a mine was given up. Far from being 'experimental,' as suggested, the longevity of these engines was sometimes extraordinary, *e.g.* the one in the Science Museum, South Kensington, was in service for more than a century and a quarter.

H. W. DICKINSON.

The Science Museum,
South Kensington, S.W.7.

Hardness of Metals in Relation to Periodicity.

IN Mr. Mallock's letter (NATURE, Feb. 19, page 276) he states that the periodicity of the hardness he determined does not fit Mendeléef's table. It is interesting to note that the hardnesses, and incidentally also the melting-points, fit rather well into the 18-period spectroscopic table which will be found on page v of the appendix of "Astronomy," by Russell, Dugan, and Stewart. Inspection will show that the hard and soft metals are grouped and differentiated, and sequences with rather well-defined maxima and minima may be observed.

A possible interpretation lies, I believe, in the electronic configuration of the atom in question. Those with the complete electron shells, as for example the rare gases, have low melting-points, whereas those with the shells about half complete, such as tungsen, osmium, and carbon, are the hardest, and with highest melting-point. S. A. KORFF.

Princeton University,
New Jersey, May 4.

The Progress of Hittite Studies—I.[1]

By Prof. J. GARSTANG.

THE remarkable development in Hittite studies, which the circumstances of the War tended to obscure, now merits the attention of all students of history. This progress is due not so much to the results of excavations or further exploration, interesting though these be, as to the decipherment of an important section of the Hittite archives from Boghaz-Keui which opens the doors to more than one library of contemporary documents. The clue was found and established on an Indo-European basis, by Prof. Hrozný of Prague in the early years of the War. Since then a circle of eminent German philologists (amongst whom may be mentioned Drs. Weber, Forrer, Weidner, Figulla, Götze, as well as Profs. Friedrich, Sommer, Zimmern, and others) has placed the new study on a scientific basis by the continuous publication of texts and transcriptions no less than by philological and critical discussion. A new light plays upon Asia Minor under the Hittite kings.

It is both interesting and instructive to look back at the origins of the subject. The Hittites have long been known, from the numerous references in Biblical literature, either as scattered settlers in Palestine or as military peoples in the north of Syria. The latter impression was confirmed, from the time when Egyptian hieroglyphs came to be understood, by scenes and inscriptions on Egyptian temple walls depicting the conflicts of the Pharaohs with this war-like rival, whom they encountered in Syria and called Ḫ-t-ȝ. Two generations ago Dr. Wright hypothesised that certain unexplained hieroglyphic inscriptions found at Hamath and elsewhere in northern Syria must pertain to the same peoples. French scholars and others adopted the idea, and it was recognised that the distribution of such inscriptions was not confined to Syria; but that ruined cities, religious sculptures, and numerous groups of pre-Hellenic monuments bore witness to the same culture-influence in Asia Minor itself. Then Prof. Sayce, who lives to see the verification of his far-sighted conclusions, after examining and comparing certain inscribed sculptures on the western coast near Ephesus, constructed his theory of a long-forgotten Empire of the Hittites, whose kings held dominion over Asia Minor and played their part in oriental history so long before the fall of Troy that their memory scarcely survives in Homeric legend. It was these kings who descended from beyond Taurus and battled with the Pharaohs in the fourteenth and thirteenth centuries B.C.

A theory so comprehensive, albeit plausible, was naturally followed by a period of reactive scepticism and investigation. It suggested, none the less, the lines of practical research. British explorers and scholars, notably Ramsay, Hogarth, Anderson, and others, joined in the quest: new materials were found and cautiously examined. Early in this century English and American universities (Liverpool, Cornell, and Princeton) organised expeditions to collate materials and collect new data. Asia Minor being diplomatically closed, excavations were undertaken by the Liverpool institute and by the British Museum at promising sites in northern Syria.

Meanwhile the German Orient Society had received permission to excavate among the remains of the largest ruined city of pre-Hellenic character in Asia Minor, at Boghaz-Keui, a small village in the north-east of the plateau within the circuit of the Halys River; and there Dr. Winckler, early in the work, had the fortune to discover hundreds of fragments of inscribed clay tablets, numbers of which were in Semitic and could be read. They contained names of Hittite kings and places (some of which could be recognised), names of Syrian princes known from Egyptian sources, records of campaigns and negotiations in Mesopotamia and in Syria; and, most important for history, the names of contemporary Egyptian rulers. Being present at the time, the present writer was courteously permitted to investigate the circumstances of the discovery, and shared in Dr. Winckler's anticipations. It was clear that these tablets contained imperial archives; their presence seemed to fix the royal palace there where they were found, and this was soon confirmed. The Hittite capital was called Ḫattušaš, the homeland Ḫatti. The latter was clearly the counterpart of the Egyptian Ḫ-t-ȝ. Not only was the Hittite Empire a reality, but the Hittite kings emerged into the full light of history, claiming their part in the contemporary events of near Asia. There remained an apparently inexhaustible supply of documents to be scrutinised, but a great proportion was found to be unintelligible though written in cuneiform script. Dr. Winckler was able, however, to publish before his death a number of the Semitic texts, chiefly concerning affairs in Syria, some of them narrating events of which parallel accounts existed from the Egyptian sources, including references to and a draft of the treaty with Rameses II. Hittite studies stood at that stage when last reviewed at the Royal Institution under the same title nineteen years ago.

It now appears from various sources that about 20,000 tablet fragments were recovered, for further discoveries were made in the next year of work. From these some 700 documents have been reconstructed and about 260 have been published. Analysis shows that, apart from the Semitic texts, six 'native' languages are involved, and of these only one, which we may call for the present 'official Hittite,' can be translated with certainty. This language is called by some Kanesic. It forms all kinds of words by suffixes, and three-quarters of its grammatical forms are to be found in Indo-European languages in the same sense. It is safe to premise at any rate a common even though

[1] Summary of three lectures delivered at the Royal Institution on Feb. 24, Mar. 3 and 10, 1927.

remote parentage (Proto-Indo-European). Hittite names, on the other hand, are prefixing, and analogy is to be sought rather in the Caucasus. In Mesopotamia, again, the Mitannian rulers' language was seemingly Aryan with Sanscrit affinities, differing from the common language of the area, which also has Caucasian elements.

The difficulty of language was evidently felt by the archivists of the time, for glossaries were compiled for the translation of unfamiliar expressions, and some documents were set out in parallel bilingual columns. The tablets were in fact the contents of royal libraries of the thirteenth century B.C., and many of them are copies of older documents that had been damaged. They cover a vast range of subjects, from imperial affairs to domestic detail. Treatises on non-political matters were so numerous as to call for a proper inventory or catalogue by the names of authors (both male and female). Among the state documents or copies of them, those of most immediate interest historically include foreign correspondence with Egypt and with Babylonia, correspondence and treaties with the Amorite chieftains of Syria and the smaller states to the north (Aleppo, Nukhašše, Barga, Carchemish, etc.); treaties with a Mesopotamian (Mitannian) prince, as well as private letters between the members of the various royal families. Happily for us to-day, a historical instinct pervaded the foreign office of the time, so that many treaties contain preambles setting forth in chronological sequence the outline of events and past relations between the contracting states or princes down to the framing of the new agreement. These prefaces contain names of old-time kings and places, records of campaigns and rebellions and former treaties. They can be checked in some cases by the prefaces to earlier or later treaties, and occasionally by allusions in documents relating to other states. They are new materials for history; and it is already possible to reconstruct and trace in outline the development of the imperial organisation, in which diplomacy and military genius play a leading part.

The earliest references to Ḫatti occur in the Babylonian records of Sargon and Naram-Sin of Agade, which take us back before the middle of the third millenium B.C. It would appear that Ḫatti was at that time one of the leading tribal areas of Asia Minor. After an interval which can only be approximated at about 500 years, the Hittite archives indicate a period of struggle for the over-lordship of Asia Minor: the first Great-King whose dominion reached to "the sea" and included Ḫatti, resided at Kuššar. Thereafter there is record of some forty-nine Hattic rulers, whose reigns cover approximately the thousand years ending with 1200 B.C. An important synchronism is found in the annals of an early King Mursil, who claims to have captured Aleppo and Babylon, and it is confirmed by the Babylonian records that this invasion brought the first Babylonian dynasty (that of Hammarabi) to an end. Unfortunately, the date of this event is not agreed on by Babylonian scholars, being variously estimated as between 1950 B.C. and 1750 B.C. Further study of the Hittite archives may help to settle that point and others connected with the Hyksos period.

When first Ḫatti became dominant among the Hittite tribes of Asia Minor, their kings continued, it would appear, to reside at Kuššar, but from the epoch of the sack of Babylon the capital is found fixed at Ḫattušaš, and so continued with possible political interruptions until the end. Aleppo claimed great power and temporary independence a century or so later, a date which may have fallen within the Hyksos period. From about 1470 B.C. onwards the records of the Ḫatti dynasty are continuous, comprising twelve consecutive reigns, some of which are described with instructive detail. Relations direct or indirect with Egypt under the eighteenth dynasty, particularly the penetration of Šubbiluliuma into Syria (period of the Amarna letters), the battle between Mutalliš and Rameses II., and the treaty of Ḫattušil III. with the same Pharaoh, give a series of fixed chronological positions on which the framework of international events can be constructed.

(To be continued.)

Wave Mechanics and Classical Mechanics and Electrodynamics.

By Prof. G. A. SCHOTT, F.R.S.

RECENT articles in this journal by Mr. R. H. Fowler, Prof. M. Born, and Dr. P. Jordan have dealt with the relation between Schrödinger's wave mechanics and the quantum theory, but it is admitted that they scarcely express the views of Schrödinger himself or those of his predecessor, L. de Broglie. The object of the present article is to give an account of the researches of these two authors from the viewpoint of classical mechanics and electrodynamics, to which they are closely related, both in subject-matter and method. A brief bibliography of their papers, as well as a few by other writers on the same subject, is appended, to which the reader is referred for details, for an outline only of the line of thought can be given in the present article.

The root of these researches is to be found in the papers of Sir W. R. Hamilton, published a century ago, in which he pointed out the close analogy subsisting between Fermat's Principle of Least Time in optics and Maupertuis' Principle of Least Action in dynamics. Just as Fermat's Principle enables us to trace the paths of light rays with considerable accuracy when the linear dimensions of our apertures and obstacles are large compared with the wave-length of light, but fails when they are so small that diffraction becomes important, so Maupertuis' Principle enables us to predict the

paths of material particles accurately so long as the linear dimensions of the paths are sufficiently large, but fails when they are of atomic dimensions. In such cases we must resort to the methods of wave mechanics.

So much being premised, we may summarise de Broglie's argument thus : every element of energy —electron, proton, or quantum—is associated with a periodic phenomenon, not specified, whose frequency is given by Einstein's equation, whether the element be at rest, or moving with uniform velocity v relative to the observer. In the latter case the periodic phenomenon at a point fixed to the moving element appears to be slowed down, like a moving clock in the theory of relativity, but at a point fixed in the observer's frame of reference it appears as a phase-wave, propagated in the direction of relative motion with the phase-velocity $u=c^2/v$. The velocities u and v are related as wave- and group-velocity respectively. Einstein's frequency equation, together with the Principle of Invariance, makes the momentum-energy fourvector of the moving element a constant multiple of the wave-vector of the associated phase-wave, whence it follows that the Action of the element is a constant multiple of Fermat's time-integral for the phase-wave, so that the Principles of Least Action and Least Time are equivalent, a result generalised by E. Schrödinger and L. Flamm.

Moreover, the quantum integrals of Bohr and Sommerfeld, being essentially Action integrals taken round closed orbits of electrons, are proportional to phase-integrals taken round rays of the associated phase-waves, which rays are identical with the corresponding orbits. Hence the quantum conditions, which state that the quantum integrals are integral multiples of Planck's Action constant h, are equivalent to the conditions for resonance between the electrons and their associated phase-waves, which state that the changes in phase of the phase-waves in passing round the orbits of their respective electrons are integral multiples of the wave-lengths.

With de Broglie the concept of the electron or other element of energy is primary, whilst that of the phase-wave is secondary, but with Schrödinger the position is reversed. In his theory the principal part is played by the so-called wave-function ψ, which determines the phase-waves and is a solution of a linear partial differential equation of the second order of the type of the wave-equation in classical mathematical physics. The electron, or element of energy, becomes merely a focus of a group of phase-waves, and in the atom, where the focus is ill-defined, it loses its individuality altogether. In order to re-establish contact with electrodynamics, Schrödinger finds it necessary to introduce a new and at first sight arbitrary hypothesis, defining the density of electric charge in terms of the wave-function, but justified by the results to which it has led at the hands of Schrödinger himself, of A. Sommerfeld and his pupil F. G. Slack, and of J. C. Slater.

Originally, Schrödinger deduced the wave-equation from a form of the Principle of Least Action suitably modified to suit a continuum of n-dimensions. He takes an integral—which we shall call I for the sake of brevity—of the form $I=\int(H-E)\mu d\omega dt$, where H is the Hamiltonian function, expressed in terms of generalised co-ordinates q and momenta p, E is the total energy, μ a suitable factor, used if necessary to make the integral invariant, and $d\omega$ is an element of extension of the q-space of n dimensions. He then replaces p by $\partial S/\partial q$ as usual, where S is Hamilton's characteristic function, puts $S=K\log\psi$, where K is a constant of the dimensions of action, and ψ the wave-function, chooses μ to be proportional to $\psi\bar{\psi}$, where $\bar{\psi}$ is the conjugate of a complex ψ, and finally makes the integral I stationary by varying ψ. This somewhat arbitrary process by the usual method yields the wave-equation. For a particle moving in 3-dimensional space it reduces to

$$\nabla^2\psi+\frac{2m}{K^2}(E-V)\psi=0,$$

where m is the mass of the particle, and V the potential energy. In his later papers Schrödinger postulates the wave-equation once for all ; it has been generalised in various ways, which need not be particularised here, by Schrödinger himself and others, notably de Broglie, L. Flamm, and O. Klein.

In general the potential energy V introduces singularities into the wave-equation, and we must seek a solution ψ, which shall be one-valued, finite and continuous even at the singularities. The conditions that this may be the case automatically select values of the energy constant E and corresponding energy levels and normal frequencies, which are alone possible for stationary processes in the system, without any appeal to extraneous quantum conditions. Thus the singularities of the wave-equation are analogous to the boundaries in such classical problems as that of the motion of a stretched string or membrane.

For example, in the problem of the hydrogen atom we have $V=-e^2/r$ in the usual notation ; the singularities are $r=0$ and $r=\infty$, and the corresponding conditions make all positive values of E possible, but only a discrete series of negative values, given by $E=-me^4/2K^2l^2$, where l is an integer. The former determine a continuous series of infinite electronic orbits ; the latter a discrete series of finite orbits, agreeing with Bohr's stationary orbits, if we put $K=h/2\pi$. In order to obtain the Balmer series Schrödinger assumes that the normal frequency is approximately a linear function of E—a relation which he states is exact on a relativity theory—and deduces that the lines of the series arise from beats between normal modes of vibration simultaneously present in the atom. In later papers he solves other problems, such as those of Planck's oscillator and the rotational oscillator, and introduces a method of perturbations for the study of more difficult cases, such as the Stark effect and the problem of dispersion and resonance, but we cannot describe his results in detail here.

