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Zoological Survey of India.

THE Government of India, like many other governments of the world, is at present passing through a financial crisis, and in order to balance its budget finds it necessary to effect heavy retrenchments in expenditure. Proposals for retrenchment have been submitted to Government by certain committees appointed for the purpose, composed of members of the Indian Legislative Assembly; the proposals which affect the Zoological Survey of India are contained in the Report (Interim) of the General Purposes Sub-Committee of the Retrenchment Advisory Committee (Part I.), recently published, and Sir C. V. Raman has considered these proposals in a pamphlet which he has issued entitled "The Zoological Survey of India—Memorandum on the Proposals for Retrenchment".

The Zoological Survey, instituted in 1916, inherited, as the Sub-Committee observes, the duties of the zoological and anthropological section of the Indian Museum; it acts as a guardian of the zoological collection of the Indian Empire and obtains and utilises information about the systematic and geographical zoology of India. The budget of the Survey for the present financial year is Rs. 2,30,000 (about £17,250); that proposed for next year is Rs. 60,000, about a quarter (26 per cent) of its present amount. One of the eight officers at present on the cadre of the Survey has been newly appointed for fisheries work in the Andamans; it is proposed by the Sub-Committee that this work should go on, at a cost of not more than Rs. 12,000 (about £900). The figures adopted by Sir C. V. Raman are exclusive of this allocation for fisheries; as he puts it, an annual budget of Rs. 2,18,000 is being cut down to Rs. 48,000 (£3600, or 22 per cent of this year's amount); as a matter of fact, the zoological work which is the primary reason for the existence of the Survey is in worse case than is implied by even this, since the anthropological section of the Survey, as well as the fisheries, is also to be continued and financed out of the reduced budget.

"We feel", says the Sub-Committee, "that the essential duties can still be carried on with the budget proposed by us provided that all unnecessary items of expenditure are deleted." *Prima facie* it is unlikely that "the essential duties" of any department can be carried on on a quarter (or, taking Sir C. V. Raman's interpretation, a little more than one-fifth) of its actual present-day cost; and in particular that the zoological and anthropological needs of an area the size of western Europe,

with a fauna and a human population far richer and more diversified than those of Europe, can be cared for on an expenditure of £3600 per annum. Leaving entirely aside the wider duties of the Survey, mere maintenance charges—the upkeep of the collections of the Museum, the display of specimens in the galleries, the pay of clerks and attendants, the maintenance of the library (probably by far the best zoological library in the whole of Asia), including the purchase of books and periodicals as well as their care—these indispensable charges swallow up a sum which will permit the payment of the salary of only a single officer, who would be entirely occupied with the administration of the Museum; while the valuable series of the *Memoirs* and *Records of the Indian Museum* must, of course, cease immediately.

There are at present seven officers (exclusive of the one recently appointed for fishery work) on the Survey; in 1906 there were four officers in the zoological section of the Indian Museum; the number had risen from one in 1875; if the Sub-Committee's retrenchment proposals are adopted, the officers of the Survey must be disbanded, the research work of the Survey must come to an end, and the hands of the clock will be put back to a period fifty years ago.

The Sub-Committee, it is fair to say, probably does not intend this; it states that "Zoological Survey work is not normally of a systematic nature, and the work of the Universities could and should be of the nature which must overlap the activities of a Government zoological department. Further, zoological survey cannot be said to have economic value." There seems to be some misunderstanding here, or rather several misunderstandings. Zoological survey work is in the first place and above all 'systematic' (in the zoological sense), and 'systematic' zoology is not the division that either is or usually can be taken up in universities. As Sir Venkata shows convincingly, the work in universities is and must be mainly morphological; facilities for 'systematic' work—large named collections for comparison, and especially a complete and up-to-date library—do not exist at the universities, and can only be had at the Survey headquarters at Calcutta; and the teachers of zoology have neither the leisure nor, it may be added, in most cases the training, for undertaking the work of the Survey in addition to their own duties. "The functions of a State Museum of Zoology, namely, the care and preservation of the national collections, the proper arrangement of zoological exhibits in the public galleries with a view to educate the public, and research in systematic zoology, cannot be relegated to a University without seriously affecting the usefulness and efficiency of both the University and the State Museum." It may perhaps be added that even if these functions could be so relegated, they would presumably have to be paid for; and the Government of India would be paying for amateur work done by servants of other institutions what it now pays to its own experts. Further, all but one (Calcutta) of the Indian universities which grant degrees in zoology are at a distance of hundreds of miles—a number at more than a thousand—from the Museum and Survey headquarters.

Regarding the alleged economic worthlessness of zoological survey work, Sir Venkata quotes the words of the late Dr. Annandale, the first Director of the Survey: ". . . Our primary function can hardly be to conduct either morphological or economic research. These are subjects rather for the colleges of India on the one hand and for the technical departments on the other. Our investigations must be those of pioneers preparing the road along which morphologists, biologists, economic entomologists, students of fisheries, and others may travel in the future. . . . We are convinced that it is impossible to build a solid structure of practical results except on a sound basis of pure science." For readers of NATURE this point need not be laboured. The first requisite for zoological work is to know what one is dealing with; before extended zoological work of any kind is so much as possible we must know what our animals are, we must get them described, named, and classified; neither economic nor any other branch of zoology is possible otherwise; in Sir Venkata's words, "Systematic Zoology is, therefore, the bed-rock on which all zoological research, economic or otherwise, stands". Yet according to the Sub-Committee "zoological survey work cannot be said to have economic value"!

Sir C. V. Raman considers that the Sub-Committee's proposals, if carried out, mean not only the end of the Survey, but also the end of the Museum. "Anyone who has knowledge of the organisation of the Museums of even some of the smaller countries in Europe will at once realise that the proposals leave no alternative but that of breaking up and distributing the collections to those institutions that can afford the expert staff to look after them." The collections are worth crores, and while the museums of Europe and America would be only too glad to acquire them, the universities of India can neither afford them

nor spare the staff and money to look after them; there is no public or private institution in India which can house even a small portion of the collections. The question of disposal, however, simplifies itself, since, under the provision of the Museum Act, the zoological and anthropological collections, except those purchased by the Government after the Zoological Survey was instituted, are the property of the Asiatic Society of Bengal, administered by the Trustees of the Indian Museum. If the Government of India terminates the trust, the collections must be handed over to the Asiatic Society or its assignees. As the Society found it necessary in 1875 to transfer all its collections to the Museum, it certainly cannot accommodate them now, after they have grown steadily for more than half a century, and they would necessarily have to be disposed of abroad.

Retrenchment on a reasonable scale, on a scale such as is contemplated for salaries, or for most of the other departments, the Survey can accept. The Department which is considered by the Sub-Committee immediately after the zoological is the archæological; a budget of 16 lakhs is here cut down to 10½—a reduction of one-third (still, however, leaving the allocation seventeen and a half times that for zoology). "We do not consider it desirable", says the Sub-Committee, "that this department [*i.e.* Archæology], which is engaged in work of considerable national importance, should be crippled." No plea of economic advantage is put forward; the Sub-Committee can, it appears, look on intellectual activities as ends in themselves, not merely as means to some material end. The claim of zoology is doubly strong; even were there no economic advantage, the Sub-Committee might well be asked to consider the works of Nature as being equally worthy of study with the works of man, and the wonderful Indian fauna as, equally with the archæological monuments, "of considerable national importance".

Upwards and Downwards in the Calculus.

Advanced Calculus: a Sequel to An Elementary Treatise on the Calculus. By the late Prof. George A. Gibson. Pp. xvii+510. (London: Macmillan and Co., Ltd., 1931.) 20*s.* net.

THE late Prof. Gibson's "Elementary Treatise on the Calculus" won the admiration of scrupulous teachers for a carefulness far in excess of what was thought adequate thirty years ago in a first course on the subject. After his resignation in 1927, Prof. Gibson prepared a sequel, of which with surprising energy he completed the manuscript within two years. At the time of his death the book was in the press and he had revised three-quarters of the proofs; Prof. MacRobert accepted the responsibility of producing the volume, and his editorial work has been done well.

Education in the calculus, as in every branch of mathematics, begins in the middle. The contents of this "Advanced Calculus" are outlined by the editor as follows:

"The treatise begins with Dedekind's theory of irrational numbers; then follow discussions of bounded sets, sequences, limits, and differentiation of functions of one variable and of functions of several variables. Chapter v. deals with existence theorems for implicit functions and with the theory of Jacobians. Three further chapters contain accounts of infinite series, complex functions of a real variable, Lagrange's expansion, maxima and minima, infinite products, and Gamma Functions.

"The integration of bounded functions forms the subject of Chapter ix.; next come expositions of curvilinear integrals, multiple integrals, and surface integrals. In Chapter xii. improper integrals . . . are introduced; and the two succeeding chapters are concerned with improper double integrals. The book closes with a chapter on the applications of the theory to the integration of series and to the Gamma Function."

Thus the title is somewhat misleading. On one hand, the volume does not touch on Fourier series or on the calculus of variations; on the other, it includes a study of first principles such as we regard as forming an introduction to analysis. It might seem that it has only to be combined with treatises on the theory of functions of a complex variable and on differential equations to provide a course truer to life than those to which we are accustomed, since in fact an English student has always some practical familiarity with the processes and applications of the calculus and with the algebra of complex numbers before he opens the works of Hardy, Goursat, or Jordan.

Unfortunately, the volume is not well suited to a place in such a scheme, for two reasons. First, there is an avoidance of the complex variable which, quite different from tacit reliance on treatment elsewhere, can only be described as morbid. All the work on series, even on power series, is subject to this criticism, and the result is that when occasionally the complex variable is admitted, some of the reasoning which is meant to be complete in itself is invalid. For example, there is no proof that an absolutely convergent series can be deranged if the terms are complex, since the only proof given for real terms involves the sums of the positive and the negative terms; the paragraph

headed "Derangement of a Series" concerns double series, and while it is true that for the theorem of this paragraph "the proof for complex terms is the same as when the terms are real", this proof depends on the corresponding theorem for single series.

Secondly, the account of first principles is not wholly satisfactory. Extremely lucid in places, it is marred by locutions of a kind which can only cause the student unnecessary mistrust of his own judgment; for example, "ξ is said to be ... interior to the interval (a, b) if there are numbers x', x'' such that $a<x'<\xi<x''<b$". In the treatment of exponentiation with an irrational index ξ, nothing but a tradition apparently invulnerable can account for the use of an arbitrary sequence tending to ξ, with the complication of proving that the number determined is independent of the sequence; the better the reader has understood what has gone before, the more puzzled he will be that the number required is not defined immediately as a bound. On the other hand, the theorem that for any integral value of n, nth powers are everywhere dense among the rationals, is not so trivial that it can fairly be taken for granted, and certainly an argument to which this theorem is essential is not "merely a repetition of the process" by which the product of two real numbers is shown to be definable. The discussion of the Riemann integral by Darboux's method is clear, and for the simple integral is satisfactory; in dealing with several variables, some fundamental topological difficulties must be shirked, but the possibility that a region connected in a rectangle may give rise to groups of regions in each quarter when the rectangle is subdivided ought not to be ignored. It is to be added that no other integral than the Riemann integral is introduced.

Development of technique is, however, a different task from stabilisation of foundations; it proceeds at a different pace and lays a different stress. In this field there could not be a better guide than Prof. Gibson. It was a habit of Herman's to protest to his pupils that they were slavishly dependent on contour integration: "I have never seen the integral yet that I couldn't do as easily without a contour as with one, and there are plenty for which Cauchy's theorem is no use at all". I am afraid that most of us took this wholesome corrective with more salt than it needed. The range of Prof. Gibson's examples of definite integrals is astonishing, and should convince the student that it is worth while to be as familiar with the methods explained as with those which are deliberately avoided.

The part of this volume which is covered by the title is valuable, and fills admirably a place not occupied by any other English work. If there are slips, these are easily corrected, and a blunder at the foot of p. 118 is too grotesque to mislead anybody. The treatise will be of great service to teachers and students of analysis. E. H. N.

Physical and Colloidal Chemistry.

(1) *Spatial Arrangements of Atomic Systems and Optical Activity; Methods, Results and Problems of Precise Measurements at High Temperatures; The Constitution and Structure of Ultramarines.* By J. M. Jaeger. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vol. 7.) Pp. vii+450. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 20*s.* net.

(2) *The Measurement of Hydrogen Ion Concentration.* By Dr. Julius Grant. Pp. viii+159+2 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 9*s.* net.

(3) *Association Theory of Solution and Inadequacy of Dissociation Theory.* By Jitendra Nath Rakshit, Rai Sheheb. Pp. v+298. (Calcutta: S. C. Auddy and Co., 1930.) n.p.

(4) *A Textbook of Practical Physical Chemistry.* By Prof. K. Fajans and K. Wüst. Translated from the German by Bryan Topley. Pp. xv+233. (London: Methuen and Co., Ltd., 1930.) 15*s.* net.

(5) *Colloids: a Textbook.* By Prof. H. R. Kruyt. Translated from the Manuscript by Prof. H. S. van Klooster. Second edition, revised and enlarged. Pp. xiii+286. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 17*s.* 6*d.* net.

(6) *Traité de biocolloïdologie.* Par W. Kopaczewski. Tome 1: *Pratique des colloides.* Deuxième édition entièrement remaniée et mise à jour. Fascicule 3: *Mésures capillaires et électriques.* Pp. 361-527 + viii. (Paris: Gauthier-Villars et Cie, 1930.) 40 francs.

(7) *Lehrbuch der physikalischen Chemie.* Von Prof. Dr. Karl Jellinek. Fünf Bände. Band 3: *Die Lehre von der Statik chemischer Reaktionen in verdünnten Mischungen (Lösungen).* Erste und zweite Auflage. Lieferung 9. Pp. xv+657-893. (Stuttgart: Ferdinand Enke, 1930.) 21 gold marks.

(1) THE publication of the lectures delivered at Cornell by the non-resident professors (of whom two are appointed in each year) has the effect in many cases of bringing a number of distinct and

independent monographs within the covers of a single book. This is perhaps inevitable as a method of providing a permanent souvenir of the lectures, but from the point of view of the reader and purchaser this system of grouping is not always ideal. Thus the present volume contains, in addition to an introductory lecture and an excellent portrait of the lecturer, reports of three courses of lectures, which have no obvious relationship to one another except that they deal with subjects which have all been studied in the laboratory at Groningen.

The principal interest of the first course on "Spatial Arrangements of Atomic Systems and Optical Activity" is to be found in the evidence that, after spending a decade in plotting graphs in illustration of the Cotton phenomenon, the author is now becoming interested in the mathematical form of his curves of rotatory dispersion, and in the circular dichroism which gives rise to them. It is a curious coincidence that an attempt to solve this problem was being made by Dr. Werner Kuhn in Heidelberg at the time when these lectures were being delivered, and that a provisional solution has been given by Kuhn and Braun whilst the lectures were being prepared for publication.

The second course of lectures, on "Methods, Results and Problems of Precise Measurements at High Temperatures", describes the work that has been done in the author's laboratory in measuring the surface tension of liquids between $-80°$ and $1625°$, with similar determinations of density, viscosity, electrical conductivity, and specific heat. In the same way, the closing lectures on "The Constitution and Structure of Ultramarines" describe the work which was summarised at the recent discussion of the Faraday Society on "X-rays and Molecular Structure".

The collection of so much work into a single volume, as an alternative to a disperse system of serial publication, will be welcomed by many readers, and, apart from the pleasure given by a continuous and readable narrative, the book will be of real service as a guide to the hitherto uncollected works of an author who has been prolific in exact research in more than one important field.

(2) In view of the fact that at least three books on the determination of hydrogen ions are already available, it was not obvious, from an inspection of the cover and title, why this volume should have been produced. The preface makes it clear, however, that the standard works on the subject have proved too difficult for use in the many industries in which strict control of acidity has been found to be essential. The present volume was therefore written to supply the "needs of the busy worker on strange ground", who is more interested in the practical applications of this type of measurement than in its theoretical basis.

The book begins badly by asserting that "acidity and alkalinity are not opposites, but merely represent stages or levels on a common scale"; and it is equally at fault in asserting that "a base is dissociated in solution into negatively-charged hydroxyl ions and a positively-charged residue", since this definition implies that aniline must not be described as a base except when it acts in the presence of water. It is not surprising that a definition such as this is followed by a confession that "it is difficult to distinguish between an alkali and a base". This confusion is confirmed and increased by a further statement that "The former term is used for soluble hydroxides of metals or of ammonia, whilst a base is essentially a salt-forming substance which yields OH' ions in solution". The author's incidental references to Debye and Hückel and to "E. H. Armstrong" are as unsatisfying as his definitions of acids and bases, and have evidently been added to satisfy the author's conscience, rather than for the sake of the busy worker, since they introduce an element of complexity, which might have been avoided by one who was himself more at home amongst modern developments in these directions.

In spite of the difficulties besetting so many writers on the theory of solutions at the present time, which the author himself has not been able to avoid, his presentation of the subject is attractive and appears likely to prove of real value to workers for whom the existing monographs are perhaps too formidable and almost certainly too expensive. Its utility is increased considerably by a section in which the methods and technique applicable to particular cases are described. Mention must also be made of the ample supply of references to original literature, which in this particular section occupy four pages of the text, and of seven pages of tabulated data which are collected at the end of the book.

(3) It is interesting to find that it is still possible to produce a book setting forth the "inadequacy of the dissociation theory" of solution and setting up the "association theory" as an adequate substitute. It is, indeed, not difficult to discover data which cannot be predicted by the theory of electrolytic dissociation, either as enunciated by Arrhenius or as developed by Debye and Hückel; but the association theory owes its popularity, not merely to the elements of truth which it obviously contains, but even more clearly to the fact that

it makes no predictions, and is sufficiently vague and intangible to be invoked as an explanation of almost any conceivable series of data. Thus it can be used to 'explain' a contraction or an expansion, an increase or a decrease of conductivity, or a change of optical rotatory power of any and every type, but only *after* the relevant data have been established.

The author is very persistent in the claims which he makes on these lines on behalf of the theory "that in solution the solutes form compounds with solvent in proportion equal to the dilution", which is really a reversion to the views of Berthollet rather than of Mendeléeff or Pickering. His comments are, however, destructive rather than constructive, and the limitations of his point of view are indicated by the fact that no reference is made either to Debye or to the Braggs, and that the index does not include any reference either to the quantum theory or to the electronic theory of valency. The book contains a large number of misprints, a few of which have been corrected in a table of errata; it is copiously supplied with references and contains many tables of experimental data.

(4-7) It is only necessary to put on record the fact that the "Practical Physical Chemistry" of Fajans and Wüst, which was reviewed in these columns (NATURE, March 8, p. 380; 1930), has been translated into English, with a preface by Prof. Donnan, in which he states that the translation will be used in his own laboratory. The book is nearly three times as big as the original German version, but this is due merely to the use of a different kind of paper, since the number of pages is very nearly the same. We may also welcome, without comment, the appearance of a second English edition of Prof. Kruyt's excellent textbook on "Colloids", and note the appearance of further instalments of Kopaczewski's book on "Biocolloïdologie" and of Jellinek's "Lehrbuch", of which earlier portions have already been reviewed.

"Of composts shall the Muse disdain to sing?"*

The Waste Products of Agriculture: their Utilization as Humus. By Albert Howard and Yeshwant D. Wad. Pp. xiv + 167 + 14 plates. (London: Oxford University Press, 1931.) 7*s.* 6*d.* net.

SWIFT decay, undeniably manifesting itself in many parts of rural England, has evoked divers proposals for changes in farming policy. 'Extensive' methods, in imitation of the large scale, fully mechanised corn-growing of certain overseas countries, have been widely advocated. But the past year or two has seen, also, the growth of an entirely contrary opinion. This holds that common sense or shattering competition is bound shortly to restrict wheat and the other great crops to those areas which, biologically and economically, offer them the best environment; and in these chosen areas, crop production will be intensive. So far it is only in America that this view has been publicly ventilated, and the volume in which Howard and his collaborator range themselves solidly on the side of 'high farming', and propound a basis for it, thus makes a timely appearance. For these authors the road to success is systematic conversion of agricultural waste products into humus. But, condemning separate methods such as green manuring, making manure in yards, etc., they insist on a single process whereby all available kinds of waste are converted together into a finely divided end product. The method, as they say, is a highly developed form of 'composting'.

The early chapters are occupied in making out the case for the authors' contention that "humus provides the very basis of successful soil management and agricultural practice". They open with a brief but critical survey of the farming systems of the world. In the policies of America and other agriculturally comparable areas they perceive the need for a great change-over which will concentrate effort on ever-increasing yield per acre rather than upon yield per man. They suggest that "a portion of the impoverished prairie lands should go back to grass"; and they charge Europe, and all other areas which have a highly developed agriculture, with an error of the first magnitude. "To supply the large quantities of combined nitrogen needed [by land from which virgin fertility has been withdrawn] all possible sources except the right one—the systematic conversion of the waste products of agriculture into humus—have one after another been utilised; guano . . . nitrate of soda . . . synthetic compounds. . . ." Cultivators in the east, desperately in need of combined nitrogen for the betterment of their humble crops, cannot afford to buy it. But, having cheap labour and an abundance of vegetable and other waste, they can be taught how to become their own "chemical manufacturers".

Drawing mainly on the studies of Waksman and others on organic matter in the soil, strong emphasis is laid on the importance of humus as a

* "The Sugar Cane", by James Grainger, M.D.; 1764.

habitat for soil micro-organisms and on the dual nature of the utilisation of waste products. Humus formation (by bacterial and fungoid action) must be regarded as quite distinct from the utilisation of formed humus by the plant. Moreover, the requirements of the first phase—the preparation of humus and its incorporation into the soil mass—are "so intensive that if the process takes place in the soil itself, it is certain to interfere with the development of the crop". From this point of view, therefore, most of the customary methods of making humus, and particularly green manuring, are fundamentally wrong. The reader may find in this phase of the argument an over-insistence upon the importance of combined nitrogen, to the neglect of considerations of soil texture. But he will find a very interesting case for the 'single source' method of supplying organic material to the soil, with the details of which the greater part of the volume is concerned.

One may doubt whether a method involving many operations, sound judgment, organisation, and careful control can be operated by native cultivators without somewhat close supervision. Experience alone can test this point, but the Indore method has, at any rate, been worked out in full detail and with much ingenuity. The raw material comprises soiled cattle bedding, cotton stalks, cane trash, weeds, fallen leaves, green manure crops (cut and carted off), urine, wood ashes, etc. There is nothing casual in providing or assembling this waste; for all relevant operations, for example, the method of littering the working cattle, are so planned as to fit into the general scheme of "humus manufacture". Fermentation, effected in pits, is initiated by addition of a simply made "fungus culture". Three turnings of the material in the pit are needed, and from start to finish of the process occupies about ninety days. With suitable modifications for monsoon weather, etc., manufacturing is kept in progress throughout the year. Prolonged experiment has furnished interesting data as to the influence of water content and temperature of the pit, the optimum carbon-nitrogen ratio of the raw material, the phases of fermentation, and the manurial value of the final product.

In the chapter describing working details, the practically-minded reader will scarcely pass by a single page without commenting on the heaviness of labour requirements. He may feel, too, that even mechanisation, which the authors point to, may never avail to meet the difficulties where labour is costly. But the authors have an answer —perhaps the only answer that could be given in such a case. They have perfected the process on the Indore station and have given full details of work, of raw materials, of the relation of head of working cattle to land area, amount of waste, and output of manurial product.

