



SATURDAY, DECEMBER 15, 1928.

CONTENTS.

	PAGE
A Neglected Aspect of Scientific Research . . . . .	913
The X-Ray Microscope . . . . .	915
The Power from Niagara Falls. By A. R. . . . .	916
Medieval Winters. By C. E. P. B. . . . .	917
Prehistoric Industries and Art in South Africa. By Dr. A. C. Haddon, F.R.S. . . . .	918
Our Bookshelf . . . . .	919
Letters to the Editor :	
Frequency Change in Scattered Light.—Prof. F. A. Lindemann, F.R.S., T. C. Keeley, and N. R. Hall . . . . .	921
The Ultra-Violet Light of the Sun as the Origin of Auroræ and Magnetic Storms.—Prof. S. Chapman, F.R.S. . . . .	921
Phosphate Content and Hydrogen Ion Concen- tration of the Surface Water of the English Channel and Southern North Sea, June 18–22, 1928.—H. R. Seiwel . . . . .	921
The Stratosphere over North India.—Dr. K. R. Ramanathan . . . . .	923
The Velocity Coefficient of a Homogeneous Bimolecular Gas Reaction.—Dr. R. G. W. Norrish . . . . .	923
Determination of Noon by Shadow.—A. Mallock, F.R.S. . . . .	924
The Understanding of Relativity.—Lyndon Bolton . . . . .	925
The Thermal Expansion of Mercury.—F. J. Harlow . . . . .	925
The Magnetic Moments of Hydrogen-like Atoms. —Dr. F. B. Pidduck . . . . .	925
The Recent Eruption of Etna. By Prof. Salvatore di Franco . . . . .	926
A 'Growth Substance' and Phototropic Response in Plants. By J. H. P. . . . .	928
The Wright Brothers' and Langley's Aeroplanes Obituary : . . . . .	930
Prof. T. C. Chamberlin. By Prof. Bailey Willis . . . . .	930
News and Views . . . . .	932
Our Astronomical Column . . . . .	936
Research Items . . . . .	937
Insect Pests in England and Wales. By Dr. A. D. Imms . . . . .	940
Gifts for the University of Cambridge . . . . .	941
Structure of the Great Barrier Reef. By J. S. G. . . . .	941
University and Educational Intelligence . . . . .	942
Calendar of Customs and Festivals . . . . .	943
Societies and Academies . . . . .	944
Official Publications Received . . . . .	947
Diary of Societies . . . . .	947

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A Neglected Aspect of Scientific Research.

IT is unnecessary to stress the vital importance of research in the development of industry. It would be admitted generally that the intensive application of the scientific method is necessary in order that British manufactures may compete successfully with foreign goods and increasing exports lead to the mitigation of the terrible evil of present unemployment. Although the business application of economic laws is leading to the merging of commercial organisations with a view to the elimination of waste by unification of method, so far economic considerations have not been applied so extensively to scientific and technological research.

In Great Britain considerable attention has been given to the organisation of research, and large sums of money have been provided for its prosecution both by Government and private institutions and donors ; but it has been neglected to organise the bibliographical research which should precede every experimental investigation. The failure to study this problem from the economic point of view is the cause of more inefficiency than is generally realised, and the application of simple economic laws would lead to a corresponding gain.

The precise extent to which research workers are wasting energy in repeating experiments that have already been made is difficult to estimate ; but those who have given much attention to the study of the literature of their special subjects are aware that the proportion of labour which is wasted for lack of information on previous work is very high. It is indeed more than possible that half the energy expended in experimental research is dissipated in useless repetition. Perhaps it is less well perceived that the same proportion of useful work is published only to be buried out of sight in masses of volumes on the library shelves. To end this extravagance would increase enormously the efficiency of scientific research and the resulting stimulus to industry would be incalculable. It is worth while, therefore, that attention should be concentrated on the indexing of recorded information, so that hard-won data may be found at need and play their part as a basis for further progress.

A contribution to the solution of this problem was made at the Oxford conference of the Association of Special Libraries and Information Bureaux (ASLIB).<sup>1</sup> In the first place, it was suggested that

<sup>1</sup> The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Fifth Conference held at New College, Oxford, September 14-15, 1928. (London : ASLIB, 26 Bedford Square, W.C.1.)

a record must be kept of every useful scientific fact discovered, that is, every important publication in which scientific or technological research is recorded, in whatever language, should be filed in a library from which the books may be borrowed as required; and secondly, that every useful paper should be indexed.

When we consider what the second proposition involves, the figures are somewhat startling, but in attempting to measure research on a world scale, the million becomes the unit, as in rationalisation generally. Careful estimates show that each year more than a million useful scientific and technological articles are published, besides some thirteen thousand separate books on these subjects. At the same time, the energy of would-be bibliographers is so great that a comparable number of bibliographical entries are printed. This means that to index the total output of scientific and technical literature needs merely the co-ordination of the work of those who are now working independently making separate bibliographies, which are of limited value in the aggregate, on account of diversity of style and lack of method.

Thus the first step towards the production of a comprehensive index to recorded data is the co-ordination of bibliographical work by the standardisation of method; and this can be done by the universal adoption of a single classification. It is suggested that individual bibliographers should agree to work together for the common good by using the same system. By so doing, each one would get a classification that embodies the accumulated experience of his co-workers, while his work would be made available for use by all and theirs by him. It is granted that a standard classification is required for the production of a great bibliography, such as the International Catalogue of Scientific Literature, for example. Conversely, if a large number of bibliographical undertakings and individuals should agree to use the same classification, their total bibliographical output would be unified immediately. An individual worker or institution would then be able to collect references on a special subject from all the standardised sources, and intercalate them in one series in a single special bibliography; while very large libraries could form comprehensive indexes in which all such uniform entries would fall into place automatically, so that information needed could be found in a moment, with the saving of weeks or months of work at each consultation. Thus, by adopting a standard classification, the separate index entries, prepared by each individual, would fit into a single whole like

the standardised parts of a machine; and, as the total volume of bibliographical work is so great, the desired index to knowledge would be well on the way to achievement.

The scheme above outlined depends on the provision of a suitable classification, such as the Brussels extension of the Dewey decimal classification. At the ASLIB conference there appeared to be some confusion of thought between the Brussels extension and the original Dewey decimal classification. Considerable support to the proposed scheme was apparent in the discussion, though unfortunately one of the more helpful contributions seems to have been omitted from the report. On the other hand, there was a tendency to discuss the limitations of Dewey's scheme, or of other systems, rather than to point out any defects in that which was advocated, or to suggest an alternative to it. It was remarked, for example, that "The problem merged into that controversial question of the general librarian, 'classified' catalogue versus 'dictionary' catalogue," although, obviously, a dictionary system, in which each classifier chose his own subject headings, could not serve to co-ordinate the work of an army of bibliographers throughout the world. The same speaker observed that "librarians of general libraries did want something better than the present basic Dewey, if we were to avoid making individual adaptations." Another urged that the Library of Congress had rejected the Dewey code. Actually, of course, by virtue of its auxiliary signs and tables, and extended schedules, the Brussels classification is more comprehensive than the original Dewey scheme, although comprised within a single volume not a great deal larger than that of Dewey. Apparently no one ventured to suggest that the Library of Congress classification could be used as the basis of a comprehensive index.

As another speaker suggested, "The best line of action in standardisation was to take what had already been done and see where the general consensus of opinion lay. . . . We should see which method had been most universally applied and adhere to that one." If these considerations are to be the basis of the decision, then it would seem that the Brussels classification would be chosen. We believe the system has been used for classifying all kinds of literature on the largest scale for a quarter of a century, and by many scientific and business institutions in all parts of the world.

It seems clear, therefore, that an attempt should be made to unify bibliographical work in the way suggested, with the view of providing a comprehensive index to the world's work and so preventing

much of the wasted effort that now occurs. A good example has been set by the Optical Society, which prints with each part of its *Transactions* an index slip in which each entry bears the Brussels classification number at its top right-hand corner; and the Royal Photographic Society has added the classification numbers to *Photographic Abstracts*. Such entries can be cut up, mounted on cards, and intercalated in one series with all other bibliographical notices classified on the same system. Authors who contribute papers to such a society have the satisfaction of knowing that their work is indexed automatically in libraries where bibliographical notices are filed on the Brussels system, and is thus made available for all time whenever and by whomsoever it may be needed.

### The X-Ray Microscope.

*An Introduction to Crystal Analysis.* By Sir William Bragg. Pp. vii + 168 + 8 plates. (London: G. Bell and Sons, Ltd., 1928.) 12s. net.

A NEW book from the pen of Sir William Bragg is always a noteworthy event. Before we open it we know that it is one which we have to read and one which it will be a joy to read. The latest is no exception. Based on and expanded from a series of lectures delivered at University College, Aberystwyth, it is intended, as its title implies, to introduce the general scientific reader to the method of the X-ray analysis of crystals. This method is no longer the monopoly of pure research laboratories, but is finding its way into the fields of applied science and is throwing light on many industrial processes. For this reason, if for no other, it is becoming more and more important that the scientific worker, no matter what his specialist line may be, should have a clear understanding of the principles of the method and some idea as to the possibilities of its application. Only so will he be able to gauge whether it has any aid to offer him in his own especial province. It is to such workers that this book is addressed, and that it will fulfil its purpose is beyond doubt. It is surprising how many aspects of the subject have been discussed in so small a volume, but the material is presented so clearly and with such skill that there is no sense of overcrowding.

The first chapter is devoted to an explanation of how the combination of the X-rays and the regular atomic arrangements characterising the crystal give rise to diffraction effects the interpretation of which afford an insight into the nature and details of these arrangements. Sir William Bragg then proceeds to explain the various experimental methods

at present in use. In this connexion his treatment of the method of the rotating crystal is peculiarly attractive, and those readers who have read other accounts will appreciate its directness and simplicity.

Having laid down the principles and given an account of the actual experimental procedure, the author goes on to describe the results obtained by their application to some inorganic substances. Each example is carefully chosen so as to bring out some aspect of importance and emphasise some line of argument. These relatively simple examples serve to illustrate the main characteristics of the various crystal arrangements and to lead naturally to the next section, which deals with more general considerations developed by the older crystallographers, in particular with the theory of space groups. Federov and, independently, other workers showed that there is only a limited number of possible arrangements of atoms and groups of atoms, 230 in all. This classification had little save a theoretical interest until the advent of X-ray methods. The older crystallographer, dependent as he was on the observation of external features, could place his crystal in one or other of 32 classes, but he knew that it should be possible to make the division a finer one and choose from 230 space groups the one to which his substance belonged. Sir William Bragg shows us how these groups naturally arise, and, further, how and why X-rays can differentiate between them. No one who has studied the subject can fail to appreciate what a triumph of exposition this chapter represents.

The next chapter returns to more practical applications, and here we find a description of some work on rather more complicated substances which have been studied of recent years. The full interpretation of the X-ray results in these cases presents many difficulties, but this account shows us that steady progress is being made and that we are learning, step by step, to read the message conveyed by these diffraction patterns. The incompleteness of the solutions is not due to any inherent weakness of the method, but rather to our comparative inexperience in handling it.

In the final chapter we are brought back again to the study of simpler structures, those of the metals, in order that other and more immediately practical aspects of the work may be presented. The X-ray method is peculiarly suitable for the study of the different phases of alloy systems and for the investigation of the changes in the structure of a metal when it undergoes any cold working process such as drawing or rolling. Those who have to deal with such problems have not been slow to realise the

value of what is really a new and immensely powerful microscope.

We said that the book was intended for the general reader, but we can equally commend it to the specialist, not that there is much danger of his leaving unread anything Sir William Bragg has to say. Deep immersion in any subject tends to restrict that breadth of vision so necessary to progress; the wood cannot be seen for the trees. There has perhaps been a tendency for certain workers to rest content when they have assigned a substance to its particular space group. It is emphasised here that this is only one step, and not necessarily a very important one. The main object is the application of the new information which the method yields towards a better understanding of the physical and chemical properties of solids. The title does not really do justice to the book. It does more than introduce the reader to the subject: it presents him with an invaluable and exceedingly interesting account of a method which is rapidly becoming more and more extensively used in the fields of pure and applied research. The world of science owes Sir William Bragg one more debt on top of a list which is already indeed a long one.

#### The Power from Niagara Falls.

*Niagara Power: History of the Niagara Falls Power Company, 1886-1918; Evolution of its Central Power Station and Alternating Current System.* By Dr. Edward Dean Adams. (Privately printed for the Niagara Power Falls Company on the Fiftieth Anniversary of its Foundation, 1927.) In 2 volumes. Vol. 1: History and Power Projects. Pp. xxii+455. Vol. 2: Construction and Operation. Pp. xv+504. (Niagara Falls, N.Y.: Niagara Falls Power Co., 1928.) n.p.

**I**N these two volumes many historical details and documents in connexion with Niagara Falls are given. There are also several historical pictures of the Falls, the earliest dating from 1678. Proofs are given of the story that on Mar. 31, 1848, the great Niagara River nearly ran dry. The waters had receded so much that the bed of the river was exposed to view. The Welland River, which runs into the Niagara, was practically dry, and a number of old gun barrels were found in it, which were doubtless thrown into the river during the war of 1812.

The theory of this phenomenon, commonly accepted, is that the wind had been blowing down Lake Erie, which is only about 80 feet deep, and

had rushed a great deal of the water from it over the Falls. It may then have suddenly changed and blown the small amount of water left up to the western portion of the lake. It is known that the ice on Lake Erie, probably broken up by these high winds, got jammed in the river between Buffalo and the Canadian side, forming a dam which kept back the waters of Lake Erie for a whole day. This sudden occurrence greatly frightened the natives, who thought that something terrible was going to happen.