In his second paper, Schrödinger pursues the analogy between Hamilton's Principle of Varying

Action and Fermat's Principle of Least Time for the propagation of waves in an n-dimensional space, now using Hamilton's Principal Function $W=-Et+S$ in place of S. The surfaces $W=$ constant are the wave-surfaces, propagated with the phase-velocity $u=E/\sqrt{2(E-V)}$, and belonging to a progressive wave-motion in the q-space. The image of the mechanical system in this space, which is determined by the instantaneous values of the co-ordinates q, moves along an orthogonal trajectory of the wave-surfaces—a ray—with the velocity $v=\sqrt{2(E-V)}$, so that $uv=E$. On the assumption that the waves have a time factor $\sin(2\pi W/h+\text{constant})$ the frequency is given by Einstein's equation $\nu=E/h$, and v becomes the group velocity corresponding to the phase-velocity u, a generalisation of de Broglie's result, but obtained from classical mechanics and not from relativity. Schrödinger concludes that a group of approximately monochromatic waves, of dimensions of many wave-lengths in all directions, represents a material particle, but only when the path is large compared with a wave-length. Then Jacobi's dynamical equations show that the image of the mechanical system always coincides with that point of the q-space at which a certain continuum of waves of the group are all in the same phase, thus constituting a 'packet of waves.' A one-dimensional example of such a packet is given in Schrödinger's paper in *Die Naturwissenschaften*. But this representation by an image is only approximate and fails for atomic systems, owing to the indefiniteness of the image; in such cases the true representation of the actual mechanical phenomenon is given by the wave-motion in the q-space and this must be determined from the wave-equation.

To overcome the indefiniteness attaching to the notion of the electron in atomic systems, Schrödinger defines the density of the electric charge, coupled with one of the mass-points of classical mechanics, as the integral, taken over the system co-ordinates of the remaining mass-points of the system, of the product of the classical charge of the selected mass-point by the value of $\psi\bar{\psi}$ at that point, where $\bar{\psi}$ is the conjugate of ψ, when both are complex quantities, ψ and $\bar{\psi}$ being of course normalised to unity. This hypothesis, already referred to above, is really indicated by the choice of the factor μ in the Action integral I, which is clearly proportional to the material density in the q-space, though Schrödinger apparently makes no mention of this connexion. Since it gives results in accordance with experiment and, moreover, agrees with the relativity definition of the electric current vector, there is a good deal to be said for it.

In conclusion, it need only be said that Schrödinger's wave-equation method has already yielded results including and even transcending those obtained by the various quantum theories, and offers a fair prospect of explaining quantum phenomena by means of the methods of classical mechanics and electrodynamics.

BIBLIOGRAPHY.

L. DE BROGLIE: *Phil. Mag.* (6), **47**, 446; 1924; *Ann. de Phys.* (10), **3**, 22; 1925; *J. de Phys.* (6), **7**, 321; 1926; *ibid.* (6), **8**, 65; 1927; *C.R.*, **184**, 81; 1927; "Ondes et Movements," 1926.
E. SCHRÖDINGER: *Ann. der Phys.* (4), **79**, 361, 489, 734; 1926; *ibid.* (4), **80**, 437; 1926; *ibid.* (4), **81**, 109; 1926; *Die Naturwissenschaften*, **14**, 664; 1926; *Phys. Rev.*, **28**, 1049; 1926.
L. FLAMM: *Phys. Zeitsch.*, **27**, 600, 733; 1926.
P. DEBYE: *Phys. Zeitsch.*, **28**, 170; 1927.
A. SOMMERFELD: *Phys. Zeitsch.*, **28**, 231; 1927.
O. KLEIN: *Zeitsch. f. Phys.*, **41**, 407; 1927.
F. G. SLACK: *Ann. der Phys.* (4), **82**, 576; 1927.
J. C. SLATER: *Proc. Nat. Acad. Sci.*, **13**, 7; 1927.

Obituary.

PROF. G. O. SARS.[1]

THE name of Georg Ossian Sars, who died on April 9 at eighty-nine years of age, has been classic to every marine zoologist for three generations—indeed since the elder, Michael Sars, then a clergyman at Florö in western Norway, published his "Beskrivelser og Jagttegelser" (1835), followed by other important memoirs which by and by led to his appointment to the chair of zoology in Oslo (Christiania) in 1854. Born in 1837, Georg Ossian Sars had the priceless example of a distinguished father and a sympathetic home, where his innate enthusiasm for marine zoology was welcomed and encouraged in no ordinary degree. Thus from early youth onward almost to his ninetieth year, the talented brain and hand unceasingly laboured at his cherished subject with a success almost unrivalled in modern times.

After a careful training in the schools of Bergen and Christiania, Sars entered the University of the latter city, where he distinguished himself in geography and natural history, finally receiving a gold medal for his researches on Crustacea. His original contributions to marine zoology thereafter began with a paper on the Cladocera in the 'sixties of last century, and by and by ranged over the whole field from Protozoa upward, so that he has left a remarkable record.

When still a young man (in 1864), Sars became a member of the Fisheries Scientific Research Committee and had facilities for studying the development of the cod off the Lofoten Islands (where his father had worked before him) on the north-west coast of Norway. He found that the cod, contrary to the general opinion, spawned in midwater, and that the eggs were pelagic, that is, float in the water, as a rule—indeed, keeping near the surface—as likewise do the newly hatched larvæ; and so with the haddock, flounder, and mackerel. We can imagine the eagerness with which he would have welcomed a marine laboratory for these and other researches in touch with his University and his class, as at fortunate St. Andrews. A skilful artist (for his touch on the black-board always delighted his students), he made a series of coloured drawings of the various stages in the developing cod, and sent

[1] I have thankfully to acknowledge information concerning the deceased naturalist from Dr. Nansen, Prof. Nordgaard, and Dr. Calman.

them to the Great Fisheries Exhibition in London in 1883, where they attracted the attention of all marine zoologists, and stimulated those specially interested in the fisheries to further investigations. He was truly the pioneer in this department and was worthy of the distinction, though subsequent observations demonstrated that the ways of Nature in the ocean are not at the mercy of currents. Thus, for example, the young cod, hatched in the offshore, seek the rocky margins of the inshore when about an inch in length, whilst the haddock passes this stage in deep water. The herring, moreover, appears to be independent of drift and currents, its eggs being adherent to the bottom, producing larvæ and young which remain near their birthplace until their powers of swimming enable them to follow Nature's instincts. Currents, again, will not fully explain the life-history of the eel. Be this as it may, G. O. Sars has the honour of leading the way into this important field. In 1874 he was appointed to the chair of zoology in the University of Oslo as successor to Prof. Halvor Rasch.

Sars' continuous researches in marine zoology during a long life are almost unequalled in the history of the subject, and strike the observer both with respect and amazement. Not only did he largely extend the boundaries of knowledge in relation to his own wonderful seas (not to allude to his work in editing various posthumous memoirs of his father), but also most of the important expeditions, from the *Challenger* to the "Voyages of the Prince of Monaco," sent him materials for study. Further, collections from New Zealand and Australia, China and the Polar Sea, South and Central Africa to Tanganyika and other places, furnished materials for his eager microscope, even dried mud from Australia and New Zealand disclosing new forms to the indefatigable worker. Moreover, when we reflect that whilst his special studies centred in the wide field of the Crustacea with autograph figures of all the Norwegian species, his unceasing labours comprehended Protozoa, Cœlenterates, Echinoderms, Bryozoa, Annelids, Mollusca (including a volume of 446 pages and 52 autograph plates on those of Norway), and even added to our knowledge of the Blue Whale and the Finner, our admiration is involuntary. No self-seeking element was there, only the inborn and genuine love of Nature and her works. His numerous original memoirs were mostly illustrated by his own facile pencil and brush, and when it is mentioned that no less than two thousand two hundred and thirty plates—including a few maps—were a portion of the result of his untiring zeal, some idea of the stupendous task may be estimated, a task at which even a more robust frame may have quailed. His studies on the copepods alone were sufficient for a reputation.

Sars' strenuous life made him more or less a recluse, but he was beloved by his students and friends, and he was ever ready to help a scientific visitor from other countries with his great knowledge and experience. As a foil to his labours he was wont to solace himself with his violin, as befitted a member of a musical family. Of a wiry frame and with refined features and dark hair like his mother and his late charming and accomplished sister, Mrs. Fridtjof Nansen, he was enabled to carry on his researches until a week or two before his somewhat sudden death—from weakness and old age. He passed away just as his colleagues, friends, and pupils had thought to celebrate the old scientist's birthday, and they had to be content with assembling at the grave to pay a last tribute. Yet though his hair whitened and his sight became dim, whilst the cramp of age somewhat affected his writing, his drawings to the last lost little of their pristine firmness and beauty—so much valued in his early years by his father. His long and busy life of unswerving devotion to marine zoology was as noble as it was rare. His career throughout was an honour to science, to his country, and to his race, and though Norway has a roll of many distinguished zoologists and explorers, it will be long before so enthusiastic and so persevering a student of the rich creeks, bays, and seas of his native country will be found.

Sars was an honorary member of numerous scientific societies in Europe, the United States, and New Zealand. He was also Commander of the 1st Order of St. Olav of Sweden; indeed, he was the recipient of many honours appreciative of his distinguished services to science. W. C. M.

PROF. M. F. FITZGERALD.

PROF. MAURICE FREDERICK FITZGERALD, B.A. (Dublin), D.Sc. (Belfast), was born on July 10, 1850, and died on May 4. The eldest son of the late Right Rev. Wm. FitzGerald, Bishop of Killaloe, he came of a family greatly distinguished in science. A brother of the late Prof. George Frances FitzGerald, F.R.S., and nephew on the mother's side of the late George Johnston Stoney, F.R.S., and Bindon B. Stoney, F.R.S., the eminent engineer, he early showed mental powers of a high order. He entered Trinity College, Dublin, in 1867, gained a scholarship in mathematics, and graduated with honours in 1871. In the following year he became a pupil with Messrs. Easton and Anderson of Erith ironworks. Under that firm he had experience on the sewerage of Doncaster and the erection of pumping machinery on the Clyde, and in 1875 went to Russia to instal similar plant at the Cronstadt graving docks. He was afterwards employed by the Russian Government on works at Riga and Odessa, and on his return to Ireland took part in important drainage works on the Shannon.

In 1884 FitzGerald was appointed to the chair of engineering in Queen's College, Belfast, a post which he filled with conspicuous success for twenty-six years. He endeared himself to a long succession of students by his most lovable character and striking individuality as a thinker and teacher. His pleasant voice with its slight touch of southern brogue, his keen sense of humour, and his zest in handling mathematical problems, gave his teaching a constant charm, increasing as the course advanced. The gentle, happy manner in which he put at their service his great natural and acquired abilities

made an unforgettable impression on those who knew him as a teacher and a friend. No pains were too much for him in training men for the arduous career of an engineer, and his guidance and help were freely extended to them after they had graduated. Poverty in material equipment was the lot of all engineering schools until recent times, but FitzGerald had the gift of making improvised models serve the purposes for which expensive apparatus is now widely available.

Before his retirement in 1910, largely due to the stress and strain of his constant but always unobtrusive work in Belfast, FitzGerald had the joy of framing the main lines of a modern engineering school with laboratories in the reconstituted Queen's University. His services were always freely given for the furtherance of the best interests of Belfast and its University. He co-operated heartily with the civic authorities in the foundation and development of their great technical institute, which is most happily linked with the University, and his advice was much appreciated. He took, as Fleeming Jenkin did, an active and potent interest in the improvement of the status and methods of craftsmen employed in plumbing and drainage. This was work of a kind dear to his heart, as he loved the workman, and longed to bring all good knowledge to his aid. He was an indefatigable worker, and filled in any free periods by the pursuit and criticism of questions of the higher mathematics and the subtle riddles of philosophy. He was, moreover, an excellent classical scholar.

His brother George and he had very acute and analytical minds and foreshadowed, if they did not reveal, some of the important discoveries and now accepted theories which have made later students famous. Withal FitzGerald was one of the most modest and unselfish of men, caring not at all for credit so long as good results were secured. His main work was that of a teacher, but some papers by him on rotating discs, whirling shafts, and other abstruse subjects were published in the proceedings of scientific societies. He prepared, after barometric observations over long trails on the Mourne Mountains, an interesting map of their contours.

In 1893 he married Annie Maria Charnock. Their only child, William, joined the Royal Flying Corps early in the War and was killed on service in France. To know Maurice FitzGerald was to gain an added faith in humanity.

News and Views.

THE Colonial Office Conference at its meeting on May 27 adopted the Report of Committee A on Colonial Scientific and Research Services. The committee restricted its inquiry to the three major groups of applied science affecting the non-self-governing Dependencies—namely, medicine, agriculture with its auxiliary branches, and veterinary science and forestry. Since, however, in most of these territories agriculture, including stock-raising, is the principal occupation of the populations, the committee has dealt chiefly in its report with the organisation of the agricultural services. It recommends the constitution of a central council with a chairman appointed by the Secretary of State for the Colonies (who should be a layman), a director (who should be a scientific worker of standing), and a deputy-director (with Colonial administrative experience). The functions of the council should be to make recommendations to the Secretary of State in regard to the broad lines of research programmes, the establishment and maintenance of a chain of Imperial research stations, the creation of a clearing-house of information, the organisation of a pool of scientific workers, and the organisation and general principles of administration of a Colonial Agricultural Research Service. Liaison is to be established and maintained with the Empire Marketing Board, the Medical Research Council, and any other body already existing or set up for the prosecution and encouragement of research of importance to the Dependencies. Although the committee recommends the immediate establishment of distinct services for medical, agricultural, and forestry research, and so on, the possibility of their eventual fusion into one common research service is not discounted. In the formation of the Colonial Agricultural Research Service the committee states that the following condition should be fulfilled: it must be well paid, the members of the service should be liable to transfer, but an officer entering the service must be safeguarded against any loss on transfer.

THE annual report for 1926 of the Imperial Institute shows the progress that has been made since the passing of the Imperial Institute Act of 1925, under the administration of the new Director, Lieut.-General Sir William Furse. The Institute is divided into two departments, dealing respectively with plant and animal products, and with mineral resources. The former, which has seven committees and is under the chairmanship of Sir David Prain, appears the more active; it has during the past year answered 920 inquiries on subjects, of which a selection are mentioned in the report; they include the prevention by planting of the migration of sand dunes in Somaliland, the utilisation of locusts for the manufacture of oil, the machinery for oil palm, and inquiries as to many vegetable products. The Mineral Resources Department during the year has answered 430 inquiries, and has a list of 16 committees. The most active development during the year has been the rearrangement of the exhibition galleries on modern museum lines, aided by contributions from seventeen out of the forty-four British Dominions and Colonies. The reserve material is being removed to store and sample rooms, where it will be readily available for examination by experts. The galleries are being devoted to exhibits of popular interest with many attractive dioramas and transparencies. An Empire Art Gallery offers to exhibit gratuitously

the works of artists from any part of the British Empire. The plan is to make the galleries 'a permanent Wembley' to arouse interest in the Empire and serve as demonstration galleries in connexion with the teaching of geography in London schools. The educational work is being aided by the grant of £6000 from the Empire Marketing Board for the equipment of a cinema, and £1000 a year for five years for its maintenance.

THE financial statement for the year shows that the Imperial Institute has an income of £43,600, of which £33,500 is required for the expenses of the staff, and £1245 for publications. The popular exhibition of material and the development of the Institute to supplement the geographical classes in London schools will not by themselves fulfil the purpose of the Institute and are not likely to secure the permanent financial support of the Dominions and Colonies. They at present contribute £21,000 a year. The statement, however, that the Mineral Resources Department is to publish reports on its investigations shows that the Institute is preparing to improve its service as an information bureau for the Empire by undertaking further investigations on the natural products of our overseas Dominions and Colonies. The permanent success of the Institute will largely depend upon this side of its work. It is discouraging to hear that, in spite of the vast size of the Imperial Institute buildings, the lack of storage space renders necessary the sacrifice of specimens, and that, as regards the Library, "unless further accommodation is provided, much valuable reference material may have to be destroyed, which would considerably affect the efficiency of the two technical departments."