There can be no doubt about the novelty of these proposals, their boldness, their ingenuity, and the interest they are certain to arouse. This is far more than a controlled method of composting; it is, rather, a new system of farming designed upon a basis of composting. As to possible difficulties of application even in tropical countries, there is, equally, no doubt. But, against this, it must be remembered that in boldness the proposals are matched by the aim, which is to make intensive cultivation possible without the use of purchased nitrogenous fertilisers.

F. L. ENGLEDOW.

Short Reviews.

(1) *The Printing of Textiles.* By Rego Capey. Pp. x+138 + 29 plates. (London: Chapman and Hall, Ltd., 1930.) 13*s.* 6*d.* net.

(2) *Textiles on Test: a Study for Distributor and Consumer of the Wearing and Washing Properties of Fabrics and Garments.* By J. Guilfoyle Williams. Pp. viii + 194 + 40 plates. (London: Chapman and Hall, Ltd., 1931.) 7*s.* 6*d.* net.

(3) *Soies artificielles et matières plastiques.* Par Robert Gabillion. (Collection Armand Colin: Section de Chimie, No. 129.) Pp. 204. (Paris: Armand Colin, 1931.) 10·50 francs.

(1) IT needs technical specialists to do justice to such subjects as these three books take into consideration. That the authors are well equipped for their several tasks is quite evident. But with due respect to Mr. Capey, exception must be taken to the association of a fifth century B.C. fabric with the subject of the Annunciation; nor does this seem to be a slip for 'A.D.' He is doubtless correct in stating that textile printing was probably independently developed in many countries; the diagrams and illustrations endeavour to lighten a dull text.

(2) Mr. Williams, in a companion volume, shows how to make such a highly technical subject attractive reading, irrespective of the numerous illustrations the book contains. His extensive knowledge is placed generously at the reader's service.

(3) M. Gabillion discourses with insight upon the subject of artificial silks and plastic materials. *Inter alia*, the pages dealing with the introduction and development of Lincrusta Walton and linoleums are not the least interesting of the two hundred pages to which the book extends. It is eminently practical, proving more readable than Mr. Capey's, though lacking the attraction attached to Mr. Williams' treatise, to which Mr. Gordon Selfridge supplies a foreword.

P. L. M.

Non-Metallic Inclusions in Iron and Steel. By Dr. Carl Benedicks and Helge Löfquist. Pp. xi + 311 + 44 plates. (London: Chapman and Hall, Ltd., 1930.) 30*s.* net.

THE useful properties of steel, especially of the higher qualities of steel, depend in large measure on the degree of freedom from non-metallic inclusions. These inclusions, by providing regions of concentration of stress, lower the resistance to fatigue, whilst they also influence the behaviour of the steel towards corrosive agents. Improvements in the manufacture of steel are largely directed towards their elimination, and for the success of such improvements a knowledge of the composition and mode of origin of inclusions is essential. The chemistry of the bath reactions in the steel furnace, by which most of them are formed, is complex, and the authors of this work have had a difficult task in their critical examination of the data. Their presentation is clear and systematic, and for the first time a mass of detailed information concerning inclusions in steel is brought together and discussed in the light of physical chemistry. Metallurgists will not all agree with some of the hypothetical equilibrium diagrams, but these furnish at least a basis for discussion.

The volume is well printed and abundantly illustrated. The micrographic and analytical methods for the identification of inclusions are described, and a general account of ingot structure is included. The practical metallurgist will also find the discussion of the means adopted to lessen the quantity of inclusions, or to disperse them in the least harmful way, an interesting study.

Nutrition and Food Chemistry. By Barnard S. Bronson. Pp. viii + 467. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18*s.* 6*d.* net.

THE author has attempted a presentation of the scientific principles of nutrition in simple form and suitable for students with little foundation in physiology and none in organic chemistry. The book includes the elements of digestion and metabolism, with details of the composition of many foods. Data are supplied from which it is possible to construct diet sheets and to estimate the suitability of common diets, but for useful dietaries the reader must consult books on dietetics.

The work is based on American practice, and includes descriptions of methods of treating or manufacturing common foodstuffs, as well as of the standards with which various foods must comply: thus, the pasteurisation of milk, the manufacture of ice-cream, and the baking of bread are described, and standards for milk and eggs are given in detail. Although certain portions are not applicable to conditions in Great Britain, the tables of analyses will be extremely useful to all those who wish to know the exact composition of any particular diet: this applies especially to research workers, since unsuspected impurities in a purified diet may markedly affect its nutritive value. For these, the appendices on the vitamin, iron, and copper contents of foods should prove of value.

The work as a whole appears to be rather advanced for elementary students, although the earlier chapters on digestion and metabolism might be read with profit: the later appear more suitable for the specialist.

The Theory of Ruled Surfaces. By W. L. Edge. Pp. ix + 324. (Cambridge: At the University Press, 1931.) 20*s.* net.

THE general type of ruled surface of the fourth order was mentioned by Chasles in 1861. In 1864 and 1868 these surfaces were studied and classified, though not quite completely, by Cayley, who obtained his different types by means of directing curves and gave algebraic equations for them. The complete classification was first given by Cremona (1868), who used the method of correspondence between two curves. Ruled surfaces of the fifth order were classified by means of their double curves by Schwarz in 1867.

Mr. Edge gives an account of this work and supplements it by his own researches, which include what appears to be the first serious attempt to enumerate the ruled surfaces of the sixth order. He employs two powerful general methods, considering the surfaces as curves in a five-dimensional space, and projecting from space of even higher dimensions. The first chapter contains an account of the principle of correspondence and of other ideas fundamental in modern algebraic geometry. There is no other book easily accessible to English readers where these are explained and applied so extensively. The properties of the ruled surfaces of orders four, five, and six are collected in tables, but there is, unfortunately, no index.

H. T. H. P.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Editorial Board: Carl S. Marvel, Editor-in-Chief; Roger Adams, W. H. Carothers, H. T. Clarke, J. B. Conant, Henry Gilman, C. R. Noller, F. C. Whitmore, C. F. H. Allen. Vol. 11. Pp. vii + 106. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 8*s.* 6*d.* net.

THIS volume contains particulars of thirty-one preparations. Of the contributors, fourteen are from the United States, two from Germany, and one each from Canada, India, and Austria. Among the interesting preparations are itaconic anhydride and acid (from citric acid), citraconic anhydride and acid (from itaconic anhydride), mesaconic acid (from citraconic anhydride), cyanogen bromide (from sodium cyanide and bromine), ethyl pimelate (from salicylic acid), fumaric acid (in 58 per cent yield from technical furfural), and thiobenzophenone (from benzophenone dichloride and sodium hydrosulphide). The conversion of acrolein into *dl*-glyceric aldehyde in 11 per cent yield is described through the following intermediates: β-chloropropionaldehyde acetal, acrolein acetal, and *dl*-glyceric aldehyde acetal. The revised collection of preparations contained in the first nine volumes of this valuable series is to appear soon. J. R.

A Century of Geology.*

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

THE geological problems of special interest in 1831 are shown by the contributions prepared at the request of the British Association, with first amongst them Conybeare's "Report on the Progress, Actual State, and Ulterior Prospects of Geological Science". His report summarised the position in general stratigraphy, which was still based on two divisions—the primary and the secondary. The secondary group, thanks to William Smith, had been classified into four systems—the Carboniferous including the Old Red Sandstone, the New Red Sandstone, the Oolitic, and the Cretaceous. All below the Old Red Sandstone was left as the primitive and transition series. The pre-Carboniferous and post-Cretaceous beds were still in confusion, but Conybeare's section from the north of Scotland to the Adriatic near Venice shows that the general succession had been established from the Tertiary to the Carboniferous and Old Red Sandstone.

The first great stratigraphical advance after 1831 was Lyell's classification in 1833 of the post-Cretaceous strata. Lyell's achievement was followed by the foundation of the Silurian system by Murchison. Murchison, in 1834, showed that the 'Upper Grauwacke Series' included four fossiliferous series, which in 1835 he grouped as Silurian. Sedgwick, a month later, in a communication to the Association at its Dublin meeting, founded the Cambrian system for the fossiliferous rocks below the Llandeilo and the schists of Anglesey and Carnarvonshire.

The fundamental advance in geology in the decade beginning 1830 was Lyell's demonstration of the uniformity of geological dynamics. The first volume of his "Principles" was published in 1830, and Murchison hailed it as "beginning to unfold the true papyri of geological history".

A different estimate was expressed by Adam Sedgwick, then the leader of British geology, who declared that Lyell's championship of uniformitarianism violated sound reasoning on geological phenomena, and that

"warped by his hypothesis . . . in the language of an advocate, he sometimes forgets the character of an historian". According to Sedgwick, if Lyell's views of the uniform order of physical events were correct, "the earth's surface ought to present an indefinite succession of similar phenomena. But as far as I have consulted the book of nature, I would invert the negative in this proposition, and affirm that the earth's surface presents a definite succession of dissimilar phenomena. If this be true, and we are all agreed that it is, . . . then 'the undeviating uniformity of secondary causes', 'the uniform order of physical events', 'the invariable constancy in the order of nature', and other phrases of like kind, are to me, as far as regards the phenomena of geology, words almost without meaning. They may serve to enunciate the propositions of an hypothesis; but they do not describe the true order of nature."

Sedgwick agreed with Brongniart that the geological and historical periods were essentially distinct; and he remarked regarding the recent appearance of man, "were there no other zoological fact in secondary geology, I should consider this, by itself, as absolutely subversive of the first principles of the Huttonian hypothesis".

Murchison, on the contrary, held that Lyell's demonstration of the unbroken transition between the Pliocene and post-Pliocene had completely swept away the arbitrary demarcation between "what had been termed the ancient and existing orders of nature".

The geologists of 1831 worked under the handicap of three fundamental uncertainties. The problem of sea-level so exercised the Geological Committee in 1831, that it asked Robert Stevenson—the authority on coastal engineering and grandfather of R. L. Stevenson—to report upon the erosion of the English coast and "the permanence of sea-level". He replied that he had little to add to his previous papers (1816 and 1820). The variability in sea-level is of perennial interest as many issues depend upon it. The test case about 1830 was that of the Baltic. Celsius in the eighteenth century had remarked that the Baltic was receding along the Swedish coast; but, as the German coast had undergone no such change since Roman times, the Swedish evidence was doubted. Leopold von Buch reconciled the observations by the hypothesis that the Swedish coast was rising about a pivot, while the German coast remained stationary. The facts were reaffirmed by a joint inquiry of the Swedish Academy of Sciences and the Russian Ministry of Marine; but the rise of the land was rejected by Lyell. He attributed the recession of the sea to the accumulation of sediment and the wind.

Lyell fortunately examined the evidence for himself, and in a paper read to the Association in 1834, accepted von Buch's conclusion that parts of the Baltic coast are rising two to three feet in a century, while other parts are stationary.

The Baltic, therefore, gives convincing testimony of the mobility of the land, which is accepted in an extreme form by some champions of isostasy. That principle was put forward from the geological evidence that the rate of the accumulation of sediments so often coincides with the rate of subsidence that the two processes must be dependent, the weight of the sediment being the cause of the subsidence. The correlative, that the unloading of an area by denudation causes its uplift, was advanced by Clarence King (1876). This cause of the rise and fall of land was maintained by Airy and Pratt, and was supported by the gravity surveys by Hayford, Hecker, and Duffield. The relief of the earth was attributed to the differences in the

* From the presidential address, entitled "Problems of Geology Contemporary with the British Association", to Section C (Geology) of the British Association, delivered in London on Sept. 24.

density of the crust, and therefore the subsidence of the crust to form oceanic basins, and its uplift into continental masses from oceanic depths would be both impossible. That theory was of service as a reaction against the lightly assumed interchange, as pictured by Tennyson, of roaring streets and central seas; but the form of isostasy that represents the earth's major relief as determined by the perfect hydrostatic equilibrium of the crust is opposed to weighty evidence.

The mathematical data for the permanence of the ocean basins seem unreliable. That the ocean floors consist of a continuous sheet of heavy material (sima) was supported by gravity determinations; but the calculations are based on the assumption that the sea surface stands at the spheroid of reference.

That some parts of the crust are in such delicate isostatic equilibrium that the surface rises when material is removed by denudation and sinks when loaded with more sediment is well established; but other parts of the surface have not this delicate poise. Faults have a downthrow of 10,000 feet, and there is no evidence that their cause was sedimentation. The dependence of subsidence and sedimentation may often be true for the geosynclines, which, owing to the rupture or instability of the crust in consequence of its deformation, are bands of long-continued weakness—or asthenostrophes (weak bands or belts).

Reluctance to accept the hydrostatic equilibrium of all parts of the crust is not due to prejudice against isostasy. But its extension to the whole surface of the earth and the claim that it proves the subsidence of an area to an oceanic depth to be a physical impossibility are contradicted by geological evidence, which appears more reliable than calculations based on uncertain assumptions.

The Fixity of Species.

The second hindrance to geological progress in 1831 was the belief in the fixity and special creation of species, which was then entrenched by theological authority.

The fixity of species had been attacked by Lamarck, but his view of the evolution of one species into another was emphatically rejected by British authorities. Buckland, who was the president of the Association at its first full meeting, denied that he was in any way disposed to favour Lamarck's theory of "the derivation of existing species from preceding species by successive Transmutations of one form of organisation into another form, independent of the influence of any creative Agent". Sedgwick repudiated "the doctrines of spontaneous generation and transmutation of species with all their train of monstrous consequences". The latter doctrine, with all its momentous consequences, was added to the principles of geology by a recruit of 1831. Early that year, Charles Darwin began the study of geology, and on his return from his first long geological excursion, which he made with Sedgwick in North Wales, received the invitation to go as naturalist with the *Beagle*. He sailed in her from Plymouth in December 1831.

Darwin's work on the voyage was mainly concerned with volcanic rocks, with gravity differentiation in molten rocks, with uplifts accompanying earthquakes, and with the evidence of widespread areas of subsidence and uplift as proved by his luminous and now firmly established theory of coral islands. His work on crustal movements was of primary importance; but by his doctrine of evolution by natural selection, he was the most potent influence on the thought of the Victorian era. According to the general interpretation of the geological record, evolution has been mainly controlled by the environment, and has proceeded slowly during the long periods of relative quiescence and more quickly when the tumultuous heaving of the crust produced relatively rapid changes in the physical conditions, as in the depth of the sea, in the temperature of sea-water, and in climate owing to the altered distribution of land and water and relief of the land.

The influence of Darwin on the whole philosophy of geology was so helpful that he was the dominant factor in its progress during the second quarter-century of the Association's work.

The geological point of view of the day as regards the relations of geology and theology was shown in Buckland's "Bridgewater Treatise" (1836, p. 414). He argued that zoophytes show such perfect unity of design that we can find no explanation of such otherwise mysterious uniformity than by referring it to the agency of one and the same creative intelligence. He extended this argument to the whole organic world. The persistence of the same structural plans and the absence of those freak animals which might be expected if animals had arisen by special creation—instead of being regarded as evidence of evolution—was claimed by Buckland as proof of special creation by one Creator.

Buckland, though he defended the creation of man at 4004 B.C., and declared in regard to the six days of creation, "I see no reason for extending the length of any of these beyond a natural day", was, nevertheless, too heterodox for some members of the Association. His view that the earth is indefinitely older than the creation of man was vehemently attacked by Dean Cockburn, the Dean of York, in 1838, and at the meeting of the Association there in 1844. It was not until about thirty years later that geology secured the independence claimed in 1832 by its doughty champion, Murchison, in his assertion of the "entire disconnexion of our science with the inspired writings".

The Origin of Ore-Deposits.

The third geological problem to which the Association directed attention was the nature of ore-deposits.

The classification of mineral veins in 1791 by Werner attributed them to the filling of fissures from solutions. Hutton, in 1795, declared the deposition of native metals from solution a

" physical impossibility ", and that sulphide ores could only be formed at high temperatures. In 1831, in reaction from such speculations as to genesis, the standard classifications relied on the form of the deposits ; Taylor rejected the formation of lodes by igneous injection and attributed ordinary ores to sublimation. As many mineral veins were too wide to have been formed by the infilling of open fissures, the electric deposition of the ores was advocated by R. W. Fox in papers to the Association. Ami Boué, in 1822 and 1829, supported the general association of mineral veins and igneous rocks, and A. L. Necker also urged, despite a few apparent exceptions, the general " connexion of igneous with metalliferous deposits ".

In 1835 the main alternative explanation—the connexion of mineral veins with great fractures—was put forward by J. Fournet. He assigned the minor veins to the filling of shrinkage cracks and small faults ; and the veins of most economic value, to deposition along major faults.

That the ores along these fractures were due to rising waters was rendered the more probable by the paper contributed by C. G. B. Daubeny at the 1836 meeting on " Mineral and Thermal Waters ". Meanwhile, the theory that ores were derived from waters percolating through the rocks beside the veins had been revived by Bischof (1847), but was generally rejected until Forchhammer and Sandberger found particles of the ordinary ore metals in all kinds of ancient rocks.

The ascensionist was then replaced by the lateral secretion theory, which was dominant for twenty years, until in 1893 the deep-seated source of most ores was advocated by Posepny. An intermediate view, advocated by Kemp, redirected attention to the general association of mineral veins with igneous rocks ; and the view that the constituents of the lodes are derived from igneous rocks is perhaps still the generally accepted theory. There are serious objections to it : for though many metals occur in the igneous rocks, the quantity appears insufficient to have furnished the lodes. Many of the claims for the presence of such metals as primary constituents of igneous rocks are invalid. The distribution of ores indicates their derivation from a layer below the igneous rocks.

The deep-seated source of ore-deposits bears on the geology of the inner earth, which was exercising geologists in 1831, when amongst subjects recommended for examination were the " accurate examination of the conclusions deducible from the known density of the earth, as to the solid structure and composition of its interior ", and " the examination of the visible disk of the moon, with the view of extending our general knowledge of volcanic forces ".

When the efforts to correlate the main relief of the earth were resumed, the most stimulating worker was Élie de Beaumont. His correlation of mountain chains was based on the view that the interior of the earth is slowly cooling and contracting so that the outer shell undergoes alternate deformation and recovery of the spheroidal form. He concluded that these crustal movements account for the mountain ranges and main relief of the earth. He realised that the crust is a unit which is affected as a whole by each of the orogenic episodes which upheaved mountain systems at the same date in even distant parts of the earth. He held that fold-mountain chains of the same orogeny are recognisable by their trend, and classified the mountains of Europe into four systems, each with a characteristic trend. As the trends were determined by the fracture of a spherical or subspherical shell, he considered that they would be on a regular geometrical pattern.

Élie de Beaumont's views attracted earnest attention, and at the first meeting of the Association Sedgwick and Conybeare were asked to report whether his maxim that mountain ranges with the same trend were of the same age holds true for the British Isles. Sedgwick replied that the older British strata are in strict accordance with Élie de Beaumont's theory, and expressed enthusiastic approval of it in his presidential address to the Geological Society. He declared—

" that the system of M. Élie de Beaumont is directly opposed to a fundamental principle vindicated by Mr. Lyell cannot admit of doubt. And I have decided, to the best of my judgment, in favour of the former author, because his conclusions are not based upon any *a priori* reasoning, but on the evidence of facts ; and also because, in part, they are in accordance with my own observations."

Conybeare was more critical of Élie de Beaumont's theory. He objected to describing the Urals and the American Cordillera as parallel, and held that the correlation of English folds by parallelism is unsatisfactory.

Élie de Beaumont's work laid the foundations of the modern study of the general plan of the earth. His fundamental principles were that the main movements in the earth's crust are due to its compression owing to the shrinkage of the internal mass, and that the collapse of the crust determines the main features in the relief of the globe. The shrinkage is probably due more to closer packing of the constituents than to cooling. That the main folding of the crust has been due to compression that at first acted on all parts of the earth, and later was confined to special belts, seems one of the most certain of geological facts.

Élie de Beaumont unfortunately adopted as the basis of his fold-and-fracture pattern the pentagonal network, which had to him the recommendation of its possession of a high degree of symmetry. The most obvious fact in the map of the world is that it has no such highly developed symmetry.

I endeavoured to show in 1899 that Lowthian Green's theory agrees with the existing distribution of ocean and continent, and with geological history, as it explains the alternation of the slow subsidence of the ocean floors and of crustal storms during which fold-mountain chains are raised by lateral compression ; it also explains the alternate emergence of the lands as the ocean basins are enlarged by the sinking of their floors and submergence of the lands by the world-wide advance of the sea due to the shallowing of the oceans when the spheroidal

form is recovered after the tetrahedral deformation has exceeded the stability of the crust.

Élie de Beaumont's elaborate classification of mountains has collapsed; for although the foundations were sound, his superstructure was not. Knowledge of the structure of mountain chains was then inadequate and much of it was erroneous. Beaumont's conception of mountains was defective; he regarded them as symmetrical ridges, and he failed to appreciate the contribution to the Association in 1842 by Henry Darwin Rogers, which laid the foundation of the modern theory of mountain formation. In 1842 Rogers read to the Association his joint paper with his brother, W. B. Rogers, "On the Physical Structure of the Appalachian Chain, as exemplifying the Laws which have regulated the elevation of great Mountain Chains generally". The Rogers considered the facts at variance with Élie de Beaumont's hypothesis. They explained mountain chains as waves in the crust due to a broad belt being pushed forward with accompanying asymmetric folding, overfolding, and inversion.

Suess showed that the existing physiography of Europe was mainly due to the Alpine System—including the Pyrenees, Alps, Carpathians, and Balkans—having been pushed northward against resistant masses which threw back the waves like forelands along a coast. Suess had the advantage over the geologists of the 'thirties of more certain petrology. They still worried over the igneous origin of granite, and even a decade later were at issue as to whether granite had been injected as a molten mass at a high temperature, or was due to aqueo-igneous action at a low temperature.

A great advance in the interpretation of the igneous and metamorphic rocks followed Sorby's application to them of the microscopic study of transparent sections. He announced its illuminating results to the Association at Leeds in 1858, showing that the crystals and bubbles in the fluid cavities in granite prove its deep-seated origin, and that the Vesuvian lavas demonstrate that the sequence of minerals in igneous rocks is determined not by their fusibility but by their order of crystallisation out of a cooling solution.

The interpretation of mountain structure had an important reaction on stratigraphy. Suess's study of world geology led to the recognition that some encroachments of the sea upon the land were world-wide; he called them the marine transgressions, and explained them by the reduction of the ocean basins.

Many cases of the rise of the sea surface may be due to changes in the ocean basins and not to a vertical uplift of the land. Suess regarded some high-level horizontal beds as left in their original position by the down-sagging of the crust elsewhere. He was so impressed by the predominance of downward movements in sunklands, rift-valleys, and oceanic deeps, and by the absence of any mechanism which he regarded as adequate for widespread horizontal uplifts, that he considered all vertical regional movements must be downward. In this he went too far; but that the land sometimes emerges owing to lowering of the sea surface, and at others is submerged by the rise of the sea-level, is now universally admitted.

In 1831 Conybeare dismissed the stratigraphical principle, "Werner's dogma of Universal Formations", as he held that in distant lands corresponding formations are not synchronous. This idea, also adopted by H. D. Rogers in a paper to the Association in 1834, was a forecast of Huxley's doctrine of homotaxis, which is less important now that as much time is available as the greediest geologist can desire.