It is known that the rim of the horseshoe fall at Niagara is wearing backwards at the rate of about five feet per annum. This fall is the principal division of the cataract. The surging water wears away the shale and deprives the limestone bed of its support. From time to time blocks of limestone break away and fall into the pool below, thus lengthening the gorge. Between 1842 and 1891 the cataract retreated and the gorge lengthened by 200 feet. On the other hand, the American fall has not changed in position or form appreciably since 1827.

The main purpose of these volumes, however, is to give the history of the rise and development of the Niagara Falls Company for the benefit of the stockholders. This company has made its mark on the industry and commerce of the United States, and its methods of generating and transmitting electricity have been closely studied by engineers all over the world. The story of Niagara power in the early nineties of last century is the story of a strenuous and successful endeavour to utilise the power then running to waste. The Cataract Construction Company was formed in June 1889. The author, Dr. E. D. Adams, was appointed the first president of the company, and is now the only surviving director.

In 1890 there were already several large electric machines at work in Europe. Siemens and Halske of Berlin, and Ganz and Co. of Budapest, had each successfully made a 750 kilowatt direct current generator. The Oerlikon Company of Zurich had built a 450 kilowatt direct current generator for use in an aluminium works, and Messrs. Escher, Wyss and Co. of the same city had constructed fourteen water turbines of 1000 horse-power each for their power station at Rheinfelden. Deprez had transmitted 80 horse-power from Bourgneuf to Paris, a distance of about 10 miles, in 1889, and the Oerlikon Works had transmitted 300 horse-power from Lauffen to Frankfort in 1890. Notwithstanding these successful applications of electricity, it is almost startling to read that power

experts in 1890 were divided in their opinions as to whether cable and rope, water pressure, compressed air, or electricity should be used. Many were strongly in favour of compressed air.

In order to get the best scientific and engineering knowledge, the Cataract Company decided to form an 'International Niagara Commission.' The president of the Commission was Sir William Thomson (afterwards Lord Kelvin), and the other members were Prof. Sellers of the Stevens Institute, Prof. Mascart of Paris, Colonel Turrettini of Geneva, and Prof. Cawthorne Unwin, who also acted as secretary of the Commission. The numbers of the Commission were finally increased to thirty-three. Some of them visited the electrical station at Deptford, which transmitted power at 10,000 volts to the sub-station at Trafalgar Square. They were favourably impressed by Ferranti's methods. They offered prizes for the best schemes for utilising the power at Niagara, but the amounts of the prizes and bonuses offered, namely, £200 and £100, do not now sound excessive. There is still to be seen in the salon, called the Niagara Room, of Brown's Hotel, London, a brass plaque commemorating the epoch-making services rendered by the International Commission. It states that the Commission publicly announced its opinion in favour of the adoption of electrical methods of power transmission. In its report, however, the Commission states that other subsidiary methods may be useful. The Commission ended by Sir William Thomson entertaining his colleagues at dinner at the Whitehall Club.

By 1900 the principal works were completed, and ten alternators, each of 5000 horse-power, were in service. In this year the Cataract Company surrendered its rights to the Niagara Falls Company. In 1904 the second power-house was constructed, and in 1906 Canadian plant, having an output of about 50,000 horse-power, was put into operation. The total installed capacity in 1926 amounted to about 680,000 horse-power.

Many diagrams are given illustrating the gradual evolution of the transmission lines and poles from Niagara to Buffalo. The development of Niagara power in 1895 gave an immense impetus to the development of the use of electric furnaces. The economic importance of aluminium, calcium carbide, abrasives, ferro-alloys, silicon, and graphite is now recognised in commerce. Willson, the inventor of calcium carbide, worked with a 200 horse-power furnace. At the present time there are furnaces at Niagara making as much carbide in a day as Willson's furnace produced in a year.

A. R.

### Medieval Winters.

*Les hivers dans l'Europe occidentale : étude statistique et historique sur leur température, discussion des observations thermométriques 1852-1916 et 1757-1851, tableaux comparatifs, classification des hivers 1205-1916, notices historiques sur les hivers remarquables, bibliographie.* Par Dr. C. Easton. Pp. iv + 210. (Leyde : E. J. Brill, 1928.) n.p.

IN the *Proceedings of the Royal Academy of Science of Amsterdam* for 1918, Dr. C. Easton published a paper on "Periodicity of Winter Temperatures in Western Europe," in which he gave the results of his analysis of a long series of historic records, but not the records themselves. He has now, at the instance of Dr. J. P. van der Stok, published the materials on which his study was based, and one can appreciate both the difficulties he encountered and his ingenuity in overcoming them. Having accomplished the enormous amount of reading, in several different languages, necessary to make a thorough collection of ancient records, he had not only to estimate the relative severity of the various winters recorded by the chroniclers, but also to compare them with the winters of recent years for which instrumental records are available.

In the absence of instrumental observations, what characteristic of a winter is most likely to impress contemporary writers and cause them to record it as severe? Evidently it is not alone the mean temperature of the three months December, January, and February, for some winters which are remembered because of a short spell of Arctic cold have also had compensating spells of warmth, and the mean temperature has been not far from normal. Moreover, in some years the lowest temperatures occur in November or March, outside the true winter season, and yet leave behind them the impression of a severe winter. In western Europe, on the borderline between frost and thaw, the number of days of frost, and the number of days without thaw, are both of considerable importance. Taking all these points into consideration, Dr. Easton evolves a method of tabulation in which, from instrumental observations at nine stations ranging from Greenwich to Strasbourg and Bremen to Lyons, he measures the mildness of the winters from 1852 to 1916 by means of a 'coefficient of temperature' on a scale of 0 to 100, low numbers signifying severe winters and high numbers mild winters. Mean temperature of the three winter months is regarded as the most important element, but days of frost, days without thaw, and very cold days (below 14°F.)

also contribute to the result, while the possibility of a prolonged cold season is allowed for by taking the mean of the three lowest minima in different months from November to March. To secure comparable results, each of these elements is expressed in terms of its standard deviation.

From 1757 to 1851 less complete instrumental observations are available for fewer stations, but it is still possible to estimate the intensity of the different winters in much the same way. Before 1757, however, instrumental observations are completely lacking, and only the more or less vague descriptions of the chroniclers are available. Before 1205 even these records become too scanty to be of value, but it was necessary to find some method of applying the coefficient of temperature evolved for the instrumental period to the 552 non-instrumental winters from 1205 to 1756.

The first step, that of arranging the various winters in order of severity, called for delicate judgment, and another assessor would certainly arrive at a different result, but no doubt the arrangement is sufficiently accurate along its main lines. The winter which is adjudged most severe is that of 1407-8, but the winter of 1607-8, "which lasted a year," also has strong claims to pre-eminence. In order to effect the comparison with the instrumental years, the author assumes that the climate of western Europe has not changed appreciably since 1200. Whatever we may think of the truth of this assumption, it was obviously necessary for the purpose. The corollary of this was that the distribution of winters of different degrees of intensity from 1205 to 1756 was similar to the distribution from 1757 to 1916. Since the latter period contains one season (1829-30) sufficiently severe to be classified as a 'great winter,' the former period would be expected to contain four such winters. Actually five 'great winters' are recognised, ending in the years 1408, 1608, 1565, 1709, and 1435, and these are all given the coefficient of temperature measured for 1830, namely, 4. In the same way 12 winters are classified as 'very rigorous' and given the coefficient 10. The disadvantage of this method is that while 1435 was little more intense than 1306, the former receives the coefficient 4, the latter 10. Having decided on the order of severity, it would have been more consistent to grade the numbers, but grading would have given an illusion of exactness which the author no doubt wished to avoid.

Estimates of this nature cannot take the place of instrumental observations, and are easy to criticise, but they have a real value in extending the range of data for such studies as the author's investigations

into periodicity. They are also of value because they require, and insist on, a conservative instead of a sensational view of the weather of former centuries. Quite apart from the estimates and calculations, however, the book is to be welcomed for its wealth of historical data extending back to 396 B.C., with full quotations and exact documentation, and critical notes, a mine of reference for historical studies.

C. E. P. B.

### Prehistoric Industries and Art in South Africa.

*South Africa's Past in Stone and Paint.* By M. C. Burkitt. Pp. xiv + 183 + 9 plates. (Cambridge: At the University Press, 1928.) 12s. 6d. net.

MR. BURKITT feels a difficulty in catering on one hand for the needs of South Africans, who naturally are interested in tracing the connexions of their local finds with the archæology of the northern hemisphere, and, on the other hand, to bring to the notice of European prehistorians the very considerable amount of investigation that has already been done in South Africa. As a matter of fact he has succeeded in doing both in an admirable manner. He has given a clear synopsis of the main stone industries of South Africa, with brief but sufficient descriptions of the various types of tools, that certainly will give the European archæologist a just conception of the whole subject, and one can well believe that South African students will find it equally valuable; Mr. Burkitt pays a well-deserved tribute of appreciation to the work done by these local archæologists.

The artefacts fall into several main groups: those of older palæolithic type are of the Victoria West, Stellenbosch, and Fauresmith industries. The last appears to have been influenced by a culture corresponding to the middle palæolithic or Mousterian phase. This influence is well marked in the industry from Glengrey Falls and that at Yardley, but by this time neanthropic man had reached South Africa. The Still Bay culture shows the passage from a typical 'Mousterian point' to a kind of 'laurel-leaf point' which is very 'Solutrean' in character. A similar evolution has been detected by Mr. Leakey in Kenya, and can also be seen in North Africa in an area where in all probability Mousterian man was in contact with Capsian man. Mr. Burkitt suggests that perhaps a similar contact between Neanthropic and Middle Palæolithic cultures occurred also in Hungary, "the cradle of the true Solutrean culture." The Wilton culture is definitely neanthropic and is a characteristic

'pigmy' industry. The Smithfield culture consists of an older and a newer industry, the latter apparently persisting into recent historic times. Finally, there are the kitchen-midden industries; these belong on the whole to the Wilton culture, though there is evidence that other peoples besides the Bushman took to a strand-looping life.

The most original part of this excellent book deals with rock-paintings, in which Mr. Burkitt has been able to establish a sequence provided by superpositions and marked by the use of distinctive pigments and notable differences in style. In Southern Rhodesia he distinguishes five different age periods, which may perhaps be resolved into three. In the Orange Free State Province several series of art styles were determined. The types of paintings of this Central Art Group are much more varied than those of Southern Rhodesia, and whenever industries have been found associated with these paintings, they can be referred to the Upper Smithfield culture. The paintings of the Southern Art Group are quite dissimilar and far inferior to those of the Central Group; all are executed in red pigment and are associated with the Wilton, that is, the Bushman, culture.

A visit was paid to Zimbabwe, and Mr. Burkitt noticed Kaffir hearths extending below one of the walls of the acropolis; he thinks it reasonable to suggest some date between A.D. 1000 and A.D. 1200 for the construction and use of these monuments.

Mr. Burkitt has written a very useful and attractive book. He was accompanied by his wife in all his expeditions, some of which were distinctly arduous. The book is well illustrated with photographs, and a large number of very good drawings of implements by Mrs. Burkitt, who also made a large series of tracings of the rock paintings. The coloured plate drawn by her explains the colour terminology and sequence.

A. C. HADDON.

### Our Bookshelf.

*Physics for Medical Students.* By Prof. Sidney Russ. Pp. vii+230. (Edinburgh: E. and S. Livingstone, 1928.) 10s. 6d. net.

ONE of the important problems that come before the teacher of physics is that of the instruction of medical students in this subject. The problem is a difficult one, because the student often shows a distaste for the subject, and it is obvious that his aim is to pass an examination which will open a door to freedom from physics. There are many text-books for medical students, but most of them are written merely for examination purposes and are not satisfactory even in this respect. Few

are designed to interest the future medical practitioner in principles of wide application in medicine, surgery, and gynæcology. Dr. Russ's book is valuable, in that it is worthy of its title and rouses the interest by pointing continually to the application of physical principles in medicine and to their use in diagnosis and treatment.

The book is short and covers the essential points of importance in examinations, but it is not written with the sole object of pandering to a syllabus; it suggests, indeed, the type of syllabus appropriate to the medical student, and the field from which examination questions might profitably be chosen.

The author has had considerable experience in the teaching of medical students, and has also an intimate knowledge of the details of the application of physics to medicine. This is well exemplified in the chapter on X-rays and radioactivity, where we find useful facts stated and duly stressed, as, for example, the mention of radon and its place in the series of radioactive elements.

It is easy to understand why the author deals only briefly with the subject of sound, but his object would have been helped by a short account of the mechanism of hearing.

The diagrams are good, simple, and easy to follow. A mistake has been overlooked in Fig. 73, where the division of the rays has been shown to take place within the prism and not on emergence. The same point is illustrated correctly in Fig. 77.

*Der fossile Mensch: Grundzüge einer Palä-anthropologie.* Von Prof. Dr. E. Werth. Teil 3 (Schluss der Werke). Pp. xi+577-898. (Berlin: Gebrüder Borntraeger, 1928.) 30 gold marks.

IN this concluding part of his treatise Prof. Werth deals with man himself, and questions of climate, industries, and associated fauna. It is generously and clearly illustrated.

The ground covered in the present volume has been so repeatedly surveyed by hosts of writers during the last decade, that it is unnecessary to say more of the parts of the book dealing with matters concerning which there is general agreement beyond the statement that the work is done well.

Turning to the contentious issues, the author still believes that the Piltown jaw is an ape's, and thinks the cranium is not sufficiently different from that of modern man to warrant the creation of a new genus for its reception. His idea of the relationships and phylogeny of the Primate groups is distinctly novel. He suggests that *Propliopithecus* and *Parapithecus* were derived from the Lemuroidea. From the former emerged the Miocene *Dryopithecus*, whose Pliocene descendant *Palæopithecus* was the ancestor of the orang, the chimpanzee, and the gorilla. The Oligocene *Parapithecus*, on the other hand, was the ancestor of two phyla, one leading (through *Pliopithecus*) to the gibbons, the other (through *Pliohylobates*) to the human family.