THE annual meeting of the British Science Guild was held on May 26, Lord Askwith occupying the chair. The report presented by Sir Richard Gregory, chairman of the Executive Committee, described the varied work of the Guild, special reference being made to the Supplement, published during the year, to the Catalogue of British Scientific and Technical Works. The Supplement was compiled by Miss D. Shaw from the lists published monthly in NATURE, and its publication was aided by the Carnegie United Kingdom Trust. Sir Richard Gregory admitted the disadvantages of keeping the Catalogue up-to-date by means of annual supplements, and stated that no more supplements would be published, though the issue of a new volume might be undertaken by the Guild later. The report included the text of a leaflet prepared by the Guild's Health Committee on the important question of the medical certification of the fact of death and on the signs of death, in which three simple tests of the fact of death are described. The Guild has been fortunate in securing Sir Alfred Mond as its president in succession to Lord Askwith, whose term of office has expired. Sir Alfred Mond possesses an unusual combination of qualifications for his new work. His name is known and honoured in science, politics, and industry, and his recent achievement in forming the great chemical combine known as Imperial Chemical Industries, Ltd., must contribute, directly and indirectly, to the advancement of pure and applied scientific research. But perhaps his most valuable qualification is possession of the "Yes" complex, to use his own expression, a qualification valuable in any president of a society, but especially in one with such an ambitious programme of work as the British Science Guild.

THE twelfth lecture of the series "Physics in Industry," arranged by the Institute of Physics, was given on May 25 in the rooms of the Institution of Civil Engineers, by Prof. W. E. S. Turner, professor of glass technology in the University of Sheffield. The subject was "Physics in the Glass Industry." Prof. Turner said that although individual scientific workers, among them Faraday, investigated the properties of glass, the subject received little attention in scientific institutions until very recent years. He referred to the research initiated in industrial laboratories on the processes of glass-making and on the properties of the material, and to the impetus which the War gave to these investigations, particularly on optical glass. Manufacturers have believed, and the belief is difficult to eradicate, that correct annealing depends on 'baking' the glass; but recent research on the variation of viscosity with temperature, and in particular the relationship deduced by Twyman, as well as the further investigations which followed from his observations, have shown that the rate of cooling is the important factor. These observations, and related research at the National Physical Laboratory, the University of Sheffield, and elsewhere have resulted in highly important improvements in annealing practice and economy of time in manufacture. Three of the principal physical properties of glass are providing fruitful fields of research, namely, thermal expansion, electrical conductivity, and optical properties. For example, expansion measurements as carried out at the Research Laboratories of the General Electric Company have led to improvements in the manufacture of electric lamps; while observations of the absorptive properties of glass for radiation in different parts of the spectrum have led to the introduction of special glasses for therapeutic and other purposes, for example the 'vitaglass' of Messrs. Chance Brothers.

DISCOVERIES of considerable archæological and historical importance have been made by M. F. Bisson de la Roque on behalf of the Louvre, while working under M. Georges Foucart, Director of the French Institute of Oriental Archæology, at the Temple of Madamud near Luxor. In 1925, a temple of the Twelfth Dynasty was found underneath the Greco-Roman temple, which lies a metre below the present surface, and statues of Senosrit III. and Senosrit II., as well as inscriptions, revealed the existence here of an important sanctuary of the Middle Empire. In 1926, four groups of statuary were discovered, figuring the local god of war, Montou, and his consort Ra Tooui, the first statues ever discovered of these deities, whose cult, lasting down to Greco-Roman times, evidently rivalled that of Ammon

Ra himself. A remarkable bas-relief figures a Roman family partaking of the annual ritual feast held at night. The operations of the current season, which are described by the Cairo correspondent of the *Times* in the issue of May 24, have been directed towards clearing the sacred enclosure around the Temple and its annexes, and have demonstrated the limits of the sacred lake.

THE sensational find of the past season's work, however, came from the Ptolemaic temple itself, where excavations of the interior have brought to light, from the relatively small areas as yet explored, a mass of stone fragments—panels, statues, pillars—used by the builders of the temple for their foundations. On these fragments, which were derived from older buildings formerly standing on the site, are inscriptions and sculptures of the Twelfth Dynasty and, of more importance, of the Thirteenth Dynasty, the first dynasty of the period between the Twelfth and Seventeenth Dynasties of which both historically and culturally practically nothing is known. Seven kings have left at Madamud evidence of their architectural activity, one of them a king hitherto unknown. It is said that the art of the Thirteenth Dynasty here revealed is very characteristic and quite distinct from that of the Twelfth Dynasty, though showing the same qualities of sobriety and elegance. The evidence to be obtained from this discovery, both now and after further exploration, will undoubtedly carry great weight in the discussion of Egyptian chronology and the length of the period which intervened between the Twelfth and Seventeenth Dynasties.

AMONG the greatest of recent earthquakes, whether measured by disturbed area or the range of its recorded oscillations, is that of Dec. 16, 1920, in the province of Kansu in north-west China. Yet even this great shock seems to have been exceeded in violence by that which occurred on the evening of May 22. According to a letter from Prof. Turner (*Times*, May 25), the first tremors reached Oxford at 10.32 P.M. (G.M.T.). From the records there and at four other observatories (Kew, Helwan, Hyderabad, and Perth in West Australia), he places the epicentre in lat. 35·8° N., long. 103·4° E., or near the western margin of the province of Kansu. That of the earthquake of Dec. 16, 1920, lay in lat. 35·8° N., long. 105·7° E. Eight days later, a strong after-shock occurred about 90 miles to the west, in lat. 35·5° N., long. 104·0° E. Earthquakes of the first magnitude are rarely repeated within the same origin except at very long intervals, say, a century or more, and it is interesting to notice the continued westerly migration of the focus, the distance between the origins of the great earthquakes of 1920 and 1927 being about 130 miles.

MANY readers of NATURE will regret to learn that Mr. John Jones, the Registrar of the Imperial College of Science and Technology (which includes the City and Guilds College), retires at the end of the current session. Mr. Jones became a member of the staff of the City and Guilds College when it was opened in 1884—it was then known as the Central Institution—and he has ever since been engaged in its administrative work. His influence on the students has been far reaching. He has taken a personal interest in their welfare; in fact, it is not too much to say that he has devoted the greater part of his life to this purpose, and not only has he followed closely the progress of each one of them in the College, but also, as secretary of the Appointments Board, he has helped many of them in their subsequent careers. His knowledge of the hundreds of students who have passed through the College is remarkable, and he has often astonished men who left many years ago by recalling forgotten incidents of their youth. He leaves the Imperial College with the good wishes of every one, and a deep appreciation of his work, ability, and personality will long remain in the minds of all who have been associated with him there.

RECENT acquisitions to the British Museum (Natural History) include the following: The Department of Zoology has acquired a large and very rare squid (*Stenotheuthis caroli*) which was washed ashore in March last at Scarborough. This is especially interesting, since the stranding of large Atlantic squids on the British coasts is relatively uncommon. Messrs. Lever Bros. have presented to the same Department a complete skull with baleen plates of a Blue Whale from one of their Scottish whaling stations. The specimen from which this skull was taken was a male 72 ft. long, and the skull itself measures 17 ft. 6 in. long by 9 ft. 3 in. wide. Among purchases for the Geological Department, the most important is a beautifully preserved skeleton of an ichthyosaur, nearly 13 ft. long, on a slab of Lias shale from Holzmaden, Württemberg. This is believed to represent a new species of the genus Eurhinosaurus, of which only one other example is known—the *E. longirostris* of the Stuttgart Museum. A band of rock in the Devonian of Gerolstein in the Eifel is famous for its crinoids (sea-lilies), but specimens with the stem attached are very rare; a slab bearing four stalked specimens of Hexacrinus with arms complete is therefore an unusual acquisition. The Department of Minerals has acquired a magnificent crystal of beryl (aquamarine) of gem quality, 13 cm. high, with a diameter of 10 cm. to 12 cm. and weighing 2505 grams (12,525 carats), from Brazil. This gem is exceptional in size and in the perfection of its crystalline development. Important financial assistance has been given by Mr. J. Spedan Lewis to a collecting expedition in Indo-China under M. Delacour and Mr. Willoughby P. Lowe. The results of this expedition are to be divided between the British Museum (Natural History) and the Paris Museum.

CHINA has been much in the public eye during the last few months: the notoriety achieved would suggest that the atmosphere is not very suitable for scientific work, so that we may congratulate those who have succeeded in producing a new scientific journal and extend a welcome to the first number of the first volume of the *Chinese Journal of Physiology* published in January last. It is to be issued quarterly by the

Chinese Physiological Society, and is edited by R. K. S. Lim, B. E. Read and Hsien Wu of Peking, and H. G. Earle of Hongkong. A number of papers deal with Chinese drugs and their pharmacology, including Chinese aconite, bastard anise, and ephedrine. R. K. S. Lim describes a method of anastomosing blood-vessels by means of aluminium couplers, and with C. T. Loo and A. C. Liu has used the method in transplanting the stomach or a gastric pouch in the dog. By showing that the transplant secretes to a meal they have demonstrated the existence of a humoral, as distinct from a nervous, mechanism of gastric secretion, thus confirming the results of Ivy and Farrell. H. Necheles describes a new method of vividiffusion, using tubes made of goldbeater's skin as dialysers: the method has been applied to show the presence of a gastric secretory stimulant in the circulating blood. All the articles in this number are in English, but articles in French or German will also be published: each paper is accompanied by an abstract in Chinese.

THE firm of Messrs. Ernest Benn, Ltd., has recently begun the issue of a series of booklets which "has the revolutionary aim of providing a reference library to the best modern thought, written by the foremost authorities, at the price of sixpence a volume." Of the titles which have so far been announced, one half relate to scientific subjects, namely, "Modern Scientific Ideas," by Sir Oliver Lodge; "The Age of the Earth," by Prof. Arthur Holmes; "The Atom," by Prof. E. N. da C. Andrade; "Chemistry," by Dr. P. E. Spielmann; "Relativity," by Prof. James Rice; "The Mind and its Workings," by Mr. C. E. M. Joad; "Psycho-Analysis," by Dr. Ernest Jones; and "Introduction to Economics," by Mr. L. C. Robbins. The first three of these have already appeared, and if they are representative of the series as a whole, Messrs. Benn are to be complimented on the provision of a very valuable addition to scientific literature of the popular kind. The subjects are treated in an interesting and easily comprehensible manner, and the scope of about 30,000 words is sufficient to give the reader a good general idea of the present state of knowledge and belief in the various departments of science. Sir Oliver Lodge's contribution is described as "the expanded substance of six talks on 'Atoms and Worlds,' broadcast in October and November 1926." It therefore necessarily covers in the main the same ground as Prof. Andrade's book, and it is of considerable interest to note the varying manner of treatment of the same material by two decidedly individualistic writers.

A free public lecture on "The Eclipse of the Sun" is to be given at the East London College on Tuesday, June 14, at 5 o'clock, by Sir Frank Dyson, Astronomer Royal.

THE University of California has conferred the degree of doctor of laws upon Prof. H. H. Turner, Savilian professor of astronomy in the University of Oxford.

AT the annual general meeting of the Linnean Society of New South Wales, Prof. L. Harrison, Challis professor of zoology in the University of Sydney, was elected president for the present session.

MR. H. J. PAGE has resigned his position as chief chemist and head of the Chemical Department at the Rothamsted Experimental Station on his appointment as head of the Research Laboratories of Nitram, Ltd.

AT the tenth annual general meeting of the Society of Glass Technology, held in Sheffield on Wednesday, April 27, Mr. W. Butterworth was re-elected president and the following officers were elected to fill vacancies: *Ordinary Members of Council*, Mr. J. D. Cauwood, Mr. F. Graves Clark, Miss V. Dimbleby, Mr. G. V. Evers, and Mr. W. W. Warren. *Honorary Secretary*, Prof. W. E. S. Turner.

IN connexion with the meeting at Essen on June 7-19 of the Association of German Chemists (Verein Deutscher Chemiker) "Achema" (Ausstellung für chemisches Apparate-Wesen) is arranging an exhibition of chemical apparatus and appliances. The exhibition will be held in the exhibition ground in the Norbertstrasse at Essen. The offices of the "Achema" are at Seelze, Hannover, to which all communications should be addressed.

DONATIONS amounting to £250 were received by the Committee formed to found a memorial to the late Mr. F. S. Spiers, secretary of the Faraday Society and the Institute of Physics. The interest on this fund is to be available for the payment of an honorarium to a lecturer on some subject in physical chemistry, the lecture to be given once in three years and to be called the Spiers Lecture. The Faraday Society has undertaken the administration of the fund for this purpose.

THE twenty-eighth annual meeting of the American Roentgen Ray Society will be held in Montreal on Sept. 20–23, under the presidency of Dr. A. Howard Pirie, of Montreal. This is the first occasion on which the Society has met outside the United States; and, to acknowledge the honour paid to a British radiologist by his election to the presidency of the Society, a party of radiologists from Great Britain is proceeding to Montreal in September to take part in the proceedings. Dr. G. W. C. Kaye has been invited by the Society to give the Caldwell lecture.

SOME details of an exploring expedition now at work in New Guinea are contained in the *Geographical Journal* for May. The expedition, which is under government auspices, is led by Mr. C. H. Karius, and left Port Moresby for the Fly River some four months ago. The Fly was to be ascended to Lario Bank by boat, where the party were to cross overland, east of the swamps, through unexplored country to the head waters of the Fly at Palmer River and the Sepik River. Thence Mr. Karius hopes to strike across the Victor Emmanuel Range and reach the Sepik lower down and follow it to Marienburg near the mouth.

THE history of science quarterly, *Archivio di Storia della Scienza*, directed by Prof. Aldo Mieli and published at Rome by the Casa Editrice Leonardo da

Vinci (Roma, 40; Via Casalmonferrato, 29), has hitherto contained articles mainly by Italian scholars. In order to render its character more international and to widen its sphere of influence, honorary editorial representatives of other nationalities have been appointed to further the cause of the journal in their respective countries. The editor for England is Mr. E. J. Holmyard (Clifton College, Bristol), who will be pleased to receive articles for publication in the *Archivio* and also to supply any information as to rates of subscription, etc. Books for review in the *Archivio* may be sent to him, or direct to Prof. Mieli, c/o the publishers, at the above address.

AN appreciation of William Bateson by an anonymous writer (*Jour. of Heredity*, vol. 17, No. 12) gives a short account of his life and work, showing that by his death the whole scientific world suffered an irreparable loss. A photograph of Merton House, Grantchester, where he lived eleven years, is given, as well as Rupert Brooke's exquisite poem on the old vicarage. It was here that the phenomenon of coupling and repulsion was discovered in sweet peas; here also that the inheritance of the various types of combs in fowls was investigated; and that "Mendel's Principles of Heredity" was written. As the exponent of discontinuity in biology and the founder of genetics, Bateson's place is secure in the history of biology, while his personal qualities will long be an inspiration to those who knew him. The article concludes with a list of his chief published papers.

A REVIEWER in NATURE of May 21, p. 739, referred appreciatively to Bragg's crystal structure discoveries, and mentioned Sir William Bragg's name alone. The reference should, however, have been to both son and father, for both were jointly concerned with the notable work on crystal structure. Indeed, Sir William Bragg says in the preface of the joint book on "X-rays and Crystal Structure" by Prof. W. L. Bragg and himself, published in 1915: "I am anxious to make one point clear, viz. that my son is responsible for the 'reflection' idea which has made it possible to advance, as well as for much the greater portion of the work of unravelling crystal structure to which the advance has led."