The zonal divisions, however, are being found less universal than had been thought. The view of Oppel (1856, etc.) that ammonite zones in all parts of the world follow in an identical succession, and the expectation that graptolite zones are equally regular and world-wide, have proved exaggerations; Dr. Spath has pointed out that the sequence of zonal ammonites differs in different basins. Geologists were once confident that the gaps in the geological column in Europe would be filled by discoveries elsewhere; such terms as Permo-Carboniferous, Permo-Triassic, etc., expressed the hope that the beds thus named would fill gaps in the European sequence. Most of these strata have been found to correspond in time with those known in Europe. Extra-European stratigraphy has shown the world-wide range of the geological systems.

The Geological Leaders of the Four Quarter-centuries.

My impression is that from 1830 until 1855 the true prophet of geology was Lyell, with his establishment of the mobility of the land and the uniformity of geological processes. From 1855 until 1880 the main advance was Darwin's establishment of evolution, which enabled fossils to be interpreted more intelligently and reliably. About 1880 the geologists of the United States revealed phenomena in their western mountains which showed that the yardstick reliable in north-western Europe and the Atlantic States of America was not applicable everywhere. The United States Geological Survey began its great influence about 1880. Nevertheless, despite the powerful stimulus of North America on geological thought in the third quarter of the past century, the most profound individual influence was that of E. Suess.

The last quarter-century is still too near for reliable appreciation of its achievements; but among the fundamental advances have been those revealing the structure of the inner earth, and especially the interpretation of earthquakes, in which the pioneer was John Milne. The recent study of ore-deposits confirms the evidence from earthquakes that the core of the earth is surrounded by concentric shells and that the metallic ores arise from the shell below the plutonic rocks as gases and solutions. The geology of mineral fields and the extension to most of the younger mountain ranges of the world of the thrustplanes which, though early recognised in mining, were first demonstrated in stratigraphy by Lapworth in the north-west of Scotland, have proved that fold-mountains are formed along belts of compression.

The Volta Conference at Rome.

THE second Volta Conference was held in Rome from Sunday, Oct. 11, until Saturday, Oct. 17, and was devoted to the subject of nuclear physics. The proceedings were opened on Sunday morning by a reception, at which addresses were given by the Marchese Marconi and Prof. Corbino—the Prime Minister, the Duce Mussolini, presiding. Six morning sessions and three afternoon sessions were held, during which many interesting contributions were made. A full report of these is to be published shortly by the Royal Academy of Italy.

The subject of penetrating radiation was handled by Dr. B. Rossi, and led to a very interesting discussion. It appears that we are yet a long way from understanding this phenomenon, but a variety of new methods of investigation are now being applied, which at least promise to yield important information. A considerable part of the conference was devoted to the discussion of the general applicability of our present theoretical ideas to nuclear problems, and it appeared, largely through the important contributions of Prof. N. Bohr, that we cannot expect the present quantum mechanics to apply to the nucleus without undergoing such a fundamental change that it might almost be said to involve a new mechanics, including the present quantum mechanics as a limiting case. In particular, it may be noted that it appears difficult to calculate the probabilities of occurrence of the different nuclear processes to within even an order of magnitude, so that it is quite impossible to decide whether there is or is not a discrepancy between theory and experiment in comparing such experimental results as the number of long-range α-particles and the number of quanta of the corresponding radiation emitted by the excited nucleus. The position appears to be that we should scarcely anticipate that the quantum mechanics would apply even to the α-particles in the nucleus as well as it does, and there is clear evidence that the questions connected with the electrons in the nucleus raise problems quite outside its scope.

Most of the nuclear phenomena which are open to experiment were discussed, such as the values of the nuclear moments, the artificial and natural disintegration of the elements, the excitation of nuclear γ-rays, the absorption of radiation by the nucleus, the information about the α-particle stationary states in the nucleus and their association with the γ-rays, and also the transference of energy from the excited nucleus to the electronic structure.

The general impression appeared to be that a definite stage in attacking the problem of the nucleus had already been reached in that recognised experimental methods had been adopted, and the general scope of the information they could provide was understood. The problem of the nucleus can at least be divided into several smaller problems, and to each there is now a definite approach by experimental methods.

The α-particles and the protons seem likely to be treated at least approximately by the present quantum mechanics, and it is possible that in the not far distant future a reasonable account of the behaviour of the light and heavy nuclei may be given in terms of certain experimentally defined stationary states of α-particles and protons, the existence of which may at least be made plausible by theoretical calculations based on the equilibrium of such particles inside a potential box. On the other hand, the question of the behaviour of the electrons appears to introduce problems which are not found elsewhere in physics. This point was specially emphasised in connexion with the discussion of the continuous spectrum formed by the disintegration electrons from radioactive bodies.

It would be difficult to express adequately the thanks which the delegates owe to the organisers of this conference, not only for the admirable arrangements which were made for the scientific discussions, but also for the magnificent hospitality which was shown to them. The success of this conference was largely due to the untiring efforts of Prof. O. Corbino and the secretary to the conference, Dr. E. Fermi, who managed to combine both the necessary firmness in directing the conference with the freedom which is so essential for fruitful discussion.

Radio Research in Great Britain.*

THE Report for last year of the Radio Research Board to the Committee of the Privy Council for Scientific and Industrial Research is of interest, as it marks the beginning of a new stage in the investigations. In the earlier work, apparatus and methods have been perfected so that trustworthy and consistent results can be obtained. It is now considered undesirable to proceed further in this direction. Scientific research on which future progress depends is divided into two branches. The first is the fundamental research undertaken without any immediate practical application in view. The second is to initiate experiments likely to indicate solutions of the urgent problems at present engaging the attention of radio engineers.

The Board considers that, while a proportion of the problems of fundamental research can be undertaken in the confines of a university laboratory, there are many problems that cannot be carried out in this way, as they require the co-operation o observers at great distances apart. This work is continued by the Board, although priority is given to experiments the application of which is clear. During last year, close collaboration was maintained with the radio research boards established by the governments of New Zealand and Australia. Priority is being given to the study of high frequency

* Department of Scientific and Industrial Research. Report of the Radio Research Board for the Period ended 31st December 1930. Pp. iii+90+4 plates. (London: H.M. Stationery Office, 1931.) 2*s*. net.

transmissions of wave-lengths less than ten metres. Much use has been made of the frequency-change method developed by Prof. E. V. Appleton for the study of the ionisation of the atmosphere and its effect on the propagation of waves. The most noteworthy advance made in the study of atmospherics during the year has been largely due to the new cathode ray oscillograph developed by Baron Manfred von Ardenne, of Berlin. By its use it was possible to photograph the wave forms of atmospherics previously observed visually.

In the frequency-change method, a small continuous change is made in the waves being generated. This produces at the receiving station a succession of interference maxima and minima due to the ground waves and the waves deviated by the upper atmosphere. It is possible to estimate from these effects the relative intensities of the ground and atmospheric waves and the angle of incidence of the latter with the ground. A comparison of the phase differences between the two sets of waves can be deduced from the interference fringes and this gives information as to the polarity of the down-coming waves. Strong experimental evidence is given of the existence of three zones of ionisation in the atmosphere. The region of ionisation which normally reflects long waves and broadcasting waves is referred to as the *E* region, while hypothetical reflecting layers above and below the *E* region are called the *F* and *D* regions respectively.

It was found that with a wave-length of 400 metres the secondary fringes were observed during the night, but that about forty minutes before sunrise their amplitude began to diminish, until only the primary fringes remained. It is concluded that with these waves the cessation of the influence of the ultra-violet radiation after sunset leads to a recombination of ions and thus causes a slow increase in the height of the equivalent layer which only ceases on the advent of sunrise. A converse effect then ensues. Observations on ' phase fading ' confirm this.

The experiments show that the maximum value of the height of the ionised layer is about 126 km., but on certain nights the height remains constant at 100-110 km. The reason for this is obscure. According to the ordinary theories of radio propagation, a greater density of electrons is required to reflect or refract short waves than long waves. A study of the *F* region (the highest) is therefore more conveniently made with short waves. The experiments made with 100-metre waves confirm theory. The variations observed during the daily runs enabled the times at which the lower *E* region just began and just ceased to reflect 100-metre waves to be accurately determined. This wave-length seems to have been fortunately chosen, as it is a critical wave-length. On some days the waves penetrate the *E* region and on others they are reflected by it.

In England the equivalent average heights of the *E* and *F* (upper) regions are about 100 km. and 230 km. respectively. Using results obtained in Washington, and adopting the two-layer hypothesis, led to heights of 105 km. and 235 km., and this shows that the hypothesis is a useful one. Work on short waves (50 metres wave-length and less) is being carried out. Already evidence has been obtained bearing on the influence of magnetic storms on the ionised layer. As the problem is closely linked with the explanations of skipped distances and Störmer's theory of long retardation echoes, the results will be important. It has been found that on the occasion of a magnetic storm the ionisation of the *E* (middle) region is sufficient to reflect 50-metre waves which normally are reflected at vertical incidence. This indicates a marked increase in ionisation above the normal value. So far, the experiments on the propagation of long waves have not led to any very definite results.

Excellent results have been obtained with the development of radio frequency standards. It is clear that the various national standardising laboratories of the world are able to measure frequency to an accuracy which surpasses the constancy of the instruments used in its comparison. The agreement between the National Physical Laboratory, the Post Office, and the American Navy on the two occasions when measurements were made was to about one part in 100,000. Experiments prove that the inaccuracy of the National Physical Laboratory's measurements of frequency did not exceed three parts in a million. Much of the credit of this great achievement must be attributed to Dr. W. D. Dye.

Obituary.

PROF. J. S. C. DOUGLAS.

THE sudden death of James Sholto Cameron Douglas on Oct. 30 at Llandudno, where he had gone to recuperate after a long illness, was a very great grief to his many friends. Prof. Douglas was more closely in touch with his colleagues, both scientific and medical, than is usual in a university ; for not only had he held the Joseph Hunter chair of pathology at the University of Sheffield since 1915 and been Dean of the Faculty of Medicine since 1923, but his professorship also involved him in a multitude of administrative duties, including the direction of the pathological work at the various hospitals in the city. In addition, he was always being called upon by his medical colleagues for expert advice on pathological matters. Not only did he carry out his duties with unsparing zeal, but as a most unselfish man he also responded willingly to all demands for assistance.

All this work of necessity limited Douglas's time for his own investigations. To some this was a matter of regret, especially as his published work revealed the mind of a capable investigator ; but, after all, the unselfishness and high skill possessed by Douglas were of infinite value to his colleagues and other medical men of the city. His kindness and genial nature, together with the great pains he took in his work, have only increased the sense

of loss felt by his colleagues. Prior to his appointment to the chair of pathology at Sheffield, Douglas was lecturer in this subject at the Universities of Birmingham (1907–11) and Manchester (1911–15).

Douglas was primarily interested in problems of immunity, but he also published some work on morbid anatomy. The most fruitful period of research included the years 1914 and 1915. In these years he published a paper on "The Cytology of the Blood in Passive Immunity", and, with the collaboration of Prof. Boycott, other papers on the composition of the tissue fluids. His other publications dealt with the adsorption of agglutinin and other immune bodies by charcoal (with Prof. Dreyer), the effect of diaphyte tubercle vaccination in guinea-pigs, relapsing pyrexia in lymphadenoma (with Prof. Arthur Hall), a study of cardiographic tracings from the base of the human heart, and the invasion of the pericardium by malignant tumours. As an investigator his work was characterised by meticulous exactness.

Douglas was born in 1879 at Leicester, the elder son of Mr. Claude Douglas, consulting surgeon to the Leicester Infirmary, and brother of Dr. C. G. Douglas, F.R.S., the distinguished Oxford physiologist. He was educated at Wyggeston Grammar School, Haileybury College, and at Christ Church, Oxford. He graduated at Oxford in 1902 and entered St. George's Hospital. After qualifying he studied abroad, mostly at Copenhagen and Dresden, as a Radcliffe travelling fellow. In 1911 he married Mary Victoire, the daughter of Mr. Richard Brice, of Burnham, Somerset. He has left behind him the best memorial any man could wish —the reputation of an able scientific worker and administrator of unlimited kindness and geniality.

THE death has occurred in Vienna of Prof. Guido Holzknecht at the age of fifty-eight years. Holzknecht was one of those medical men who took up the scientific study of X-rays soon after their discovery. He was responsible for the exploitation of X-rays especially in the field of examination by means of the fluorescent screen. In the years before the War he was perhaps more responsible than anyone for perfection in this technique, and at the Vienna General Hospital it was developed to such an extent that photography in X-ray work was of minor account. Holzknecht was a prolific writer, and there is scarcely a branch of radiology upon which he did not make important contributions. His device known as the chromoradiometer was an early attempt at measuring the doses of X-rays given to the surface of the body. Holzknecht was a big figure in the X-ray world, whether from a diagnostic or therapeutic point of view, and by his work during the last thirty years, in which, unhappily, he suffered what proved to be fatal damage to himself, he did much to put the subject on a scientific basis.

MR. EDWARD STEP, who died on Nov. 8, aged seventy-five years, was widely known in the world of entomology and natural history, and by his books was undoubtedly one of the pioneers of the popular study of Nature. He had just completed a book on "Bees, Wasps, Ants, and Allied Insects of the Wayside and Woodland", which will be published shortly. For more than fifty years Mr. Step had been a member of the South London Entomological and Natural History Society, was one of its early presidents, and was to have been president for the coming year. He was also a fellow of the Linnæan Society. In 1928 he was president of the British Empire Naturalists' Association.

WE regret to announce the following deaths:

Prof. Edward S. King, Phillips professor of astronomy in the Harvard College Observatory, known for his pioneer work in photographic photometry, on Sept. 10, aged seventy years.

Dr. John Sampson, formerly librarian in the University of Liverpool, known for his work in gypsy lore, and author of "The Dialect of the Gypsies of Wales," on Nov. 8, aged sixty-nine years.

Prof. Charlotte A. Scott, formerly professor of mathematics in Bryn Mawr College, the first woman wrangler in the University of Cambridge, on Nov. 8, aged seventy-three years.

Major U. P. Swinburne, formerly Chief Inspector of Mines of the Union of South Africa, on Nov. 7, aged sixty-two years.

News and Views.

DRS. BOSCH and Bergius, who share the Nobel prize for chemistry in 1931, represent German developments in industrial chemistry which have earned the admiration of the whole scientific and industrial world and have stimulated extensive researches along parallel lines in other countries. Dr. Bosch's name is indissolubly associated with that of Prof. Haber in regard to the catalytic production of ammonia from atmospheric nitrogen, whilst Dr. Bergius's researches on the production of volatile hydrocarbons by hydrogenation of organic material under pressure have already given us the expressive term 'berginisation'. Thus the fame of each rests on the reaction of hydrogenation under pressure leading to materials of international importance. The catalytic synthesis of ammonia originated with Haber and van Oordt's work in 1905, when atmospheric pressure was employed, but as the work progressed, and was taken up by Nernst, Jost, and others, the question of providing adequate experimental facilities for working under pressure arose; the process was adopted by the Badische Anilin und Soda Fabrik in 1910, and Dr. C. Bosch, whose name is particularly associated with studies on the catalyst poisons, took a prominent part in its development. The success with which his pioneering investigations were conducted is illustrated

by the world-wide use, at the present time, of the Haber-Bosch process for the fixation of nitrogen.

DR. F. BERGIUS, who was born on Nov. 11, 1884, at Goldschmieden, near Breslau, has made the study of the influence of high pressure on chemical reactions his chief interest. This work, which was described in his book, "The Use of High Pressures in Chemical Actions", was preliminary to the development of his widely known process for the manufacture of oil from coal—a process which was first patented in Great Britain so long ago as 1914. The importance of the process to a coal-producing and oil-importing country such as Great Britain is obvious, and it was therefore not surprising that the speakers at the symposium on the British fuel problem, recently held by the British Association, devoted attention to its advantages and limitations. Much work on the subject has been done under State as well as private auspices, and it is of interest that, on Nov. 24, the production of oil and petrol from coal is to form the subject of an address to the Imperial College Chemical Society by Prof. C. H. Lander, formerly Director of Fuel Research. The award of the Nobel prize for 1931 for physics has been postponed until next year.

THE Polish Physical Society, the Polish Chemical Society, and the Society of Polish Electrical Engineers, with the support and assistance of the Polish Academy of Sciences, Cracow, the Polish Academy of Technology, the scientific societies of Warsaw and Lwow, and various other Polish scientific institutions, arranged for a celebration of the Faraday centenary, on Nov. 6, at Warsaw, in the large hall of the Technical High School. The President of the Polish Republic, Prof. Moscicki, and three members of the Government were present; the British Embassy was also represented. After a short introductory speech, made by Prof. St. Pieńkowski, Dr. Ladislas Natanson, professor of natural philosophy in the Jagellonian University, Cracow, delivered a lecture on the "Life and Discoveries of Michael Faraday". Addresses were also delivered by Prof. W. Swietoslawski, of the Warsaw Technical High School, who discussed and explained Faraday's chemical and electrochemical researches, and Mr. T. Czaplicki, who chose for his subject, "Faraday and the Modern Science of Applied Electricity". The proceedings concluded with an exhibition of various pictures connected with Faraday's life and work. The commemorative meeting was an impressive testimony of the deep reverence and gratitude which, in Polish scientific circles, is attached to Faraday's memory.

THE following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting on Nov. 30: *President*, Sir Frederick Hopkins; *Treasurer*, Sir Henry Lyons; *Secretaries*, Dr. H. H. Dale and Sir Frank Smith; *Foreign Secretary*, Lord Rayleigh, *Other Members of Council*, Dr. J. A. Arkwright, Prof. G. Barger, Prof. W. L. Bragg, Prof. E. P. Cathcart, Mr. A. C. G. Egerton, Mr. R. H. Fowler, Prof. E. S. Goodrich, Prof. G. H. Hardy, Prof. W. N. Haworth, Prof. C. E. Inglis, Prof. O. T. Jones, Sir Thomas Lewis, Dr. N. V. Sidgwick, Prof. A. G. Tansley, Prof. G. I. Taylor, Prof. D'A. W. Thompson.

A RECENT issue of the *Dalhousie Review* contains an interesting article by Dr. D. F. Fraser-Harris, entitled "Medical Pioneers in Science". In substance, however, this brochure selects and records accurately the upbringing and achievements of those presidents of the Royal Society of London who, successors of Newton, have held medical degrees. This method of discussing the data of biography often affords unexpected comparisons and coincidences. There seem to have been, within the defined period, nine presidents possessing medical degrees, namely: Sir Hans Sloane, Bt. (1727–41), Sir John Pringle, Bt. (1772–78), W. H. Wollaston (June 1820–Nov. 1820), Sir Benjamin Brodie, Bt. (1858–61), Sir Joseph Hooker (1873–78), T. H. Huxley (1883–85), Lord Lister (1895–1900), Sir Charles Sherrington (1920–25), and Sir F. Gowland Hopkins. Of these, only three may be said to have followed medicine or surgery as a means of livelihood, though the remainder were closely associated with medical studies. Sloane was created a baronet by George I., an honour to which no English physician had before attained. Lister was raised to the peerage (1897), the first medical man receiving that dignity. Lately, various character adjectives have been applied to Faraday; the author deems Lister to have been "learned, dignified, gentle, courteous, strong, industrious, modest"—we may surely add that above all he was serene. Eight of the foregoing presidents were married, Wollaston being the exception. He himself was one of the seventeen children of a Norfolk clergyman, whilst Sir Benjamin Brodie was, alike, one of the seventeen children of the rector of Winterslow, Wiltshire.

IN connexion with the award of medals by the Royal Society for the present year (NATURE, Nov. 14, p. 821), it is interesting to recall that the Copley Medal for 1831 was allotted to Sir George Biddell Airy for his papers on the construction of the achromatic eye-pieces of telescopes and on the achromatism of microscopes, on the spherical aberration of eye-pieces, and for his other papers on optical subjects in the *Cambridge Philosophical Transactions*. Airy was not at the time a fellow of the Royal Society, that honour being given him later, namely, in 1836. In the year previous to this, he had been appointed Astronomer-Royal. Airy was president of the Royal Society from 1871 until 1873, whilst on five occasions he was chosen president of the Royal Astronomical Society. With regard to the awards of Royal medals, it appears that none were made in 1831 or 1832.

IN delivering the fifteenth Bedson Lecture at Armstrong College, Newcastle-on-Tyne, on Nov. 13, Prof. John Read dealt with researches on essential oils. He pointed out that the unique flora of Australia belongs to an ancient, slowly-changing order of things which, standing aloof in the isolated Australian environment, has stamped its impress deeply upon the indigenous organic products of the continent. In a laudatory reference to the collaborative work of R. T. Baker

and H. G. Smith, the striking fact was mentioned that the merit and value of Smith's work were imperfectly understood in Australia, and "the classical researches of this pioneer chemist of the Southern world remained unappreciated during his lifetime by all but a scanty few of his British colleagues". After giving a general review of the chemical characteristics of the Australian flora, Prof. Read explained some of the recent work which has been carried out in the St. Andrews laboratories upon piperitols and menthols. Among the interesting exhibits was a 50-gram specimen of pure dextro-menthol, prepared by a new process from 200 grams of *dl*-menthol.

IN concluding his lecture, Prof. Read urged his listeners to avoid an undue restriction of vision in their chemical studies. "The conditions under which much of our chemical research work is carried out at the present day", he said, "are such as to produce, in the absence of correctives, a species of mental myopia among chemists. We chemists should strive to acquire balance and a broader vision; to pay more attention to economic and geographical considerations and to the chemical resources of our Empire; to cultivate an interest in botany, agriculture, and other related branches of science: in brief, we should learn to 'think imperially' in chemistry. The test-tube and the still, the transactions and abstracts of our chemical societies, are the tools of our craft; but we are citizens of a wider world. Let us stand back from our laboratory benches occasionally and contemplate the results of our own and our colleagues' researches against the background of our science, our Empire, and our world."

THE Thomas Hawksley lecture to the Institution of Mechanical Engineers was delivered on Nov. 6, by Mr. Ll. B. Atkinson, who chose as his subject the mechanical aspects of electricity. He pointed out that to mechanical engineers some of the modern theories must appear very nebulous. They cannot escape from the fact, however, that electrical and mechanical actions involve an interchange between visible motion and invisible motion. When electrons are moved from positive ions by mechanical motion, there must be some motion somewhere as the equivalent of the mechanical work which will reappear when the surrounding field collapses owing to the return of the electron to the atom to which it belongs. The fact that it has been proved that magnetic fields are due to electron rotations premises rotational energy as the form of the energy hidden from sight, but, nevertheless, existing and recoverable from the magnetic field. These ideas must in some way incorporate themselves into the explanations which will emerge in the future. Physicists, having failed to explain magneto-electrical actions which involve wave effects by the old mechanics, are now trying, with considerable success, to explain the old mechanics by wave effects. But, just as Faraday's and Maxwell's conceptions explained action at considerable distance by action at atomic distance, so explanation of atomic actions by wave mechanics must ultimately resolve itself into finding out the nature of the medium in which the wave takes place. The joy and satisfaction of scientific inquiry lie in the continual striving after fuller explanations.