This is a very strange variation of the many

recent attempts to evade recognition of our relationship to the giant apes. The admission of the real affinities of the Piltdown man would make the adoption of such a scheme of human ancestry impossible.

*The Journal of the Institute of Metals.* Vol. 39. Edited by G. Shaw Scott. Pp. xii + 814 + 63 plates. (London: Institute of Metals, 1928.) 31s. 6d. net.

THE president's address, with which the present volume opens, is devoted to the subject of the 'thermal equilibrium diagram,' in order to show that such diagrams, which may appear to be of merely academic interest, have great practical value for the foundryman and the worker in metals. Several alloy systems are described in illustration, and a further example is afforded by a paper describing the changes in standard silver which are brought about by heat treatment. It is of interest that this alloy may be made to develop structures which under the microscope closely resemble those of hardened steel by quenching under different conditions. Several systems of alloys containing that very reactive metal, zirconium, have been prepared with the aid of a high-frequency induction furnace working in a high vacuum, but owing to the very limited range of solid solubility of the intermetallic compounds which are formed, the alloys do not promise to be of technical value.

Other papers deal with hot and cold working, and an investigation which has great practical consequences has now been published, dealing with the deterioration of lead cable sheathing by cracking. The difficulty is found to be due to the low fatigue limit of lead, and it has been overcome by alloying with cadmium and either tin or antimony. The May lecture has as its subject the chemical properties of crystals, and the volume contains the usual extensive section of abstracts, the net having been cast so wide that few papers of interest to metallurgists can have escaped inclusion.

*Einführung in die theoretische Physik.* Von Prof. Dr. Max Planck. Band 4: *Einführung in die theoretische Optik; zum Gebrauch bei Vorträgen, sowie zum Selbstunterricht.* Pp. vii + 184. (Leipzig: S. Hirzel, 1927.) 6 gold marks.

THIS "Introduction to Theoretical Optics" concludes appropriately the series of four volumes on "Theoretical Physics" by Dr. Max Planck. General mechanics, the mechanics of deformable bodies, and the theory of electricity and magnetism are the subjects of the three earlier volumes.

According to the author, his object has been to present and interpret, chiefly by word, the more important general principles, rather than to elucidate them mathematically. Fundamental formulæ have necessarily been freely employed. Space, however, has not been sacrificed to their development. From the large amount of material available, only a limited selection has been possible. The treatment is based almost entirely upon the electromagnetic wave theory. It is only in the last chapter, devoted to the geometrical optics

of non-homogeneous bodies, and particularly to dispersion, that use is made of quanta mechanics or the principles of relativity.

The discussion of the optical questions dealt with is simple and lucid. The book will certainly appeal not only to the lecturers and students for whom it is intended, but also to a much wider circle of general scientific readers. J. W. F.

*Der Werdegang einer Eruptivmasse: Geologisch-petrographische Analyse der Intrusionstektonik im Schwarzwalde.* Von S. von Bubnoff. (Fort-schritte der Geologie und Paläontologie, herausgegeben von Prof. Dr. W. Soergel, Band 7, Heft 20.) Pp. viii + 239 + 6 Tafeln. (Berlin: Gebrüder Borntraeger, 1928.) 20 gold marks.

PROF. SERGIUS VON BUBNOFF is well known, especially from his "Geology of Europe." In this monograph he gives a detailed account of the south-western margin of the Black Forest, with special reference to its contact phenomena and intrusion-tectonics, a term familiar from its use by Prof. F. E. Suess for the mountains to the east. Prof. von Bubnoff holds that the schists and gneiss of the Black Forest are older than the granitic intrusions. He rejects the view that the metamorphic rocks were formed in Upper Palæozoic times, and expresses doubts as to this age for those in the Variscan Mountains. The book is illustrated with excellent maps and plates, and is an important contribution to the geology of south-western Germany.

*The Philosophical Bases of Education.* By Dr. Robert R. Rusk. Pp. 205. (London: University of London Press, Ltd., 1928.) 5s. net.

THE title of this book would have been better chosen as the "Idealistic Philosophical Basis of Education." The author has no particular use for either the naturalistic or pragmatic philosophies, and concentrates all his attention on idealism. He gives quite a good account of naturalism and pragmatism in education, with his bias towards idealism showing through, and then presents the case from the idealistic point of view. The book is well written and the subject matter well arranged. The author's account of the historical development of idealism from the days of Socrates, through Rousseau, Kant, and Fichte, to the modern idealism, is good.

*Temperament: a Survey of Psychological Theories.* By Constance Bloor. Pp. iv + 202. (London: Methuen and Co., Ltd., 1928.) 5s. net.

IN this book the author has made a brave attempt to solve the various problems presented by a consideration of the word temperament. After a discussion of the various contributions made by the older writers, we are introduced to five temperaments, the sanguine, the choleric, the phlegmatic, the melancholic, and the cautious. The author appears to be impressed by the physiological basis of temperaments provided by the glands of internal secretion and by their inter-relationship with the sympathetic and para-sympathetic nervous systems. Probably time will show that this is the correct view to be taken.



## 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.]

## Frequency Change in Scattered Light.

WORK has been carried out in this laboratory on the frequency change in scattered light (Raman effect), using a plane polarised beam. The preliminary results seem sufficiently interesting to be worth publishing even in an incomplete form. With carbon tetrachloride and an unpolarised beam, it is found that the modified lines of wave-lengths 4400 Å., 4419 Å., and 4447 Å., produced by subtracting the quanta corresponding to the infra-red wave-lengths 46 $\mu$ , 32 $\mu$ , and 22 $\mu$  from the violet mercury line 4358 Å., are all about equally strong. If the exciting light is plane polarised, the line 4447 Å. is missing when the scattered light is examined in the plane of polarisation of the incident light, but appears with about twice the intensity of the other two when observed in a direction at right angles to it.

The only explanation of this phenomenon which suggests itself, couched in terms of the classical theory, would seem to be that the oscillation giving rise to the modified line at 4447 Å. is linear, whereas the other two are not. If one assumes that a polarised quantum can only interact with a linear oscillator if the plane of polarisation is perpendicular to the line in which oscillation occurs and that it is re-radiated polarised parallel to this line, it is clear that the above result would be observed.

This explanation is of course only tentative. The exact intensity ratios are being determined, and work on other liquids with unsymmetrical molecules as well as on crystals is proceeding which will, it is hoped, throw further light on this interesting phenomenon.

F. A. LINDEMANN.  
T. C. KEELEY.  
N. R. HALL.

Clarendon Laboratory, Oxford,  
Nov. 28.

## The Ultra-Violet Light of the Sun as the Origin of Auroræ and Magnetic Storms.

THE novel theory of auroræ and magnetic storms described by H. B. Maris and E. O. Hulburt (NATURE, Nov. 24) cannot be examined in detail until their promised paper appears, but some of its principal features induce me to believe that the true explanation of these phenomena must be sought along different lines.

The theory supposes that occasional sudden blasts of ultra-violet light are responsible for auroræ and magnetic storms. The terrestrial effects would be almost immediately felt, and would depend relatively little upon the position of the emitting area on the sun's disc; unless, indeed, the area were in a hollow on the sun, it would be not less than about half as effective if 60° from the centre of the disc as at the centre.

These consequences appear incompatible with the marked tendency for abnormal terrestrial magnetic conditions to recur after about 27 days, which is the rotation period of the sunspot zone relative to the earth. The arguments based on this recurrence-tendency by E. W. Maunder in 1905 remain valid in demonstrating that magnetic storms are caused by

something that travels outwards from particular disturbed areas on the sun in laterally limited beams; it must therefore almost certainly be corpuscular. It affects the earth only when the stream comes near the earth, and though the stream may be intermittent, its emission must be in progress for a much larger fraction of the time than that during which it is effective in producing magnetic disturbance. Evidence is accumulating to indicate that the material of the stream occupies a time of the order of a day in passing from the sun to the earth. It therefore seems that in proposing ultra-violet radiation, in merely contemporaneous excess, as the cause of magnetic storms, the theory starts from a false major premise.

Apart from this fundamental objection, the proposed explanations of the two phases of a magnetic storm seem doubtful. The eastward 'drift-current' (to use the term introduced in my letter to NATURE of Oct. 13, 1928), to which the authors attribute the initial increase of horizontal magnetic force, would affect the sunlit and dark hemispheres very unequally, contrary to usual observation in a magnetic storm; in my opinion, variations in the intensity of ultra-violet radiation are associated with changes in the solar diurnal magnetic variation of quiet-day type, instead of with magnetic disturbance.

In the second, and principal, phase of a magnetic storm, the horizontal magnetic force is decreased, and the authors ascribe this to diamagnetism in the auroral zones, due to the spiral motion of ions then present there in unusual number. When R. Gunn's recent interesting diamagnetic theory of the solar diurnal magnetic variation appeared (*Physical Review*, July 1928), I examined the nature of the field of a strongly diamagnetic auroral zone, and concluded that it would differ in important respects from the magnetic disturbance field. But should the authors' radically different conclusion be correct, and the diamagnetic field be qualitatively in accord with observation, it would still seem that the diamagnetism of the spiralling charges in the auroral zone would be of minor importance compared with the effect of the drift currents in this zone.

I hope shortly to publish a new discussion of the theory of magnetic disturbance, assuming the cause to be a neutral ionised stream (as suggested by F. A. Lindemann, *Phil. Mag.*, 38, 669, 1919). In this connexion Mr. V. C. A. Ferraro and I have extended, and partly corrected, my investigation (*Camb. Phil. Soc.*, 21, 577; 1923) of the motion of such a stream in the earth's magnetic field. In view of the past history of terrestrial magnetic theory, it would be too much to anticipate that this new discussion will avoid cause for criticism, but, in this difficult field, criticism and speculation are both necessary. I regret, however, that my criticism of the theory proposed by Mr. Maris and Mr. Hulburt must be of so root-and-branch a character.

S. CHAPMAN.

Imperial College of Science and Technology,  
South Kensington, S.W.7, Nov. 28.

## Phosphate Content and Hydrogen Ion Concentration of the Surface Water of the English Channel and Southern North Sea, June 18-22, 1928.

ATKINS, who has carried out numerous analyses of the phosphate content of the English Channel, has found that water containing 30 to 40 milligrams of P<sub>2</sub>O<sub>5</sub> per cubic metre in the winter is almost completely devoid of phosphate in the early summer owing to its utilisation by algæ. The depletion occurs first in the upper layers in the spring, when

the sunshine begins to exceed about three hours a day. The time varies, and a comparison of one year with another has shown that the main differences are due to the dates when the phytoplankton multiply rapidly and use up the phosphate at a greater rate than it is being re-formed from dead organisms (Harvey, 1928).

Likewise, a rapid multiplication of the phytoplankton crop in an area will lower the amount of carbon dioxide in the water, causing a decrease in the concentration of hydrogen ions (the *pH* value will be raised). Thus, in the surface water of the English Channel a lowered *pH* value is associated with a high phosphate content in the winter, and a high *pH* value with a low phosphate content in the spring and summer.

During the present cruise of the *Carnegie*, on the trip from Plymouth, England, to Hamburg, Germany, a number of surface samples from the English Channel and southern North Sea were collected and analysed for phosphate, hydrogen ion concentration, and salinity. The phosphate analyses were made by the colorimetric method of Denigès (Atkins, 1928), the salinity by the method of Knudsen, and the hydrogen ion concentration by the method of Barnett and Barnett (1921).

The hydrogen ion concentrations are expressed as *pH*. The indicator used for these determinations was cresol red, and the values have been corrected for salt error. The salt-error correction has been adopted from Ramage and Miller (1925), who, using cresol-red indicator and Clark and Lub's borate standards,<sup>1</sup> have studied the depression of the hydrogen ion concentration caused by salinities of 5 to 35 parts per thousand and give a correction of -0.27 to be applied to colorimetric *pH* measurements made on ocean water lying between 32 and 35 per mille salinity.

Data were obtained during June 18 to 22, 1928, at stations 1 to 13 located in the English Channel, stations 14 to 18 in the Straits of Dover, and stations 19 to 32 in the southern North Sea. Station 33 is in the mouth of the Elbe River.

The general low phosphate values of the surface water of the English Channel (except for stations 5, 6, and 7) direct attention to the fact that the phosphate in the upper water layers is being utilised by the phytoplankton at a greater rate than it can be replenished. The high values of phosphate recorded for stations 5, 6, and 7 may perhaps be due to local enrichment by ships, upwelling of the bottom water, or by drainage from the adjacent land. The average phosphate content of the surface water of the English Channel over the route followed by the *Carnegie* (exclusive of stations 5, 6, and 7), is 8.64 milligrams  $P_2O_5$  per cubic metre. The average hydrogen ion concentration expressed as *pH* and corrected for salt error is 8.03.

The phosphate values recorded for the southern North Sea are lower than those of the English Channel, the surface water in this case being almost completely devoid of phosphate. The average phosphate content of the North Sea stations was 3.44 milligrams  $P_2O_5$  per cubic metre, and the average hydrogen ion concentration expressed as *pH* and corrected for salt error, 8.11.

The records for the surface water of the Straits of Dover show phosphate values closely approximating those recorded for the North Sea. The average  $P_2O_5$  content of the five stations in this locality was 3.65 milligrams per cubic metre, and the average hydrogen ion concentration expressed as *pH* and corrected for salt error, 8.05.

<sup>1</sup> Clark and Lub's borate standards are used to calibrate the instrument in use in this laboratory.

Comparing the above values of phosphate and hydrogen ion concentration for the English Channel and southern North Sea, it would seem that for the period of observations, June 18-22, 1928, there was a greater photosynthetic activity in the surface water of the southern North Sea than in the English Channel. The variation in temperature for the whole series of stations was not more than 1.2°. The average temperature of the English Channel stations was 12.8° C. and of the North Sea stations 12.9° C.