A BOOKLET entitled "The Production and Distribution of Clean Milk" has been prepared by Mr. A. T. R. Mattick (*The Dairyman, Ltd.*, 43 Great Tower St., E.C. 2*s.* net), dealing with the essential factors for the production of clean milk. It is profusely illustrated and gives much useful information. Clean milk is of importance not only to the consumer but also to the producer, for clean milk is milk with improved keeping qualities, and much monetary loss (estimated at £425,000 per annum) falls upon the producers in Great Britain owing to souring before delivery.

"WHY Everybody should assist in fighting Disease in the Tropics" is the title of a pamphlet issued by the Ladies' Committee of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, appealing to members of the public to become associates of the Institute (minimum annual subscription, 10*s.* 6*d.*). It is hoped in this manner to obtain the funds necessary for maintenance purposes, so that other donations may be placed to the endowment fund. Mr. John Masefield contributes a forceful foreword on the value of research in tropical diseases and of Sir Ronald Ross's contributions to the subject.

UNDER the title "Modern Fruit Tree Spraying and what it Costs," the Ministry of Agriculture has recently issued an illustrated brochure, by Mr. J. Turnbull, useful to fruit-growers. It is issued as Miscellaneous Publications, No. 58, and is obtainable at the office of the Ministry, 10 Whitehall Place, London, S.W.1, price 6*d.* post free. The pamphlet is written to meet the difficulties that growers often encounter in their spraying operations and are nearly always due to inattention to some detail the importance of which is frequently not realised. The grower can be confidently recommended to consult this publication for information respecting the type of spraying plant best adapted to his needs and the relative costs of operation in each case.

MESSRS. G. CUSSONS, Ltd., of the Technical Works, Manchester, have sent us a copy of their folder of illustrations showing types of apparatus and equipment suitable for use in technical schools and colleges. The excellence of Messrs. Cussons' models is widely appreciated, and in this pamphlet will be found particulars of apparatus for teaching dynamics, building construction, hydraulics, steam, electricity and solid geometry. Among, perhaps, the most interesting of the appliances illustrated are the model for explaining the winding of armatures, the experimental air channel and fan-testing apparatus, and a complete hydraulic plant, including an electrically driven centrifugal pump, reservoir, Pelton wheel, Thomson turbine, weir tank, sump and Pitot tube. Many of the pieces of apparatus are designed especially for laboratories where wall space is limited or where portable apparatus is desirable.

MESSRS. GALLENKAMP'S catalogue of general and industrial apparatus (19 Sun Street, Finsbury Square, E.C.2) has been very greatly expanded to meet the multifarious demands of scientific workers not only in pure chemistry but also in the cognate sciences and in various branches of technology. Thus, in the eighth edition, in addition to the ordinary equipment of furniture and apparatus used in educational laboratories, ample provision is made for the consultant and for the research worker in every department of chemistry, and also for the study of such special kinds of work as the testing of coal, cement, asphalt, petroleum, soils, milk, sugar, beer, wines, spirits, vinegar, and textiles. Mechanical apparatus offered for sale includes petrol-gas generators, high vacuum pumps, and centrifugal machines of various types, and amongst the electrical equipment we find drying-ovens, furnaces, motors, and commutating rectifiers. There is also a wide choice of optical apparatus such as microscopes, spectrometers, quartz

spectrographs, polarimeters, refractometers, projection lanterns, and epidiascopes, whilst the botanist will find a lengthy list of fresh and preserved material, together with microtomes and other essential apparatus. A valuable feature of the book is the inclusion of a mass of useful information interspersed at intervals, much of the apparatus being not only clearly depicted but somewhat minutely described. Thus there is a general description of the electrometric apparatus used for determining hydrogen-ion concentrations, together with details for its use and for the preparation of the electrodes. Similarly, anemometers for measuring the speed of draughts in flues, viscometers, electric furnaces, pyrometers, and also the automatic recording balance for studying the sedimentation and flocculation of soils, are well described. At the end there is a long list of text-books and works of reference, classified according to subjects, and 46 pages are devoted to chemicals and reagents—products of the British Drug Houses, Ltd. The volume is attractively bound and well illustrated.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An assistant in the medical unit of the Welsh National School of Medicine—The Secretary, University College, Cardiff (June 15). A lecturer in painters' oils, colours, and varnishes at the L.C.C. Hackney Institute, Dalston Lane, E.8—The Education Officer (T.1.a.), The County Hall, Westminster Bridge, S.E.1 (June 15). A Government Inspector of Mines, Tanganyika Territory—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (June 18). An assistant lecturer in physics in the University of Sheffield—The Registrar, University, Sheffield (June 18). Junior assistants in the electricity and engineering departments of the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (June 18). Visiting instructors at the L.C.C. School of Engineering and Navigation, Poplar, for the following subjects : carpentry and joinery, acetylene welding, electrical installation work, engineering workshop practice, and engineering economics—The Education Officer (T.1.a.), The County Hall, Westminster Bridge, S.E.1 (June 20). A demonstrator of physics at St. Bartholomew's Medical College—The Dean of the College, E.C.1 (June 23). A junior technical officer for the Air Ministry Technical Development Staff, to assist in development work in connexion with aeronautical instruments and small precision apparatus, with special reference to problems relating to high altitude flying—The Chief Superintendent, R.A.E., South Farnborough, Hants (June 25, quoting A.158). A head of the textile department of the Harris Institute, Preston—The Principal and Secretary, Harris Institute, Preston (June 30). A demonstrator in the department of mechanical engineering and motive power of the City and Guilds (Engineering) College—Prof. W. E. Dalby, City and Guilds (Engineering) College, Exhibition Road, S.W.7.

Our Astronomical Column.

EXPLODED WIRES.—The reports of the great American observatories in recent years make frequent mention of observations on 'exploded wires.' Those who wish for information on the nature and object of these experiments will welcome an article on the subject by Prof. H. N. Russell in the *Scientific American* for May. The wires are made of various metals or alloys and drawn out to extreme thinness. A powerful current from a condenser charged up to about 40,000 volts is then passed through them, instantly reducing them to gas. The spectra of this gas at its various stages of cooling are then photographed with the aid of a rapidly revolving mirror, the whole phenomenon lasting about 1/25,000 of a second.

From the initial brightness it is estimated that temperatures of 20,000° C. are attained. The vapour at this time is far hotter and brighter than the solar photosphere, and approximates closely to the photospheres of the hottest stars. It has been proved that when hottest and least expanded, the column of glowing gas is opaque, and gives a continuous spectrum. It is at that time a good conductor of electricity, which is given as an explanation of its opacity. A bright-line spectrum from an electric spark shows up when placed in front of the exploded wire, but is invisible behind it. On the other hand, as the gas of the exploded wire cools, the continuous spectrum weakens and disappears, and the bright lines due to the incandescent gas appear.

The two stages correspond to the spectra of the solar photosphere (hot and opaque) and of the reversing layer (cooler and transparent). It is possible to get both spectra at once by placing the wire to be exploded inside a wooden groove, thus retarding the expansion of the gas. The cooler gas in the outer part of the groove acts as the transparent reversing layer ; the hotter gas within acts as the photosphere, and the familiar Fraunhofer lines are seen.

The changes in the spectrum of the exploded wire are similar to those in a nova, and show that the phenomena exhibited by the latter are due to the rapid expansion of the gases at its surface owing to abnormal heating from some unknown cause. These experiments have probably produced the highest temperatures and the closest approach to photospheric conditions that have yet been attained on earth.

THE POSITION OF THE AXIS OF MARS.—There are now three determinations of the position of this axis that have some claim to precision : (1) Lowell, from the polar cap ; (2) W. H. Pickering, from other markings on the disc ; (3) Struve, from the satellites. The question has been brought before the superintendent of the American Ephemeris, Prof. W. S. Eichelberger, as the computations for physical observations of the planets are made in that office. He has taken the opinion of several astronomers and has himself revised Struve's work of 1911, using observations up to 1924. His revision indicates that Struve's position accords well with recent observations, and further, he notes that a recent revision by Prof. W. H. Pickering gives a result much nearer Struve's position than his published result. On these grounds he has decided to use Struve's position in the American Ephemeris (and the other almanacs that use its data), beginning with the year 1931.

Research Items.

GYPSY LINGUISTICS.—In vol. 5, No. 4, of the *Journal of the Gypsy Lore Society*, Prof. R. L. Turner, by his ingenious application of methods of analysis to ascertain the position of Romani in Indo-Aryan, is able to offer suggestions as to the probable date, place, and line of departure of the gypsy exodus from India. An initial criticism disposes of the theories which assign Romani an affinity with the Dard group and that of its opponents who connect it with languages now farther in India, such as Western Pahari. The failure of both schools is due, according to Prof. Turner, first to comparison of Romani with a dialect group as it exists to-day, and secondly to neglect of the differences of value in the principles of conservation and innovation as evidence for determining dialectal connexions. Taking the early isoglosses in primitive Aryan, the middle Indo-Aryan of the Asokan edicts, Pali and the literary Prakrits, and the modern languages, the argument from the innovations points to an agreement between Romani and the central group and a difference from the north-west. Romani therefore belonged originally to the central group which now comprises Rajasthani Hindi, central and eastern Pahari, and perhaps Behari. Turning to conservations, Romani has preserved sounds which were radically modified in the central group after the gypsies had passed to the north-west, possibly about 250 A.D. Later innovations which arose in the north-west during the stay of the gypsies with that group appear in Romani, as might be expected. The argument is further borne out by an examination of both vocabulary and morphology. It is, however, by no means certain that the gypsies entered Persia speaking a single language, as Dr. Sampson maintains. There are striking differences of morphology and vocabulary between European, Armenian, and Syrian Romani, while many of the resemblances might be referred back to a common Indian origin rather than a post-Indian period of community. Yet even if at the time they emerged from the Hindu Kush they were already separated by certain isoglosses, it is reasonable to suppose they preserved contact and exerted a certain amount of mutual linguistic influence.

GAS STORAGE OF FRUIT.—The Department of Scientific and Industrial Research, Food Investigation Section, has just published Special Report No. 30 (London: H.M. Stationery Office, 1927. 1*s.* 9*d.* net), on gas storage of fruit, the research in connexion with which has been carried on by Messrs. Franklin Kidd, Cyril West, and M. N. Kidd. Their investigation, though still in the pioneer stages, may have considerable commercial importance. They have explored methods of extending the storage life of living fruit and vegetables, and retarding their natural senescent changes. Live fruits and vegetables in storage continue their process of respiration, and it seems possible by controlling the supply of oxygen and carbon dioxide to regulate the speed of the living machine as it travels through its normal course of growth and senescence. The method used was to store apples in a gas-tight chamber, the composition of the atmosphere of which could be regulated and varied by means of flues, and then to note the speed of ripening and compare the condition of the fruit with that of material stored in the ordinary way. In general, the authors' results show that within certain limits the rate of ripening of fruit after gathering is directly related to the amount of oxygen, and inversely to the amount of carbon dioxide present in the atmosphere in which it is stored. At the ordinary temperatures which obtain onwards from September through winter and spring, it was found that atmospheres containing about 10 per cent. of carbon dioxide, with an equivalent reduction in the amount of oxygen to about half its normal value, were the most effective. At lower temperatures the effectiveness of the method decreases, just as it does at higher temperatures. At ordinary temperatures the storage life of apples may be approximately doubled in length. Experimental evidence is also given to show that reduced concentrations of oxygen and accumulations of carbon dioxide actually depress respiratory activity in the apple, and this depression is approximately proportional to the increase in length of the storage life of the fruit.

GREEN MANURING.—A booklet has been issued (London: Ernest Benn, Ltd., 1927) containing the papers contributed to the third Rothamsted Conference. These conferences are attended by persons of practical experience in the special subject under consideration from widely varying localities, and their views carry much weight. The third conference dealt with green manuring, a practice already important in the tropics, and to a less extent in other parts of the world, but in England less widely employed at present owing to severe economic and climatic limitations. The use of green manuring is to build up fertility and augment the water-holding capacity of the soil, or to maintain a rich soil in good condition. Its importance therefore to the farmer naturally varies according to the supply and cost of farmyard manure. The general view of the speakers indicates that under favourable conditions green manuring can be used in Great Britain with considerable benefit to the succeeding crop, but that the practical difficulties are often very great; *e.g.* risks of drought or disease in the succeeding crop may be incurred, and the establishment of the catch crop is not always easy. Mustard fallow followed by wheat is at present the most general type of green manuring practised in England, but red clover before potatoes, and lupins in the case of light land, may be useful. Finally, emphasis is laid on the necessity for a study of local conditions, as general methods cannot as yet be recommended with safety.

SPEY SALMON.—In a report on the salmon investigations on the River Spey in 1923 (*Fisheries, Scotland: Salmon Fish.*, 1926, V. (November 1926)) Mr. W. J. M. Menzies gives the results of the examination of 1763 fish caught during the months of April, May, June, July and August, in the sweep nets worked in the lowest two miles of the river's course. The majority of the fish were divided between the 1+, 2, and 2+ age groups, though of the three the 2-winters fish were slightly the most numerous. The 3-winters fish were unfortunately poorly represented owing to the lack of samples at the beginning of the season. April was mainly the spring fish month, May was a transition period between spring and summer fish, and June and July were almost wholly summer fish months. The bulk of the grilse appeared in July, and the decline in the number of grilse is again illustrated, occurring as it does in most Scottish rivers. 4·1 per cent. of the whole catch were previously spawned fish, and of these 72 salmon, only 2 had spawned twice. 66 per cent. of the smolts migrated after 2 years of river life and 33 per cent. after 3 years. The correlation between parr length at first year and age at smolt migration is again noticeable, the smaller parr at the end of the first year becoming 3-year smolts and the larger parr becoming 2-year smolts. This correlation appears to

be continued also in the sea life. The zone of rapid growth on the scales begins to appear at the end of April, and growth increases in rapidity as the summer advances. The curious checks in this summer growth that have been previously noted appear again, in the 1+ group in July and in the 2+ group nearly a month earlier.

GENETICS OF LEBISTES.—The little cyptinodont fish, *Lebistes reticulatus*, has now been used for some years in genetical experiments and has consistently shown a type of inheritance from male to male through the Y-chromosome. Crossing over is found to occur regularly between the X- and Y-chromosomes in males and between X- and X-chromosomes in females. As the result of extensive experiments, Winge (*Jour. Genetics*, vol. 18, No. 1) describes the inheritance of eighteen genes for colour markings in the males, the females being normally dull grey throughout. He has obtained forms with fresh colour patterns from the West Indies and elsewhere, and believes that a large number of such colour varieties exist. Each pattern involves the presence of certain red, yellow, or black spots, accompanied in some cases by changes in the shape of the caudal fin. Nine of the patterns here described are new, and two previous patterns are shown by crossing over to be compound. Of the whole number, nine are located in the Y-chromosome and three in the X-chromosome. Five of these have shown crossing over. A single gene, causing stripes on the body, is not sex-linked but is located in an autosome. It must be said that the patterns, which are carefully recorded in coloured plates, sometimes show a range of variation which may be due to their compound character. Dr. Winge emphasises the view that since, in Lebistes, crossing over occurs freely between the Y- and the X-chromosomes, a single dominant factor for maleness must be present in the Y-chromosome, and this must also presumably cross over, thereby transforming the Y- into an X-chromosome, or vice versa. Certain sex intergrades are also described.

EMBRYOLOGICAL STUDIES AND TISSUE CULTURE.—The Year-Book of the Carnegie Institution of Washington for 1925–26 contains reports of work done in the Department of Embryology. Young human embryos in the stages with 2 to 16 pairs of somites have been carefully investigated and monographed by Drs. G. W. Bartelmez and H. M. Evans, and a description of a still earlier human ovum has been published with coloured photomicrographs. Among numerous investigations of the blood and nervous systems may be mentioned the observation by Mrs. M. R. Lewis and Dr. H. B. Andervont, through tissue culture, that the sarcomatous tumours of chickens are composed chiefly of hypertrophied white blood corpuscles. They suggest that an irritant substance produced in the blood plasma stimulates these cells to abnormal activity; and they were able to transfer the tumour from chicken to chicken through either the blood plasma or the white cells. Rat tumours were similarly found to consist of an epithelioid modification of the mononuclear blood-cell, such cells if transplanted producing a fresh tumour. Among anthropological studies may be mentioned measurements of the Rama and Sumu Indians in Nicaragua, the evolution of human teeth and the inheritance of webbed toes.