TEN years ago, practically the only ignition system for the internal combustion engines used on British and Continental cars included the use of a magneto. At the present time, coil (or battery) ignition systems are used on at least eighty per cent of the cars being produced. The chief reasons for the adoption of coil ignition are its lower cost on multi-cylinder engines, the avoidance of difficult problems in the driving of the ignition unit, and the difficulty in finding a suitable type of magneto when high-speed engines are under consideration. Hence the paper read by E. A. Watson on Oct. 30 to the Institution of Electrical Engineers is a timely one. It is now commonly assumed that the amount of energy delivered in the discharge by the ignition system bears no direct relation to the energy necessary for the ignition of the explosive charge. In all cases the latter is a very small quantity and the electrostatic energy stored in the capacitance connected with the sparking plugs is always sufficient to cause ignition of the explosive mixture employed in the cylinder of an internal combustion engine. The mathematical theory of the induction coil, considered as two separate coils, is well known and is directly applicable. Prof. Taylor-Jones has shown how to find the coefficient of coupling which will give the best results. A clear and scientific account is given of the theoretical principles underlying the application of the induction coil to the specific purpose of ignition. The problems still left to the manufacturer are in connexion with small matters of detail, points conducive to cheapness of manufacture and trustworthiness in operation. Coil ignition is now practically a standardised method.

THE Imperial Bureau of Animal Genetics, established under the directorship of Prof. F. A. E. Crew, at the University of Edinburgh, is one of a series of nine imperial agricultural bureaux designed for the purpose of collecting, collating, and disseminating amongst research workers in the British Empire information of a scientific and technical character. It has already made good progress in a work which the dispersal of published contributions to agricultural knowledge in all sorts of odd corners of literature makes increasingly important and even necessary. During 1931 two comprehensive bibliographies have been published. The first contains references to papers dealing with the biology of the fleece, a contribution prepared for the Imperial Wool Conference of 1930, and including works published up to 1929. In addition to the list arranged alphabetically according to authors, there is included a subject index, which forms a useful guide to the varied matter discussed. The second bibliography is more ambitious, and aims at bringing together the chief information upon the subject of fur-bearing animals. This compilation, which has had the advantage of many scientific collaborators, gives a summary classification of fur-bearing animals, and under each species groups the titles of relative papers. It is devised for

the assistance of workers interested in the domestication of these useful animals, and includes references to papers on ecology in relation to conservation and utilisation of a natural resource, as well as to papers on the actual breeding of the animals in captivity. The first bibliography (32 pp.) is published by Messrs. Oliver and Boyd at 2*s*. 6*d*. net; the second (36 pp.) is duplicated typescript and may be obtained from the Bureau, price 1*s*.

A SECOND line of co-operative activity adopted by the Imperial Bureau of Animal Genetics is the publication of a *Quarterly Bulletin*. Its purpose, to judge by the three numbers of Vol. 2 which are before us, is to bring its readers in touch with current investigations, partly by the review of books bearing on genetics and relevant problems, and partly by short articles summarising the state of knowledge along different lines. In these numbers the chief summaries deal with lethal factors and live stock breeding, and fur production. The articles are far from exhaustive, but they suggest the scientific outlook, and in the case of fur-production a timely hint is given that the unskilled adventurer may lose much money in attempting to breed for marketable pelts under conditions of locality and climate which make profitable results impossible. It is announced that on the appointment of Mr. Eldon Moore to the editorship of the *Eugenics Review*, his place as Chief Officer of the Bureau has been taken by Dr. F. Fraser Darling.

IN an account of the birds in Mr. Whitley's private zoological garden at Paignton, now being published in the *Avicultural Magazine*, Dr. E. Hopkinson mentions (p. 245) five white specimens of the Australian zebra-finch (*Taeniopygia castanotis*) as having to be kept each in a separate compartment on account of their spitefulness. This is worth noting, as the species, though spirited and well able to look after itself in spite of its very small size, is not normally intolerant, even of its own kind in the breeding-season. It would seem, therefore, as if the white birds, which have only appeared recently, may have a different character from the normally coloured ones. This is certainly the case with a not distantly allied but much larger finch, the Java sparrow (*Munia oryzivora*), in which the white specimens are undoubtedly far more vicious than the normal birds. This may be, however, because the white birds are a domestic race and therefore at home in captivity, while practically all normal specimens are wild-caught and hence more apt to be nervous. In the case of the zebra-finch, however, normal birds are nowadays aviary-bred like the white ones, the species, long known as a free breeder in captivity, having been fully domesticated during this century. If whiteness and pugnacity are often correlated, this may be the reason why the giant fulmar (*Ossifraga gigantea*) is generally white in south polar latitudes and coloured farther north, for it is in polar conditions that the struggle for existence would be most severe among these powerful predatory sea-fowl.

A BREED of Mexican hairless swine has been studied by Elmer Roberts and W. E. Carroll (*Jour. of Heredity*, vol. 22, No. 4), who find that hairlessness is inherited as a simple Mendelian difference in crosses with Chester White. The skin is not entirely devoid of hairs, but they are sparse and the condition is therefore one of hypotrichosis. The heterozygotes have half as much hair as the normal. This condition is quite different from the type of hairless pigs prevalent in some parts of the United States, which is caused by a deficiency of iodine associated probably with goitre in the mother; the young are born dead or die shortly after birth, but the condition can be cured by administration of iodine. Hairless dogs, rats, mice, rabbits, and calves are known, as well as featherless fowls. Some of these factors are lethal. A vigorous naked sheep is, however, described by E. T. Popova-Wassina in the same journal (vol. 22, No. 3). It was born in a flock of black sheep, near Moscow, which had been intensely inbred. The skin was completely bare except for a few hairs on the hind legs and the tip of the tail. The skin was black instead of slate-blue, and the animal—a male—was of full vitality. It is probably a homozygous recessive, brought out by the close inbreeding which had been practised in the flock for twenty years.

WE have received from the British Drug Houses, Ltd., London, N.1, a number of leaflets describing different products issued by the firm. Acriflavine 'B.D.' was the first brand of British acriflavine used as an antiseptic wound dressing: it finds a use in a variety of septic conditions. Caprokol is a brand of hexylresorcinol: it is a urinary antiseptic which can be given by mouth. It is a highly active bactericide, and its action is enhanced by the fact that it reduces the surface tension of the urine so that it has a great penetrating power. It also acts as a soothing anodyne in urinary tract infections. Carotene B.D.H. has the growth-promoting power and anti-infective action of vitamin A, although it is not itself the vitamin. Recent research has suggested that carotene is converted into vitamin A in the animal body. It is issued in the form of pellets. Elixir Valibrom B.D.H. is a pleasant and safe hypnotic: it contains chloralamide, potassium bromide, and extract of valerian. A similar elixir is also issued containing 0·03 per cent morphine in addition. Liver Extract B.D.H. is used in the treatment of pernicious and certain other anæmias, such as that of pregnancy or sprue. It contains the liver fraction which stimulates the production of reticulocytes by the bone marrow. Livogen is a preparation of liver containing vitamins B_1 and B_2, to which has been added hæmoglobin and a yeast extract also containing vitamins B_1 and B_2. It is recommended as a general tonic and for the treatment of secondary anæmias. Manganese butyrate B.D.H. is of value in certain acute local conditions, especially those resulting from staphylococcal infections or in the complications of gonorrhœa. It is administered by intramuscular injection, a one per cent solution being used.

IN December 1930 the Central American Expedition of the University of Pennsylvania explored Yucatan in an aeroplane with the view of locating Maya ruins. A full account of the work of the ex-

pedition by Mr. P. C. Madeira appears in the *Museum Journal* (Pennsylvania) for June 1931. Several new sites were found and some were examined, but it is of interest to note that the leader of the expedition believes that the location of sites of ruins by aeroplane, in such a densely forested region as Yucatan, is of little scientific value owing to the difficulty of ground expeditions finding them again. Theoretically it is of course possible to fix the position on the map, but practically the mapped position may be, and probably is, a mile or two in error. This makes it impossible for an expedition cutting its way through the jungle to find the site without great loss of time and the use of many parties. Mr. Madeira suggests that the aeroplane might mark the site by dropping some destructive gas along lines forming a triangle with the site in the middle. Thus an exploring party could pick up the trail of the destroyed vegetation and so find the ruins. Another suggestion he makes is to drop, by parachute, on the ruins "a strongly constructed machine that would send out electrical waves for a considerable period" and so guide explorers to the spot. At any rate, until a sure method is devised of guiding a land party through the jungle to the site of ruins located only from the air, the discovery of further ruined cities by aeroplane seems to Mr. Madeira to be nothing but a fascinating and somewhat expensive sport.

PREVIOUS paragraphs in NATURE have noticed the operations conducted by the organisation known as "River Flow Records" on the rivers Moriston and Garry, in the Ness Basin, Inverness-shire. There has recently been issued a further series of quarterly reports, in two sets, by Capt. W. N. McClean, the director of the organisation, covering the six months from October 1930 to March 1931. These reports contain a detailed record of the rainfall within the basin during the period in question, with comments on the variations at the different gauging stations, and a statement of river-levels with the corresponding flow in cusecs set out in tabular form and the "Remaining Flow-off" from the catchment area in each case. The report on the River Garry also contains an examination of the rainfall records at Glenquoich Lodge on Loch Quoich, for the sixty years from 1870 to 1929, with a series of diagrams showing the annual rainfall, the deviation of the annual rainfall, and the aggregate rainfall to date, given as an excess or deficiency above or below 110 inches per annum. The Meteorological Office reckons the annual average for a period of 35 years (1881–1915) at 110·75 in. The report mentions that a striking characteristic of the record, which is found in those of other Scottish gauging stations, is the comparatively low rainfall of the twelve years, 1878–1889. At Glenquoich the following thirteen years gave a normal average and the twenty-seven years, 1903–1929, a much higher average. The mean of the records of thirty-five Scottish gauges gives similar conditions since 1889, though individual gauges differ very considerably. Copies of the reports can be obtained at the office of River Flow Records, Parliament Mansions, Victoria St., S.W.1.

THE Safety in Mines Research Board Paper No. 69, on the ignition of fire-damp by coal-mining explosives (Part 1, Gallery Experiments. H.M. Stationery Office, 1*s.* 6*d.*), by Grimshaw and Payman, deals with the causes of ignition of firedamp by permitted explosives, and gives suggestions as to the use of such explosives. The experiments show that it is really the conditions under which the explosives are used which determine whether they will ignite firedamp or not, and safety in their use depends as much, if not more, upon the care with which the operation is carried out than upon any specific property of the explosive. The experiments had in view an investigation of the conditions under which a given charge of a permitted explosive will cause ignition of firedamp underground. There is a long discussion of foreign theories of ignition and of the utility of tests. It is considered that the experiments rule out any possibility of utilising flame photography as a means of distinguishing explosives or methods of firing explosives. A shot-hole well placed, well loaded, and well stemmed is regarded as the best preventive of ignition of firedamp by explosives available to-day, and some simple rules which are likely to add to safety in the pit are given at the end of the paper.

THE Report of the Ordnance Survey for the year ending March 31, 1931, shows satisfactory progress in all departments, even if the staff and means available are far from adequate for all the cartographical and other work that is desirable. The Director-General notes the demand for revision of large scale plans of many areas which cannot be met by the Survey. Frequently the work is done by local surveyors employed by the municipality concerned, but the result seldom reaches the standard of accuracy of the Ordnance Survey. As regards small scale maps, a new quarter-inch series of England and Wales has now been published. A new feature of this series is the addition of town traffic diagrams on larger scales, showing the principal roads through the chief towns. They will be bound up with the folded editions, and are ready for sheet 11 of England and Wales and sheet 3 of Scotland. Another feature of interest is the proposal to produce a relief shaded edition of the one-inch map; after experiment, a satisfactory method has been found. The growing number of Ordnance maps printed annually shows that the popularity of these maps is rapidly increasing.

PART 18 of the "Catalogue of Indian Insects", issued by the Government of India, is devoted to the coleopterous family Carabidæ. The author, Mr. H. E. Andrews, has adopted a wide point of view, and the insects listed represent not only the Indian Empire but also the greater part of south-east Asia. The Catalogue is intended as a complete survey comprising all references to the Carabidæ inhabiting this territory. The classification followed is the recent one of T. G. Sloane, with certain adaptations. Thus, one new tribe (Idiomorphini) has been introduced and one tribe (Mormolycini) has been excluded. The arrangement of the Catalogue is alphabetical under genera, and each genus has its species arranged

in a similar order, with synonymical and other references, and the areas wherein they are known to occur. Mr. Andrews's contribution, which extends to 389 pages of letterpress, represents the most extensive family so far dealt with in this Catalogue, and is likely to remain a standard for many years to come.

THE Executive Council of the National Institute for the Blind has issued its annual report for the year ended March 31, 1931. A full account is given of the work and activities of the Institute with many illustrations. The output of braille books and periodicals was on the whole greater than for many years, and no less than 27,136 bound volumes were produced. The production of manuscript works and textbooks in braille for blind students has been continued by a band of volunteer writers, and this library now numbers 7000 volumes. The income of the Institute has been maintained, but the future naturally gives cause for anxiety, and emphasis is laid on the value of the annual subscription. The British "Wireless for the Blind" fund provided 13,000 wireless sets to date, and it is hoped that a further 7000 sets will soon be distributed, thus equipping with sets the estimated 20,000 blind persons without means of obtaining them.

A NEW oceanographical journal has appeared from Madrid in *Revista del Consejo Oceanografico Ibero-Americano*. The numbers that have so far appeared contain several important articles in oceanography by authorities in different countries, as well as bibliographical notes and the proceedings of the Council. The same body is responsible for a series of memoirs in oceanography, which includes papers by Dr. J. A. Fleming and J. P. Ault on the last cruise of the *Carnegie*, one by G. S. Huelin on gravimetric work at sea, and a useful list of oceanographical voyages of all countries by Prof. R. de Buen. This list omits few names of any significance.

THE seventeenth of the series of lectures on "Physics in Industry", arranged by the Institute of Physics, will be delivered by Mr. A. Whitaker, on "Physics in Sound Recording", at the Royal Institution, on Nov. 26, at 5 P.M.

AT a meeting of the London Mathematical Society on Nov. 12, the following officers and new members of council were elected: *President*, Prof. A. C. Dixon; *Vice-Presidents*, Prof. S. Chapman, Prof. H. Levy, Mr. T. L. Wren; *Treasurer*, Dr. A. E. Western; *Librarian*, Prof. H. Hilton; *Secretaries*, Prof. G. N. Watson, Mr. F. P. White; *New Members of the Council*, Mr. M. H. A. Newman and Mr. H. T. J. Norton.

IT is announced by Science Service that Mr. Masani Nagata has been awarded the Donohoe Comet Medal by the Astronomical Society of the Pacific, for his discovery of the first new comet of 1931. The observation was recorded in NATURE for Aug. 1, p. 192.

IT is announced in *Science* for Oct. 23 that the John Fritz gold medal, conferred by the four American societies of civil, mining and metallurgical, mechanical, and electrical engineers, has been awarded for 1932 to Dr. Michael I. Pupin, professor of electro-mechanics and director of the Phœnix Research Laboratory at Columbia University, for his achievements as "scientist, engineer, author, inventor of the tuning of oscillating circuits and the loading of telephone circuits by inductance coils".

THE annual Congress of the Royal Institute of Public Health will be held in Belfast on May 10–15, 1932, under the presidency of the Marquess of Londonderry, chancellor of the Queen's University of Belfast. The inaugural meeting will be held on the morning of May 10, and the scientific work of the congress will be conducted in the following sections: Section 1, State Medicine and Municipal Hygiene (including Port Sanitation); Section 2, Industrial Hygiene; Section 3, Women and Children and the Public Health; Section 4, Tuberculosis; Section 5, Pathology, Bacteriology, and Biochemistry.

THE latest catalogue of Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, is No. 541, giving the titles of upwards of 1300 works dealing with Africa. It should be of interest to geographers and anthropologists.

MESSRS. Baillière, Tindall and Cox, 7 and 8 Henrietta Street, W.C.2, have just issued a very useful classified catalogue of current books dealing, respectively, with animal husbandry and agriculture (including horticulture and forestry). The catalogue gives also the titles of certain periodicals relating to the subjects dealt with in the main list.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A master at the Government Technical School, Kingston, Jamaica, for metal work and engineering subjects—C.A., The Secretary, Board of Education, Whitehall, S.W.1, or The Secretary, Scottish Education Department, Whitehall, S.W.1 (Nov. 23). A research student at the Institute of Pathology and Research, St. Mary's Hospital—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W.2 (Nov. 23). A lecturer in mechanical engineering at the Northampton Polytechnic Institute—The Principal, Northampton Polytechnic Institute, St. John Street, E.C.1 (Nov. 25). A professor of pathology in the University of Sheffield—The Registrar, University, Sheffield (Nov. 27). A junior assistant pathologist at the Royal Sussex County Hospital—The Secretary-Superintendent, Royal Sussex County Hospital, Brighton (Nov. 28). A radium officer for the National Radium Regional Centre at Plymouth (South Devon and East Cornwall Hospital)—The General Superintendent and Secretary, South Devon and East Cornwall Hospital, Plymouth (Nov. 28). A pathologist at the Infants Hospital, Westminster—The Secretary, Infants Hospital, Vincent Square, S.W.1 (Nov. 30). A research fellow in bacteriology at the Lister Institute of Preventive Medicine—The Secretary, Lister Institute, Chelsea Bridge Road, S.W.1 (Dec. 5).

ERRATUM.—NATURE, Nov. 14, p. 821, third paragraph of "News and Views", last line but one: for "1300 years" read "1300 million years".

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.*]

Representation of Crystal Structure.

THE atomic structure of crystals is not an altogether simple matter to represent on paper. What is required, of course, is a portrait of a unit cell: that is, of any selected parallelopiped, with atoms at its corners and with just enough volume to include within itself a complete sample of the crystal pattern. A common device is to reproduce in picture form a three-dimensional model of such a cell. Another is

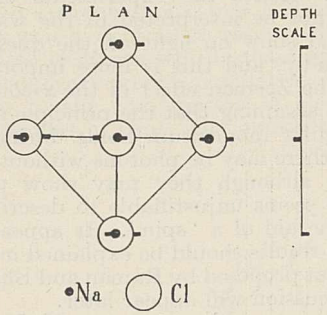


FIG. 1.—Atomic plan of sodium chloride on cube face (001). The symbols bear no relation to atomic volumes. Compare "Introduction to Crystal Analysis", Fig. 32.

to map out the contents of the cell upon one of its six faces. The rays employed for the purpose of projection must be parallel with that edge-direction of the cell which is inclined to the chosen face: thus in some cases the projection is orthogonal, and in others oblique.

Further, it is necessary to adopt a notation to indicate the depth of individual atoms represented on the plan. This depth is always stated as a fraction of the depth of the unit cell as a whole. Two conventions

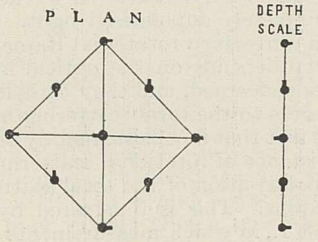


FIG. 2.—Atomic plan of diamond on cube face (001). Compare "Introduction to Crystal Analysis", Fig. 33.

are in common use: (1) the depth of an atom may be shown by varying the depth of shading employed in the ornamentation of its symbol; or (2) it may be expressed by attaching an appropriate number, such as $\frac{1}{4}$ or 25, where 25 means 25 per cent. Both conventions become difficult at a very early stage of complexity.

The notation illustrated in Figs. 1-3, while equally simple in principle, admits of wider application. The depth of any atom is indicated in these figures by a pointer, which rotates in clock fashion. If the pointer is directed downwards, the atom lies in the lower half of the unit cell, and vice versa. A depth scale, vertical in the cases illustrated, but oblique where necessary, is added to complete the picture. It is drawn to the same scale as the plan, and its length can be stated in angstrom units.

It is easy with this notation to indicate depths of two or more atoms which happen to be superimposed in plan, even where these atoms belong to different chemical elements. It is also easy to proceed from

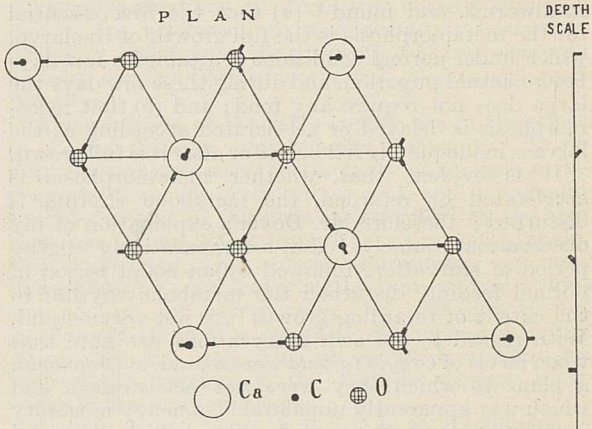


FIG. 3.—Atomic plan of calcite on base (0001). The symbols bear no relation to atomic volumes. Compare "Introduction to Crystal Analysis", Fig. 45.

one plan to another—in fact, to map out the crystal on any desired plane. For example, one can map diamond or calcite at right angles to its cleavage; in which case the origin of the cleavage becomes manifest in alternations of open and close spacing of the atoms.

Figs. 1-3 were drawn while reading Sir William Bragg's illuminating "Introduction to Crystal Analysis", and may be compared with the rather more complex originals, upon which they are based.

E. B. BAILEY.

The University, Glasgow,
Oct. 21.

Effects of Inadequate Feeding on Insect Metamorphosis.

MR. DOVER in his communication on this subject [1] has confused the phenomenon of metamorphosis with that of moulting. These two phenomena are entirely distinct. It is well known that, whereas all insects periodically moult during their life-cycle, only certain groups undergo metamorphosis. Regarding moulting, his observations support the views to which I subscribed in my papers quoted by him. My conclusions [2] were that the number of moults is in proportion to the length of the larval life, and that moulting cannot be solely, and possibly is not mainly, correlated with growth but is primarily connected with metabolism. Mr. Dover observed that when the larvæ of *Orgyia turbata* completed their life-cycle sooner, they underwent a lesser number of moults than is normally the case. He concluded that the decreased number of moults was due to a lesser accumulation of waste nitrogenous matter. The only difference between our views seems to be that, whereas I connect moulting with general metabolism (which includes excretion), he connects it specifically with excretion, but without advancing evidence in support of his conclusions.

The question of the influence of inadequate feeding on metamorphosis, with regard to which there seems to be a radical difference between Mr. Dover's views and those of many other entomologists, including

myself, is of far greater importance. Kellogg and Bell,[3] Northrop,[4] Tangl,[5] Kopec, and others, working on different groups of insects, showed that inadequate feeding, qualitatively or quantitatively, prolonged the larval life of the insect concerned. The observations of Krizenecky[6] and of Szwajsowna[7] on mealworms, however, did not seem to support this conclusion. Thereupon I carried out a series of experiments on mealworms, and found[8] (*a*) that the first essential for the metamorphosis is the full growth of the larva, which under normal conditions is attained a few days before actual pupation, and during these few days the larva does not require any food; and (*b*) that metamorphosis is delayed or accelerated according as the larva is inadequately fed before or after it is full grown.