The mean latitude of the group of stations in the English Channel is 50° 26' north; in the Straits of Dover, 51° 02' north; and for those in the North Sea, 52° 34' north. Thus, the mean difference in daylight (sunrise to sunset) between the stations of the English Channel and North Sea for the mean epoch of observations, June 20, 1928, was 24 minutes, the North Sea group having approximately 3 per cent longer

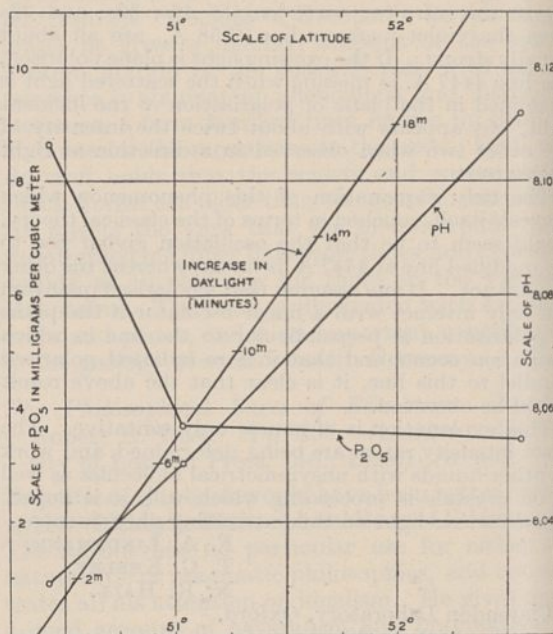


FIG. 1.

period of daylight. Therefore, other conditions being equal, we should for this period expect an increased amount of plant growth and reproduction for the North Sea group which would lower the phosphate content and hydrogen ion concentration in the upper water layers.

Fig. 1 illustrates the relation between  $P_2O_5$  content, hydrogen ion concentration, and change in daylight-interval for the groups of stations in the English Channel, Straits of Dover, and North Sea during the period of observation. The average of the data for each of these groups is plotted against the mean latitude of each group.

H. R. SEIWELL  
(Biologist and Chemist on  
board the *Carnegie*).

Carnegie Institution  
of Washington.

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**The Stratosphere over North India.**

ASCENTS of sounding balloons carrying Dines meteorographs carried out from the Upper Air Observatory, Agra, during the last two and a half years have yielded interesting information regarding the height and temperature of the base of the stratosphere over northern India and their remarkable seasonal variations. A brief summary of the results may be of interest to readers of NATURE.

All the three types of transition from the troposphere to stratosphere classified by W. H. Dines, namely—

*Type I*—When the stratosphere commences with an inversion;

*Type II*—When the stratosphere begins with an abrupt transition to a temperature gradient below 2° C. per kilometre without inversion; and

*Type III*—When the decrease of lapse-rate takes place gradually;

are met with. In addition, a fourth composite type with I above II or III is common between the months November to April.

During the period April 1926 to March 1928, 46 records of ascents going up to the stratosphere are available. The mean height of the tropopause ( $H_c$ ) is 15.9 geodynamic or 16.3 ordinary kilometres and the mean temperature ( $T_c$ ) 199° A.

In Fig. 1 are plotted the heights and temperatures of

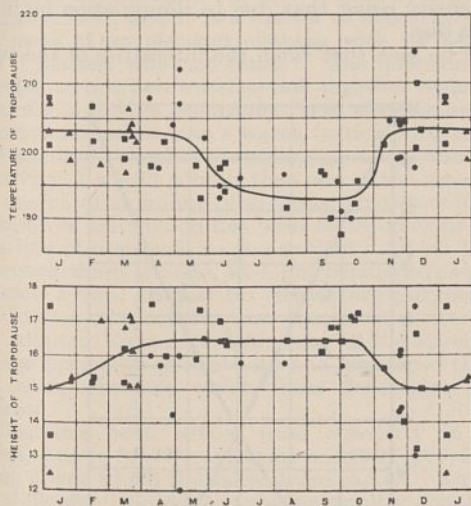


FIG. 1.—Variation of the height and temperature of the tropopause over Agra during the year.

● Observations in 1926.  
 ■ " " 1927.  
 ▲ " " 1928.  
 Total Number of Observations, 46.

the tropopause obtained from the records of these ascents. When the transition is of the composite type, both positions of rapid changes of lapse-rate are plotted. The sudden jump of temperature and height of tropopause between October and November is specially noteworthy, as it occurs more than a month and a half later than the time of withdrawal of the monsoon from north India. From the point of view of seasonal variation, we may divide the year broadly into two parts:—

(1) *Middle of May to end of October.*—During this period, the type of tropopause is either I or II; if II, the initial sudden change of lapse-rate is followed by an inversion soon after, so that there is always an inversion of temperature in the stratosphere. The mean value of the height of the tropopause is 16.5

geodynamic kilometres, and its mean temperature 194.5° A. The period of activity of the monsoon in northern India is July to September.

(2) *November to middle of May.*—In this period, types III and IV are more frequent. Even here there is almost always an inversion of temperature above 17 geodynamic kilometres. The mean values of  $H_c$  and  $T_c$  during this period are 16.2 gkm. and 201° A. if we take the values corresponding to the higher value of  $H_c$  on occasions when the transitions were of type IV, and 14.9 gkm. and 203.5° A. if we take values corresponding to the lower values of  $H_c$ .

A significant feature shown by the results of the monsoon period is the comparatively high temperature

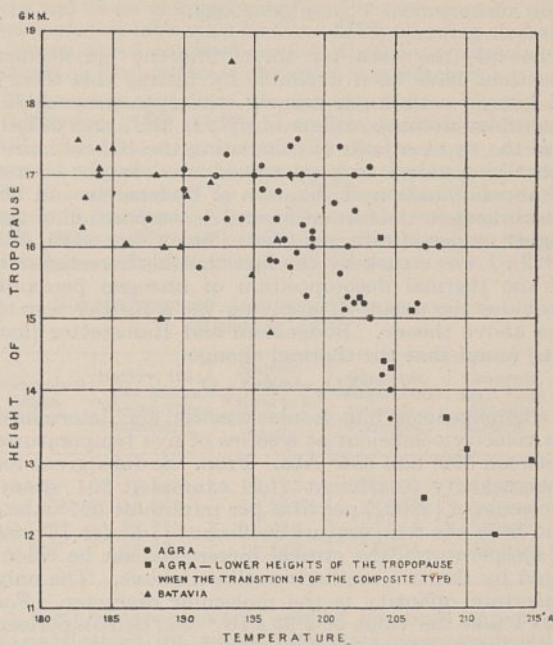


FIG. 2.

between 4 and 13 gkm. and the close agreement of the height-temperature lines between these limits with those of saturation adiabatics.

In Fig. 2 are shown the values of  $T_c$  plotted against the corresponding values of  $H_c$ . The values obtained by Bemmelen from ascents at Batavia are also plotted for comparison. The general tendency of  $H_c$  to approach a limiting value of about 17.5 gkm. with decreasing  $T_c$  is very suggestive.

K. R. RAMANATHAN.

Meteorological Office,  
 Poona, Oct. 12.

**The Velocity Coefficient of a Homogeneous Bimolecular Gas Reaction.**

THE theory of kinetic activation has been shown by Hinshelwood to lead to a simple explanation of homogeneous bimolecular reactions ("Kinetics of Chemical Change in Gaseous Systems," Oxf. Univ. Press). According to this view, two molecules react on collision when their joint kinetic energy at impact exceeds a certain limiting value  $E$ , termed the critical increment for the reaction. The number of binary impacts of this kind per second in a gas can be calculated by means of the kinetic theory as

$$\sqrt{2}\pi\sigma^2\bar{u}n^2e^{-E/RT},$$

where  $\sigma$  is the molecular diameter,  $\bar{u}$  the root mean square velocity, and  $n$  the number of particles per cubic centimetre. By comparing this expression with

the actual number of molecules reacting, we can calculate the value of the critical increment  $E$ . Thus, if  $k$  is the velocity coefficient of a bimolecular reaction measured in gram molecules per minute per litre, we have

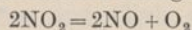
$$2\sqrt{2}\pi a^2 \bar{u} n^2 e^{-E/RT} = k \cdot C^2 \cdot \frac{6.06 \cdot 10^{23}}{10^3 \cdot 60},$$

where  $C$  is the concentration of the reacting substance in gram molecules per litre.

An independent means of determining  $E$  is provided by a determination of the temperature coefficient,  $\eta$ , of the reaction and calculating according to the Arrhenius equation

$$\eta = e^{-\frac{E}{R} \left( \frac{1}{T} - \frac{1}{T+10} \right)}.$$

So far, the data for three different bimolecular reactions have been available for testing this theory of kinetic activation, namely, the homogeneous bimolecular decompositions of  $2N_2O$ ,  $2HI$ , and  $2Cl_2O$ , and the two methods of calculating the critical increment give values in good agreement. In the course of an examination of the data of Bodenstein and his co-workers on the formation and decomposition of the higher oxides of nitrogen (*Zeit. Phys. Chem.*, **100**, 68; 1922), I was struck by the fact that his investigation of the thermal decomposition of nitrogen peroxide provides the means of applying yet a further test to the above theory. Bodenstein and Ramstetter (loc. cit.) found that the thermal change



is a homogeneous bimolecular reaction and determined its velocity coefficient at a series of five temperatures between  $592^\circ$  and  $656^\circ$  Abs. From the data given for the velocity coefficient (for example, 204 gram-molecule of  $[2NO_2]$  per litre per minute at  $627^\circ$  Abs.) and from the temperature coefficient (1.51 for  $10^\circ$  rise of temperature), the critical increment can be calculated by the two methods outlined above. The only uncertain quantity is the molecular diameter. For this I take the value of  $3.33 \times 10^{-8}$  cm., by comparison with the identical values found by Rankine for the  $N_2O$  and  $CO_2$  molecules. In any case the variation in the value of  $\sigma$  makes very little difference to the value of  $E$ , which, for example, is only altered to the extent of 3 per cent by a 100 per cent increase in the molecular diameter.

The results of the calculations for nitrogen peroxide have been added to the table of Hinshelwood given below, and the satisfactory agreement will be seen to provide a further confirmation of the theory of kinetic activation.

Reaction. Thermal Decomposition of	$E$ vel. coeff.	$E$ temp. coeff.	Abs. Temp. of Identical Vel. Coeff. (0.0914 g. mol./litre/sec.).
$2N_2O$	55,000	58,500	956
$2HI$	43,900	44,000	760
$2NO_2$	33,200	32,000	575
$2Cl_2O$	22,000	21,000	384

R. G. W. NORRISH.

Department of Physical Chemistry,  
Cambridge University.

#### Determination of Noon by Shadow.

CORRECT time is now so widely distributed that devices for the accurate reading of sundials are scarcely more than curiosities; but as a curiosity it may be worth while to put on record a method which I used from 1875 to 1880, by which the meridian passage

of the sun was determined to within one second by means of a shadow, without any lens or other optical appliance, thus:

A straight rod,  $R$  (Fig. 1), in the plane of the meridian was used as the gnomon, and in the same plane and parallel to  $R$  was a straight piece of wire,  $W$ , at such a distance from  $R$  that the diameter of the latter when viewed from  $W$  was half the angular diameter of the sun. When the sun is on the meridian,  $W$  casts two shadows of equal intensity corresponding to the equal areas of the sun's disc which are not covered by  $R$ . The intensity of these shadows changes rapidly with the sun's motion. If  $R$  cuts the sun's limb at the four points  $A, B, C, D$ , the areas of the sun's disc left uncovered by  $R$  are (if  $\angle AOB = \phi_1$  and  $\angle COD = \phi_2$ ) proportional

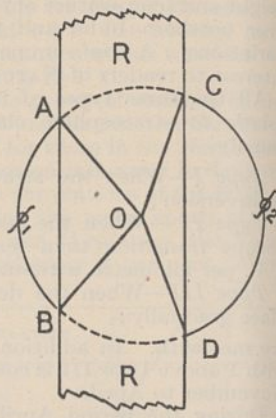


FIG. 1.

to  $\frac{1}{2} \sin \phi_1$  and  $\frac{1}{2} \sin \phi_2$ , and the ratio of these two quantities gives the relative intensity of the shadow. This is shown in Fig. 2, where the ordinates give the intensity, and the abscissa time in seconds, the unit intensity being that due to illumination by half the sun's disc.

It will be seen that when the intensities of the two

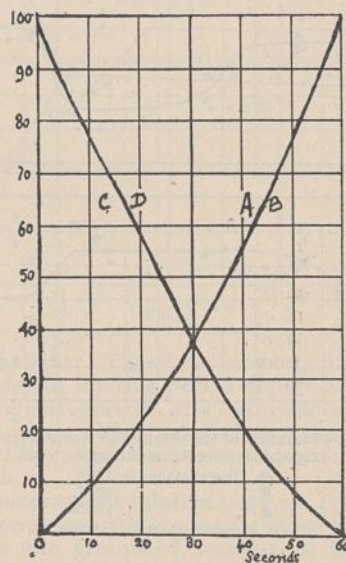


FIG. 2.—Viewed from  $W$ , one minute will elapse between the times at which the edge of  $R$  is a tangent to the sun's limb, and when the same edge forms a diameter. The curve  $AB$  gives the intensity of the shadow of  $W$  thrown by that part of the sun exposed between  $R$  and  $AB$ ,  $CD$  being the simultaneous intensity of the shadow thrown by the corresponding area between  $CD$  and the other edge of  $R$ .

shadows are identical, the variation in intensity is rather more than 5 per cent per second, a difference which is readily appreciated by the eye, if the screen on which the shadows fall is protected from stray light.

A. MALLOCK.

9 Baring Crescent,  
Exeter.

The Understanding of Relativity.