HYDROGRAPHIC SURVEYING.—In Publication No. 118 of the U.S. Coast and Geodetic Survey, Lieut.-Commander J. H. Hawley gives particulars of a wire sweep for use between two launches to locate obstructions to navigation such as isolated pinnacle rocks, wrecks, or coral formations. The sweep wire, up to 5000 yards in length, is weighted at either end and at intervals of 100 to 300 yd., and suspended from floats by lengths of wire, equal to the depth below the surface at which it is desired to search. Tow-lines from the launches are attached to the terminal weights, and sweeping is carried out at not more than 1½ knots. The sweep wire is made up in units of 100 feet attached to each other by a gadget which parts when the sweep wire meets an obstruction. The great length of the sweep wire and the fact that the method has been used successfully for the location of some 4000 obstructions over an area of 6000 square miles justifies the very complete details which are given of the equipment, and the methods used of plotting the swept channel. Particulars of the launches, their gear for shooting and getting in the sweep, and the method used for determining the actual depth of the sweep wire while being towed, are also included. Considerable skill must be required in handling in a moderate sea, while in rough weather any such method would be impracticable.

OCEAN CURRENTS.—The International Hydrographic Bureau at Monaco has published an article on "Ocean Currents in Relation to Oceanography, Marine Biology, Meteorology, and Hydrography" by Admiral Niblack (*Special Publication* No. 19). A study of oceanic currents by the Bureau had been suggested last autumn by a delegate from Peru, who "doubtless had in mind the sudden temporary and disastrous climatic change brought about in that country in 1923, when the Humbolt current, on the West Coast of South America, had deviated from its normal course," but the Bureau generally agreed that such a study should be left to the hydrographic departments of the maritime countries. In this popular review, Admiral Niblack discusses a number of lines along which further knowledge would be of practical value for purposes other than navigation. Answers to a number of questions upon the best available methods and instruments for attacking various outstanding problems are elicited from the readers of the review, in order "to assist in the standardisation of the methods and results of oceanographic exploration." It seems early in the life of this infant science of physical oceanography, bristling with problems which can only be attacked indirectly or must await advances in other sciences before their solution is possible, to seek standardisation of methods.

OIL PROSPECTS OF THE BATTLE RIVER AREA, ALBERTA.—The summary report of the Geological Survey of Canada for 1925, Part B, contains the results of much reconnaissance and detailed examination of the Battle River area, principally in the vicinity of the Alberta-Saskatchewan boundary. The stratigraphy is chiefly Upper Cretaceous, presenting a succession of alternately marine and non-marine deposits. Generally speaking the structures are simple, the regional dip being gentle, though at least one broad fold, the Ribstone-Blackfoot anticline, has been proved; this fold has a N.E.-S.W. strike, with dips on either flank ranging from 7 ft. to 23 ft. per mile. It is doubtful whether such a flat fold in these Cretaceous deposits would be sufficient to cause oil or gas accumulation of any magnitude, and the question can only be decided by the drill. The author of the report, Mr. G. S. Hume, is not without optimism: while he admits that predictions are hazardous, he is of the opinion (based on certain assumptions) that the fold "may offer favourable prospects for oil." Much of his optimism seems to

turn on a practical application of Munn's hydraulic theory of oil migration and accumulation. This theory, elaborated by J. L. Rich, defines the principal cause of oil and gas migration as "the movement of underground water which carried with it minute globules of oil and bubbles of gas, possibly as fast as they are formed. Accumulation results from the selective segregation of oil and gas, which on account of their buoyancy always tended to work their way upward as they are carried along and are caught and retained in anticlinal or other suitable traps." The author applies this theory to structural conditions in Alberta, pointing out that water might enter the porous Cretaceous beds of the foothills and travel eastward through the Alberta syncline, thus flushing the oil and gas eastward; this would have the effect of rendering the territory under survey at least potentially encouraging.

THE PRESERVATION OF STONE.—The first report which has been issued by the Department of Scientific and Industrial Research in connexion with the problem of stone decay makes very interesting reading (Report of the Stone Preservation Committee. Pp. iv + 33 + 4 plates. (London: H.M. Stationery Office, 1927.) 1*s.* 3*d.* net). It is of course very largely of a preliminary character, as, for example, in the part dealing with bacteriological attack, and wisely no attempt is made as to definite conclusions in dealing with so complex a problem, but Mr. Scott Russell is to be congratulated on the ingenious methods which he has developed for the study of the subject. The difficulty of preparing microscopic sections of a sound and hard piece of stone is well known, and while it is obvious that a microscopic examination of decaying surfaces is of the first importance, it is very difficult to see how this can be managed. Mr. Scott Russell, by his method of infiltration with a synthetic resin in the liquid form and converting it afterwards into the solid form, has solved this problem, and some of his photo-micrographs showing the presence of the deadly sulphate of lime crystals within the stone are of the greatest interest. He has also devised an ingenious method of determining the amount of, and kind of, porosity by impregnating the limestone with resin and then dissolving away the stone and examining microscopically the resin skeleton. Of special interest are his discussions of the weathering in London of Portland stone and the conditions existing where a soot layer has been formed. Up to a certain point the soot layer seems to have a certain preservative value, but in other cases bad rotting and decay is found behind the soot layer, and it is difficult to say to what causes these very opposite results of the formation of the layer are due. Investigations on the lines of those being pursued by Mr. Scott Russell will help us to solve very important and practical problems of this kind.

THE MECHANISM OF CYCLONES.—The issue of the *Proceedings of the Imperial Academy of Japan* for February contains an abstract of a paper by Mr. T. Kobayasi, of the Aeronautical Research Institute of the University of Tokyo, which describes an alternative theory of the constitution of cyclones to the 'polar front' theory of Bjerknes, and is to appear in full in the Report of the Institute. According to Kobayasi, the 'squall line' in a cyclone is the line along which the air that has entered the cyclone from the districts north-east of its centre comes into contact with that coming from the south-east. If there is a temperature gradient in the north-south direction, the two streams produce a discontinuity of temperature along this line. The theoretical shape of the line agrees with the actual shape of the squall line on the weather map in many cases. In the upper atmosphere the cyclone is taken as a vortex in a stream, and lines of flow and pressure distribution curves are shown. The heights at which this is a plausible description of a cyclone are calculated from the speed and temperature gradients of a number of Japanese cyclones, and they come out from 30 to 70 per cent. greater than the height of the 'surface layer' as calculated by Dines for England.

INFLAMMABILITY OF COAL DUSTS.—One of the recent publications (Paper 31) of the Safety in Mines Research Board (London: H.M. Stationery Office, 1927. 1*s.* 6*d.* net) contains an historical survey of the laboratory methods of determining the inflammability of coal dusts and a preliminary examination of the problems involved in such an investigation. It has been shown that the relative inflammabilities of coal dusts depend on a number of factors, and several possible methods of determination are discussed. The most satisfactory method of comparing the relative inflammabilities is probably the determination of the amounts of inert dust which must be added to prevent the propagation of flame. The advantage of such a method is that the results are immediately applicable to the prevention of explosions in coal mines. Previous determinations by this method have not given results of a high order of accuracy, but it is believed that the sources of error have now been eliminated. The paper, which is the work of A. L. Godbert, serves to indicate the lines on which further research in the Board's laboratories is proceeding.

STRUCTURE OF IRON OXIDE COATINGS.—The process by which a smooth rust- and wear-resisting coating of iron oxides is produced on the surface of iron objects was described by F. S. Barff in 1877. The structure of such a coating, obtained by treating the sample of iron at about 700° with steam and then cooling in air, has been determined by R. M. Bozorth by means of X-ray analysis, using X-rays of different absorption coefficients but nearly equal wave-lengths. The results have been published in the *Journal of the American Chemical Society* for April. The coating consists of layers of ferrous oxide, magnetite, and ferric oxide, and the thicknesses of the layers are estimated to be of the order, 10^{-2} cm., 2×10^{-4} cm., and 2×10^{-5} cm., respectively.

HEAT OF SOLUTION OF SODIUM CHLORIDE.—A new type of adiabatic calorimeter, which can be used with small quantities of material to determine heats of solution over a wide range of concentration with a high degree of accuracy, is described by S. G. Lipsett, F. M. G. Johnson, and O.Maass in the April issue of the *Journal of the American Chemical Society*. The calorimeter consists of a closed silver vessel divided into two compartments. The salt and the solvent are placed in the separate compartments and mixed at the proper moment by rotating the calorimeter. A thermo-couple, which receives its heat by radiation, is employed to ascertain when the outer bath and the calorimeter are at the same temperature. The apparatus has been used to determine the surface energy of solid sodium chloride by measurement of the difference between the heat of solution of ordinary crystalline sodium chloride and that of the finely divided salt at the same concentration. A value for the surface energy of 400 ergs per sq. cm. is given, but owing to the possibility of error in the calculation of the amount of surface, this figure is only approximate.

The Wellcome Historical Medical Museum.

BY invitation of Mr. Henry S. Wellcome, a conversazione and meeting of the Royal Anthropological Institute was held at the Wellcome Historical Medical Museum on the evening of May 24. A number of members of the Prehistoric Society of East Anglia, which had held a London meeting at the Royal Anthropological Institute that afternoon, was also present. A cordial message of greeting had been cabled by Mr. Wellcome, who is at present in America, and at his request the guests were received on his behalf by Mr. H. J. E. Peake, president of the Institute, and Mrs. Peake.

A short address on the character and contents of the museum in its anthropological aspect was delivered by Prof. Elliot Smith. Prof. Elliot Smith said that the great museum that Mr. Henry S. Wellcome has created is unique. It affords a concrete demonstration of the history of man's attempts to cope with the fundamental problems of life and death. If such a collection is of interest to physicians and surgeons, it is of vital importance to anthropologists, because it deals with that particular aspect of the study of mankind which is now for the first time coming to be recognised as the central aim of all humanistic inquiry. It illuminates the motives for customs and beliefs, and provides the material for interpreting what is involved in the idea of progress; but it also suggests the explanation of superstition and intolerance.

The fundamental attribute of all living creatures is the fact that they are alive; and their essential reactions serve the purpose of preserving the life that is their distinctive property. In man these instinctive processes receive articulate expression, and to the unconscious reactions for self-preservation are added innumerable devices that are deliberately invented as rational means of preserving and adding to the vital substance. In the Wellcome Museum is displayed a vast collection of charms, amulets, and elixirs of life that have been used by people of every race and clime, and of every time from the upper palæolithic to twentieth-century London, for the purpose of self-protection. As the originally rational excuse for the efficacy of most of these givers of life was shown to be unfounded, many of them still survived in popular estimation, but being stripped of any justification for their reputation, they fall into the category of magic.

Another aspect of essentially the same process is displayed in the practice of mummy-making, the use of relics and magic bundles, and the initiation of medicine-men. Ancient literatures contain accurate reports of the real beliefs of the people of antiquity —that the processes of mummifying the body or making an image of a king conferred upon him a new existence and a new and divine personality, which enhances his powers of conferring safety and prosperity upon every individual among his subjects. The pretence of mummification is the essence of the initiation of a medicine-man, giving him a new name and new powers of life and death; and the symbol of his powers is the magic bundle, which is either the actual mummy or the pretended relic of his predecessor. In the Wellcome Museum are the mummies, the mummified heads, the magic bundles, the graven images, the standards, and the dress of the medicine-men, the amulets, the elixirs of life, the equipment of the astrologers and alchemists, that afford concrete demonstrations of the reality of these things.

The wonderful reproductions in the museum of a chronological series of pharmacies provide a dramatic demonstration of the historical links between the magic of the past and the science of to-day.

Important as the collections of the Wellcome Historical Medical Museum are as an objective record of the history of medicine and the associated sciences, its great value lies in the fact that it affords a demonstration of (and an instrument of research into) the universal problems of human aspirations, and that Mr. Wellcome had this wider vision of its meaning is shown by the fact that he has placed an anthropologist in charge of the Museum.

A vote of thanks to Mr. Wellcome was moved by Lord Onslow and seconded by Dr. Spencer, president of the History of Medicine Section of the Royal Society of Medicine. In putting the vote to the meeting, Mr. Peake emphasised Mr. Wellcome's services to humanity, of which the Museum represented part only. He referred to his work for tropical medicine, especially at Khartoum, and his support of archæological exploration. Starting as a history of medicine, the Museum is becoming more and more anthropological in outlook. He referred also to Mr. Wellcome's judgment, in view of this aspect of the Museum, in selecting Mr. Malcolm, a trained anthropologist, as the conservator of the Museum. In replying on behalf of Mr. Wellcome, Mr. Malcolm emphasised the desire of its founder that it should develop as a Museum devoted to research.

The Production of Pure Chromium, Manganese, and Silicon.

IN connexion with the researches on the alloys of iron at present being carried on at the National Physical Laboratory, accounts are given by F. Adcock, Dr. M. L. V. Gayler, and N. P. Tucker in a paper read recently before the Iron and Steel Institute, of the successful attempt to produce three steel-making elements in a state of high purity. It is of interest that each element is prepared by an entirely different type of process. Chromium is made electrolytically, manganese is produced by distillation, and silicon by purely chemical purification.

The chromium was prepared by the electrolysis of an aqueous solution containing 30 per cent. of pure chromic acid and 1 per cent. of sulphuric acid. Lead anodes were used with tin or steel cathodes. Three types of apparatus are described, for one of which, with a steel cathode rotating at a rate of 30 revolutions per minute, the following data are given: The temperature of the bath was 20° C., the voltage 5·2, with an amperage of 140. The current densities at the cathode and anode were 28 amp. and 7·2 amp. per sq. dm., and the yield of chromium in 30 hours was 500 grams, with a current consumption of 8·3 ampere-hours per gram.

All the samples as deposited contained hydrogen and oxygen, the former being liberated during remelting *in vacuo*. The oxygen, which in the cathode chromium is in a form which leaves no residue on solution in acid, is converted on vacuum heating into insoluble chromium oxide (Cr_2O_3). This can be removed, however, by heating the solid metal in pure, dry hydrogen to 1500°-1600° C. (The melting point of chromium is considerably above that of iron, but has not yet been accurately determined.) After these treatments, spectroscopic examination failed to reveal any impurities.

The great hardness of electrolytically deposited chromium, 600-650 Brinell, is apparently caused by

the occluded hydrogen, the crystalline form, and possibly the oxygen. It is not possessed by metal of high purity melted or annealed at high temperatures in vacuum or hydrogen, the hardness being then so low as 70 on Brinell's scale.

Manganese of purity 99·3 per cent. may be prepared by the reduction of the oxide by aluminium if the purest available materials are used. Allmand and Campbell's process of production electrolytically from a neutral bath of ammonium and manganese sulphates is also capable of yielding small quantities of the pure metal. By distillation under a pressure of 1 mm.-2 mm. in a high frequency induction furnace at a temperature just above the melting point of the metal, manganese with total impurities less than 0·01 per cent. is readily obtained. The metal thus prepared is silver grey in colour and very brittle. On remelting *in vacuo* the ingot produced is extensively cracked, a phenomenon associated with the critical points which are observed on cooling from fusion. The metal is hard enough to scratch glass and very brittle. When exposed to air it does not tarnish as do ordinary samples of the metal.