It is evident that, whether metamorphosis is accelerated or retarded, the metabolic rhythm is disturbed; therefore Mr. Dover's explanation of my observations, namely, "that a comparatively lengthy period of starvation, followed by an equal period of normal feeding, disturbed the metabolic rhythm to the extent of retarding growth", is not very helpful. With regard to his own observations, we note that when larvæ of *Orgyia turbata* were reared on *Crotolaria*, a plant to which they were not accustomed, and which was apparently unpalatable, a heavy mortality occurred among them, and those which survived completed the larval period sooner. From this he concludes that inadequate feeding accelerates metamorphosis. This conclusion is based on the assumption that *Crotolaria* is less nutritious than the usual food plant, which may not be necessarily correct. Before sending this communication for publication, Mr. Dover was good enough to discuss the subject with me. He informed me that he had not ascertained by weighing or otherwise whether the larvæ fed on *Crotolaria* were smaller or bigger than those reared on the usual food plant, nor had he followed the complete history of the individuals fed on *Crotolaria* in order to determine their power of reproduction. Without applying these simple tests, to assume that *Crotolaria* provided inadequate food and to suggest that an insect which has once gained a foothold on the unusual plant may be more numerous than on the favoured ones appears scarcely justified. In this connexion the observations of Parfentev[9] on another species of *Orgyia* are of more value. This author studied the question by a series of carefully controlled experiments, and concluded that inadequate feeding retards metamorphosis and prolongs the larval life, a conclusion which is in consonance with the views of many entomologists, including myself, and is entirely opposed to Mr. Dover's interpretations.

HEM SINGH PRUTHI.

Zoological Survey of India,
Calcutta, Oct. 8.

[1] NATURE, **128**, 303, Aug. 22, 1931.
[2] NATURE, **116**, 938, Dec. 26, 1925.
[3] Kellogg, V. L., and Bell, R. G., *Jour. Exp. Zool. and Science*, N.S., **18**; 1904.
[4] Northrop, J. H., *Jour. Biol. Chem.*, **30**; 1917.
[5] Tangl, F., *Arch. ges. Physiol.*, **130**; 1909.
[6] Krizenecky, J., *Biol. Zentrbl.*, **34**; 1914.
[7] Szwajsowna, P., *C.R. Soc. Sci. Vars.*, **9**; 1916.
[8] Pruthi, H. S., *Brit. Jour. Exp. Biol.*, **3**; 1925.
[9] Parfentev, I. A., "Défense des Plantes", Leningrad I.; 1925.

The Spin of the Photon.

RECENTLY a number of papers have appeared on the question as to whether the phenomena of polarisation of light can be explained by the assumption of a 'spin' of the photon.[1] Kastler and Frisch deduce from their experiments that the photon possesses no spin, and Kastler argues further that the phenomena of polarisation should be explained on statistical grounds. Raman and Bhagavantam, on the other hand, argue that the interesting results obtained by Bär and Hanle[2] on the reversal of the state of polarisation of Raman lines when observed in the direction of propagation of the primary beam can be explained only on the assumption that the photons possess spin. They seem to link circular polarisation definitely with a spin of the photon about the line of propagation.

The arguments of Frisch and Kastler are based upon the Sommerfeld-Rubinowicz explanation of the selection principle for the azimuthal quantum number (principle of conservation of angular momentum of atom plus photon), but applying the same principle, and the principle that the atom-magnet can orient itself in any direction making certain definite quantised angles with the external field (as proved by Stern and Gerlach's experiment), it can be shown that the absorption of Zeeman components can never disappear with reversal of the field, but it will be modified on passing through two fields, whether parallel or antiparallel. Hence the experiments of Frisch or Kastler cannot be interpreted in the way supposed by them and show no light on the question of the spin. Secondly, and this is more important, a discussion of the Zeeman effect of the π-components of the D_1 line, assuming that the principle of conservation of angular momentum holds during radiation, shows that there may be photons without any 'spin' whatsoever, although they may show polarisation. It therefore seems unjustifiable to describe polarisation with the aid of a 'spin'. It appears that Bär and Hanle's results should be explained in some other way than that proposed by Raman and Bhagavantam.

A full discussion will appear later.

M. N. SAHA.
Y. BHARGAVA.

Physical Laboratory,
Allahabad, India,
Oct. 14.

[1] Frisch, *Zeit. für Physik*, vol. 61, p. 626; Kastler, *Jour. de Physique*, May 1931; Raman and Bhagavantam, NATURE, **128**, July 18, 1931.
[2] *Naturwiss.*, vol. 19, p. 463, 375; 1931.

Light Scattering in Liquids.

As was pointed out by Raman and Krishnan,[1] the nebulosity or wings which appear accompanying the original lines of the mercury arc in the spectrum of the light transversely scattered by liquids consist of nearly completely unpolarised light. These wings arise from an unresolved rotational Raman scattering, their intensity depends on the optical anisotropy of the molecules concerned, and they contribute in a not negligible degree to the total scattering by the liquid. Owing to the fact that it consists mainly of unpolarised light, the existence of rotational scattering affects the observed depolarisation of the total scattered light to a notable extent. This is illustrated by the figures given in Table I., in which measurements with carbon disulphide, benzene, and toluene are shown. The first column of figures gives the depolarisation, as measured with a nicol and a spectroscope with a *very wide slit*, so that the Rayleigh and rotational Raman scattering are superposed.

TABLE I.

Substance.	Total scattering (observed value).	Rayleigh scattering (observed value).	Spin theory (quantum).	Classical theory (Maxwellian).
Carbon disulphide	64·0	56·0	55·5	36·4
Benzene . .	41·5	33·3	33·1	20·6
Toluene . .	45·0	37·0	35·1	22·0

In the second column are given the values obtained using *a very narrow slit*, so that only the Rayleigh

scattering is recorded on the plate with the exposures given. The third column gives the theoretical value of the depolarisation calculated on the theory of spinning photons referred to in recent communications by Sir C. V. Raman and S. Bhagavantam. The fourth column gives the values calculated on the basis of the classical or Maxwellian theories of light-scattering. It will be seen that the agreement between the second and third columns of figures is very striking.

S. VENKATESWARAN.

210 Bowbazar Street,
Calcutta, India,
Oct. 12.

[1] NATURE, **122**, p. 882; 1928.

Photoelectrons and Negative Ions.

PROF. WELLISH'S letter under this title [1] calls for some comment.

In a mixed current of electrons and negative ions traversing a gas, it is usual to assume that the proportion of free electrons will decrease exponentially with the distance covered parallel to the electric force, owing to the combination of electrons with neutral molecules. Thus, the number of photo-

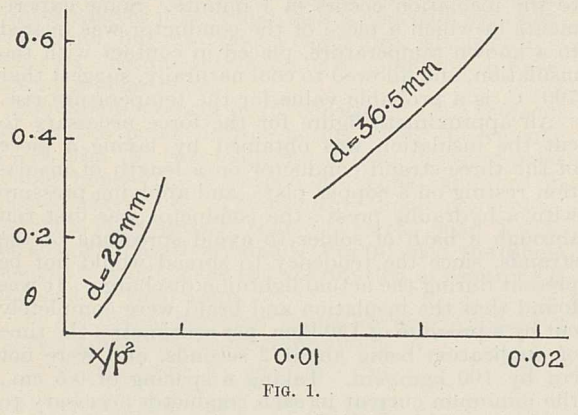


FIG. 1.

electrons surviving in a free state after travelling a distance d will be $N_d = N_0\epsilon^{-\lambda d}$, where N_0 is the number starting from the electrode. J. J. Thomson [2] has shown that we may put $\lambda = \frac{U}{KX} \cdot \frac{1}{L} \cdot \frac{1}{\beta}$; where X is the field strength; K, L, and U the mobility, mean free path, and velocity of thermal agitation of the electrons; and $1/\beta$ the probability that any one encounter between an electron and a gas molecule will result in their combination. In theory, K and L are both inversely proportional to the gas pressure p, and Townsend [3] finds that K and U are also functions of X: so we may expect that λ will be a somewhat complicated function of X/p^2, even if we assume that β is a constant characteristic of the gas, and not in its turn a function of the electron energy.

Wellish states that, in order to fit the theory to his experimental current/voltage curves, different values of λ are necessary for curves made with different frequencies of the alternating field. This is only to be expected, since the corresponding values of X will be different. The real question is whether a single value of β, not λ, can be found to fit all the curves.

With regard to the experimental procedure, there are serious practical objections to the use of current/voltage curves. The effects under consideration are functions of the field strength, and the actual magnitude of λ will therefore vary along the curves. The exact correlation of theory with experiment is not only very laborious, but also is subject to an unnecessarily wide margin of error. These complications can be avoided by keeping the voltage constant and varying the frequency of the alternating field cycle: the curves obtained in this way are much easier to interpret.

The effect can be studied in detail by my method,[4] in which, by means of two synchronised alternating fields separated by a grid, the current/*frequency* curves are resolved into two clear-cut horizontal 'steps'. From these the proportion of free electrons to total current (Wellish's θ, my N_d/N_0) can be read directly.

A crucial test of Wellish's theory lies in the effect of d, the distance between the electrodes. If no electron captures occur in the body of the gas, as he suggests, then, for given values of X and p, θ should be independent of the distance travelled by the free electrons. I am not at present in a position to make this experiment; but a re-examination of my published data [5] shows that θ can be expressed as a function of X/p^2, for a given value of d, and that when d is changed there is a complete discontinuity in the graph (see Fig. 1). This shows at least that an appreciable fraction of the electron capture must occur in the body of the gas.

J. L. HAMSHERE.

Leysin, Switzerland.

[1] Wellish, NATURE, **128**, 547; Sept. 26, 1931.
[2] J. J. and G. P. Thomson, "Conduction of Electricity through Gases", vol. 1, 138; 1928.
[3] Townsend, "Motion of Electrons in Gases". Oxford, 1925.
[4] Hamshere, *Proc. Camb. Phil. Soc.*, **25**, 205; 1928.
[5] Loc. cit., p. 217.

Change of Dielectric Polarisation of Carbon Disulphide with Temperature.

ONE of us (J. M.) has determined the changes of density D and dielectric constant E of carbon disulphide with temperature.

On the basis of these data we have computed the dielectric polarisation P, using the formula of Clausius Mossotti:

$$P = \frac{E-1}{E+2} \cdot \frac{1}{D}.$$

The accompanying curve (Fig. 1) represents the results

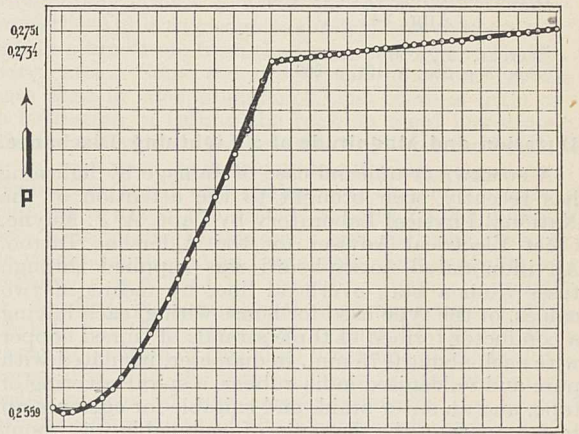


FIG. 1.

of this computation for the temperature interval from − 60° up to − 112°.

The value of P decreases gradually from 0·2751 at − 60° to 0·27372 at − 90° C. At − 90° there appears a sudden drop in the value of polarisation. It should be noted that at this point there appear also

a jump in the value of the dielectric constant of carbon disulphide and a distinct change of slope in the density curve. Moreover, this is a point of change from one liquid modification of carbon disulphide into another one, also liquid.

The sudden change of the value of P at $-90°$ suggests that the structure of the carbon disulphide molecule undergoes a change at this point. We have already observed a similar effect with ethyl ether.[1]

M. WOLFKE.
J. MAZUR.

Physical Laboratory,
Technical Institute, Warsaw,
Sept. 22.

[1] NATURE, **126**, 684; 1930: **127**, 236; 1931.

Diamagnetism of Liquid Mixtures.

WE have been for the past year working on the diamagnetism of liquid mixtures. Our method was to determine the mass susceptibility by a Curie balance, using a powerful electromagnet of the Pye type. Several mixtures have been studied carefully. By careful adjustments we are confident that our error in susceptibility value is not more than half per cent. In all cases studied, straight lines have been obtained between the mass susceptibility and composition. It is thus clear that the additive law is generally obeyed by liquid mixtures. Our list includes mixtures of benzene with chlorobenzene, hexane, carbon tetrachloride, and nitrobenzene, mixtures of hexane with nitrobenzene, and mixtures of acetone with chloroform.

Density curves obtained in all these cases have shown a departure of nearly three per cent, the maximum being about five to six per cent in the cases of benzene-nitrobenzene and acetone-chloroform. We therefore agree with Ranganadham [1] that the results of Trew and Spencer [2] require correction, but so far we have not been able to obtain departures from the additive law when mass susceptibilities are considered. Work with many other liquid mixtures is in progress.

S. RAMACHANDRA RAO.
G. SIVARAMAKRISHNAN.

Annamalai University,
Annamalainagar, S. India,
Aug. 24.

[1] NATURE, **127**, p. 975; 1931.
[2] *Proc. Roy. Soc.*, A, **131**, p. 209.

Duration and Magnitude of a Lightning Discharge.

A SOMEWHAT unusual case of damage by lightning has recently been brought to the attention of the National Physical Laboratory by Capt. A. J. Mayne, Chief Electrical Adviser for the Aldershot Tattoo. An illuminated notice-board was supplied through fuses from a bare overhead line, by means of two cables, of the type used for house wiring, each having a conductor formed of three strands of tinned copper wire each about 0·75 mm. in diameter, insulated with pure and vulcanised india-rubber, a spiral covering of tape, and an outer braid, and suitable for currents up to 8 amperes: the diameter of each cable was about 5 mm. The two cables were taped together at intervals of about ten metres, and were supported by the creosoted wooden terminal pole of the overhead line and one other similar pole.

At a time when the circuit was not energised, a lightning discharge took place through the cable line, and passed to earth down the supporting poles, in each of which a spiral track was cut: the fuses protecting the cable line were shattered, but no damage to the overhead line was evident. As a result of this discharge, the rubber insulation and tape have been cleanly slit throughout their length and the conductor extracted; the outer braiding has been slit and hangs loose; and each copper conductor has been greatly deformed on one side. At certain points the two conductors have partially cohered. There is no evidence of melting of the copper, and, at most points, no burning of the insulation. At a few points, however, and particularly where the two cables were taped together and the conductor remained in contact with the insulation, burning or melting of the rubber and singeing of the braid have occurred.

It is evident that the lightning current was in the same direction in both cables, and gave rise to an attractive force, under the influence of which the conductors cut the insulation as scissors would do, and came violently into contact.

It is of interest to attempt to calculate very roughly the limiting duration and magnitude of the discharge. For this purpose it is necessary to know the temperature rise of the copper, and the force necessary to cut the insulation. The maximum temperature attained evidently lay between 1100° C., the melting point of copper, and 200° C., a temperature at which no damage to the insulation occurs in 1 minute. Some experiments in which a piece of the conductor was heated to a known temperature, placed in contact with the insulation, and allowed to cool naturally, suggest that 700° C. is a probable value for the temperature rise.

An approximate figure for the force necessary to cut the insulation was obtained by laying a piece of the three-strand conductor on a length of insulation resting on a copper plate, and applying pressure with a hydraulic press: the conductor was first run through a bath of solder to avoid spreading of the strands, since the tendency to spread would not be present during the actual lightning discharge. It was found that the insulation and braid were completely cut by a pressure of 150 kgm. per centimetre, the time of application being about 2 seconds, and were not cut by 100 kgm./cm. Taking a spacing of 0·5 cm., the minimum current in each conductor necessary to produce a force sufficient to cut the insulation is 60,000 amperes. This current must have supplied the energy required to raise the conductor temperature by 700° C., approximately 3000 joules per metre, in the duration of the lightning discharge. Hence it may be calculated that the maximum duration of the discharge was 20×10^{-6} seconds.

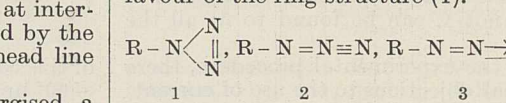
It may be noted that the average rate of energy input to each metre of conductor was at least 150,000 kilowatts.

R. S. J. SPILSBURY.

The National Physical Laboratory,
Teddington, Oct. 12.

Structure of the Azide Group.

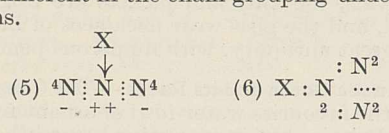
L. E. SUTTON has given [1] measured values of the dipole moments of the *liquids* phenyl azide, *p*-chlorphenyl azide, and *p*-tolyl azide, and applies this evidence to discriminate between the structural formulæ below (1–4). The evidence is strongly in favour of the ring structure (1).



In contradistinction to this, in each of the *crystalline* azides for which structures have been obtained hitherto, the crystals of sodium, potassium, thallium,

and cyanuric azides, (i) the azide group occurs as a short chain, and (ii) it is the central atom of the chain that carries the valence bond of the group.

These differences, in my opinion, are due to an instability inherent in the chain grouping under certain conditions.



The electronic formula (5) represents a stable group of three nitrogen atoms, provided that one additional electron is supplied from outside so as to make a total of $3 \times 5 + 1 = 16$, for example by means of a polar linkage with an electro-positive radical X.

When, however, a non-polar linkage is formed between X and N, it is no longer possible for electrons to group themselves in octets about the nitrogens of the chain. The stability lost in this way can be regained only by disruption or by the formation of a ring, as, for example, at (6). This is the ring found by L. E. Sutton for the non-polar liquids he examined, and written by him as at (1), in accord with the chemical notation.

On this evidence, the grouping must take the ring form whenever it is bound into a molecule by a non-polar bond, but may take a chain form whenever it is either an electronegative ion or is bound into a molecule by a polar bond.

The dipole moment of (5) consists of (*a*) a moment due to the polar linkage acting along the valency X – N, and (*b*) two moments due to the semi-polar double bonds N – N, which are equal and act in opposite directions. The resulting dipole moment is, therefore, substantially that due to the bond X – N, and so is comparatively small. For (6), also, the dipole moment is small, since the distribution of electrons is balanced for each atom.

The calculated parachor values are nearly equal for the two groupings, being respectively

$$3 \times 12{\cdot}5 + 2 \times 23{\cdot}2 - 3 \times 1{\cdot}6 = 79{\cdot}1$$

and

$$3 \times 12{\cdot}5 + 23{\cdot}2 + 16{\cdot}7 = 77{\cdot}4.$$

T. C. SUTTON.

Research Department, Woolwich,
Oct. 14.

[1] NATURE, **128**, 639, Oct. 10, 1931.

Slow Combustion of Hydrocarbons.

Two recent papers by S. Lenher [1] on the slow thermal oxidation of ethylene afford very striking confirmation of a modification of Bodenstein's mechanism [2] for the oxidation of acetylene, which I have developed to explain the proportions in which carbon monoxide, carbon dioxide, water, glyoxal, formaldehyde, and formic acid are formed in the reaction. Instead of Bodenstein's reaction

(5) $C_2H_2O_2' + O_2 \longrightarrow CO_2 + HCOOH,$

which fails to explain the proportions in which carbon dioxide and formic acid are formed, the deactivating collisions with oxygen are assumed to occur in two ways in a ratio determined principally by steric factors thus :

(5*a*) $C_2H_2O_2' + O_2 \longrightarrow CO + CO_2 + H_2O,$

(5*b*) $C_2H_2O_2' + O_2 \longrightarrow 2CO + H_2O_2.$

With an additional but very minor reaction

(7) $2C_2H_2O_2' \longrightarrow CO + CHO.CO.CH_2OH.$ [3]

The scheme, with these modifications, accounts for all the observed phenomena within the limits of experimental error. It is now evident, from very careful analytical work by Lenher,[1] that hydrogen peroxide is produced in the oxidation of ethylene. This can be most readily accounted for by a reaction such as (5*b*) above,

$$C_2H_4O_2' + O_2 \longrightarrow CO + H_2O_2 + HCHO,$$

rather than by the less probable deactivation by water suggested by Lenher, and conditions for the formation of dioxymethyl peroxide would be even more favourable. Lenher's kinetic measurements on ethylene, and also those of Thompson and Hinshelwood,[4] show a close parallelism with acetylene and indicate that the reaction proceeds by a similar mechanism. Lenher claims that the large yield of ethylene oxide obtained with short contact time, high temperature, and high ethylene concentration proves the chains to be short and discounts any theory postulating direct formation of carbon monoxide and carbon dioxide from the first collision complex as in (5*a*) and (5*b*). My experiments on acetylene using packed and open vessels,[5] and similar experiments by Lenher [1] on ethylene, show that the chain length in these reactions is at least of the order of 400, and such products as ethylene oxide and methyl alcohol [6] are to be regarded as the result of an alternative non-chain propagating deactivation by the hydrocarbon molecule, which only becomes of importance at high temperatures, high concentrations of hydrocarbon, or special conditions of surface. These views, with my results on acetylene oxidation, will shortly be published in a more extended form.

R. SPENCE.

Armstrong College,
University of Durham.

[1] S. Lenher, *Jour. Am. Chem. Soc.*, **53**, 3737, 3752 ; 1931.
[2] M. Bodenstein, *Zeit. phys. Chem.*, B, **12**, 151 ; 1931.
[3] Norrish and Griffiths, *Jour. Chem. Soc.*, 2829 ; 1928.
[4] Thompson and Hinshelwood, *Proc. Roy. Soc.*, A, **125**, 277 ; 1929.
[5] R. Spence, NATURE, **128**, 153 ; 1931.
[6] W. A. Bone, NATURE, **127**, 481 ; 1931.

Occurrence of *Lithothamnion* in the South Indian Cretaceous.

IN continuation of my note regarding the occurrence of *Lithothamnion* in certain Cretaceous rocks of the Trichinopoly area,[1] I write to state that I have further been able to recognise similar, or even identical, algæ in a limestone from the Cretaceous of the Pondicherry area. Some sections of this limestone reveal these algæ in such abundance that there is little or no hesitation in calling the rock an algal limestone. The discovery of these algæ in the rocks of the Pondicherry area must be considered as doubly interesting; first because it will now enable us to extend the statement made about the occurrence and importance of these algæ in the Trichinopoly area as being true of the whole South Indian Cretaceous, and secondly as revealing a new field for providing further material for detailed palæontological investigations of the South Indian Cretaceous algæ in general. The stratigraphical position of this algal limestone of the Pondicherry area, and the general facies of its associated fossils, suggest an age corresponding to the lower Ariyalurs (Senonian) of the Trichinopoly area ; and hence we may reasonably conclude that, in this Pondicherry limestone, we have an occurrence of *Lithothamnion* even older than that which has been discovered in the Trichinopoly area.

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[1] NATURE, **128**, 225, Aug. 8, 1931.

Research Items.

The Cult of the Bull in Scotland.—Mr. A. D. Lacaille, in *Folklore*, vol. 41, No. 3, brings together evidence from place-names, folklore, and archæology bearing upon the existence of a bull-cult in Scotland in prehistoric and protohistoric times. In the west, where Gaelic is still spoken, place-names are coupled with bovines; for example, a wood called 'Coille nan Tairbh' (Wood of the Bulls), near Kilmartin in Argyll. Nearby are several round cairns and other remains and sculptures on a granite outcrop; while a round cairn at Largie nearby yielded one of the most interesting sculptured stones of Scotland on which are figured eight axe-heads, suggesting work of the early bronze age. Names from bulls are given to rivers; for example, the 'Tarff' ('Tarbh', Gael., a bull) or 'Tarbhan', a little bull; 'Loy' from 'Laogh', a calf; for example, 'Alt Fionn Laoigh', 'the Burn of the White Calf'. Not only are antiquities present in the neighbourhood of places designated under an appellation incorporating a bovine name, but also there are legends associated with such features, as well as special practices observed by the people at certain times of the year. One of the most important places of pilgrimage in Scotland was an island on Loch Maree, where ancient rites survived long after the Reformation, associated with St. Mhaolrubh and a sacred well, where a bull was sacrificed on Aug. 25. Reginald of Coldingham records the sacrifice of a bull in honour of St. Cuthbert at Kirkcudbright; and the holy pool of St. Fillan at Strathfillan, Perthshire, effective in curing mental derangement, lost its virtue through the immersion of a mad bull. A legend of the combat between the Red Bull of England and the Black Bull of Scotland is associated with the Pulpit Rock of Ardlui. Representations of the bull are found on sculptured stones of prehistoric and early Christian times, but only in the east and north-east of Scotland.