SIR ARCHDALL REID'S difficulty (NATURE, Nov. 24, p. 808) would probably be eased, if not altogether met, by the "Introduction" of Eddington's "Mathematical Theory of Relativity," more particularly the last paragraph on p. 5.

The difficulty seems to arise from the confusion of two distinct things, an object and its measure, it being mistakenly supposed that the measure of a thing is an absolute property of it and independent of the person who measures it and of his circumstances.

The actual fact is that relativity is not concerned with things in themselves objectively considered, but with their measures, and a measure, whether of an interval of time or of length or anything else, is as much a property of the measurer—or of his instruments, which are merely extensions of himself—as it is of the thing measured, regarded objectively. A measure therefore may be expected to vary with the circumstances of the observer, amongst others, his state of relative rest or motion. It would, in fact, be strange if it did not.

Bearing this distinction in mind, there is nothing incredible in lengths, times, masses, or any other physical quantities measuring up differently according to the state of rest or motion of the system in which they occur, relative to an observer in another system. No experience is contradicted. In fact, the opposite supposition contradicts the known facts of the electro-magnetic field, and it is a matter of observation that the mass of an electron changes with its velocity; and if masses, why not times? The question is not whether or not two watches tick together regarded as a purely objective occurrence, but whether one man observes the other man's watch to tick with his own.

Regarding the main question, the understanding of relativity, I would submit that one of the reasons for the comparative failure of so many expositors to make themselves understood has been an injudicious choice of a line of approach to the subject. Of all lines of approach there is none, as I am persuaded, equal to Einstein's own, at least for elementary purposes. It is a matter of much surprise that more writers have not adopted Einstein's definitions of the special and general principles of relativity and developed the subject along the line which these definitions clearly indicate.

Einstein's book suffers from obscurity in many places, but it has the supreme merit of providing a string about which the subject can candy. No doubt the difficulty in crediting the unfamiliar conclusions of relativity must take its share in this failure, but before laying so much blame upon it I respectfully suggest that Einstein's method of approach be tried more widely. I speak from experience, for I have tried this method to the exclusion of all others, and I certainly have no reason to complain of failure, if I may judge from press notices and private correspondence. My first application of this method,—very successful, as attaining its main object, and within its limitations, which were severe,—was public talk some eight or nine years ago, though perhaps the incident has now been forgotten.

LYNDON BOLTON.

4 Shakespeare Road,  
Bedford.

[THE modest remark made by Mr. Bolton in the concluding sentence of his letter refers, we expect, to the fact that in 1921 he was awarded the prize of about £1300 offered by the *Scientific American* for the clearest explanation of relativity for general readers.—ED. NATURE.]

The Thermal Expansion of Mercury.

IN a recently published book on "Heat and Thermodynamics," by Dr. J. K. Roberts, reference is made on pages 202 and 203 to my work on the thermal expansion of mercury. Comparison is made in a table between my results obtained by the silica weight thermometer method and those published by Callendar and Moss which were obtained by the Callendar-Regnault absolute method. The author of the book referred to makes the following comment:

Until the very considerable differences between the values at low temperatures obtained by Callendar and Moss and those obtained using weight thermometers are explained, this table must be taken as representing all that is known about the coefficient of absolute expansion of mercury. The position is obviously unsatisfactory.

It does not appear to be generally known that in a publication (*Trav. et Mém. Int. Bur. des Poids et Mes.*, 1917) there are recorded further observations on the thermal expansion of mercury for the range 0° to 100° C. carried out by Chappuis by the Callendar-Regnault method. These observations agree well with those obtained with the silica weight thermometer, as the following table shows:

COEFFICIENT OF ABSOLUTE EXPANSION OF MERCURY × 10<sup>6</sup>.

Temperature Range, 0° to t°.	Harlow, 1914. (By Silica Weight Thermometer.)	Harlow, Revised Values to be Published Shortly.	Chappuis, Weight Thermometer of Verre Dur.	Chappuis, 1917. (By Absolute Method.)
0- 30°	18,168	18,175	18,171	18,189
0- 50°	18,188	18,192	18,183	18,206
0- 75°	18,213	18,216	18,211	18,227
0-100°	18,244	18,248	18,254	18,248

A further paper on this subject has been prepared for publication, in which later and more extensive observations on the thermal expansion of vitreous silica are applied to my observations published in 1914.

F. J. HARLOW.

Chelsea Polytechnic,  
Manresa Road, London, S.W.3.

The Magnetic Moments of Hydrogen-like Atoms.

DR. BRETT'S letter in NATURE of Oct. 27 seems to imply that the magnetic moment of a hydrogen-like atom has so far been calculated only for radial quantum number zero. I therefore venture to give the general result, expecting, however, that it has already been calculated by others. The calculation is easily performed by expressing Darwin's functions in terms of Laguerre's polynomials of non-integral rank. It is convenient to write  $j = k + 1$  when it is positive and  $-k$  when it is negative, and to write  $J = \sqrt{(j^2 - \gamma^2)}$ ,  $N = J + p$ ,  $n = \sqrt{(N^2 + \gamma^2)}$ , where  $p$  is the radial quantum number and  $\gamma = 2\pi Ze^2/hc$ . We find that the magnetic moment is

$$\frac{j(2l+1)(2Nj+n)}{(2j-1)(2j+1)n} \text{ Bohr magnetons,}$$

$l$  being the equatorial quantum number. This is the expression of spacial quantisation in Dirac's system.

F. B. PIDDUCK.

Corpus Christi College,  
Oxford, Nov. 14.

## The Recent Eruption of Etna.

By Prof. SALVATORE DI FRANCO, University of Catania.

ETNA has always presented the most varied geodynamic and eruptive phenomena, separated by periods of repose so varied that it is futile to make any attempt to define them with precision. During the nineteenth century there were ten great classical eruptions accompanied by imposing emissions of lava. From 1892 to 1910, Etna did not present any outburst of importance ;

warning, an explosion occurred in the highest crater on the north-east side, while the central crater was quite still. At 18h. a new vent opened in the Val del Leone (2700 metres), with emission of lava over about 350 metres ; at the same time the subterranean course of the lava was directed to the south of Monte Frumento, so far as the eastern flank of Monte Cubania, where a second

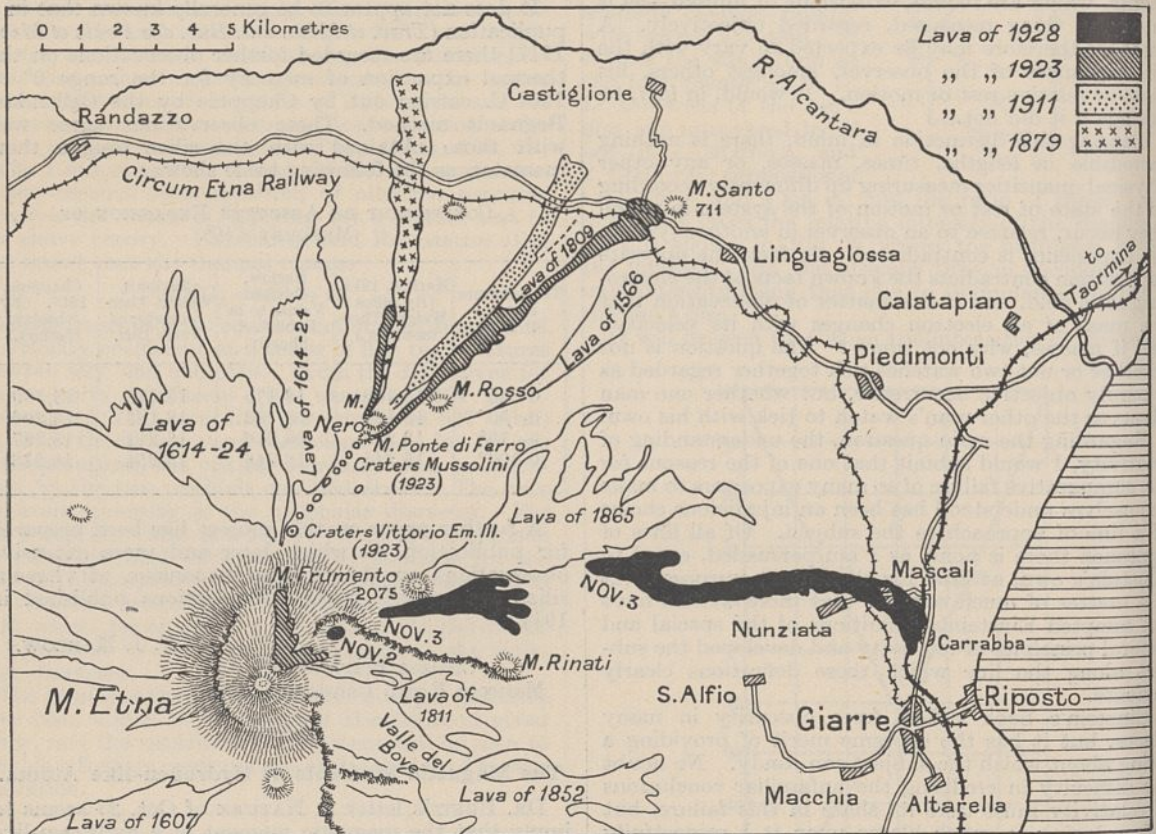


FIG. 1.

for the eruption of 1908 in the upper part of the Val del Bove stopped after a few days. Since then, we have had the eruptions of 1911, 1918 (of a few hours' duration), 1923, and the present year.

When Etna is in eruption the lavic magma accumulated in its interior does not as a rule issue from the central crater, but opens a passage in its lateral walls, either because the lava is unable to rise so high as the summit (3313 metres above sea-level) or because it exerts on the flanks of the volcano a pressure so great that it breaks them in places and flows through. Thus, at 16 h. 30 m. (3.30 P.M., G.M.T.) on Nov. 2, 1928, without any

warning, an explosion occurred in the highest crater on the north-east side, while the central crater was quite still. At 18h. a new vent opened in the Val del Leone (2700 metres), with emission of lava over about 350 metres ; at the same time the subterranean course of the lava was directed to the south of Monte Frumento, so far as the eastern flank of Monte Cubania, where a second

vent was opened, the lava from which invaded the valley below and stopped on the plain of the Donne. Towards the evening of Nov. 3, a more intense lavic effusion prolonged the subterranean course of the lava so far as the region 'La Naca' (1150 metres), where the third vent was opened (Fig. 2), the lava from which emerged and reached nearly to the village of Carabba, about 1500 metres from the sea. Along this subterranean course, small craters occur in the form of buttons and of different magnitudes.

The present eruption of Etna is one of the feeblest recorded in history, but the enormous

damage done is greater than that in other eruptions of longer duration.

The district traversed by the lava is the most fertile on Etna, and what was once the smiling district of Mascali, a flourishing fruit-grove, a luxuriant garden, or a fine vineyard, is now buried beneath an enormous mass of hard and smoking lava. In the piazza of Mascali, after the lava had closed in on the village, the church and belfry still held out; but the lava surrounded it, and, on Nov. 7, the church collapsed, dragging the belfry with it in its ruins (Fig. 4).

Etna in eruption is a truly grand and impressive spectacle that defies description. The rumbling volcano mutters gloomily in its new mouths, and from it issues a fiery stream which at the origin runs like a river of viscous incandescent material; a couple of kilometres farther downwards the movement is shown by the slow sliding of the great masses which cover the interior incandescent pasty mass, whilst in front the movement is manifested by the continuous crumbling of lumps of various sizes, pushed forward by the pressure of the internally fluid lava, and detached from the sides of

magma, and through this last extension of the stream, districts not invaded at first, and property so far spared, are continually threatened with invasion and consequent destruction.



Photo.] FIG. 2.—Principal vent with the liquid incandescent magma on the right; by night. [Pirrone



Photo.] FIG. 3.—Cascade of lava near the Fossa Santoro; by night. [Pirrone.

the mass of lava with a metallic noise, the incandescent mass inside appearing like the interior of a great heated oven.

The stream then exerts on the lateral moraines formed by the consolidated lava a constant pressure so as to make some point of the moraine give way, determining a rearrangement of the

The temperature of the flowing lava is about 1050°, yet, before issuing, it was higher, because the passage of the gases adds a pressure of many atmospheres to the surrounding pressure, and occasions a loss of internal heat, known as the heat of expansion. A curious phenomenon, which indicates the low temperature of the surface layer of the lava-flow, is the presence of several tree trunks entangled in the crust of the lava that show no sign of the action of heat beyond an incipient charring. Sometimes the stream has dug into the ground so that trees are torn up with all the soil about their roots. Near the lava there is always noticed the smell of hydrochloric acid, and near the eruptive mouths that of sulphur dioxide.

In the recent eruption are noticed blocks of old lava, torn from the deep strata of the ground which form part of the framework of Etna, like the rocks which are observed in the denuded strata and dykes of the Val del Bove. This lava, however, does not represent the true massive compact lava; is of a greyish-black colour, rather

heavy, and similar to that of the latest Etnean eruptions. One notices a moderate abundance of enclosures of plagioclase, a little augite and still less olivine, magnetite, and vitreous material.

On Nov. 12 the eruption entered decisively on the decreasing phase, and on the date of writing (Nov. 18) the external manifestations of the

eruption may be said to have come to an end. There are already to be seen fumaroles with beauti-

than would be expected, seeing the very low position of the mouth from which the lava was emitted. An end so premature was principally due to the lack of fragmentary material. The mouths of the eruptive apparatus were not able to form those great cones which, like monuments, indicate to posterity the hundreds of eccentric eruptions of Etna.