The melting point of the manganese has been determined in an atmosphere of hydrogen and is given as $1244° \pm 3°$ C. Four change points have been observed in the cooling curves at the following temperatures: 1191°, 1024°, 742°, and 682° C. The change at 742° C. appears from the micro-structure to be associated with a change of crystal structure, though no such effect is observed in connexion with that at 682° C. One or both of these changes is accompanied with a marked change of volume.

The method finally adopted for the production of silicon of high purity is as follows: The best available sample of commercial silicon is broken up as small as possible and just covered with water. Strong hydrochloric acid is then added in small quantities at a time, and after the action has quietened down a considerable amount of hydrochloric acid and some nitric acid, and the whole is digested for 24 hours. The impurities, consisting mainly of iron and aluminium silicates and the silicides of iron, calcium, and magnesium, are dissolved. After the necessary washing and filtering the residue is placed in a platinum dish, water added, which is followed by a considerable excess of strong sulphuric acid and small amounts of hydrofluoric acid in small quantities at a time. When all apparent action has ceased, the mixture is evaporated until it fumes. When cool it is digested with water for some hours, filtered and washed. It is again treated with strong hydrochloric acid for several hours, filtered, washed, and dried in a steam oven. The product under favourable conditions contains 99·94 per cent. of silicon and possesses a structure consisting entirely of extensively twinned crystals. F. C. T.

The San Andreas Rift.

IF it were only for its connexion with the Californian earthquake of 1906, the San Andreas rift would be one of the most interesting fault-systems known. The movements that were the cause of that earthquake took place in the northern half of the rift, from San Juan on the south, with three submarine interruptions, to near Cape Mendocino on the north, a total length of about 270 miles. The rift, however, is known to extend more than 300 miles south of San Juan, as far as the desert regions of southern California.

The earthquake of 1906 directed attention to our ignorance of the course of the rift in the latter regions, and, during the past six years, the detailed mapping of the San Andreas fault and the associated fault-zone, together known as the San Andreas rift, has been carried out by Dr. L. F. Noble, of the U.S. Geological Survey. His work is not yet finished, but a report by him of unusual interest on the results already attained is published in the "Year-Book of the Carnegie Institution of Washington" (No. 25, 1925–26, pp. 415-428).

The area studied by Dr. Noble is the southern portion of the rift along the south border of the Mohave Desert and extending across the San Gabriel Mountains into Cajon Pass. The rift here runs in a south-easterly direction and appears as a continuous chain of scarps, trough-like depressions, and ridges, all of which afford clear evidence of recent movements. So straight is the line of the rift that one can see along it for 25 miles or more. Bordering this profound master-fault is a belt of roughly parallel and interlacing fractures, in some places as much as six miles wide. The characteristic features of the rift often change abruptly along its strike. Within half a mile, a scarp may give place to a ridge and the ridge to a trough, or a scarp facing one way may die out and give place to a scarp facing in the opposite direction. The features differ much in size. Some depressions are mere trenches a few feet wide and one or two feet deep. Others are as much as one hundred feet in depth and many hundreds of feet wide. They are in all stages of modification by erosion, either still fresh or almost obliterated. As a rule, the older features are on a much larger scale than those of recent date, indicating that the earlier movements were of the greater magnitude. Some of the recent features point clearly to horizontal movements along the fault. For example, near Cajon Pass, four deep ravines that descend the steep slope of the San Bernandino Mountains on the east side of the rift are displaced abruptly at the fault-trace, each ravine appearing on the west side of the fault at a point at least 150 feet farther to the north-west.

The fault-zone bordering the great fault is a mosaic of elongated blocks, the longer axes of which are parallel to the strike of the fault. In many places the rock-masses are so shattered and different formations are so mixed together that it is impossible to map them. The dominant structure is a sort of slicing that appears to be mainly the result of horizontal shear along the San Andreas fault. Along some of the branching faults are narrow strips of steeply dipping Tertiary sediments pinched between much older crystalline rocks. One of these strips runs for a distance of twelve miles through the highest part of the San Gabriel Range, and in most places does not reach a hundred yards in width.

At but few places in the fault-zone are similar rocks to be found on both sides of the fault. In one portion fifty miles in length, the fault is bordered continuously on the south side by pre-Cambrian schists, while the rocks on the other side are Mesozoic granites and pre-Cambrian gneisses. No clearer evidence of the magnitude of the fault-displacements could be desired.

The first movement along the rift of which the date can be determined approximately occurred between late Mesozoic and early Quaternary times. The different stages of erosion exhibited by the recent, sub-recent, and older topographic features along the rift prove that faulting has taken place at intervals all through Quaternary time and that it has not yet come to an end. C. D.

University and Educational Intelligence.

CAMBRIDGE.—The following appointments have been made: Mr. F. Debenham, Gonville and Caius College, to be reader in geography; Mr. T. G. Bedford, Sidney Sussex College, to be lecturer in physics; Dr. E. M'Kenzie Taylor, St. John's College, to be lecturer, and Dr. H. E. Woodman, demonstrator in agricultural chemistry; Mr. T. K. W. Fair, Jesus College, to be demonstrator in agricultural physiology, and Mr. W. A. Wooster, Peterhouse, to be demonstrator in mineralogy.

K. R. H. Johnston, Sidney Sussex College, A. C. Candler, Trinity College, and G. A. Bell, St. John's College, have been elected to the Henry P. Davison scholarships at Harvard, Yale, and Princeton Universities respectively.

It is proposed to establish new lectureships in structural crystallography in the department of mineralogy and in cultural anthropology in the faculty of archæology and anthropology. It is also proposed to build a special animal house to provide facilities for studying the metabolism of pigmented animals, a capital grant for the purpose having been offered by the Empire Marketing Board.

LONDON.—A research studentship, value £100, is being offered by Bedford College for Women to graduates of the college of not more than three years' standing. Particulars are obtainable from the Secretary.

OXFORD.—The Preamble to a form of Statute providing that women shall be eligible to any professorship, readership, or other university teachership, has been approved by Congregation.

The University Observatory is to be extended at a cost not exceeding £2750, and Prof. H. H. Turner's report on the work of the Observatory for the period May 1, 1926-Mar. 1, 1927, has been published. The various activities of the institution include the well-known seismological investigations by Prof. Turner and a research on "'Trepidation,' or the Fluctuation in the Solar System," by Dr. J. K. Fotheringham.

ST. ANDREWS.—Prof. H. J. Rose, professor of Latin since 1919 at Aberystwyth, has been appointed professor of Greek in the United College. Prof. Rose graduated at McGill University, Montreal, in 1904; he was appointed Rhodes Scholar from the Province of Quebec and went to Balliol College, Oxford. Prof. Rose has published volumes on "The Roman Questions of Plutarch," "Primitive Culture in Greece," and "Primitive Culture in Italy."

THE Royal Society announces that the secretaries are prepared to receive applications for the Mackinnon and Moseley Research Studentships, which are each of the annual value of £300. The appointments will, in the first instance, be for two years, but may be extended. Particulars and forms of application can be obtained from the assistant secretary of the Society, Burlington House, W.1. The completed forms must be returned by June 22 at latest.

Two vacation courses to be held during the coming August are being organised by Leplay House. One will be held in the High Pyrenees, with Aix-les-Thermes as its principal centre. The other will be 'a students' camp' in the Austrian Tyrol in Aldrans, 1700 feet above Innsbruck. The courses are open to all university lecturers, teachers, students, and others interested in geographical, historical, and social studies. Particulars may be obtained from Leplay House, 65 Belgrave Road, Westminster, S.W.1.

Calendar of Discovery and Invention.

June 5, 1838.—In the Journal of Caroline Fox, under this date is an entry describing a visit to King's College, London, to see Wheatstone's electric telegraph, which "is really being brought into service, as last week they began laying it down between London and Bristol, to cost £250 a mile. . . . Wheatstone has been giving lectures, and in fact is in the middle of a course. No ladies are admitted, unfortunately; the Bishop of London forbade it; seeing how they congregated to Lyell's, which prohibition so offended that gentleman that he resigned his professorship."

June 5, 1854.—More than seventy years ago, James Bowman Lindsay conceived the idea of signalling through water without wires, making experiments in the Tay, at Portsmouth, and elsewhere; and on June 5, 1854, he took out a patent for "a mode of transmitting telegraphic messages through and across water without submerged wires, the water being made available as the connecting and conducting medium."

June 6, 1761.—Transits of Venus across the sun's disc occurred in 1631 and 1639, 1761 and 1769, and in 1874 and 1882. That of 1631, though predicted, was unobserved, while Horrocks and Crabtree, two young English astronomers, were the sole observers of that of 1639. The transit of June 6, 1761, was the first to be observed by astronomers generally and many described it, while the transits of the last century were utilised to determine the solar parallax.

June 7, 1866.—On this day Francis Herbert Wenham, one of the early pioneers of flight, took out his patent, No. 1571, for improvements in apparatus for aerial navigation. His patent included "a novel arrangement of surfaces placed one above the other and kept in parallel planes by means of cords or rods or webs of woven fabric," this system of surfaces being arranged as a suitable structure for containing the motive power.

June 8, 1829.—The collaboration between Liebig and Wöhler was the outcome of a proposal by the latter. The two had met at a friend's house in Frankfort, and on June 8, 1829, Wöhler wrote to Liebig from Sacrow, near Potsdam: "If you are so minded, we might, for the humour of it, undertake some chemical work together, in order that the result might be made known under our joint names. Of course, you would work in Giessen and I in Berlin, when we are agreed upon the plan, and we could communicate with each other from time to time as to its progress."

June 9, 1810.—The compound steam engine was brought into use by Woolf, who on June 9, 1810, took out a patent "for further improvements in the construction and working of steam engines." In a Woolf engine, steam was used expansively in the high-pressure cylinder and then passed direct to the low-pressure cylinder without an intermediate receiver. Woolf engines were considerably more economical than those previously used.

June 9, 1881.—One of the inventions which aroused the enthusiasm of Lord Kelvin was the improved form of secondary battery brought out by Faure. Many experiments were carried out at Glasgow, and in a letter to the *Times* on June 9, 1881, entitled "Electrical Storage of Dynamical Energy," Kelvin directed attention to the importance of the new form of accumulator.

June 10, 1717.—The "Sermo de structura florum" of Sébastien Vaillant (1669–1722) was read in Paris at the opening of the Jardin Royal de Paris, and afterwards published in Latin and French; the perusal of this thin volume is stated to have suggested his sexual system of plants to Carl Linnæus (1707–1778) ten years later. E. C. S.

Societies and Academies.

LONDON.

Physical Society, April 8.—C. L. Fortescue: The characteristics of thermionic rectifiers. Rectifying valves working at low voltages with unsaturated electron currents are discussed. The most economic conditions are briefly dealt with; so far as the limited information with respect to the life of modern valves is concerned, it is probable that long life should be provided for.—B. L. Worsnop: The scattering of X-rays and the *J* phenomenon. Experiments have been carried out using a 'balance method' to obtain the *J* discontinuity which Barkla found with heterogeneous X-rays scattered by elements of low atomic weight; no such discontinuities have been found. Probably some condition which has not yet been published is required for its production.—Ezer Griffiths: A carbon dioxide measuring instrument based on sound velocity measurement. A quartz crystal is maintained in vibration piezo-electrically, and stationary waves are set up in the gas between the flat surface of the crystal and a movable reflector. The position of the nodes is recognised by the reaction on the quartz crystal, resulting in an increase of the current in the maintaining circuit. The distance from node to node is a measure of the composition of the gaseous mixture, assuming it is composed of two gases which do not react.

Geological Society, April 27.—F. W. Shotton: The conglomerates of the Enville Series of the Warwickshire Coalfield. The conglomerates are found at three horizons, to which, in descending order, the names of Allesley, Corley, and Arley-Exhall have previously been applied. The derived pebbles consist chiefly of dark Valentian sandstone, carboniferous limestone, and carboniferous chert. Igneous material is extremely rare. The Arley-Exhall pebbles are mainly carboniferous cherts, with less abundant limestone and Valentian sandstone; while the Corley materials are predominantly Valentian, with some chert, but limestone is very rare among them. The Valentian pebbles of the Arley-Exhall conglomerate were probably derived from the west, whereas similar material at the Corley horizon came from the east. It seems most reasonable to suppose the previous existence of Upper Valentian deposits upon the present north-to-south underground extension of the Nuneaton ridge. The limestone-pebbles of the Corley conglomerate may have come from the west or from the south-west.—F. C. Phillips: The serpentines of the Shetland Islands, and the associated rocks and minerals. The Shetland Islands consist mainly of a series of schists and paragneisses, with a strike over the greater part of the area of about north 10° east, and a steep westward dip. Around the eastern and western margins of Mainland occur patches of Old Red Sandstone sediments, and on the north an extensive development of igneous products of that age. A series of old intrusions, ranging from ultrabasic to acid, is found among the metamorphic rocks. The most basic of these earlier intrusions, chiefly developed in the northernmost islands of Unst and Fetlar, was a dunite, now almost entirely serpentinised. A constant accessory in these rocks is a chromespinel, and in places this becomes concentrated as workable deposits of chromite. The ores are of two main types: banded chromite-serpentine and lenticles of massive chromite-rock. The gabbro, succeeding on the east, is extensively altered, the original pyroxene being uralitised and the felspar converted to a saussuritic aggregate. Later mineralogical and chemical changes have been brought about by dynamic metamorphism and low-temperature weathering.

Linnean Society, April 28.—Hugh Scott: Narrative of an expedition to Abyssinia. The journey was undertaken to examine the insect fauna and, so far as possible, the flora of the highlands of central Abyssinia. The fauna and flora are of peculiar interest in that they are those of a large well-watered, elevated country in the heart of Africa, isolated from surrounding regions by low-lying desert or semi-desert tracts; and that they exhibit a remarkable blend of Palæarctic, Ethiopian, and Oriental elements. The Expedition set out from Addis Ababa, the capital, at more than 8000 feet above sea-level, and several very different types of country, lying at elevations between 5500 and 12,000 feet, were visited. These included the primeval forest of Djem-Djem, composed mainly of giant juniper-trees; Mount Zuquála, an extinct volcano with a lake in its crater, and carrying giant heath; the plains southwards to Lake Zwai, a region of dry bush and thorn-scrub; the park-like country, forest, and heath-land of Mount Chillálo; and the Muger Valley, a great chasm more than 2000 feet deep, with precipitous sides. A curious mixture of temperate and distinctly African plants was frequently met with.—W. P. Pycraft: Restoration of the left innominate bone of Rhodesian man. The restoration is based on the greater part of the left ilium. That portion of the ilium forming the outer wall of the 'false-pelvis' is remarkable for its great height and the quite unusual position of the greater sciatic notch. The acetabulum of the fragment is remarkably small and shallow, and the form of its articular surface is unusual. What answers to the lower segment of the horse-shoe loop in modern pelves is splayed out backwards so as to cause the acetabulum to look backwards and downwards, instead of forwards and outwards as in modern man. The position of the ischium and pubis is markedly different from that of modern pelves.