The Fulani of Northern Nigeria.—Some notes on the Fulani of Northern Nigeria, collected by Mr. G. W. Webster during a residence of twenty-four years, are recorded in *Man* for November. Little can be learned from the settled Fulani, who have intermarried with native tribes and are under the influence of Islam, while the nomad Fulani are shy and inaccessible. A few families admitted the author to their intimate family life. They were startlingly white in appearance and of surprising mentality. They have slim and athletic figures, with beautiful hands and feet, oval faces, and straight or slightly wavy silken hair, usually worn in three to six plaits, but sometimes wound round the head in a single plait and fastened by a silver bodkin with a filigree head, or merely bundled up under a containing cap. Combings or horsehair are used by both sexes to increase the length of the hair. The men have straight or aquiline noses, the women short straight noses or long thin noses, sometimes tip-tilted. The lips are well chiselled, and fine, though often spoilt, according to our ideas, by tattooing of the lower lip, which thickens it and makes it pendulous. The ordinary dress for both sexes is a leather kilt, ornamented with tassels of cowry and shells or beads. It is frequently ornamented with patterns said to be heraldic. The older men wear, in addition, a sleeveless shirt of white cloth, the women a cloth wrap put round the body to form a dress from armpit to calf. The older men wear a phrygian cap or straw hat, as a protection from rain and sun when travelling. Women are usually bare-headed. Boys and girls herding cattle wear the kilt, a tanned skin over the shoulder, and the straw hat. The girls in addition have breast-plates of copper, silver, or even calabash. On holidays and festivals, the kilts and jackets are brightly embroidered, and the girls wear necklaces of beads, said to be of great antiquity, with numerous pendants.

The Canada Goose and its Races.—The Canada goose is one of the favourite water-fowl of ornamental ponds in Great Britain, but in its native home it has been a source of annoyance, at any rate to the zoologists. *Branta canadensis* has several geographical races, and in the absence of investigation of the segregation of the races in their far northern breeding grounds, a satisfactory classification of material containing mixed migrants has been impossible. P. A. Tavener, having at hand new collections of breeding and summering specimens from Baffin's Land and elsewhere, has made a fresh attempt to solve the problem (*Ann. Rep.* for 1929, Nat. Mus. Canada, p. 28, 1931). He notes that the experienced sportsman often distinguishes, by habit, stance, action, or voice, races which to the taxonomist appear to be all but identical. As a result of his comparison of characters and sizes the author now groups under the specific name of *Branta canadensis*, three races—the honker or eastern form (*B. c. canadensis*), the western form (*occidentalis*), and the lesser form (*leucopareia*). But, partly on account of its breeding in juxtaposition with *leucopareia* without general hybridisation, he separates *B. minima* as a definite species, in which category he also places *B. hutchinsi*; the latter, apart from niceties of colour, appears to be a diminutive edition of *leucopareia* and *canadensis*.

Larval Freshwater Shrimps from Japan.—Dr. Zu Yokoya, in his paper "On the Metamorphosis of Two Japanese Freshwater Shrimps, *Paratya compressa* and *Leander paucidens*, with Reference to the Development of their Appendages" (*Journal of the College of Agriculture*, Imperial University of Tokyo, volume 11, No. 2; 1931), investigates these two freshwater crustaceans, one belonging to the Atyidæ and the other to the Palæmonidæ. Although describing briefly the various larval stages of each and figuring them, he pays special attention to the development of the appendages and of the muscles attached to them. Both species are found commonly in a pond in the grounds of the University of Tokyo, therefore abundant material was forthcoming, the larvæ also being hatched from the egg in aquaria and partially reared. The larvæ of *Paratya compressa* are rather like those of *Caridina wyckii* as described by von Daday, the larvæ of *Leander paucidens* somewhat resemble those of *Palæmonetes varians* as described by Gurney. *Leander paucidens* has an enormous fifth leg, specially large in the early stages. The author observed a larva in stage IV. catching a larval Ephemera with these precociously developed long legs. It is an interesting fact that these caridean larvæ should feed on insects. In the later stages the change in form of these legs is so great that one wonders whether the food is also changed. The paper is well illustrated by very careful drawings of the larvæ and of all the appendages in each stage, the latter occupying eight double plates. The whole is a valuable contribution to the study of decapod development, especially as little is known of these Japanese larvæ.

Entomogenous Fungi.—Mr. T. Petch has chosen the study of fungi which attack insects as his special branch of mycology. He has spent many years in Ceylon, and is now in England, pursuing his favourite

hobby. His most recently published work is entitled "Notes on Entomogenous Fungi" (*Trans. British Mycological Society*, vol. 16, pt. 1, pp. 55-75, 1931). The species described therein are members of the genera *Beauveria*, *Sporotrichum*, *Rhinotrichum*, *Volutella*, *Hypocrella*, *Isaria*, *Nœmosphœrella*, *Oospora*, *Tilachlidium*, *Acremonium*, *Botrytis*, *Metarrhyzum*, *Cephalosporium*, *Sterigmatocystis*, *Penicillium*, and *Cordyceps*. Most of the descriptions refer to foreign species, and many of them have not been named before. A study of the genus *Cordyceps* revealed the presence of four species which had an atypical ascus. Instead of the characteristic cylindrical ascus with fusiform spores dividing into part-spores, these species have a clavate ascus with fusiform, non-dividing spores. The name of *Ophiocordyceps* is proposed for this genus.

Chromosomes and Constitution.—A. A. Moffett has a very interesting paper upon this difficult subject in reference to the Pomoideæ in the *Journal of Pomology and Horticultural Science*, vol. 9, June 1931. Earlier work from the John Innes Horticultural Institution has shown, for the cultivated apples, that these strains are polyploid, and that the greater productivity of certain strains can be traced to an even number of sets of chromosomes, whilst triploids are relatively infertile, as similar odd multiple polyploids have proved to be in *Prunus* and *Rubus*. At first sight the basic number of chromosomes in the apple seemed to be 17, with diploids 34 and triploids 51 in the gametes. But the curious secondary association of pairs of bivalents noticed in the pollen mother-cells, occurring after the normal pairing at prophase of nuclear division, has already suggested that these 17 chromosomes represent a complex grouping from an original set of seven, three of which were represented three times and four twice. Moffett has extended these observations through a number of the genera of the Pomoideæ, data being tabulated now for species in ten genera, including that variable North American genus *Cratœgus*. Whilst the usual numbers of chromosomes in the gametes seem to be invariably 17 or a multiple of 17, the frequent occurrence of similar secondary pairing of the original bivalent pairs is regarded by Moffett as supporting the view that all the Pomoideæ are secondary polyploids founded on an original basic set of seven chromosomes. It is suggested that the common morphological characters of this group may be associated with this unusual cytological constitution.

Kaolin Minerals.—The results of a long-continued investigation of clay minerals by C. S. Ross and P. F. Kerr are presented in *Prof. Paper* 165 E of the U.S. Geol. Survey, 1931. The older methods of study have been supplemented by applying the X-ray powder-method, and tests of this kind have been effectively carried out on the same materials as those used in the chemical, dehydration, and optical investigations. Complete correlation of results is therefore attained. The conclusion is reached that instead of one kaolin mineral there are at least three distinct species. These are called *kaolinite*, *nacrite*, and *dickite*, the last being after A. B. Dick, who described the original material from Anglesey. All three have generally the accepted composition $2H_2O.Al_2O_3.2SiO_2$, but some kaolinite varies in the direction of higher SiO_2. Kaolinite is stable over the lowest temperature range; it is formed by the weathering of feldspathic rocks and by thermal carbonate-bearing waters. Dickite is stable at higher temperatures, and seems to have been formed by moderately heated hydrothermal solutions; it is not known as a product of weathering. Nacrite is the high temperature form, and is formed by hypogene processes. These results probably explain most of the current differences of opinion about the mode of formation of 'kaolin'.

Tide-gauge Measurements of Height Differences.—Among other interesting papers and reports included in the *Comptes Rendus* of the fifth meeting of the Baltic Geodetic Commission at Copenhagen, Oct. 13–18, 1930 (pp. 275; Ilmari Bonsdorff, Helsingfors, July 1931), is one by D. la Cour on the determination of differences of height by tide-gauge measurements in Denmark. Great difficulty has been found in levelling by the ordinary optical methods over the broad belts of water that separate the islands of Denmark from the mainland; large systematic errors have been found which render the results uncertain. La Cour has investigated the departures of the water surface in these belts from the horizontal, with the aim of avoiding the need for carrying an optical beam horizontally across the belts; this process of determining differences of height he calls 'quasi-levelling'. He has investigated the water-level by tide-gauges at certain Danish stations, and has found a considerable systematic variation of level, depending on the pressure gradients between Shetland and Aaland, and Calais and Cracow; extrapolating to zero pressure gradient, he finds that the corresponding water-level at Esbjerg is 28 cm. below mean water-level. He shows that changes in the mean water-level over a period of a few years can be deduced with a far smaller probable error when the correction to zero pressure gradient is made than when this is not done. He considers, also, the effect of the rotation of the earth in producing a difference of level across belts along which a current is flowing, and believes that this affords the most accurate means of estimating the difference of level. He finally suggests the experiment of laying a small lead pipe across the strait between Denmark and Sweden, in order to connect the levelling bases of the two countries.

An Effect of X-Rays on Matter.—A number of attempts, generally regarded as unsuccessful, have been made to affect the stability of atomic nuclei by non-radioactive methods. An elaboration of one due to Smits is described by G. I. Pokrowski in the *Physical Review* for Sept. 1. The effect consists in the supposed possession of radioactive properties by bodies when they have been exposed to X-rays. In Prof. Pokrowski's experiments, X-rays from tubes run at about 100 kilovolts were used. Light elements were not affected, but after heavy elements had been irradiated it was found that a new ionisation of gases was detectable in their presence, falling off in intensity with a period of half decay of the order of half an hour in the case cited. Another set of experiments was made which showed that a screen could be observed to scintillate in the same circumstances. By combining the two sets of observations, it was deduced that the energies of the particles correspond with those of weak α-particles, so that the phenomenon, if its reality can be maintained, would appear to be some stimulated form of disintegration of nuclei which are not normally radioactive.

Measurement of High Voltages.—A lecture given by Prof. W. M. Thornton to the Institution of Electrical Engineers and published in the October number of the *Journal*, discusses the possibility of making instruments for measuring very high voltages. This problem is an urgent one at the present time. The conclusion arrived at is that high voltage instruments can be made as simple in construction and as accurate and convenient to use as those for lower voltages. In the absolute form, when an ellipsoid instrument is

used, the degree of precision approaches the highest physical accuracy. Using this instrument, Prof. Thornton finds very easily a value for the velocity of light which is in excellent agreement with the best of the standard determinations. Another type of instrument is the corona voltmeter, the action of which depends on the appearance of ionisation at the surface of the corona rod. The lack of an accepted theory of corona formation is a hindrance to the general acceptance of the formula which Prof. Thornton gives, but it is accurate, and he thinks the instrument will soon be developed so as to give very high accuracy. The constancy of hot wire ionisation and spark phenomena in gases leaves little doubt that the effects of ionisation are capable of repetition to a high degree of certainty. The electric wind is not at first sight a promising phenomenon to use for precision measurements, yet Chattock has shown that it is steady within one per cent, and further experiments have confirmed his results. Although not quite independent of the frequency, the ionic wind voltmeter is as accurate as any hot wire bridge can be made. It is necessary to work at voltages below that at which corona appears on the filament. Above this point the instrument may fluctuate several per cent above a mean value.

Optical Rotation and Atomic Dimension.—D. H. Brauns, in the *Bureau of Standards Journal of Research*, vol. 7, No. 3, refers to previous investigations which show that for the halogen acetyl derivates of the monosaccharides glucose, fructose, xylose, and arabinose the differences in specific rotations Cl–F, Br–Cl, and I–Br have the same ratio, 41 : 17 : 21, which is in close agreement with the ratio 41 : 16 : 21 for the distances of the carbon to the halogen atoms in homopolar compounds (mean of values of Arkel and de Boer and of Goldschmidt). The values for the mannose derivatives, however, give the abnormal ratio 41 : 25 : 35. The details for the preparation of the crystalline halogen derivatives of tetra-acetyl mannose, including the iodo-compound, are given in the paper. The behaviour of the mannose derivatives is then studied in relation to space models, and the conclusion is reached that the hydrogen of the first asymmetric carbon, to which the halogen is also attached, is influenced by the atoms of the second carbon acetyl group, whereas such an influence does not exist for the other halogenated monosaccharides. The results show that the study of the principle of optical superposition should be carried out in the light of these configurational peculiarities.

Isotopes of Lithium, Sodium, and Potassium.—The *Journal of the Franklin Institute* for September contains a detailed paper by K. T. Bainbridge on the above subject. Magnetic analysis of the positive rays of lithium from a heated spodumene source showed no change with temperature in the relative abundance of Li^6 and Li^7, in agreement with Aston and Morand. Different results of other observers are considered to be effects of space charge. Ions of the alkali metals were produced from heated natural silicates, the technique being described in considerable detail. Sodium and potassium were examined for the presence of small amounts of isotopes other than Na^{23}, K^{39}, and K^{41}. If Na^{21} or Na^{25} exist at all, they are present to less than 1 in 3000 of the main isotope and Na^{22} cannot be present to an extent greater than 1 in 800 of Na^{23}. From analysis of potassium it is concluded that there is less than 1 part in 1500 of K^{43}, less than 1 in 600 of K^{42}, and less than 1 in 300 of K^{40}, in reference to K^{39}, if they exist at all.

Astronomical Topics.

Comets.—Dr. Bower and Miss Miller found a markedly hyperbolic orbit for Ryves's comet from the August observations, but the October ones show that it does not differ much from a parabola ; the following is a close approximation to it :

T	1931 Aug. 25·9447 U.T.	
ω	168° 16′	1931·0
Ω	101 28	
i	169 16	
log q	8·8704	

They give the following ephemeris for 0 h. U.T. in *Harvard Card* 184 :

	R.A.	N. Decl.
Nov. 24	10h 42m 32s	1° 41′
Dec. 4	10 33 4	2 9
14	10 20 13	2 56
24	10 3 57	4 3

The comet is still within reach of moderate instruments, but is fading rapidly. It is important to follow the comet as long as possible in view of the near approach that it recently made to Jupiter ; the elements given above indicate that it was nearest to Jupiter on Oct. 10, 1930, the distance being fourteen million miles ; it remained within half a unit for more than two months.

Mr. F. E. Seagrave finds the following elements for Nagata's comet from observations made at Yerkes Observatory on July 23, Aug. 5 and 31 :

T	1931 June 10·82188 U.T.	
ω	318° 45′ 39·31″	1931·0
Ω	191 37 39·20	
i	42 27 28·51	
log e	9·9707006	
log q	0·0137314	
Period	62·9261 years	

The period is probably too short, but there is little doubt that the orbit is an ellipse of moderate period.

Mr. Durrad's announcement of a comet in the northern sky, Nov. 5–Nov. 9, proves to have been erroneous ; the comet does not exist.

Mutual Eclipses of Jupiter's Satellites.—Before the time when these eclipses were predicted they were very seldom observed. The Rev. T. W. Webb in his well-known " Celestial Objects " (1881 edition) stated that there was only one recorded instance. The duration of the eclipses is brief and they are likely to be missed unless the observer is forewarned. The Computing Section of the British Astronomical Association undertook some years ago to predict these phenomena, and also those in Saturn's system ; these predictions have led to many of these phenomena being observed ; the results should be of value in improving the elements of the orbit planes ; eclipses by Jupiter are of little use for this purpose. The seasons for such eclipses recur every six years, when the orbit-planes of the satellites pass through the sun ; one of these seasons has just begun, and Major A. E. Levin, who is both president of the Association and Director of the Computing Section, devoted part of his presidential address on Oct. 28 to this subject. The geometry of the eclipses is somewhat intricate, but that of the mutual occultations, as seen from the earth, is still more so. The predictions are published in the British Astronomical Association Handbooks for 1931 and 1932. The next one that is visible in England at a convenient hour is the eclipse of II by I early on Nov. 23 ; it begins at 1h 20m A.M. and lasts 6 minutes. There are many visible ones in December, as Jupiter then rises earlier.

Educational Broadcasting.

AMONG the many discussions at the British Association centenary meetings which received comparatively little publicity was that which followed Prof. Winifred Cullis's paper on "Broadcasting in Adult Education". There are few more hopeful signs amid our present difficulties than the attempts which are being made to utilise for instructive purposes the new powers and forces which science has placed at our disposal in broadcasting and the cinema. It is generally admitted that progress in the exact or physical sciences, such as chemistry, physics, engineering, has far outstripped progress in the social sciences. Partly, no doubt, this is due to the disparity between the volume of research in these fields as compared with research in the physical sciences, but the prejudices and conservatism which are still widely prevalent in such fields as eugenics, education, and psychology are a contributing factor which is largely responsible for the absence of a true social science or sociology.

Progress in this field depends not only on research in biology and anthropology but also to a very large extent on the education of the community, if the results of scientific research are to find application. Prof. Cullis described the admirable experimental work which has been initiated in adult education since the establishment of the Central Council for Broadcast Adult Education in 1928. The series of pamphlets on "The Changing World", recently issued by the British Broadcasting Corporation as an introduction to a series of evening talks to be broadcast on Mondays to Fridays from Sept. 28, 1931, to March 25, 1932, illustrates the considerable progress which has already been made with the two main problems presented by the development of a specialised programme technique and of interesting the listening public.

These attractive pamphlets demonstrate the possibility of securing simple, informal, and continuous treatment of live subjects which are of wide general interest and related to experience in a way which appeals to a general audience. They are designed not only to arouse interest in the future talks but also to encourage the formation of study or discussion groups, and contain lists of books dealing with the various topics, which assist further reading and the attainment of a balanced and impartial view.

As its title indicates, the present series of pamphlets has as its main purpose the practical object of assisting the listening public to understand more fully the changes which are taking place in industry, art, and politics largely through the impact of science. This is fundamental work if the community is to have any real capacity to sort out the issues and to lend its continuous and intelligent support to policies which will enable civilisation to regain control over events.

The pamphlet by Prof. Henry Clay is introductory to twenty-four talks on industry and trade, and gives an outline of the ways in which changing wants have shifted prosperity from the basic industries or those supplying the necessaries of life to those that supply luxuries. Prof. Clay suggests that British industry is possibly losing trade because it persists in supplying goods that will last, when its customers chiefly desire variety and novelty. Into this picture, changing conditions in regard to population and emigration are fitted as a background to the factors of technical progress and mass production, upon which discussion is sometimes exclusively centred. Tendencies in industrial organisation and their economic effects, both in relation to the persistence of poverty and the relations of government and industry, are reviewed in an impartial way that opens up wide and fundamental questions.

It is all to the good that such questions as the relations between technical advance and the maldistribution of economic prosperity should be examined widely in this way. Too often the discussion is limited by prejudice or is characterised by an absence of perspective, and Prof. Levy's essay on science in perspective endeavours to place science in its rightful position in regard to the changing conditions under which we live. The rate at which scientific and technical development has proceeded in the last century is probably a prime reason why even yet the gap between scientific or technical advance and social, political, and economic developments is scarcely realised, still less the danger which confronts premature attempts at legislation with inadequate knowledge. Here, as well as in the demonstration that science has provided us with a fresh medium in which art can find expression and, above all, with the means and technique to plan our future, the series of talks which Prof. Levy introduces should greatly promote the interpretation of the true relations of science to society and culture.

Fundamental questions are also raised by the talks on the modern State to which J. A. Hobson writes an introduction. These, too, envisage the part which the specialist is called upon to play in the evolution of order and reasoned control in the sphere of politics if the modern State is to be adequate for the increasing demands made upon it. Existing parliamentary institutions are admittedly ill-adapted to deal with many of the problems, such as those of the relations between capital and labour, town industries and agriculture, manufacturing and distributive trades, key industries, transport, atmospheric pollution, etc., now confronting the State, and departmental action is frequently either ill-informed or unguided by a considered policy. The development of new methods cannot come without the help of scientific workers, and their help cannot be effective unless public opinion understands and appreciates the contribution they have to offer. So, too, in the international sphere, even yet society is slow to realise how imperative science has made the need for co-operation, and that both our material and international life needs replanning as an organic whole in which the co-operative effort of all classes of society and of all nations make their particular contribution to the common weal.

This is no Utopian ideal: it is a practical proposition. As Mr. John MacMurray points out in an introductory essay to the talks on education and leisure, the maintenance of an advanced civilisation depends upon the preparation of the minds which live in it and by it so that they can meet the demand for constant adaption to new conditions, for elasticity and versatility of mind. Primarily this is an educational problem, and the method of education by broadcasting offers a prospect of countering the inertia and mechanisation of mind for which our educational methods far more than our industrial conditions are responsible. If we can acquire the capacity to change our opinions continuously, in a balanced and controlled fashion, by a continuous testing of them against the changing facts of experience—which is only another name for a scientific outlook—we shall find that modern industrial conditions, and the wider services rendered by the modern State, so far from repressing or cramping individuality and personality, offer it wider opportunities. To learn the use of leisure is to learn how to live and to discover the way to control and transform the forces which, unchecked, threaten the existence of our civilisation.

Control of West Indian Insect Pests.

THE reduction of insect damage in all parts of the British Empire is a problem of primary importance. Adequate and reliable physico-chemical methods are available, yet in many parts of the world their cost, or the conditions governing their application, render them essentially unsuitable. Some other avenue of approach has to be opened up in these circumstances, and a method which shows evident promise is the practical utilisation of the parasitic and predaceous enemies of pests, or, in other words, biological control. In 1928, Dr. J. G. Myers, of the Imperial Institute of Entomology, was commissioned to devote two years' study to the possibilities afforded by biological methods of control in respect to the main insect pests of agriculture in the British colonies of tropical America. A preliminary report by Dr. Myers on his investigations has recently been published by the Empire Marketing Board.* In this report he discusses the main geographical, topographical, meteorological, biological, and agricultural conditions upon which the distribution and prevalence of insect pests presumably depend. At the same time there is reason to believe that such factors have a very direct bearing upon the prospects of applying biological control methods.

In carrying out his exploratory mission, Dr. Myers has visited most of the West Indian Islands and also parts of the mainland of South America. Notwithstanding the extensive area covered in these travels, he has been successful in assembling a large amount of practical information. Since sugar-cane is the most important crop in the British West Indies, the pests affecting it, naturally, received the most attention. The most important of these latter, in the region as a whole, is the small moth-borer (*Diatræa* sp.). While this insect has numerous parasites, only two appear to be reasonably efficient. The most valuable of these seems to be *Lixophaga*, which has accordingly been introduced into Barbados and Antigua. As regards the notorious cane-froghopper of Trinidad, which still remains a pest of the first rank, no effective parasite has yet been discovered, though the possibility of its being found in the mainland remains for the future. The large moth-borer of cane (*Castnia licoides*) is now serious only in Trinidad; it is controlled by flooding the fields in British Guiana. Since it is increasing in Trinidad, an effective parasite is greatly needed. While no parasites are as yet known, the discovery of the original plant-host of this insect by Mrs. Myers is held to render the search more likely to prove successful. The cane root-borer (*Diaprepes abbreviatus*) is likewise a very serious pest in Barbados. The discovery of an effective egg-parasite of two allied species in Haiti and Montserrat has rendered the problem more hopeful, and its introduction into Barbados is being arranged for.