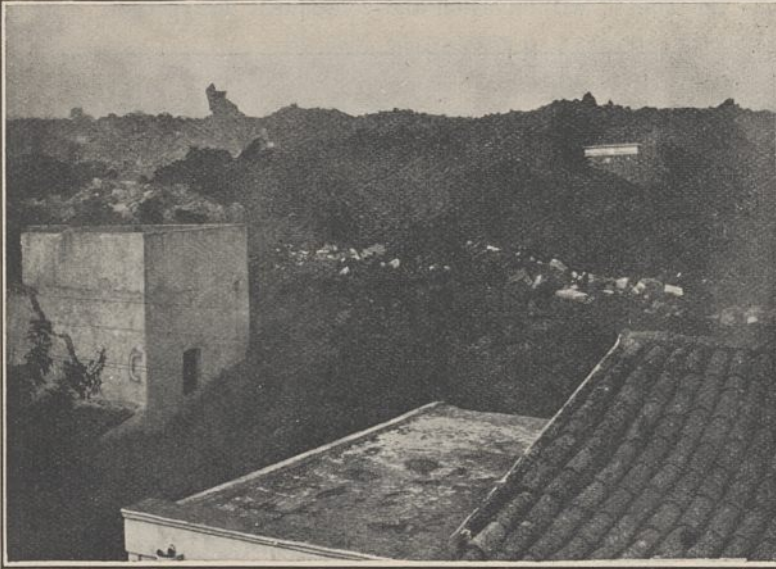


FIG. 4.—The last houses of Mascali burning.

ful incrustations of sublimated substances, especially of ammonium chloride. On the whole, this eruption of Etna has been of brief duration, briefer

Many threatened villages have been spared, but the district round Mascali remains buried for ever. After the tremendous eruption of 1669, which destroyed many villages and reached as far as Catania and the sea, passing rapidly over 18 km., this is the first instance of a district invaded by lava. At some future time, when the district now covered with lava once again enables plants to flourish and to provide men with means of living, the present eruption will be forgotten or will remain as an historical event, until another will come to revive its memory and pass through the same cycle of events.

#### A 'Growth Substance' and Phototropic Response in Plants.

THE remarkable development made in recent years in animal physiology in the study of the endocrinal secretions and their relation to growth has naturally encouraged the tendency to find growth-regulating substances in plants. Most such suggestions as yet are notable for their slender experimental basis, so that the more importance attaches to a recent dissertation by Dr. F. W. Went,<sup>1</sup> describing numerous experiments carried out in his father's laboratory at Utrecht, which are regarded by the author as establishing the existence of a growth substance (*Wuchsstoff*) in the organ of one plant, the coleoptile of the oat.

The coleoptile is a remarkable little structure—the first part of the shoot of the oat (or other grass) seedling to emerge from the grain into the air; it is a little hollow cylinder with a conical closed top which is burst through by the first leaf of the plant, when it is left as a collar around the base of the lamina. It has been the basis of innumerable studies in plant physiology, and it is no exaggeration to say that recently scores of papers have come each year from Continental laboratories dealing with this little structure. Indeed, one distinguished German botanist is reported as saying that there is at present a 'coleoptile fashion' in the German laboratories.

The reason for this intensive study is that the coleoptile is the classic object upon which was first demonstrated by Charles Darwin the reception of

an external (light) stimulus at one point, the apex of the coleoptile, followed by a growth movement, curvature towards the light, near the base of the object. Thus the response of the plant to light apparently could not be the direct result of the action of light upon a complex growing tissue. Rather we had to deal with an external stimulus received in one region, from which influences then were transmitted which modified the mechanism of growth at work in another region of the plant. Thus the phototropic response of this little organ has profoundly influenced the development of botanical ideas as to growth and its response to light and gravity, etc.

The new outburst of experimental activity upon the coleoptile followed upon some interesting experiments by Boysen-Jensen, in which he showed that if the tip of the coleoptile were cut off and then replaced again upon the stump by the aid of a little gelatin, when the tip was afterwards illuminated laterally, the usual tropic curvature took place in the base of the organ. This immediately seemed to place the growth controlling machinery in the category of substances, in this case diffusible through gelatin, which were moving from the receptive tip towards the responsive base of the coleoptile. The one-sided illumination of the tip then modified either the formation or the subsequent distribution of these substances, or partially destroyed them, so that on their arrival in the basal region, unequal growth now took place.

Since Boysen-Jensen's papers an army of in-

<sup>1</sup> "Wuchsstoff und Wachstum," by F. W. Went. *Rec. des Trav. bot. Neerland.*, 25, 1-116; 1928.



vestigators have entered this field and interpretations are almost as numerous as the workers; it is only intended here, however, to refer to the recent interesting monograph by Dr. Went, which, starting from the phototropic problem, has ended by contributing rather to the more general problem—the nature of the mechanism involved in normal growth.

Dr. Went has developed a most beautiful and careful technique for which reference must be made to the original paper, which is very clearly written and is full of interest. The crucial experiment, repeated in many forms, consists in placing a number of coleoptile tips (grown in darkness and manipulated in red light, to which they are insensitive) upon a thin slice of jelly (gelatin, agar or silica gel). When afterwards a little piece of this jelly is placed asymmetrically upon the cut end of another coleoptile, from which the tip has just been removed, the result is a negative curvature (*i.e.* away from the side receiving the jelly) which is interpreted as due to the growth substances diffusing from the jelly into the base of the coleoptile.

After 170 minutes or so (at 25° C.) this original negative curvature was followed by a positive curvature which soon cancelled the first curvature and is regarded as due to the regeneration of a new 'physiological' tip, which apparently forms first on the side of the cut stump not under the jelly, and from which a new supply of growth substances must be released into the base of the coleoptile. This 'physiological' tip is a very obscure phenomenon. The stump simply heals by slow suberisation and drying at the cut surface; there is no regeneration of active growing cells as when a wound phellogen forms beneath the cut surface.

Dr. Went shows by remarkable experiments that the amount of curvature produced is proportional to the number of tips that are put upon the jelly originally and to the length of time they are left upon it; in fact, that the curvature is determined by the absolute amount of this growth substance thus placed upon the stump of the reacting coleoptile.

Dr. Went is then led to consider how this substance, diffusing from the coleoptile tip, determines its growth. In the first place, the coleoptile exhibits a strictly limited type of growth. No new cells are formed throughout its extension in length, except perhaps in its two vascular bundles, and all increase in length is due to increase in cell size as the result of taking in water. Dr. Went's *Wuchsstoff* must act, then, by modifying this process of extension in cell size, and he suggests that it modifies the extensibility of the wall. Such an effect is a very subsidiary type of growth modification, and it is doubtful if it is desirable to call the substance producing it 'growth substance.'

Curiously enough also, the cells at the tip of the coleoptile, presumably the first to come under the influence of this substance, which Dr. Went shows is only produced at the tip and by no other part of the coleoptile, are the least extended in length in the coleoptile. He is thus led to sug-

gest that there is a second necessary factor governing cell extension, namely, the supply of what he describes as the materials required for wall extension. These are supposed to come from the base of the coleoptile and to be limiting the extension of these apical cells. Presumably, such wall-extending materials would be carbohydrate in nature, and as the cells of the tip, as of the rest of the coleoptile, are originally packed with starch, it is a little difficult to accept this interpretation of the failure of the apical cells to extend in length. There are obviously other alternatives. For successful cell extension the extensible stage in wall development must coincide with the development of high osmotic pressures within the cell. Starch disappearance always begins at the apex of the coleoptile, and possibly the walls in this region are too thick and inextensible to stretch at the time that the rest of the cells of this organ are taking in water and extending.

Dr. Went discusses the mode of transport of the *Wuchsstoff* down the coleoptile. He confirms an earlier observation of Brauner that protoplasmic streaming occurs in the cells, and from his observations of this process concludes that this is responsible for a downward rate of movement which is 200 times too fast to be explained by diffusion. He has some very interesting experiments in which he watches the transfer of the substance from a piece of jelly at the top cut end, down the coleoptile and into a piece of jelly at the lower end. He concludes that some of the substance is missing, 'used up' in the length of coleoptile, though it is not clear why this missing substance should not be looked upon as in transit. He is unable in a similar experiment to get his growth substance carried in this manner *up* the coleoptile from a jelly containing it placed at the lower end. This is surprising, as presumably the streaming machinery should be equally effective in carrying substances in either direction, and, indeed, Dr. Went assumes that it is responsible for carrying the wall-extending materials up to the apical region of the coleoptile from the reserves in the grain.

Dolk's experiments had previously suggested that without the growth substance from the apex of the coleoptile, no extension in length of this organ is possible. Dr. Went is inclined to agree with this, and, indeed, not only in the coleoptile, but also in earlier experiments by Taanmes upon shoot defoliation, the effect of such leaf removal upon cell extension in the internode was remarkable. The cells towards the base of the coleoptile are not so long as those farther up this structure. Dr. Went cut out the middle region of the coleoptile and placed the jelly with the growth-promoting substance on the cut stump. He thus obtained a slight elongation (six per cent in three hours) in cells of the stump which previously had ceased to grow, whilst without such jelly no increase in length occurred.

From experiments upon the rate of diffusion, Dr. Went is able to make a rough estimate of the molecular weight of the *Wuchsstoff*. On the assumption that it is non-ionised, he thus arrives at the figure 376. Until now, the substance has defied

chemical characterisation; it is present in such minute quantities in the jelly and probably contaminated by other substances diffusing from the injured cells. It has been impossible to produce similar activity by the use of any pure substance in its place.

A new chapter thus seems to be opened in the study of the correlating influences controlling the

process of cell extension in the tissues of the plant. It is safe to predict that the subject will not be left long in this interesting state, but that further work will elucidate the connexion of the apex of the coleoptile with the extension of its base, and at the same time determine the significance of this mysterious *Wuchsstoff* that diffuses from the cut tip when placed on agar. J. H. P.

### The Wright Brothers' and Langley's Aeroplanes.

IN the new wing of the Science Museum, South Kensington, in perhaps the most prominent position, will be found the original Wright aeroplane with a long descriptive notice. This states that it was the first power-driven man-carrying aeroplane to make a free, controlled, and sustained flight. The machine, which was built by Wilbur and Orville Wright, was flown by them on Dec. 17, 1903, at Kittyhawk, North Carolina, and its production was the result of their prolonged experimentation and research, which had been stimulated by the gliding experiments of Otto Lilienthal.

Since the first flights were made the aeroplane has been preserved in the Wright laboratory, but certain parts which had been damaged during their last flight, one extending over 59 seconds and covering a distance of 852 feet, have been replaced, and the machine restored to its original condition.

The fact that this machine, essentially American in ownership and manufacture, should be in the possession of a British museum is rather significant, and is the key to a publication which has just been issued by the Smithsonian Institution, dealing with their relations with the Wright Brothers. The publication, which was issued over the name of C. G. Abbot, Secretary of the Institution, is an attempt to clarify an unfortunate controversy, to correct misunderstandings, and to do justice alike to three great pioneers of human flight—Wilbur and Orville Wright, and Samuel Pierpoint Langley, who, as they themselves said, gave them "a helping hand at a critical time." The details of the controversy, which in parts is rather painful, need not concern us at present, but the difficulty was associated with the exhibition in the United States National Museum in 1918 of a reconstructed variation of a machine which Langley endeavoured to fly in 1903. The label attached to it originally described it as "The original full-sized Langley Flying Machine"; this was later amplified to include a claim that it was the first man-carrying aeroplane in the history of the world capable of sustained free flight; that it was tested over the

Potomac River by Langley in 1903, and successfully flown in June 1914.

As a result of the controversy and further investigation into the actual flights carried through by this machine, the label was altered to indicate that in the opinion of "many competent to judge," the machine was the first "heavier than air craft" in the history of the world capable of free flight under its own power, since it had become clear that in the original test no proper flight had emerged. Smarting under a sense of injustice, Mr. Orville Wright presented their machine for exhibition for five years to the South Kensington Museum.

Committees connected with the Smithsonian Institution have investigated the historical accuracy of the statements which have appeared on the labels, and now in this pamphlet the invitation of the Smithsonian Institution to Mr. Wright is renewed, to deposit for perpetual preservation in the United States National Museum the Kittyhawk plane with which he and his brother, it is agreed, were the first in history to make successful sustained human flight in a power-propelled heavier-than-air machine.

As a further display of goodwill, the Institution is willing to let Langley's aeroplane rest on its merits, and has directed that the label on the Langley Aerodrome shall be so modified as to tell nothing but facts, without additions of opinion as to the accomplishments of Langley. The label now reads: "Langley Aerodrome. The original Samuel Pierpoint Langley Flying Machine of 1903. Restored."

No doubt it was because the Wright brothers have always been appreciated in Great Britain for their wonderful pioneer work in this new field of human endeavour that the machine was deposited in one of our Museums. Whether or no it should now be returned to the United States is clearly a matter for Mr. Orville Wright himself to decide. We, at any rate, in Great Britain shall be extremely sorry if it is to leave our shores; but in any case it is to be hoped that the Science Museum authorities will take steps to procure the production of as close a replica as possible.

### Obituary.

PROF. T. C. CHAMBERLIN.

A MASTER of research has passed in Thomas Crowder Chamberlin, emeritus professor of geology in the University of Chicago, whose death occurred on Nov. 15, shortly after celebrating his eighty-fifth birthday on Sept. 25. His place is with the greatest thinkers of the past. He leaves few if

any equals among his contemporaries. His far-flung research into the processes of the universe is a challenge to younger students to spread wings of imagination toward the unknown, but only with thorough understanding of the course to be flown and constant checking of the navigation.

Chamberlin, the glacialist, geophysicist, and cos-

mogonist, was a geologist in that large meaning which he expressed at the Cleveland meeting of the Geological Society of America a year ago, in calling upon his colleagues to overleap the bounds of a petrified, terrestrial science. Rocks are not dead. They are to be studied as living assemblages of energy, organised according to the laws of physics and chemistry. He bade geologists explore these domains intensively, as their own. He invited them to penetrate the marvellous cosmogonies of the atoms, where in those intimacies of Nature lies hidden the secret of evolution. He unrolled the history of the planet and traced our dynamic descent from our parent, the sun. His concept of geology embraced the solar system and touched the stars. Fully aware that he could not long sustain the effort, he appealed earnestly to his fellows to carry on in all the fields of science of which "astronomy is the foreign department."