Society of Public Analysts, May 4.—W. R. Schoeller and C. Jahn: Investigations into the analytical chemistry of tantalum, niobium, and their mineral associates. (vii.) The precipitation of tungstic acid by tannin. (viii.) The separation of tungsten from tantalum and niobium. Small quantities of tungstic acid are quantitatively recovered from tungsten solutions containing alkali chloride by precipitation with tannin and cinchonine hydrochloride. A method of determining small amounts of tungsten in the presence of large amounts of earth acids has been based on this principle. Small amounts of earth acids in tungstic trioxide are determined by fusing the mixture with sodium hydroxide and treating the fused mass with sodium chloride solution; sodium tantalate and niobate remain undissolved.—S. G. Clarke: The separation of vanadium and tungsten. Vanadium may be determined in the presence of large amounts of tungsten by precipitation with cupferron (ammonium salt of nitroso-phenyl hydroxylamine) after treatment of the solution with hydrofluoric acid, neutralisation with ammonia, addition of hydrochloric acid, and dilution. The precipitate is separated, washed, and ignited at a low temperature, the residual vanadium pentoxide dissolved in dilute sulphuric acid, and the solution reduced with sulphur dioxide and titrated with permanganate.—J. M. Jones and T. McLachlan: The determination of moisture by the volatile solvent method. The method is satisfactory for emulsions, such as butter and margarine, and gives more consistent results than any other method for such products as jam, honey, and malt extract. The use of toluene as a solvent enables the results to be obtained

in a shorter time than when benzene or petroleum spirit is used.—F. Wokes and S. G. Willimott: A study of antimony trichloride as a possible quantitative reagent for vitamin A. The reaction is probably due to condensation, and can be retarded by dehydration of the solvent. The depth of the initial blue coloration obtained under standard conditions may be used to measure the vitamin A content of the oil. The intensity of colour is expressed in Lovibond blue units 30 seconds after mixing the solution of the oil and reagent.—B. S. Evans: New processes for the determination of certain elements in lead. The sample is dissolved in nitric acid, lead separated as sulphate, and arsenic precipitated with sodium hypophosphite and separated by shaking with benzene and filtering. Antimony is determined in the filtrate, and the arsenic in the precipitate is determined by an iodimetric method. Bismuth is determined colorimetrically with potassium iodide after separation of the lead as sulphate and chloride, and sulphur is determined gravimetrically after dissolving the metal in *aqua regia*, evaporating the solution to dryness, and dissolving the residue in dilute hydrochloric acid.

Optical Society, May 12.—M. von Rohr: Contributions to the history of English opticians in the first half of the nineteenth century (with special reference to spectacle history). Although London opticians during the eighteenth century had carried out splendid work as craftsmen, they were not very quick at adopting new ideas. This was a great drawback, especially as about 1818, Fraunhofer succeeded in raising the standard of his factory to an unrivalled height. Although Fraunhofer's innovations do not seem to have had any direct influence on English opticians, they were acknowledged by English men of science. Strenuous endeavours were made between 1826 and 1829 by Sir John Herschel and Michael Faraday to produce optical glass, and theoretical work was carried out by Airy, Coddington, and Hamilton. London opticians, however, did not derive the same amount of help from such scientific innovations as the Vienna school did from Stampfer and Prechtl, and the good fortune of securing Petzval's help gave, in 1840, the leading position in the manufacture of photographic lenses of high aperture to the Viennese firm of Voigtländer. The inventions of stereoscopy and photography presented opticians with new problems, and English amateurs were the first to understand photographs as perspectives of the depicted object. At the end of the period a well-directed optical glass factory was established in England.

Royal Meteorological Society, May 18.—Harold Jeffreys: Cyclones and the general circulation. If there were no variation of temperature with latitude, the atmosphere could rotate with the earth like a rigid body, and this would be a stable state. But increase of temperature towards the equator implies that the velocity from the west must increase with height, and in these conditions frictional interaction between different layers of the air and between the lowest layer and the ground would suffice to destroy any motion symmetrical about the earth's axis. Irregular horizontal interchange of air must therefore be developed, and this implies the known system of cyclones. One effect of the interchange would be that the normal winds at the surface must be on the whole as much easterly as westerly; the easterly prevailing winds are near the equator and the westerly ones in higher latitudes. This mechanism would give slow anticyclonic circulations near the poles, apart from possible local conditions.—George M. Meyer: Early water-mills in relation to changes in the rainfall of east Kent. Records of water-mills in Domesday and in mediæval law-suits show that the streams of the district were of greater volume at the end of the eleventh century than to-day, and that the decrease was rapid about 1275. Early in the fourteenth century, silt was carried down by the Gestling or North Stream, whereas now practically none is brought down by that stream or by the Stour near its mouth. Indeed, the varying discharge of the streams represents approximately the changes in the rainfall. These variations had a profound effect upon the silting up of local harbours, a point which may well affect the choice of site for any prospective new harbour.—S. Morris Bower: Report on winter thunderstorms in the British Islands from January 1 to March 31, 1926. The widespread thunderstorms about Feb. 16, 1926, which appear to have accompanied the passage of five squall lines, are specially treated. Figures showing the diurnal variation in the frequency of winter thunderstorms in 1925 and 1926 are included.

PARIS.

Academy of Sciences, April 20.—André Charrueau: A figure of equilibrium, of revolution, of a liquid mass in rotation, submitted to a Newtonian attraction between its particles and to the surface tension.—V. Dolejšek: The systematics of the X-rays.—P. Brun: The surface tension of liquid mixtures in the neighbourhood of the critical state. Studies in the critical temperatures of miscibility of liquids. Measurements of surface tensions of aqueous ethyl alcohol and isoamyl alcohol.—Herszfinkiel: The elements with atomic numbers 43, 61, 75, 85 and 87. Historical account of searches for these elements.—Robert Stumper: The thermal analysis of the dehydration of gypsum. The temperature of formation of calcium sulphate semihydrate is higher as the velocity of dehydration increases, but the temperature of formation of anhydrite is practically uninfluenced by this factor, at least within the limits of the velocities studied.—J. F. Durand and M. Banos: The addition of acetylene to carbon monoxide: the synthesis of quinone. Mixtures of carbon monoxide and acetylene treated with cuprous chloride in hydrochloric acid or ammonia solution gave no results, but in pyridine solution a reaction takes place from the products of which *p*-quinone was isolated.—L. Dollé: The hydrogeology of chalk.—P. Chevey: The transitory vascular networks of the spawn of *Acara tetramerus*.—J. Chaine and J. Duvergier: The distinction between *Gadus capelanus*, *minutus* and *luscus* by their sagitta.

April 25.—Maurice Hamy: The measurement of the radial velocities of the stars.—Jean Perrin and Mlle. Choucroun: The rôle of molecular induction in activation by shock.—R. de Forcrand: Researches on the thallous carbonates. Thermochemical data for thallium carbonate.—Erhard Tornier: The properties of the prime numbers explained by the theory of probabilities.—Emile Borel: Remarks on the preceding communication.—A. Kovanko: The integration of series of totalisable functions.—Louis Barbillion: The true period of direct governors.—Haroutune Anjour: A new method for studying the movement of a solid body.—Charles Frémont: The cause of the cupel formation in the breaking of certain test pieces by traction.—P. David: Detection (in wireless telegraphy) by the valve.—Georges Balasse: The electrodeless discharge in damped waves or maintained waves. The continuous spectra of cæsium and potassium.—Mme. L. François-Franck: An arrangement for biological photomicrography and kinemamicrophotography. A diagram in plan and elevation of the

proposed apparatus is given.—Emile **Rousseau**: The photochemical action of the mercury vapour arc on a liquid containing formaldehyde covered with olive oil.—Edmond **Vellinger**: The rotatory power of tartaric acid. Reply to a criticism by L. Longchambon.—Const. A. **Kténas**: The enclosures and endomorph lavas of Fouqué-Kaméni.—G. **Nicolas**: New biological observations on *Fegatella conica*.—G. **Nadson**: The perforating algæ, their distribution and their rôle in Nature. These perforating algæ are very widely distributed, and develop in great quantities in many seas. They perforate calcareous substances from the delicate teguments of the Bryozoa up to the hardest limestone rocks. Their action, although scarcely visible on cursory examination, is on a very large scale and has important results on the circulation of calcium on the earth's surface.—René **Souèges**: The embryogeny of the Leguminoseæ. The development of the proembryo in *Trifolium minus*.—A. **Sartory**, R. **Sartory**, and J. **Meyer**: Researches on the causes of the appearance of the perithecium in *Aspergillus fumigatus*.—R. **Fosse** and Mlle. N. **Rouchelmann**: The action of pulped liver on ammonium cyanate.

CAPE TOWN.

Royal Society of South Africa, Mar. 16.—J. M. **Watt** and Marie G. **Brandwijk**: On *Xysmalobium undulatum*—a chemical and pharmacodynamical study of 'Chonga' (Bitter-wortel). This drug is used in South Africa as an intestinal and uterine sedative.—C. G. S. de **Villiers**: The comparative anatomy of the breast-shoulder apparatus of the three aglossal anuran genera Xenopus, Pipa and Hymenochirus. It is considered that Xenopus and the Hymenochirus group will prove to be more closely allied with each other than with Pipa, but in the absence of any developmental material of Hymenochirus, the mutual relationships of the Ethiopian Aglossa remain a matter of pure speculation.—G. A. H. **Bedford**: Description of three new species of Anoplura from South African mammals. The new species are named *Linognathus taurotragus* (from eland), *Linognathus gnu* (from black wildebeest or gnu), and *Linognathus ferrisi* (from blue wildebeest).—Sir Thomas **Muir**: Note on hyperorthogonants. Sylvester's suggested generalisation of the original conception of an orthogonant, although neglected for a generation, has, since Hadamard recalled it to notice in 1893, received considerable attention. The same does not hold in regard to a second generalisation (the hyperorthogonant) which is of quite a different type and not improbably may prove the more important of the two. Use was first made of a hyperorthogonant in a paper by Petrini in 1901.

MELBOURNE.

Royal Society of Victoria, Mar. 17.—Alfred J. **Ewart** and Phyllis **Jarrett**: Contributions to the flora of Australia (No. 33). Additions to the flora of the Northern Territory. Further examinations have been made of material collected by the senior author in Central Australia, as well as of Mr. Allan's Northern Territory collections and of material in the Tate Herbarium, Adelaide. The genus Wycliffea is merely a highly cleistogamic form of *Glinus Spergula*. The paper contains 15 additions to the flora and 80 locality records.—H. M. **Treloar**: Variation of wind with height at Melbourne when geotropic winds are northerly. The mean change of wind with height in a particular class of Melbourne winds is considered, and close agreement shown to exist between computed and observed winds between the heights 50 m. and 800 m. Values of the eddy diffusivity for different parts of this height range are derived. In computing the theoretical wind distribution, difficulties associated with the use of the usual boundary conditions are avoided by applying certain determining conditions at a definite height, which height is found from the observations.—Alice M. **Coverlid**: The leaves of *Grewia polygama*. A decoction made by pouring boiling water over the leaves of this plant, which is a member of the order Liliaceæ, is used by white people throughout the Northern Territory and the north of Queensland, where it grows, as a remedy for dysentery. Examination showed nothing to which its alleged properties could be ascribed, except tannins, and these were present only to the extent of 4 per cent. of the dry weight of the leaves. The aborigines, credited with knowing any native plant of medicinal value, do not use this plant.—Arthur M. **Lea**: Australian Curculionidæ of the subfamily Gonipterides. The paper deals with a subfamily of Australian weevils which feed principally on eucalyptus leaves. Notes are given on synonymy, variation and distribution, and twenty species are described as new. One of the species, *Gonipterus scutellatus*, was accidentally introduced to South Africa, South America, and New Zealand, where it has become so abundant that the 'blue,' 'manna,' and other gums are threatened with destruction. The South African Government recently sent an entomologist to Australia, where he found a minute wasp that destroys its eggs, and this has been successfully introduced to South Africa.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 13, No. 3, March).—Carl **Barus**: Pinhole probe experiments with massive air columns. The acoustic pressures inside a conical horn were investigated. The curve showing the relation between pressure and depth in the horn is practically a straight line except at the mouth and base of the horn.—William V. **Houston**: The fine structure of the helium arc spectrum. A low current density was used and the discharge tube was cooled in liquid air. A compound Fabry-Perot interferometer was used for the diffuse series line λ5876 and gold films on the simple interferometer for the sharp series line λ7065. By these means it was shown that the helium spectrum has a triplet structure similar to that predicted by Heisenberg.—Paul S. **Epstein**: Two remarks on Schrödinger's quantum theory. The first relates to the relativity effect in the neutral hydrogen atom; the second deals with the theory of light quanta.—Boris **Podolsky**: On King's classical theory of radiation. Objections are raised that if the electron behaves as a rigid body and acquires a precession, it cannot absorb energy and maintain the frequency of precession, and also that a spinning electron moving with uniform translational velocity cannot have a precession.—H. **Sponer**: Absorption bands in nitrogen. The ultra-violet band system found by Birge and Hopfield in emission is a true absorption system of nitrogen.—J. C. **Slater**: Action of radiation and perturbations of atoms.—George B. **Welch**: The periodicity of photo-electric thresholds. As might be expected if the photo-electric threshold is a measure of the energy from incident radiation required to detach an outer electron, the threshold-atomic number curve is periodic with maxima for the alkali metals. The value for gold is anomalous.—L. F. **Heimlich**: Microsporogenesis in the cucumber.—Sophia **Satina** and A. F. **Blakeslee**: Further studies on biochemical differences between sexes in plants. Extracts of female plants are generally stronger

reducers of potassium permanganate than extracts from male plants. The results are closely parallel with those of the Manoilov reaction, but the reducing substances effective in the two cases are different. The reactions depend on quantitative rather than qualitative differences.—E. M. East: Inheritance of trimorphism in *Lythrum salicaria*. Self-sterility is not due to selective pollen-tube growth. The two kinds of pollen carry the same factors so far as trimorphism is concerned. Flower differences are conditioned by three genes, long style being recessive.—F. G. Benedict and E. G. Ritzman: (1) The fasting of large ruminants. Four steers have been subjected to fasts of 5 to 14 days. Records were obtained of changes of body-weight, amount of excreta, gaseous metabolism, and so on. The total carbon dioxide production in consecutive half-hour periods was measured in a respiration chamber. During the fast, the character of the urine changes from that of herbivora to that of omnivora and nitrogen excretion increases. Heat production (determined from the carbon dioxide production and respiratory quotient) decreases, at first rapidly and then more slowly. Metabolism depends on the previous feeding (maintenance or sub-maintenance) and is notably higher in young animals. (2) The basal metabolism of steers. The effect of the temperature of the environment is small. The metabolism reaches a steady value about 30 hours after the last feed. Respiration experiments during four consecutive half-hour standing periods and during 24-hour periods when the animal stood or laid down at will showed that posture has little effect. The true basal metabolism is 1300 + calories per square metre of body surface, which is 40 per cent. greater than that of man. (3) The metabolic stimulus of food in the case of steers. Animals fasted for two days and then given a ration low in protein all showed a great increase of metabolism consequent on the ingestion of food. Any additional activity during feeding periods and 'the work of digestion' required by the movements of food masses through the intestines cannot account for the increased metabolism observed. It is suggested (after Grouven) that carbohydrates in the ruminant are fermented to form fatty acids and are wholly absorbed at this stage; these acids in the blood stimulate cell activity.—Leonell C. Strong: Studies on the effect of potassium alum-hydrochloric acid solutions on the growth and fate of neoplastic tissue. (1) Effect on a slow-growing adeno-carcinoma of the mouse. A stock of mice the females of which develop spontaneous mammary gland cancer has been produced. Potassium alum in hydrochloric acid was given in the drinking water, and it so affects the host or the tumour that the growth of the later is definitely slowed down and the host animal is able to live longer than it would if untreated. Complete regression of spontaneous tumours has been observed after combined oral administration and subcutaneous injection.—C. F. Roos: Dynamical economics. Competition, monopoly, and co-operation in general functions of demand and cost are discussed mathematically.—Edwin B. Wilson: On the proof of Sheppard's corrections.—D. V. Widder: Note on a generalisation of Taylor's series.—George D. Birkhoff: (1) A theory of matter and electricity. The theory requires the introduction of a 'substance coefficient' and an 'atomic potential' and it is claimed that it satisfies the demands of determinateness and stability.—(2) The hydrogen atom and the Balmer formula. By the use of the theory put forward in (1), a formula of the Balmer type is obtained.—G. A. Miller: Groups generated by two operators of order three whose product is of order three.