In addition to sugar-cane, the insect pests and their parasites of cacao, cotton, mahogany, banana, coffee, and so on, also come under consideration. In these connexions it needs to be pointed out that, for several of the pests, little hope is expressed that suitable parasitic enemies will be found within the confines of the West Indies or the adjacent mainland. Certain of the injurious species of insects are Old World pests which have become accidentally introduced, without their natural parasites or predators, into the West Indies. There are other cases in which the same pest, or closely allied species, is much more effectively parasitised in Africa or the Orient than in tropical America. Taking facts of this kind into account, the possibility of introducing suitable parasites into the West Indies from the Old World tropics is one which requires fullest consideration, since it may lead the way to the permanent control of the pests concerned. With the cacao thrips, for example, Dr. Myers suggests that a species of parasite from the Gold Coast may prove to be a useful introduction. Against cotton-stainers (*Dysdercus*) certain tachinid flies from Queensland or Nigeria are suggested, and for the banana-borer (*Cosmopolites sordidus*) it is recommended that a search for possible parasites should be made in New Guinea.

If the suggestions made in this report be translated into practice, they will lead to experiments of the utmost value in testing the soundness of the biological principles and ideas that are involved. Difficulties are likely to be encountered in the transit of living material of this kind over vast tracts of land and water. With the increase of aerial communications such troubles will become greatly reduced. The aeroplane, it may be added, has already been adopted by Dr. Myers in the transmission of moth-borer parasites from Cuba to Antigua, whence they were sent on in cold storage to Barbados.

This report should be read by all interested in the subject, and due credit must be given to the Empire Marketing Board, through the financial provision of which the investigations recorded therein were rendered possible.

A. D. IMMS.

* Empire Marketing Board. A Preliminary Report on an Investigation into the Biological Control of West Indian Insect Pests. By Dr. J. G. Myers. (E.M.B. 42.) Pp. 173. (London: H.M. Stationery Office, 1931.) 1s. net.

Measurement of Pressure and Temperature in the Upper Atmosphere.

DR. A. K. DAS, B. B. Ray, and D. N. Dasgupta, of Alipore Observatory, Calcutta, have sent a description of apparatus designed to yield measurements of atmospheric pressure and temperature at various heights. The advantages claimed over the ordinary meteorograph are that the required information is available within a very short time and at small expense.

For determining pressure, a small glass bulb drawn out at one end into a narrow spiral tube is used. A small pellet of strong sulphuric acid is introduced into the tube; the apparatus is then placed in a chamber with glass windows, the air of which can be gradually removed by a pump. The pressure is shown by a suitable manometer. Exhaustion is carried to the point when the pellet of acid is just reaching the open end of the tube, and the pressure at this moment is observed. The apparatus is then placed inside a light box packed with non-conducting material, the open end of the tube projecting beneath the box so as to overhang a small bowl containing a mixture of sugar and potassium chlorate. It is attached at some distance below a balloon, which carries it up until the pressure has fallen to that value which will allow the acid to emerge and explode the mixture in the bowl, the smoke of the explosion being observed from the ground in a theodolite. Measurement of the angle subtended by the line joining the balloon and the apparatus, and of the angular elevation of the latter, enables the height at which the explosion occurs to be measured.

A slight modification of the arrangement, illus-

trated by Fig. 1, allows temperature to be measured instead of pressure. As before, we start with air at surface temperature and pressure enclosed by the pellet of acid, but the explosive mixture is enclosed in a sealed copper vessel (*E*). The bulb is packed in non-conducting material, so that it is only the temperature of the explosion chamber that changes when the apparatus is carried up beneath a balloon. The fall of pressure due to the fall of temperature allows the pellet of acid to emerge from the spiral tube at a temperature that is determined by a special experiment on the same lines as that made for calibration of the apparatus for pressure measurement, the temperature in this case being varied.

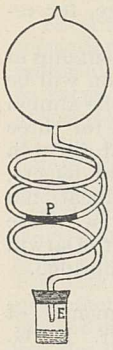

FIG. 1.

It will be seen that for every individual reading of pressure and temperature a special calibrating operation must be made in addition to the construction of a new apparatus. These drawbacks do not necessarily imply that the method is unworkable. A more serious objection is that the method of determining the height of the explosion is obviously liable to serious error unless the altitude is small compared with the highest altitudes attained by the balloon meteorograph for which this apparatus is proposed as a substitute. Its possibilities could be estimated if practically simultaneous sets of values of pressure and temperature were obtained, for the values of pressure could be calculated by Laplace's equation from the observed values of height and temperature, and could be compared with those found experimentally. The apparatus when used for measuring temperature must necessarily ignore inversions of the ordinary fall of temperature with height, and so could never give the thermal structure of the atmosphere in great detail.

Since the above communications were received, Dr. A. K. Das has forwarded a description of a modified form or extension of the device which he has specially designed to supply the missing information. It is shown in Fig. 2.

Glass is used throughout, except for the cork *c*. The vessel *V* contains a small quantity of potassium chlorate and sugar. The shaded parts contain strong sulphuric acid, the unshaded parts air. There is a constriction in the upper horizontal length of tube and a valve *v*, consisting of a glass tube drawn out at each end, which allows acid to travel from left to right only. The whole is packed in cotton-wool, except for the bulb *B* and a part of its stem, and is carried up by an ordinary pilot balloon. So long as temperature is decreasing, the valve is closed and acid is sucked up the stem of *B* owing to the fall of temperature and pressure in *B* through the capillary tube the open end of which is labelled t_1; but as soon as an inversion of temperature is encountered and the pressure in *B* is increased, the valve opens and a drop of acid emerges at t_2 so as to explode the mixture below it. The smoke of the explosion is observed through a theodolite, and its height, which is that of the inversion, is measured by the 'tail-method' described above. The partial filling of the apparatus with acid appears to offer no difficulty, the acid being sucked in through t_1; subsequently some acid is withdrawn from t_1.

Dr. Das does not say whether the apparatus has been tested. A difficulty that at once suggests itself is that of ensuring that the charge shall not be exploded prematurely by a rise of temperature at ground level. Sensitive thermograms show that the air near the ground is constantly varying in temperature whenever a wind is blowing, the effect being due largely to turbulence of the air. It would appear that the bulb *B* would need to be insensitive to these if a premature explosion is to be avoided; at the same time, the balloon that carries the apparatus up must rise quickly if the former is to remain visible to high elevations, and, if the bulb is not very sensitive, inversions may fail to be recorded unless they extend through a considerable height. Ingenious though the device may be, it seems very doubtful whether it or those formerly described will prove to be practical substitutes for apparatus of the type already in use with registering balloons.

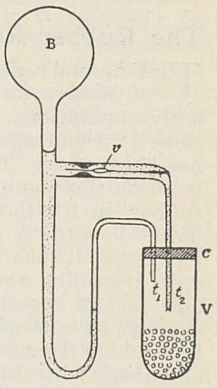

FIG. 2.

E. V. NEWNHAM.

Prehistoric Society of East Anglia.

IN his presidential address before the Prehistoric Society of East Anglia on Oct. 7, Mr. J. P. T. Burchell took as his subject the relation of Neanthropic man to the ice age. Mr. Burchell pointed out that a convenient datum line in the quest for the correct geological horizons of the successive cultural stages is provided by the deposits of the 100 ft. terrace of the Thames, and the fact that north of the Thames the Acheulean and Mousterian cultures overlay the lower Boulder Clay. Recent work on the upper glacial deposits of the Yorkshire coast and the estuary of the Humber was correlated by Mr. Burchell with the discoveries made in the Brown Boulder Clay of Hunstanton by J. Reid Moir, and advanced in evidence of a late Pleistocene, Aurignacian-Upper Mousterian stage having been succeeded by climatic conditions which resulted in the formation of the Brown Boulder Clay of the Hunstanton and Lincolnshire coast and of the Coombe deposits (? Boulder Clay) of Yorkshire. Examination of the Lower Estuarine Clay of Northern Ireland had revealed a palæolithic industry of Magdalenian character which must predate the formation of that deposit.

At the same meeting, Mr. A. L. Armstrong described an open-air site at Scunthorpe, Lincolnshire, where an Azilian-Tardenoisian floor, covered by blown sand, was found to be superimposed upon a late Aurignacian deposit. This confirms the sequence already observed in the cave-floor deposits of Mother Grundy's Parlour, Cresswell Crags, Derbyshire, where excavations carried out by Mr. Armstrong in 1924 revealed the gradual development of Upper Aurignacian culture in England and established the fact that this development was of a distinctive character and practically free from Magdalenian influences, while it was found to be overlain by an Azilian-Tardenois culture—the microburin appearing in the last few inches.

Excavations in the Mendip caves and elsewhere have since confirmed these conclusions and it is now recognised that the latest phase of this developed Aurignacian culture is essentially an English one.

Hitherto, definite occupation sites have been confined to caves, but four years ago what appeared to be an open station was located on the North Lincolnshire Cliff Range, in the Scunthorpe district. This has since been consistently examined each year and

the original conclusion proves to be correct. The site, though confined to a limited area, has yielded a typical series of developed Aurignacian tools, including long batter-backed blades, keeled scrapers, and burins of various types; also microlithic blades.

The Scunthorpe area has long been known as one of the type stations of the Azilio-Tardenoisian culture in England, and the Upper Aurignacian site forming the subject of this communication is situated within a few miles of one of the areas where pygmy tools are most abundant. The industry represented, however, is free from Tardenoisian influences. Pygmy tools are extremely scarce, and it is believed to be a representative site of the native culture upon which the Azilian and the Tardenoisian was engrafted. Tools which appear to belong to the same cultural epoch have been collected on the ridges southwards towards Lincoln, occurring upon the surface together with tools of later industries, and what is likely to prove a second definite occupation area has now been located in the vicinity of Willoughton and is under examination.

The Rubber Research Institute of Malaya.

THE annual report of the Rubber Research Institute of Malaya for 1930, covering the fourth year of active operations, shows that in spite of difficulties caused by shortage of staff, very considerable progress has been made. The Soils Division has continued its work on the manuring both of immature and mature rubber, and although the low price of rubber has induced caution in the application of artificial fertilisers, it has been possible to obtain valuable data regarding the effect of nitrogen, and nitrogen and potash together. A paper is to be published shortly, summarising our information on manuring the rubber tree, and the Soils Division is also co-operating with Imperial Chemical Industries, Ltd., and Malayan Fertilisers, Ltd., in similar experiments.

Other work has been concerned with practical methods of soil conservation and particularly the value of cover crops, and there is increasing realisation that the mere growth of a cover is not a universal remedy for trees in poor vegetative growth. Small fertiliser dressings, given individually to the young trees, seem a more economic way of inducing rapid growth without prejudice to future soil fertility.

In spite of the absence of a head of division, the Botanical Division has made considerable progress with its investigations on the improvement of *Hevea* planting material by vegetative means and on the response of the tree to different methods of tapping. This work, carried on not only at the experimental station but also in co-operation with various estates throughout Malaya, is providing information on the replanting of old areas which are becoming wasting assets through root disease in the old trees, as well as assisting the selection of new clones from high yielding trees or seedlings of known origin. Tapping experiments have indicated the existence of three or four very promising new Malayan clones.

The Chemical Division has continued its work on the separation and characterisation of latex constituents, particularly on the non-caoutchouc constituents which affect so largely the properties of raw and unvulcanised rubber. In addition, investigations have been carried out on the efficiency of sheet manufacture, the drying of crepe and sheet, the cause and elimination of defects in lower grade rubber, and the preservation and concentration of latex. Methods of spectrographic analysis are being developed by the Institute for soil investigations and for such problems as the effect of minute traces of certain metals on the properties of raw rubber.

University and Educational Intelligence.

CAMBRIDGE.—R. J. Pumphrey, of Trinity Hall, has been appointed University demonstrator in the Department of Zoology.

A grant of £125 has been made from the Balfour Fund to L. C. Beadle, of Pembroke College, for research on the biology of African lakes.

The managers of the Pinsent-Darwin studentship in mental pathology give notice that an election will be made in December. The studentship is of the annual value of not less than £200, and is tenable for three years. The student must engage in original research into any problem having a bearing on mental defects, diseases, or disorders; but may carry on educational work concurrently. Applications should be made before Dec. 5 to the Secretary, Pinsent-Darwin Studentship, Psychological Laboratory, Cambridge.

EDINBURGH. — The following appointments of lecturers have recently been made:—Mr. E. G. Dymond, in natural philosophy; Dr. E. L. Ince, in mathematics; Dr. R. A. R. Gresson, in zoology (cytology); Dr. Peter Gray, in zoology (vertebrate embryology); Lieut.-Col. S. Hunter Cowan, in forest engineering.

AMONG the honours approved by the King, arising out of the recent dissolution of parliament, is that conferred upon Sir W. Martin Conway, who has been made a baron. Sir Martin Conway was member of parliament for the Combined English Universities from 1918 until 1931.

THE Carnegie Foundation for the Advancement of Teaching has issued its twenty-fifth annual report, for the year ending June 30, 1930. Dr. Henry S. Pritchett, who was associated with Andrew Carnegie in organising the Foundation in 1905, presided over its administration from then until August 1930, when he made over charge to Dr. Henry Suzzallo. Starting with an endowment of ten million dollars, the Foundation has grown until its resources now amount to more than thirty-two million, whilst its annual expenditure, chiefly on pensions for University officers and teachers and their widows, is not far short of two millions. Among the topics of outstanding interest dealt with in the president's report is that of American college athletics. Dr. Pritchett exposes the too common exploitation of the student, his diversion from genuine college study and social life, his service under professional trainers in preparation for a commercial show before the public. As an indication of the importance of the rôle football plays in American university finances, he cites the fact that at Harvard the income from athletics (almost wholly from football) is one and a quarter million dollars, as compared with an income of three millions from tuition. In connexion with the study of the relations of secondary and higher education, which is being conducted by the Foundation jointly with the Pennsylvania State Department of Public Instruction, two comprehensive examinations have been administered in some fifty colleges and universities with the special object of measuring effective knowledge as distinguished from raw information. The results indicate that the American system of term courses with term examinations and credits fails lamentably as regards what is supposed to be the central purpose of the college, namely, teaching the student to think. Incidentally, they indicate better mental capacity in students of the sciences than in students of arts subjects.

Birthdays and Research Centres.

Nov. 22, 1875.—Prof. L. N. G. FILON, F.R.S., Goldsmid professor of applied mathematics and mechanics in the University of London and Director of the University Observatory.

Recent investigations have confirmed that double-refraction produced artificially by stress in transparent materials shows local anomalies of dispersion similar to those caused in ordinary refraction by the usual absorption bands. The present anomalies, however, do not seem to be connected with any absorption bands in the material, and their cause and the mechanism of their appearance is still a mystery. The first step towards the solution must be the collection of accurate data for a number of materials, particularly glasses or jellies of graded composition. For this purpose the collaboration of one or more manufacturing firms is essential; workers to carry out the observations, which are delicate and laborious, are also badly wanted.

The effect in question seems likely to throw a good deal of light upon the interaction of radiation and matter in the solid state, and, so far, has been studied only in a preliminary manner.

Nov. 23, 1864.—Sir PETER CHALMERS MITCHELL, C.B.E., F.R.S., secretary of the Zoological Society of London.

I fear that the increasing burden of administration will leave me no time even to work out certain anatomical investigations which I had to drop during the War. Indirectly I am continuing to study in London and at Whipsnade the relations of animals to light, heat, and fresh air.

A particular inquiry that ought to be taken up is the comparative study of the voices and sounds made by mammals, reptiles, and amphibians. I have no doubt that information interesting in itself and throwing light on systematic affinities could be got. As an example: kangaroos are habitually silent animals, but a kangaroo which is frightened or excited when it is being anæsthetised has a voice very like that of the marsupial wolf.

Nov. 26, 1889.—Prof. H. R. ROBINSON, F.R.S., professor of physics in the East London College, University of London.

With some of my colleagues at East London College, I am engaged in refining the methods of 'magnetic spectroscopy' for secondary cathode particles. We hope to elucidate some of the finer details of the interaction of X-rays and bound electrons, and we intend to increase the absolute accuracy of the measurements. Increased accuracy will enhance the utility of these methods in supplementing the data of X-ray spectroscopy, and will also remove some of our uncertainty as to how far discrepancies in the existing measurements may be ascribed to inconsistencies in the accepted values of the fundamental atomic constants.

Nov. 27, 1888.—Dr. EZER GRIFFITHS, F.R.S., principal assistant, Physics Department, National Physical Laboratory.

My work falls within the domain of physics applied to industry. The problems are largely determined by the wishes of various committees. A few of the investigations are: heat transmission to banks of piping such as are used for air cooling; hygrometry at temperatures below and above normal temperatures; the study of the thermophysical properties of refrigerants; determinations of the thermal resistivity of the soil throughout the year by a method utilising an electrically heated sphere buried in the ground; methods of measuring the amount of water in fogs; the measurement of the heat of formation of nitrous oxide.

Occasionally an investigation takes one far afield. The study of the variables causing loss of 'bloom' on frozen lamb necessitated a detailed study of the entire chain of processes from the killing floor in New Zealand to the London market.

Societies and Academies.

LONDON.

Royal Society, Nov. 12.—**A. Fowler** and **J. S. Badami**: Spectrum of the hydrogen–nitrous oxide flame. Observations of the bright cap or cone which appears near the base of the hydrogen–nitrous oxide flame in a mixed jet have shown that the spectrum is closely similar to that of the ammonia–oxygen flame. It differs from the latter in the greater intensity of the HO and NO bands and the lower intensity of the NH_2? bands, the NH band at λ3360 being about the same in both.—**S. H. Bastow** and **F. P. Bowden**: On the contact of smooth surfaces. The experimental work has shown that it is very difficult to place surfaces together without dust or solid particles coming between them. When elaborate precautions were taken to eliminate dust and the surfaces were scrupulously clean there was no evidence for 'floating'. A polished glass plate lowered on to a similar plate in air at atmospheric pressure sank down quickly to within a fraction of a micron of it. This small separation, which represents the limit of smoothness of the plates, was the same whether they were in high vacua, air, alcohol vapour, liquid alcohol, or water. The apparent 'floating' at a height of 4 microns is due to dust or solid particles between the plates.—**W. B. Mann** and **B. G. Dickens**: The thermal conductivities of saturated hydrocarbons in the gaseous state. Experiments have been carried out with methane, ethane, propane, and normal butane using the hot-wire method of investigation. The results obtained for the saturated hydrocarbons indicate a decrease of conductivity with each addition of a CH_2 group. Moreover, on plotting the thermal conductivity of the gas at 0° C. against the molecular weight ($O_2=32$) it was found that a smooth curve could be drawn through the four points obtained. This curve was found to be hyperbolic. A definite variation of the temperature coefficient with molecular weight is also indicated by the experimental results.

EDINBURGH.

Royal Society, Nov. 2.—**G. W. Tyrrell** and **Martin A. Peacock**: The petrology of Iceland (2). The petrography of the acidic and intermediate intrusives and extrusives. The acidic and intermediate igneous intrusive rocks of Iceland were found to occur as relatively small stocks, and bosses, sills, dikes, and veins, together with extrusive domes and lava flows. They cover only one per cent of the total area of Iceland, and are thus very much inferior in bulk to the dominating basaltic lavas.—**Tudor Jones**: The primitive conducting mechanisms of the vertebrate heart. An introduction to the study of their appearance and development in *Lepidosiren paradoxa*. All the conducting mechanisms hitherto described are represented in *Lepidosiren*, in respect of their situation and connexions, by purely nervous structures. The mechanism consists of a nervous continuum comprising regions of the medulla oblongata and communications involving the sixth aortic arch, the ductus Botalli, the pulmonary artery, the sinus venosus, atria and ventricles of the heart and the

pulmonary vein, with bilateral connexions at three (probably segmental) levels. The continuum—or cardiac neural primordium—precedes the general development of the cardiac musculature and forms a nodal nervous complex, to which it appears the whole development of the characteristic form of the heart may be referred as to an organic system of developmental foci.—**George W. McCrea**: An X-ray examination of *d*-mannitol and *d*-mannose. *d*-Mannitol: (see NATURE for Jan. 31, p. 162); *d*-Mannose: unit cell, $a = 5{\cdot}53$ A., $b = 17{\cdot}66$ A., $c = 7{\cdot}59$ A.; space-group, Q^4; calculated density, 1·602 gm. per c.c.; 4 molecules per cell. A manno-pyranose ring structure is probable in the *d*-mannose molecule, and the greatest length of the molecule is along the *c* axis.—**R. B. Mooney** and **H. G. Reid**: The absorption spectra of cyanogen and the cyanogen halides. Measurements are given of the band edges of the cyanogen absorption spectrum in the region 2380-1850 A. The influence of temperature on the relative intensities of the bands has been studied. The long wave-length limits of the regions of continuous absorption due to the cyanogen halides are: CNCl, 2240 A.; CNBr, 2540 A.; CNI, 3100 A. and 2150 A.—**W. O. Kermack** and **W. H. McCrea**: An operational method for the solution of linear partial differential equations. A general method has recently been given by Prof. E. T. Whittaker for the solution of differential equations by definite integrals. A closely related solution is now given, in which a differential operator appears in place of the integration. This may be regarded as a generalisation of Maclaurin's theorem. Certain applications of the theorem, including its application to the theory of generating functions, are discussed.—**H. S. Ruse**: On the definition of spatial distance in general relativity. A mathematical analysis of the problem of defining spatial distance (in a general Riemannian space-time) leads to a definition alternative to that recently obtained from astronomical considerations by E. T. Whittaker. Applied to a Galilean space-time and to the de Sitter world, the formula derived from the new definition yields the quantities hitherto regarded as representing 'spatial distance' in these particular cases.

PARIS.