Chamberlin will always be known as the author of the planetesimal hypothesis of the birth and growth of the earth. Its fundamental concepts are wholly his. The mutual reactions of the sun and a passing star in giving birth to the planetary system he reasoned from the orderly movements of the planets, as he has more recently argued the erratic origin of comets in the sun's unguided, eruptive activity. These concepts are the survivors of a large number of possible hypotheses which he investigated, rigorously applying the method of multiple hypotheses. His endeavour was to find a process that would give rise to swarms of matter endowed with energy in such wise that the dynamic peculiarities of the planetary system might evolve from them. The initial idea of the growth of the planets by a gathering in of planetesimals was forced upon him by the failure of the gaseous and meteoritic assemblages of matter to meet the tests to which he and his collaborator Moulton patiently subjected them. Some thirty odd years ago he compared the work in which he was engaged to that of a miner exploring an old mine to ascertain what of value might have been left in the leads. It was not until he had proved the old leads valueless that he turned to new prospects, which he exploited patiently, persistently, and critically in discriminating search for the true vein of reality.

In collaboration with the colleagues whom he drew about him, Chamberlin was dominant because of the tremendous mental power behind his thinking, but never by assumption of authority. He put forward every idea that his fertile mind conceived. Then he tried each one by natural logic, as his phrase was, and he expected his associates to test his suggestions by every pertinent, crucial fact or by mathematical analysis. He welcomed a justified destructive critique as clearing away an obstruction to advance. He constantly guarded himself and his fellow students against over-confidence in the verity of his assumptions.

Shortly before the appearance of his last work, "The Two Solar Families," which reviews his

previous work critically and presents supplementary facts that strongly support the original deductions, Chamberlin wrote: "The most friendly thing that I can urge is that you look critically into my logic and my conclusions. I have, of course, great confidence that in all essentials I am in the line of reality, but it behoves others to discount any self-partiality that may creep into my work." Unfortunately, few are qualified by understanding of geology, geophysics, and celestial dynamics to analyse, much less to criticise, Chamberlin's contributions to the science of the earth and the solar system. His philosophy of geology will not bear its full fruitage until a generation shall have grown up free from the inherited theories that he discarded and open-minded toward the new ideas he inspired.

Chamberlin's intellectual detachment from his own ideas was the more remarkable because he was a man of very strong convictions. He was most conscientiously convinced, however, of the inviolate integrity of truth, and he defended the truth, as facts presented it, from misrepresentation by himself as sternly as from attacks by others. The vigour of his argument, backed by his powerful personality, sometimes conveyed the idea that he was opinionated, but his force of expression simply represented the intensity of his pursuit of actualities. He was infinitely patient with new suggestions, whereas he could be bitingly severe in rejecting the false or meretricious.

In geology, Chamberlin has contributed largely to an understanding of glaciation and Pleistocene climates. He himself would speak with amusement of the apparent inconsequence of his intellectual evolution from a student of glacial cold to an investigator of solar heat. It was a natural evolution, however, for his philosophic mind, which traversed all terrestrial and related phenomena understandingly. His "Manual of Geology," prepared in co-operation with his devoted associate, R. D. Salisbury, is distinguished by its penetrating analysis and correlation of facts, as well as by the consideration of alternative views of unsolved problems.

This is not the place to enumerate his many contributions to geology, to describe his official activities in the U.S. Geological Survey, or his service to the University of Chicago. Neither may we dwell upon his more intimate relations with his fellows. He was a most inspiring teacher provided the student was in earnest. He would discuss his own ideas without reserve with his associates, and he welcomed theirs. He was most conscientious in giving credit to others, and his scorn was unsparing for those who would take credit for borrowed ideas. As mass is energy, so Chamberlin was sincerity; and his sincerity was housed in a great and noble mind.

BAILEY WILLIS.

WE much regret to record the death on Dec. 7 of Dr. J. W. L. Glaisher, F.R.S., senior fellow of Trinity College, Cambridge, at the age of eighty years.

## News and Views.

THE managing committee of the National Trust estate at Ashridge has recently let the shooting over the property to some local sportsmen. Many naturalists are much concerned at the inevitable interference with the wild life and the consequent destruction of hawks, owls, and other 'vermin.' At a recent meeting, the Herts Natural History Society unanimously passed a resolution deploring the action of the National Trust in letting the shooting rights on the Ashridge estate, recently acquired for the nation by public subscription. The resolution points out that the preservation and shooting of game inevitably entails the destruction, disturbance, and discouragement of various beautiful and interesting forms of wild life; and that the establishment of the Ashridge estate as a national Nature reserve is much more in accord with public feeling, and with æsthetic and scientific interests, than the letting of shooting rights to private persons. Having regard to the facts above stated, the Herts Society urges the National Trust definitely to establish the Ashridge estate as a Nature reserve and wild life sanctuary, which step the continuance of game preserving and shooting on the estate would render impossible. The establishment of Nature reserves is an ecological experiment of the results of which we know at present very little. Animals may need a certain amount of control as well as the vegetation, and aliens such as the grey squirrel have to be prevented from interfering. But at present we imagine that all biologists would agree that the best thing to do is to leave the animals alone and see what happens. Shooting for sport must always be detrimental.

THE growing interest in the evidence for so-called spiritualistic phenomena is reflected in the popular symposium which the *Daily News* is publishing. The series of articles appears under the names of a number of different persons in various walks of life who attempt to reply to three questions set them under the terms of reference. The first deals with the point of whether the claims of the spiritualists are proved or disproved, or whether indeed they are likely to be proved or disproved. The second asks for the evidence upon which the conclusions of the writer are based; and the third seeks information concerning the opinion of each contributor as to whether the pursuit of spiritualistic practices tends to be injurious to the minds and bodies of those taking part in them. Mr. Robert Blatchford opened the discussion in a characteristic article, which, however, failed to appreciate altogether the scientific aspect of the question. The symposium is being continued by a number of other writers, including Sir Oliver Lodge, who, in the issue of Dec. 8, wisely refrains from answering directly any of the three questions, contenting himself with an attack upon the mechanistic interpretation of life, and concluding with the statement that the evidence for survival has grown of late years and is still growing. Mr. J. M. Robertson, in the issue of Dec. 10, holds that the history of fifty years fails to afford scientific proof

either of (1) 'spiritual' control of inanimate objects, or (2) communications to human beings from deceased persons. The series, although of little importance to scientific men, may be of some interest in so far as it may throw light upon the attraction that spiritualism appears to have for numbers of people, thereby illustrating some curious points in religious psychology and the foundations of belief.

UNDER the chairmanship of Brigadier-General G. H. Gater, Education Officer to the London County Council, Mr. Ormsby-Gore, Parliamentary Under-Secretary of State for the Colonies, gave a valuable address on "Developments and Opportunities in the Colonial Empire" on Dec. 6, at University College, London, at a public meeting arranged by the Association of Scientific Workers. To the concentration of attention upon the settlement, development, and constitutional issues of the British self-governing Dominions may be attributed the lack of appreciation by the public of the remarkable developments which have taken place during the lifetime of the present generation of the non-self-governing dependencies, said Mr. Ormsby-Gore. After giving a number of striking illustrations of the rapid economic expansion of different colonies, he outlined the tasks of the Colonial Office. The Colonial Office is responsible for the opening up and development of new means of communication in these overseas territories, and the application of science to the problems of agricultural production, public health, and education. The demand for adequately trained personnel is increasing, more especially the demand for those who have received a thorough training in the biological sciences. In particular, the dependencies are now thoroughly alive to the importance of the plant geneticist for the development of new and higher-yielding varieties of all the various tropical crops. But apart from that particular outlet, biologically trained men will find scope for the application of this special knowledge in the administrative and political services. Such knowledge will be an invaluable asset, for it will give them a greater appreciation of the problems awaiting solution and a fuller understanding of the peoples for whose development they are accepting responsibility.

In his introductory remarks, General Gater paid tribute to the energy, enthusiasm, and appreciative understanding which Mr. Ormsby-Gore has brought to bear upon the problem of Empire development. The four personal visits he has paid to the non-self-governing dependencies, first to the West Indies and British Guiana, to East and Central Africa in 1924, to West Africa in 1926, and that to Malaya and Ceylon from which he has only recently returned, indicate his desire to study problems on the spot. The suggestions and recommendations contained in the reports dealing with these visits are alike admirable, and have played a great part in promoting the expansion of the scientific services. As chairman of the Advisory Committee on Native Education in Tropical Africa, Mr. Ormsby-Gore has given abundant evidence also

of his grasp of the essentials in education policy. In thanking Mr. Ormsby-Gore for his address, Sir Thomas Holland endorsed the appeal which he had made for biological teaching in the schools, and for trained biologists for the Colonial Services. Sir Richard Gregory reinforced this appeal, and also referred to the significance of Mr. Ormsby-Gore's appreciative understanding of the rôle which science plays in the development of the world's resources and man's knowledge of his environment, without which there can be no healthy mental and physical growth. Scientific workers are greatly indebted to Mr. Ormsby-Gore for his persistent advocacy in Parliament of the cause of science. Mr. Ormsby-Gore's address will be printed in full in the December issue of the *Scientific Worker*, the official organ of the Association of Scientific Workers. Copies of this journal may be obtained by forwarding threepence in stamps to the General Secretary, Association of Scientific Workers, 25 Victoria Street, London, S.W.1.

An interesting case of so-called voodoo, or more properly witchcraft, is reported from Pennsylvania by the New York correspondent of the *Times* in the issue of Dec. 5. Three persons have been accused of the murder of a farmer named Ribmeyer in York County. Of the accused, one was a local 'pow-wow' doctor, while of the other two, aged respectively eighteen and fourteen, the family of the elder, named Hess, was convinced that it had been bewitched and consequently had suffered a series of misfortunes. The help of the pow-wow doctor was sought, and he accused Ribmeyer, who lived as a recluse on his farm, and said that the spell would never be broken until they had obtained a lock of his hair. This is a variation of the well-known method of breaking a witch's spell by drawing blood from the witch, but the use of a lock of hair is familiar in principle both in English and American folklore as a method of curing ills such as headache, toothache, or other which may well be the result of a spell. It was stated by the coroner that during the last two years no less than five infants had died in York County as the results of witch-doctoring, but members of the County Medical Society say this figure is much too low. A determined effort is to be made to drive out 'pow-wow' doctors. It is said that voodooism has been practised in York County and rural Pennsylvania since revolutionary times. Presumably 'voodooism' is not to be taken literally, but as a descriptive term for the arts of the witch and dispenser of charms and spells.

DISCUSSING human speech and expression by gesture in a lecture delivered on Dec. 6 at the Royal Institution, Sir Richard Paget stated that children when they invent words for themselves commonly do so by making (unconsciously) a pantomime with their mouths. In archaic Chinese, in ancient Sumerian (as spoken at Ur of the Chaldees), in the Aryan and Semitic languages and even in Polynesia and on the west coast of North America, the same root words occur—made by the same descriptive tongue gesture—as for example the upward movement of the tongue which produces the word 'al,' meaning 'high,' or

'strong' or 'protect' or 'rise.' The human courtship gesture words 'lub' and 'kam' are also found (with small variation) in all these languages. To the objection that the theory of mouth pantomime is fanciful, it may be replied that so is man's unconscious mind, and that we are all born full fledged for flights of fancy but soon moult or are plucked in the course of our education. 85 per cent of the word groups in the first 20 pages of Kailgren's Dictionary show pantomime evidence, while for Aryan roots the proportion is 77 per cent or more, and 86 per cent for groups of Polynesian and North American Indian words collected by Paul Rivet. Both the names and the symbols of the so-called Arabic numerals are formed by mouth or hand pantomime. Hand gestures were less used by the northern races than the southern, because the northerners led harder lives and had less hand leisure. Originally human speech may have been a simple universal language like the universal sign language of deaf mutes; it has since become elaborated and conventionalised. In song the musical language of emotion and the pantomime language of thought are ceremonially wedded. Poetry is a descriptive dance of the tongue and lips performed under the joint direction of the mind and the emotions.

THE problem of the origin of life has been much discussed, and little progress has been made in spite of the researches of the colloid chemist and the experimental physiologist. It has revolved about the relatively simple and yet complex enough microscopic organisms in which plant life and animal life seem to join hands. The problem is, however, pushed one stage further back, speculatively and tentatively, by J. B. S. Haldane in an article on "The Origin of Life" in the *Rationalist Annual* for 1929. He visualises the beginning of living things in a far-back primitive ocean, which, through the uninterrupted action of the ultra-violet rays of the sun acting upon a mixture of water, carbon dioxide, and ammonia in the absence of atmospheric oxygen, had reached the consistency of hot dilute soup (probably rather clear than thick). The discoveries of the bacteriophage and the gene, and that the main difference between the former and a lethal gene, namely, that the latter is only known within a cell and the latter outside, points to the bacteriophage as a gene which has broken loose, and as an ultramicroscopic something, which if not actually alive is on the verge of life. It is a step beyond the enzyme on the road to life. At about the same stage are the viruses which cause such diseases as smallpox and hydrophobia. They can multiply only in living tissue, and pass through filters which stop bacteria.

MR. HALDANE thinks that the primitive organisms were probably ultramicroscopic; further, since they lived in an atmosphere containing little or no oxygen, they must have obtained the energy they needed for growth by some other process than oxidation, namely, by fermentation. The embryos of the most highly organised creatures, chicks and mammals, start life in an anaerobic fashion; so that the phylogenetic test supports the hypothesis. Probably the first living or

half-living things were large molecules synthesised under the influence of the sun's radiation, and only capable of reproduction in the particularly favourable medium in which they originated. But the molecules of organic things possess a persistent type of build, and that suggests a common molecular ancestor, or, in other words, that one, and only one, primitive organism was the fountain-head of all things living. This may have been due to a single happy synthesis, or more likely to the start obtained by the progeny of the first success enabling them to swamp later tentative entrants to the organic world. There is many a 'perhaps' and an 'if' in the story, but it is a speculation which, one of these days, will be put to the experimental test.