Official Publications Received.

BRITISH.

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1926, presented to the Annual Meeting, February 21st, 1927. Pp. 41+16. (York.)

British Chemical Abstracts issued by the Bureau of Chemical Abstracts. Index, 1926. Pp. 430. (London: Society of Chemical Industry.)

The Physiological Society. Session 1927–8. Rules, List of Members and Dates of Meetings. Pp. xii+32. (London.)

Transactions of the Faraday Society. Index, Vols. 1 to 20. Pp. 55. (London and Edinburgh: Gurney and Jackson.) 13*s.* 6*d.* net; paper, 10*s.* 6*d.* net.

Union of South Africa: Department of Agriculture. Bulletin No. 11: Cheddar Cheese-making. By Jas. P. Gow. Pp. 16. (Pretoria: Government Printing and Stationery Office). 3*d.*

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1926. Pp. ii+13. (Cape Town.)

Board of Education. Report on the Science Museum for the Year 1926. Pp. 27. (London: H.M. Stationery Office.) 1*s.* net.

The University of Leeds: Department of Leather Industries. Report of the Advisory Committee on the Work of the Department during the Sessions 1924–25 and 1925–26. Pp. 8. (Leeds.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 37: The Soluble Silicate Content of Soils. By W. R. G. Atkins. Pp. 433-436. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

Falmouth Observatory. Meteorological Notes and Tables for the Year 1926. By Joshua Bath Phillips. Pp. 11. (Falmouth.)

Proceedings of the Cambridge Philosophical Society. Vol. 23, Part 6, April. Pp. 617-754. (Cambridge: At the University Press.) 7*s.* 6*d.* net.

The Physical Society. Proceedings, Vol. 39, Part 3, April 15. Pp. 171-250. (London: Fleetway Press, Ltd.) 6*s.* net.

The North of Scotland College of Agriculture. Bulletin No. 32: Crane Fly Grub and the Oat Crop. By John Rennie. Pp. 14. Bulletin No. 33: Acarine Disease in Hive Bees; its Cause, Nature and Control. By John Rennie. Pp. 34+5 plates. 1*s.* (Aberdeen.)

Electricity Commission. Electricity (Supply) Act, 1926. Central Scotland Electricity Scheme, 1927: Scheme prepared by the Electricity Commissioners in pursuance of Section Four of the Electricity (Supply) Act, 1926. Published by Order of the Central Electricity Board. Pp. 10+1 map. 1*s.* net. Supplementary Particulars. Pp. 73+4 diagrams. 2*s.* 6*d.* net. (London: H.M. Stationery Office.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 65, No. 365, May. Pp. 469-552+xxx. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Forest Bulletin No. 68: Notes on the Comparative Economic Cost of Wood and Metal Sleepers in India, and Cost of Treatment. By J. H. Warr and H. Trotter. (Economy Series.) Pp. v+29+8 plates. 1.12 rupees; 3*s.* Forest Bulletin No. 70: *Hoplocerambyx spinicornis*—an important Pest of Sal. By D. J. Atkinson. (Entomology Series.) Pp. ii+24+5 plates. 15 annas; 1*s.* 6*d.* (Calcutta: Government of India Central Publication Branch.)

Journal of the Indian Institute of Science. Vol. 9A, Part 9: Derivatives of Naphthaquinolines and Naphthaisoquinolines. By Charles Stanley Gibson, Kalvoi Venkatakrishna Hariharan, Kottiazath Narayana Menon and John Lionel Simonsen. Pp. 179-191. 12 annas. Vol. 9A, Part 10: i. Isomeric Phenylserines; ii. The Unstable Modification of *iso*Nitroso-camphor; iii. d-Mannitol from 'Gardenia turgida.' By M. O. Forster and Keshaviah Aswath Narain Rao. Pp. 193-207. 12 annas. (Bangalore.)

Publications of the Dominion Astrophysical Observatory, Victoria. Vol. 3, No. 15: The Orbits of three A-type Spectroscopic Binaries. By W. E. Harper. Pp. 315-329. Vol. 3, No. 16: Two Spectroscopic Binary Orbits. By R. M. Petrie. Pp. 331-339. Vol. 3, No. 17: Two K-type Spectroscopic Binaries. By W. E. Harper. Pp. 341-348. (Victoria, B.C.)

Publications of the South African Institute for Medical Research. No. 20: The Plague Problem in South Africa; Historical, Bacteriological and Entomological Studies. By J. Alexander Mitchell, Dr. J. H. Harvey Pirie and Dr. A. Ingram. Pp. 85-256. (Johannesburg.)

Aeronautical Research Committee: Reports and Memoranda. No. 1062 (E. 23): Dopes and Detonation. Second Report by Prof. H. L. Callendar. Experiments made in the Air Ministry Laboratory at the Imperial College of Science, London, under the Direction of R. O. King, by Dr. E. W. J. Mardles and W. J. Stern, assisted by N. R. Fowler. (B.4. Engines, £2.—T. 2372.) Pp. 31+5 plates. 1*s.* 3*d.* net. No. 1069 (Ae. 251): On a Modification of the Chattock Gauge, Designed to Eliminate the Change of the Zero with Temperature. By W. J. Duncan. (C.1. Accessories-Instruments, 93.—T. 2368.) Pp. 5+1 plate. 6*d.* net. No. 1074 (Ae. 256): Full Scale Tests of a Suspended Air Log. By J. K. Hardy. (C.1. Accessories-Instruments, 94.—T. 2391.) Pp. 4+1 plate. 4*d.* net. (London: H.M. Stationery Office.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 36: On the Index Fossil of the *Cleistopora* Zone. By Dr. Louis B. Smith. Pp. 423-431+plates 20-22. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2*s.* 6*d.*

Bishop's Stortford College. Report of the Proceedings of the Natural History Society, 1926. Pp. 23. (Bishop's Stortford.)

FOREIGN.

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 19: Monsoon-Currents in the Java Sea and its Entrances. By H. P. Berlage, Jr. Pp. 28+21 plates. (Weltevreden: Landsdrukkerij.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 20: On the Mechanism of Cyclones and Anticyclones, Part 2. By Tatuo Kobayasi. Pp. 205-233. 0.50 yen. No. 21: Lower Limit of Inflammability of Ethyl Alcohol, Ethyl Ether, Methyl Cyclohexane and their Mixtures. By Yoshio Tanaka, Yuzaburo Nagai and Kinsei Akiyama. Pp. 235-246. 0.25 yen. (Tôkyô: Koseikai Publishing Office.)

United States Department of Agriculture. Department Bulletin No. 1469: The Satin Moth, a recently introduced Pest. By A. F. Burgess and S. S. Crossman. Pp. 23+1 plate. (Washington, D.C.: Government Printing Office.) 10 cents.

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 378: Tables for Albers Projection. By Oscar S. Adams. (Special Publication No. 130.) Pp. ii+24. (Washington, D.C.: Government Printing Office.) 5 cents.

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 2: Record of Current Educational Publications, comprising Publications received by the Bureau of Education to January 1, 1927. Pp. 58. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the United States National Museum. Vol. 70, Art. 18: Small Shells from Dredgings off the Southeast Coast of the United States by the United States Fisheries Steamer *Albatross* in 1885 and 1886. By William H. Dall. (No. 2667.) Pp. 134. Vol. 70, Art. 23: A Revision of the Beetles of the Genus Oedionychis occurring in America north of Mexico. By Doris Holmes Blake. (No. 2672.) Pp. 44+2 plates. Vol. 71, Art. 11: Notes on the Melitaeid Butterfly *Euphydryas phaëton* (Drury), with Descriptions of a new Subspecies and a new Variety. By Austin H. Clark. (No. 2683.) Pp. 22+5 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1926. Pp. ix+205. (Washington, D.C.: Government Printing Office.) 25 cents.

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 78, 1926. Pp. iii+506+40 plates+228. (Philadelphia, Pa.)

Department of Commerce: Bureau of Standards. Technologic Papers of the Bureau of Standards, No. 337: Soundproofing of Apartment Houses. By V. L. Chrisler. Pp. 253-260. (Washington, D.C.: Government Printing Office.) 5 cents.

Bulletin of the American Museum of Natural History. Vol. 53, Art. 2: The Aquatic Mollusks of the Belgian Congo, with a Geographical and Ecological Account of Congo Malacology. By Henry A. Pilsbry and J. Bequaert. Pp. 69-602+plates 10-77. (New York City.)

Diary of Societies.

SATURDAY, JUNE 4.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Eastern District Meeting) (at Town Hall, Maidstone), at 11 A.M.—T. F. Bunting: Housing in Borough of Maidstone; Widening of Maidstone Bridge; New Elementary School.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB, at 8.15.—Sir Leonard Rogers: Climate and Disease Incidence in India: Forecasting Epidemics.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Scottish Meeting) (at Dunfermline).

MONDAY, JUNE 6.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. Harvey-Gibson: Account of the Life of De Saussure 1767-1845, with the gift of the MSS. of a Translation of his "Recherches chimiques sur la végétation," 1804.—Ethel Currie: Fossil Echinoidea of Somaliland.—A. Calder: A Case of Partial Sex Transformation in Cattle.—W. O. Kermack and W. T. H. Williamson: Stability of Suspensions, Part 2, The Rate of Sedimentation of Kaolin Suspensions containing Colloidal Silicon Dioxide.—Amy Fleming: The Peripheral Sympathetic Innervation of the Uterus (*to be read by title*).—W. L. Ferrar: Consistency of Cardinal Function Interpolation (*to be read by title*).—Prof. W. H. Lang: Contributions to the Study of the Old Red Sandstone Flora of Scotland, Part VI., On *Zosterophyllum Myatonianum*, Penh., and some other Plant Remains from the Carmyllie Beds of the Lower Old Red Sandstone. Part VII. On a Specimen of Pseudosporochnus, from the Stromness Beds (*to be read by title*).—Sir Thomas Muir: The Theory of Orthogonants and Latent Roots from 1881 to 1918 (*to be read by title*).

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. F. Aveling: Mental Association.

TUESDAY, JUNE 7.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. J. P. Hill: Exhibition of Lantern-slides of Echidna Embryos.—R. I. Pocock: The Gibbons of the Genus Hylobates.—Dr. C. A. Nilsson-Cantell: Some Barnacles in the British Museum (Natural History).—R. Gurney: Zoological Results of the Cambridge Expedition to the Suez Canal, 1924. Report on the Crustacea, Copepoda (Littoral and Semi-Parasitic).—P. Esben-Petersen: New Species of *Neuroptera Planipennia* in British Collections—IV.

THURSDAY, JUNE 9.

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology Sections) (Summer Meeting).—Laryngological Session, at 2.30.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. W. E. H. Berwick: Modular Invariants Expressed in Terms of Quadratic and Cubic Irrationalities.—H. Bohr: On the Limit Values of Analytic Functions.—Prof. E. H. Neville: The Logarithmic Singularity of the Quarter-period K.—Prof. J. Proudman and F. Edith Mercer: On the Theory of the Oscillations of a Rotating Mechanical System of Infinite Freedom.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Royal Anthropological Institute), at 6.—Dr. E. D. Hutchinson: The Psychology of Creative Effort.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Dr. T. H. Harrison: The Use of Photo-electric Cells for Precision Photometry of Electric Lamps.—R. Kingslake: An Experimental Study of the Best Minimum Wave-length for Visual Achromatism.—Sushil Krishna Datta: On Brewster's Bands. Part II.

FRIDAY, JUNE 10.

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology Sections) (Summer Meeting).—Otological Session, 10 A.M. to 12.30.—Papers on Progressive Middle-ear Deafness:—Dr. Scott Stevenson and E. Horace Richards: Preliminary Study of Chronic Middle-ear Deafness.—G. J. Jenkins: Paper.—Dr. D. McKenzie: What is Progressive Middle-ear Deafness?—Dr. A. Gray: Demonstration by Stereoscopic Transparencies of Specimens of the Temporal Bone.—Dr. D. McKenzie: Posterior (Mastoid) Drainage in Acute Suppuration of the Middle Ear.—Laryngological Clinical Meeting, at 4.—Cases and Specimens by W. S. Syme, H. Kisch, T. B. Layton, and others.

ROYAL ASTRONOMICAL SOCIETY, at 5.—B. M. Peek: Observations of Novæ, 1926-27.—Dr. H. Spencer Jones: Note on the Mass of Venus deduced from Cape Heliometer Observations.—Dr. J. K. E. Halm: On a Graphical Determination of the Orbital Elements of a Spectroscopic Binary.—R. C. Johnson: Note on the Origin of Certain Radiations in Cometary Spectra.—V. A. Ambarzumian and N. A. Kosirev: Radiative Equilibrium in Inner Layers of Stars.—P. A. Taylor: (*a*) The Equilibrium of the Calcium Chromosphere; (*b*) The Light-Intensity of the Calcium Chromosphere.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—J. H. Awbery: The Latent Heat of Evaporation of Sulphur.—H. Lowery: The Refraction and Dispersion of Carbon Tetrachloride.—P. K. Kichlu: Regularities in the Spectrum of Ionised Neon.—Demonstration of the Schönherr-Hessburgh Nitrogen Fixation Arc, by Capt. G. J. Finch.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—C. T. Onions: The New English Dictionary.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Report of the Special Committee on Tabulating the Results of Heat Engine Trials.

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

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Prof. H. L. Hawkins: Echinoid Illustrations of Some Problems in Evolution (Lecture).

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB (in Department of Zoology and Comparative Anatomy, Oxford), at 8.15.—Prof. J. Barcroft: Respiratory Pigments.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—C. L. Woolley: The Excavations at Ur.

SATURDAY, JUNE 11.

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology Sections) (Summer Meeting).—Otological Session (Clinical Meeting), at 10.—Dr. G. Portmann: The Saccus Endolymphaticus and an Operation for Draining the same for the Relief of Vertigo.—Cases and Specimens by Dr. A. R. Friel, A. R. Tweedie, Dr. T. B. Jobson, N. Barnett, E. B. Barnes, and others.

PUBLIC LECTURES.

WEDNESDAY, JUNE 8.

UNIVERSITY COLLEGE, at 5.30.—Prof. Raymond Pearl: Experimental Vital Statistics. (Succeeding Lectures on June 9 and 10.)

THURSDAY, JUNE 9.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital), at 5.—Prof. B. J. Collingwood: Molecular Movement in the Living Body.

FRIDAY, JUNE 10.

UNIVERSITY COLLEGE, at 5.30.—Prof. R. A. S. Macalister: Celtic Art. (Succeeding Lectures on June 13 and 15.)

SUNDAY, JUNE 12.

GUILDHOUSE (Eccleston Square, S.W.), at 3.30.—Dr. R. E. M. Wheeler: Some of the Ancient Civilisations of Britain.

CONVENTIONS.

JUNE 4 TO 7.

ANNUAL CONFERENCE OF THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS (at Plymouth).

JUNE 6 TO 9.

CONVENTION OF CANADIAN CHEMISTS (at Quebec).

JUNE 6 TO 11.

PHOTOGRAPHIC CONVENTION OF THE UNITED KINGDOM (at Warwick).

Monday, June 6.—Afternoon.—Welcome by the Mayor of Warwick. Installation of President. Presidential Address. Annual General Meeting.

Tuesday, June 7.—Evening.—H. Baker: Lecture.

Wednesday, June 8.

Thursday, June 9.—Evening.—A. S. Newman: Lecture.

Friday, June 10.—Evening.—A. Keighley: Lecture.

Saturday, June 11.

JUNE 16 AND 17.

CONGRESS OF INTERNAL COMBUSTION ENGINE (at Padua).