Academy of Sciences, Oct. 12.—**A. Lacroix**: Obituary notice of Friedrich Becke.—**André Blondel**: Comparison between a cable with distributed constants and a circuit in *T*.—**W. Vernadsky** and **A. Vinogradoff**: The chemical composition of *Lemna* as characteristic of the species. Each species of *Lemna* collected in localities so far apart as the Ukraine and the Baltic region, and in different years, possesses a definite composition which characterises it.—**J. Schokalsky**: A new hypsometric map of the Soviet Union (European part) on the scale of 1/2,500,000.—**Léon Pomey**: New remarks relative to the last theorem of Fermat.—**E. O. Lovett**: A problem of Gambier in the deformation of surfaces.—**Hadamard**: Remarks on the preceding communication.—**B. Galerkin**: The elastic equilibrium of a thick rectangular plate.—**Kourensky**: The fundamental equation of exterior ballistics.—**J. Ph. Lagrula**: The inconvenience of using four stars in the local connexion of two photographs of large field, even when the distance of the centres is considerable.—**Th. V. Ionescu**: Ionised gases and the working of valves with positive grid. In a previous paper the author has shown that the velocity of propagation of waves in tubes containing ionised gas can be calculated, assuming for the gas a definite period of vibration. It is now shown that, taking these vibrations into account, the working of valves with positive grid can be explained, and the formula of Barkhausen obtained.—**F. Esclangon**: A method of measuring an alternating high-frequency magnetic field. The Foucault currents produced are measured by a mercury thermometer. It has been proved that the velocity of heating is proportional to the square of the field strength and to the square root of the frequency.—**B. Demetrović**: Some experiments concerning the reflection of X-rays. Description of experiments proving that the X-rays are strongly reflected by surfaces which form a bad mirror for visible light.—**F. Vlès** and **A. Simchen**: Remarks on the permanganate spectrum.—**J. Gilles**: Quintuplets and triplets of O III.—**E. Herzog** and **G. Chaudron**: The protection by cathode polarisation of iron dipped into aerated saline solutions. Depolarising deposits can be formed by simple aeration of metallic surfaces dipped into saline solutions. These experiments explain why certain metallic additions can exert a protective action on a metal being corroded.—**Georges Arditti**: The oxidation of paraffin oil. A study of the action of air in the presence of various catalysts on paraffin oil at 130° C.—**Mme. N. Demassieux** and **Victor Henri**: The ultra-violet absorption spectra of pure hydrochloric acid and bromine. Hydrochloric acid, prepared by methods commonly regarded as giving a pure product, gives an absorption spectrum in the ultra-violet which varies with different specimens. These differences have been traced to the presence of bromine: a trace of bromine in 10 *N* hydrochloric acid gives an absorption which is several thousand times more intense than that produced by the same quantity of bromine in water. Whilst chemical methods fail to detect smaller proportions of bromine than 0·001 gm. per litre, the ultra-violet absorption spectrum can detect less than one-tenth of this.—**Augustin Boutaric** and **Raymond Amiot**: Experimental researches on the adhesion of lubricating layers to metals. Plates of various metals (copper, iron, aluminium, and rustless steel) were dipped in oil, allowed to drain for measured times, and the plate then centrifuged at 5000 rotations per minute. A relation between the oil on the plate (p) after a time of draining (t), and the limiting weight after centrifugation was established.—**Picon** and **Cogné**: The study of some sulphides of the rare earths. Description of the preparation and properties of the sulphides of yttrium, lanthanum, cerium, neodymium, and samarium.—**J. Bancelin**: Carbonates of the chromiammines.—**Raymond Paul**: Some pentenyl derivatives.—**C. Le Camus** and **F. de Saint-Just**: Magnetic and electrical observations in the Sahara. Measurements of the magnetic elements and of the atmospheric electrical field were made at Gao, Tanesrouft, and Camp Louis Marin (Hoggar), the two latter being new observation points.—**A. Maige**: Remarks on the subject of the physico-chemical mechanism of the amylogen condensation (in plants).—**O. Duboscq** and **P. Grassé**: The parabasal apparatus and the cytoplasmic constituents of zooflagellæ.—**F. Marceau** and **L. Acolat**: General considerations on the circulation of the arterial and venous blood in three-chambered hearts of vertebrates and the measurement of the degree of mixture.—**L. Lutz**: The soluble ferments secreted by the hymenomycete fungi. Comparison of the anti-oxygen power of tannin and the phenolic constituents of essential oils.—**J. Magrou**, **Mme. M. Magrou**, and **P. Reiss**: Action at a distance and the development of the egg of the sea-urchin. Attempt at an interpretation.—**E. Brumpt**: *Cercaria ocellata*, the cause of dermatitis in bathers, arises from a *Bilharzia* of the duck.—**Georges Bourguignon**: The interpretation of the variations of muscular chronaxy by repercussion, with and without functional troubles.

Official Publications Received.

BRITISH.

Proceedings of the Physical Society. Vol. 43, Part 5, No. 240, September 1. Pp. viii+416-643. (London.) 7s. net.

Sierra Leone. Annual Report of the Department of Agriculture for the Year 1930. Pp. ii+59. (Freetown: Government Printer.)

Natural Science and Archæology Society, Littlehampton. Reports of Proceedings, 1928-1930. Pp. 40. (Littlehampton.)

Philosophical Transactions of the Royal Society of London. Series A, Vol. 230, A668: Determination of the Yard in Wave-Lengths of Light. By Dr. A. E. H. Tutton. Pp. 293-322. (London: Harrison and Sons, Ltd.)

Journal of the Chemical Society. September. Pp. iv+2229-2508+x. (London.)

Eleventh Annual Report of the Research Council of Alberta, 1930. (Report No. 26.) Pp. 76. (Edmonton: W. D. McLean.) 35 cents.

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 28th October 1931. Pp. 40. (Newcastle-upon-Tyne.)

Proceedings of the Royal Society of Edinburgh, Session 1930-1931. Vol. 51, Part 2, No. 19: Photochemical Measurements of Light Intensity in two Common Vegetable Types in Tropical Africa, by means of the Improved Eder-Hecht Photometer. By Dr. John Phillips, J. D. Scott and J. Y. Moggridge. Pp. 150-161. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1s.

Department of the Interior, Canada. Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 7: July, August, September 1930. By Ernest A. Hodgson. Pp. 101-118. 25 cents. No. 8: October, November, December 1930. By Ernest A. Hodgson. Pp. 119-138. 25 cents. No. 9: January, February, March 1931. By Ernest A. Hodgson. Pp. 139-156. 25 cents. No. 10: April, May, June 1931. By Ernest A. Hodgson. Pp. 157-174. 25 cents. (Ottawa: F. A. Acland.)

Proceedings of the Royal Irish Academy. Vol. 40, Section A, No. 2: Observations on Atmospheric Ionisation at Glencree, Co. Wicklow. By J. J. Nolan and P. J. Nolan. Pp. 11-59. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. 6d.

Ministry of Agriculture and Fisheries. Fourth Progress Report of the Foot-and-Mouth Disease Research Committee. Pp. 375+12 plates. (London: H.M. Stationery Office.) 7s. 6d. net.

Aeronautical Research Committee. Report for the Year 1930-31. Pp. iv+89+4 plates. (London: H.M. Stationery Office.) 2s. net.

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 9, Memoir No. 2: Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch), Part 5. By Dr. L. F. Spath. Pp. 551-658+plates 103-124. 12.14 rupees; 21s. New Series, Vol. 19: Upper Carboniferous Fossils from Afghanistan. By Dr. F. R. Cowper Reed. Pp. iii+39+4 plates. 3.10 rupees; 6s. 3d. (Calcutta: Government of India Central Publication Branch.)

Bulletin of the Raffles Museum, Singapore, Straits Settlements. No. 5, August. Pp. ii+121+8 plates. (Singapore.) 1 dollar; 2s. 6d.

Report of the Botanical Survey of India for 1929-30. Pp. 10. (Calcutta.)

Quarterly Journal of the Royal Meteorological Society. Vol. 57, No. 242, October. Pp. 405-486. (London: Edward Stanford, Ltd.) 7s. 6d.

University of London: University College. Calendar, Session 1931-1932. Pp. lxxxi+511+lxxxiii-ccxii+36. (London: Taylor and Francis.)

Report for 1930 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool. Edited by Prof. James Johnstone and Dr. R. J. Daniel. Pp. 115. (Liverpool: University Press of Liverpool.) 5s.

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 56, Part 2, September. Pp. 155-278+lv-clxxvii+xxii+28 plates. (London.) 7s. 6d.

FOREIGN.

U.S. Department of the Interior: Office of Education. Education Leaflet No. 4: Education in Porto Rico, 1920-1930. By Pedro A. Cebollero. Pp. ii+13. 5 cents. United States Publications on Education. Price List 1931. Pp. ii+49. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States 1928-1930. Chapter 14: Professional Education of Teachers. By Benjamin W. Frazier. Pp. 40. 10 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the American Museum of Natural History. Vol. 61, Art. 9: The Fourth Florida Whale Shark Rhineodon Typus, and the American Museum Model based on It. By E. W. Gudger. Pp. 613-637+plates 23-32. (New York City.)

Publications of the Wagner Free Institute of Science. Vol. 2: Studies of Evolution in the Genus Spirifer. By Carroll Lane Fenton. Pp. x+436 (50 plates). (Philadelphia.) 6 dollars net.

Visindafélag Islendinga (Societas Scientiarum Islandica). 9: Frequency Curves determined by Semi-Invariants. By Thorkell Thorkelsson. Pp. 50. (Reykjavik: Bókaverslun Sigfúsar Eymundssonar.) 3.00 kr.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 3, No. 8-9, Août-Septembre. Pp. 379-464. (Prague: Regia Societas Scientiarum Bohemica.)

The Tôhoku Mathematical Journal. Vol. 34, Part 2 August. Pp. ii+187-396. (Sendai.)

University of Denver: Department of Anthropology. Archæological Survey of Eastern Colorado. By E. B. Renaud. Pp. 102. (Denver, Colo.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 15, No. 1: The Marine Lower Cretaceous Deposits of Japan, with Special Reference to the Ammonites-bearing Zones. By Saburô Shimizu. Pp. 40+4 plates. (Tôkyô and Sendai: Maruzen Co., Ltd.)

Ministero dell' Agricultura, Egitto: Servizio Tecnico e Scientifico. Bollettino No. 92: Su di una grave infezione dei cani al Cairo. Note preliminari del Prof. Dott. Matteo Carpano. Pp. 23. (Cairo: Government Press.) 5 P.T.

U.S. Department of Agriculture. Circular No. 175: Experiments for the Control of the San Jose Scale with Lubricating-Oil Emulsions in the Pacific Northwest. By E. J. Newcomer and M. A. Yothers. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 8, No. 2, August. Pp. 65-112. (Tokyo: National Research Council of Japan.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 6: Über die Anzahl der Idealteiler. Von Zyoiti Suetuna. Pp. 155-177. 0.40 yen. Vol. 2, Part 7: Über die irreduzibelen Substitutionsgruppen, deren Grade Primzahl sind, von Kenjiro Shoda; Bemerkungen über vollständig reduzibele Gruppen, von Kenjiro Shoda. Pp. 179-209. 0.50 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 3, Part 4: Neogene Shells from Karafto and the Hokkaido, by Matajiro Yokoyama; Tertiary Mollusca from Iwaki, by Matajiro Yokoyama. Pp. 185-204+plates 11-13. 0.60 yen. Section 3: Botany. Vol. 3, Part 2: Systematic and Anatomical Studies of some Japanese Plants, I. By Yoshisuke Satake. Pp. 485-513. 0.50 yen. (Tokyo: Maruzen Co., Ltd.)

U.S. Department of Commerce: Bureau of Standards. Circular of the Bureau of Standards, No. 393: Reclaimed Rubber. By A. T. McPherson. Pp. 22. 10 cents. Research Paper No. 332: Measurement of Lenard Rays. By Lauriston S. Taylor. Pp. 57-72. 10 cents. Research Paper No. 334: Interpolation of the O.S.A. "Excitation" Data by the Fifth-Difference Osculatory Formula. By Deane B. Judd. Pp. 85-91. 5 cents. (Washington, D.C.: Government Printing Office.)

The Bashford Dean Memorial Volume. Archaic Fishes. Edited by Eugene Willis Gudger. Article 3: The Genital System of the Myxinoidea; a Study based on Notes and Drawings of these Organs in *Bdellostoma* made by Bashford Dean. By Prof. J. Leroy Conel. Pp. 63-102+4 plates. (New York: American Museum of Natural History.)

Diary of Societies.

FRIDAY, NOVEMBER 20.

ROYAL SOCIETY OF MEDICINE (Physical Medicine Section) (at British Red Cross Clinic, Peto Place, N.W.1), at 5.—A. Woodmansey: Catalysis in relation to Mineral Waters.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. F. Lowater: The Band Spectrum of Zirconium Oxide.—W. A. Wood: Lattice-distortion of Cold-drawn Constantan Wire.—Dr. F. Aughtie: (*a*) A Remote Electrically Recording Accelerometer with Particular Reference to Wheel-impact Measurements; (*b*) A Remote Electrically Recording Load-gauge for Wheel-impact Measurements.—Prof. E. V. Appleton and G. Builder: Wireless Echoes of Short Delay.—Prof. Kerr Grant: *Demonstrations*:—A Contrivance for Demonstrating the Law of Errors; a New Type of Surface-tension Meter; and a New Type of Static Electrometer.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at University, Liverpool), at 6.—Prof. I. M. Heilbron: Nature's Variations on the Isoprene Theme.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Presentation of Sixth Report of the Marine Oil Engine Trials Committee.

SOCIETY OF DYERS AND COLOURISTS (at 36 George Street, Manchester), at 7.—C. M. Whittaker: Random Leaves from a Viscose Yarn Dyer's Notebook.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—W. L. Shand: Pattern and Design in Pictorial Photography.

SOCIETY OF DYERS AND COLOURISTS (Glasgow Section) (at George Hotel, Glasgow), at 7.15.—H. E. Potts: Patents.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry—South Wales Section) (at Mayfair Café, Cardiff), at 7.15.—Dr. J. H. Quastel: Dyestuffs and Biological Activity.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at St. Enoch Hotel, Glasgow), at 7.30.—Prof. J. C. Philip: The Abstracting of Chemical Literature.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. G. Brown: Modern Pressed Brick Manufacture.

INSTITUTE OF BRITISH FOUNDRYMEN (Sheffield and District Branch) (at Albany Hotel, Sheffield), at 7.45.—J. E. Hurst: Further Experiments with Air and Oil-hardening Cast Irons.

SOUTH LONDON BOTANICAL INSTITUTE (323 Norwood Road), at 8.—J. E. Lousley: Plant Parasites (Lecture).

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.15.—Dr. Louisa Martindale: Recent Advances in Deep X-Ray Therapy in Gynæcological Conditions.—Dr. B. Solomons: Obstetric Methods at the Rotunda Hospital in 1909 and 1929.

ROYAL SOCIETY OF MEDICINE (Radiology Section), at 8.30.—Discussion on X-ray Diagnosis of Diseases of the Chest.—Dr. S. Melville: Tuberculous and other Non-malignant Conditions.—Dr. P. Kerley: Malignant Conditions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. C. H. Lander: Oil and Petrol from Coal.

ROYAL AERONAUTICAL SOCIETY (Hull and Leeds Branch).—Lt.-Col. W. L. Marsh: Speed in Aviation and what it means.

SATURDAY, NOVEMBER 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Perrett: The Music of Ancient Greece (1): The Enharmonic Genus.

BRITISH PSYCHOLOGICAL SOCIETY (at King's College), at 3.—Rev. H. L. Philp: Frustration of Will Acts.—M. F. Lowe: Blood Distribution during Mental Activity.—*Demonstrations*:—A. G. Caws: Perception of Tachistoscopically Exposed Symbols.—R. Westgate: Effect of Affective Stimuli on Muscular Work.

INSTITUTE OF BRITISH FOUNDRYMEN (Wales and Monmouth Branch) (at University College, Cardiff), at 6.30.—Prof. A. A. Read: The Microscope in Metallurgy.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch—Junior Section) (at Manchester College of Technology), at 7.—A. Hopwood: Non-Ferrous Founding.

MONDAY, NOVEMBER 23.

ELECTRICAL ASSOCIATION FOR WOMEN, at 6.15.—The Healing Effects of Electric Rays.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London)

(jointly with Students' Section of Institution of Civil Engineers), at 6.45.—L. A. Beaufoy: Mechanical Solution of Rigid Frames.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R. Grierson and others: Discussion on The Electrical Heating of Buildings.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—E. W. Dickinson and H. W. Grimmitt: The Design of a Distribution System in a Rural Area.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—E. A. Watson: Coil Ignition Systems.

INSTITUTE OF CHEMISTRY (Leeds Area Section) (Annual General Meeting) (at Great Northern Hotel, Leeds), at 7.15.—At 7.30.—A. R. Tankard and others: Discussion on The Food and Drugs Act, 1928.

ROYAL SOCIETY OF ARTS, at 8.—H. R. Ricardo: Diesel Engines (Howard Lectures) (1).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Prof. L. S. Dudgeon: Vincent's Angina and Allied Affections of Mouth and Throat.

TUESDAY, NOVEMBER 24.

ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION (at B.M.A. House, Tavistock Square), at 3.—Sir Hubert Bond: Testimonied in his own Bringingsforth (Maudsley Lecture).

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—M. Breton: Sericulture in the British Empire.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Discussion on Nervous Dyspepsia.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: New Light on the Origin of Species (2).

INSTITUTE OF MARINE ENGINEERS, at 6.—A. E. L. Chorlton: The Work of Akroyd Stuart and the Development of the Oil Engine in which it is carried on (Akroyd Stuart Award Paper, 1930–31).

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—H. S. Hind: The Recording and Reproduction of Talking Pictures.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—R. M. Charley: Recent Progress in Large Transformers.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—E. W. Dickinson and H. W. Grimmitt: The Design of a Distribution System in a Rural Area.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—A. J. Bull: How it works in Photography (4): Three Colour Photo-engraving.

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.—Gossip Meeting.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—H. T. Hildage: Works Progress.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Dr. A. N. Tucker: Sudan Music.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall).—H. V. Stead: Diesel Engines for Overseas Work.

WEDNESDAY, NOVEMBER 25.

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—Discussion on Active Immunisation in Virus Diseases.

EUGENICS SOCIETY (at Linnean Society), at 5.30.—Prof. C. G. Seligman: Race and Temperament.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Annual General Meeting) (at Chartered Institute of Patent Agents, 1 Staple Inn Buildings), at 5.30.—T. B. Hennell: Men or Straw: An Account of Surviving Straw Handicraft.

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—B. G. Robbins: The Training of Young Automobile Engineers.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Mining Institute, Newcastle-upon-Tyne), at 7.15.—Angus Watson: The Adventure of Life.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum, Leicester), at 7.30.—H. L. Long: Science in the Modern Laundry (Presidential Address).

ROYAL SOCIETY OF ARTS, at 8.—G. G. Blake: An Investigation throwing New Light upon Duplex Therapy and other Electro-medical Applications.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at Red Lion Restaurant, Red Lion Square), at 8.—J. Blackburn: Some Obstacles to the Determination of the Effect of Practice upon the Differences between Individual Performances.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 11 Chandos Street, W.1), at 8.30.—Dr. C. S. Read: Out-Patient Psychiatry.

THURSDAY, NOVEMBER 26.

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—W. F. Brazener: The Casting of Tough Pitch Copper.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch—Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—F. Whitfield and others: Discussion on Internal Combustion Engines.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Clinical Pathological Meeting.

BRITISH PSYCHOLOGICAL SOCIETY (at 55 Russell Square, W.C.1), at 8.30.—Prof. T. H. Pear: Suggested Parallels between Modern Speech and Clothing (Lecture).

INSTITUTE OF BREWING (North of England Section) (at Midland Hotel, Manchester).—W. A. Riley: Problem of Bottling.

FRIDAY, NOVEMBER 27.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 3.15.—Prof. J. Kendall: Ionisation Theories: Old and New.

ROYAL ASTRONOMICAL SOCIETY (Meeting for Geophysical Papers), at 4.30.—Dr. H. Jeffreys: On the Variation of Melting-Point within the Earth.—R. Stoneley: The Thickness of the Continental Layers of Europe.—A. W. Lee: The North Sea Earthquake of Jan. 24, 1927.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. F. H. Todd: Some Measurements of Ship Vibration.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at 36 George Street, Manchester), at 7.—J. M. Preston: Textile Microscopy.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Dr. W. A. Scoble and others: Discussion on Wire Ropes, their Selection and Use.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—D. W. McJannet: Progress in the Design and Construction of Static Transformers.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Alfred Ewing: The Work of Sir Charles Parsons.

SATURDAY, NOVEMBER 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Perrett: The Music of Ancient Greece: The "Orestes" Fragment.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 20.

UNIVERSITY COLLEGE, DUNDEE, SCIENTIFIC SOCIETY (at Dundee), at 4.30.—Prof. J. Read: An Organic Chemist looks at Australia.

INSTITUTE OF CHEMISTRY, at 8.—Dr. J. V. Eyre: Recent Advances in the Fermentation Industries (Streatfeild Memorial Lecture).

SATURDAY, NOVEMBER 21.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. St. George Gray: The Romans in the South of England.

MONDAY, NOVEMBER 23.

UNIVERSITY COLLEGE, at 5.30.—Prof. G. Dawes Hicks: The Philosophy of Religion (Hibbert Trust Lectures). (Succeeding Lectures on Nov. 30, Dec. 7 and 14.)

ST. LEONARD'S SCHOOL, ST. ANDREWS, at 8.—Prof. J. Read: Alchemy and the Alchemists.

TUESDAY, NOVEMBER 24.

GOLDSMITHS' HALL, E.C., at 4.30.—Dr. H. H. Dale: Biology and Civilisation (Norman Lockyer Lecture).

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL.—Dr. R. T. Grant: The Pathology of Endocarditis. (Succeeding Lectures on Dec. 1 and 8.)

WEDNESDAY, NOVEMBER 25.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—D. Lees: Venereal Diseases in City Life.

KING'S COLLEGE, LONDON (at 40 Torrington Square, W.C.1), at 5.30.—Dr. W. Borowy: Poland and its Civilisation in the Middle Ages.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Prof. E. A. Milne: The Theory of Stellar Structure. (Succeeding Lectures on Nov. 26 and 27.)

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 6.—P. T. Lloyd: The Form *versus* the Machine in Office Records.

BELFAST MUSEUM AND ART GALLERY, at 8.—Dr. K. G. Emeléus: Atoms, Electrons, and X-Rays.

THURSDAY, NOVEMBER 26.

SCIENCE MUSEUM, SOUTH KENSINGTON (in connexion with Exhibition of Modern Glasses), at 4.45.—R. W. Clark: The Supreme Glass: Fused Silica.

ROYAL INSTITUTION, at 5.—A. Whitaker: Physics in Sound Recording (Institute of Physics Lectures on Physics in Industry).

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Sir William Beveridge: The Meaning of Purchasing Power (Stevenson Lecture).

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. C. E. Inglis: Vibrations in Railway Bridges and Impact Allowances (Armourers' and Brasiers' Company Lectures). (Succeeding Lectures on Dec. 3 and 10.)

BATTERSEA POLYTECHNIC, at 7.—Dr. H. Phillips: The Walden Inversion: The Mechanism of the Substitution of Groups in Saturated Organic Compounds (2).

FRIDAY, NOVEMBER 27.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Prof. L. Hogben: Genetic Principles in Medicine and Social Science. (Succeeding Weekly Lectures in Michaelmas Term and in Lent Term beginning on Jan. 15.)

SATURDAY, NOVEMBER 28.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Pilgrims of Medieval England.

CONGRESS.

FRIDAY AND SATURDAY, NOVEMBER 20 AND 21.

PUBLIC WORKS, ROADS, AND TRANSPORT CONGRESS (at Royal Agricultural Hall).

Friday, Nov. 20, at 11 A.M.—H. R. Lintern: A Philosophy of Civil Engineering Training.

H. R. Lintern: Considerations affecting Highway Department Organisation.

At 3.—F. H. Osmond-Smith: Suicide in Agriculture.

H. T. Tate: Statutory Small Holdings.

T. G. Ellis: The Economic Principles which should govern the Equipment of Small Holdings.

H. Davis: Street Lighting in relation to Transport.

Saturday, Nov. 21.—S. C. Baggott: The Collection and Disposal of House Refuse.

EXHIBITION.

THURSDAY AND FRIDAY, NOVEMBER 26 AND 27.

SCIENTIFIC EXHIBITION (at 16 Royal Terrace, Edinburgh), 5.30 to 9.