THE leading article in NATURE of Nov. 3 on "The Understanding of Relativity" has drawn an inquiry from a correspondent with regard to the idea of gravitational attraction. The questions asked are: "Does the sun exercise an attraction upon the earth? Does the earth exercise an attraction upon a pendulum? Does the attraction of a mountain deflect a plumb-line?" Our correspondent goes on to say that the highest authorities answer these questions in the negative, and their answers are not intelligible to the ordinary student, who is hampered not by want of faith, but by want of understanding. It might be suggested to those who share this difficulty that they ask themselves whether their understanding would be any clearer if the questions were answered in the affirmative. The simple facts that the earth moves towards the sun, that a pendulum tends towards its lowest point, and that a plumb-line leans towards a mountain, are of course data of experience, independent of any theory or explanation, and no one has any difficulty in visualising them. But if one goes further and asks why they happen, is his question really answered more intelligibly if he is told that the sun, or the earth, or the mountain has some mysterious power by which it attracts its distant votary, than if he is told that the latter behaves in the manner natural to it in the circumstances in which it finds itself? Neither answer is of course an 'explanation' in the true sense of the word, and our correspondent might well consider whether his preference for the *Deus ex machina* of gravitational force is not a legacy of early years, when anthropomorphic conceptions were more satisfying than abstract descriptions. The contention of the article in question was, of course, not that the whole detailed structure and development of the theory of relativity were simple to understand, any more than are those of the classical electromagnetic theory, for example, but that the *special* difficulty that is supposed to envelop relativity is the result, not of an intrinsically esoteric character, but of instinctive incredulity on the part of the student.

THERE are many obvious advantages in using battery eliminators to get rid of the trouble of charging the accumulators used with ordinary radio receiving sets. When the eliminators are directly connected with the electric mains of the supply company serious risks, however, may arise unless special pre-

cautions are taken. The requisite precautions are laid down in the wiring rules of the Institution of Electrical Engineers. In our opinion, the responsibility of instructing the public lies with the retailers of the eliminators. We think that there is a real danger. In the *Electrical Review* for Nov. 30, Mr. Rawll describes some appalling cases of dangerous wiring. In one case he found that a bare wire taken from the supply terminals passed through the kitchen to the receiving set worked off the supply mains in the living room. The full pressure of the supply existed between the water tap in the kitchen and this wire, and in certain circumstances this might easily give a fatal shock to anyone making a circuit between the two. This had been going on for months without those in the house realising the risk they were running. The pressure between one of the supply mains and the gas or water pipes or a damp floor or wall in Great Britain is usually 230 volts. Touching the wire and an earthed conductor with dry fingers the electric shock is usually slight. But between moist hands, or between a moist hand and the feet in damp boots on a damp floor, the shock can be dangerously severe. Experience has shown that the shocks received from alternating current supply mains are more severe than those from direct current supply. When properly installed, radio battery eliminators can be made as safe as the electric wiring used for lighting a house. Apparently many of the amateurs who instal the apparatus are quite ignorant of the risks arising from electric shock.

THE annual congress of the British Institute of Radiology and Röntgen Society, which was held at the Central Hall, Westminster, on Nov. 14-17, proved a pronounced success. The attendances were large and much interest was evinced. The president, Dr. G. W. C. Kaye, Superintendent of Physics at the National Physical Laboratory, referred in his presidential address to the steady growth of the Institute, which, with the affiliated members, now has a membership of 800, and to the increased scientific facilities at the house of the Institute at 32 Welbeck Street. The address included a historical review of the genesis and evolution of the electrical discharge tube in the seventeenth and eighteenth centuries, particular reference being made to the work of von Guericke, Boyle, Newton, Hauksbee, Gray, Nollet, and others. Prof. W. L. Bragg gave the ninth Mackenzie Davidson memorial lecture on the subject of "X-ray Optics," and Mr. Sampson Handley delivered the eleventh Silvanus Thompson memorial lecture on "Radiology from a Surgeon's Standpoint." A day was devoted to a medical discussion on the value of the opaque meal in diagnosis. Among the physical and technical papers read was one by Dr. G. Shearer on industrial applications of X-ray spectroscopy, one by Mr. W. E. Schall on recent developments in X-ray apparatus, and one by Mr. W. V. Mayneord on X-ray dosage and distribution. The British X-ray manufacturers organised an exhibition of apparatus which attracted large numbers and, in its comprehensiveness and progressive nature, was highly to be commended.

A large party of members accepted the kind invitation of the Director of the National Physical Laboratory to visit the Laboratory where, among other things, they were shown in operation the million volt equipment, a Coolidge cathode-ray tube, constant-potential X-ray outfits, together with demonstrations relative to X-ray spectrometry, measurement, and protection.

AMONG the finds which have recently been retrieved from the tomb of Tutankhamen is mentioned an interesting cult object which illustrates the beliefs of the ancient Egyptians in regard to the relation of the god Osiris, the king, and the crops. This was a figure found in a wooden box and heavily wrapped in linen. When the bandages were removed, a hollow figure of wood was found which had been filled with silt from the Nile. In this, grain had been planted and it had then been wrapped as a mummy. The sprouting of the grain would thus make the mummy a symbol of the resurrection of the god Osiris or of Tutankhamen himself.

ON Nov. 30 occurred the centenary of the birth of Gustav Anton Zeuner, the distinguished German professor and director of, first, the Zurich Polytechnic, then of the Freiburg School of Mines, and from 1873 until 1895 of the Dresden Polytechnic. Born in Chemnitz, he passed through the School of Mines in Freiburg, spent some time in Paris, where he became friends with Poncelet and Regnault, and in 1853 assisted to found the journal *Civil ingénieur*. Six years later, the same year that Rankine included in his "Treatise on the Steam Engine" a section on the new science of thermodynamics, Zeuner published his "Grundzüge der mechanischen Wärmetheorie," which was followed by many valuable works on this and other subjects. Zeuner retired from the directorship of the Polytechnic at Dresden in 1895 and died there on Oct. 17, 1907.

THE unity of science was well illustrated in the recent Thomas Lowe Gray Lecture of the Institution of Mechanical Engineers, delivered on Nov. 30, by Prof. W. E. Dalby, who dealt with the possible vibration of a ship's hull under the action of an unbalanced engine. Commencing with the well-known differential equation of vibration of an elastic body when subjected to damping and forced oscillation, Prof. Dalby examined the consequences which ensue when an engine, unbalanced in various ways, is placed at various positions in a ship's hull either coinciding with nodes or between them. Some results of modern practice were described, in which engine vibration trouble in ships had been successfully overcome, and an interesting parallel was drawn between these and the effects of unbalanced railway locomotives on bridges which have been examined recently by a joint committee representing the Department of Scientific and Industrial Research and the railway companies.

THE Council of the Institute of Metals has found it necessary to alter the date of the twenty-first annual general meeting and 'coming-of-age' celebrations of the Institute, from that originally announced (Mar. 6 and 7) to Mar. 13 and 14 next. The programme

includes a dinner and dance at the Trocadero on Mar. 13, and a *conversazione* and exhibition to be held in the Science Museum, South Kensington, on Mar. 14, when objects of special interest in relation to the work of the Institute will be displayed; offers of such objects are invited and should be made to the secretary, Mr. G. Shaw Scott, 36-38 Victoria Street, Westminster, London, S.W.1. The annual May Lecture of the Institute is to be given on May 7 by Sir Oliver Lodge. The annual autumn meeting will be held in Düsseldorf next September, and it is proposed to hold there a general discussion on laboratory methods of metallurgical research.

THE "Statistical Report of the Health of the Navy" for the year 1926 has recently been issued (London: H.M.S.O.). The returns for the total force show a decrease in the incidence of disease as compared with the five years' average and also with relation to 1925. The disease showing much the largest incidence was influenza, of which there were 1769 cases, all of a mild type. Of malaria there were 280 cases, and it is remarked that it is difficult to render a hammock mosquito-proof by means of a mosquito net. Experiments with various types of net-spreaders will, it is hoped, result in obtaining more efficient protection.

A STANDARD time conversion chart, at the low price of ten cents, has been published by Bureau of Standards, Department of Commerce, U.S.A. It consists of a cardboard disc on which the twenty-four hours are marked, twelve in white and twelve in black. The disc revolves on a card on which the meridians east and west of Greenwich are marked. Against certain of the meridians there are place names. More could easily be added by the user. There can obviously be nothing novel in the construction of such a chart, but it is strongly made and boldly printed, and should prove useful in many schools and elsewhere.

AMONG the forthcoming books of Messrs. W. Heinemann (Medical Books), Ltd., are the following: "On Nephritis," Dr. A. C. Alport; "Fruit and Health," Dr. S. M. Belfrage; "The Machine of Life," Dr. Ethel Browning; "Clinical Observations on Infant Feeding and Nutrition," Dr. H. Gladstone; "Common Colds," Dr. Leonard E. Hill and M. Clement; "The Treatment of Varicose Veins by Intravenous Injections," Dr. J. D. P. McLatchie; "The Mechanism of the Larynx," V. E. Negus; and "The Art of Surgery," Dr. H. S. Souttar.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in geography and geology at the Exeter Diocesan College for Schoolmasters—The Principal, Saint Luke's College, Exeter (Dec. 20). A lecturer in chemistry, with special qualifications in physical chemistry, in the Bradford Technical College—The Principal, Technical College, Bradford (Dec. 28). A rural science teacher and assistant agricultural organiser under the Merioneth Education Committee—The Secretary to the Merioneth L.E.A., Education Department, Dolgelly (Dec. 28). A head of the

department of metallurgy, including pure science, of Constantine Technical College, Middlesbrough—The Director of Education, Education Offices, Middlesbrough (Dec. 31). A lecturer in zoology in the Egyptian University, Faculty of Science—The Dean of the Faculty of Science, Egyptian University, Cairo (Jan. 1). A physiologist at the Experimental and Research Station, Cheshunt, for the investigation of virus diseases of plants—The Director, Experimental and Research Station, Cheshunt, Herts (Jan. 31). A full-time teacher of engineering at the Verdun Technical School, Northwich—The Director of Education, Dept. "C," County Education Offices, City Road, Chester. An assistant in the mechanical engineering section of the engineering department of the Halifax

Municipal Technical College—The Principal, Municipal Technical College, Halifax. A master to teach workshop practice (particularly metal-work) and either engineering or building trades subjects at the Sheerness Technical Institute and Junior Technical School—The Principal, Technical Institute and Junior Technical School, Sheerness. A man with teaching experience in physics, chemistry, and mechanics, at Cordwainers Technical College—The Principal, Cordwainers Technical College, St. John's Lane, E.C.1.

ERRATUM.—In the letter "Elastic Constants of Single-crystal Aluminium Wire" in NATURE of Oct. 27, p. 650, line 14, for "tenths of a gram" read "tens of grams."

### Our Astronomical Column.

USE OF THE 24-HOUR DAY.—About forty years ago an effort was made to assimilate the astronomical and the civil day, making both begin at midnight and using 24-hour reckoning. The effort was a failure, little encouragement being given by astronomers as a whole, and no response being received from the general public. In the last few years the situation has changed; astronomers in general have abandoned the plan of beginning the day at noon, and now follow the civil reckoning in this respect (except that they do not use summer time). This change was suggested by the British Admiralty, and after international discussion was adopted in all the ephemerides from the beginning of 1925. The International Astronomical Union, which met at Cambridge in July 1925, gave further endorsement to the new system, making, however, an exception in the case of the Julian day, which still begins at Greenwich noon.

As regards the use of 24-hour reckoning, there is one department of civil life, namely, the railway timetables, in which its introduction seems desirable. For short journeys there is little difficulty; the use of the symbols A.M. and P.M. at the heads of columns sufficiently meets the difficulty. But in the case of journeys lasting for a large fraction of 24 hours, probably most people find some trouble in interpreting the indications of the tables. The trouble may not be very grave, but it would certainly be diminished by carrying the reckoning of hours up to 24.

The council of the Royal Astronomical Society recently authorised Prof. H. H. Turner to approach the railway companies of Great Britain with this end in view. They replied that they had no objection to the change, but desired an expression of opinion from the general public before making it. Accordingly, a letter appeared in the *Times* of Dec. 8, signed by the Astronomer Royal, by Rev. T. E. R. Phillips (president of the R.A.S.), and Prof. Turner. It gives a brief rehearsal of the above facts, notes that the 24-hour system is general in Continental timetables, and emphasises the fact that the change proposed is strictly limited to railway tables. The failure of forty years ago was largely due to the attempt then made to introduce 24-hour reckoning for all civil purposes: this attempt is now abandoned, so that people may continue to lunch at one and dine at eight, instead of substituting thirteen and twenty. It is hoped that there will be sufficient public response, in one direction or the other, to give the railway companies an indication of the general trend of opinion.

A NAKED-EYE SUNSPOT.—Although not unusually big, a recent group of spots was seen by a number of people through fog or thin cloud prevalent at times

during the transit of the spots across the sun's disc. One observer, near Piccadilly, previously unaware of the existence of the spots, saw the two terminal members of the group as separate dots on Dec. 4 when the angle subtended by them was less than 4'. The group was of stream type with the components closely packed, and changes in their shape denoted considerable activity. Spectroscopic observations made at Worthing on Nov. 30 and Dec. 1 provided more precise evidence of this activity. Position and area of the group are as follows:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
11	Nov. 30–Dec. 11	Dec. 5.6	9° N.	1/800 of hemisphere

A magnetic disturbance was recorded at Greenwich between Dec. 5, 22h. and Dec. 6, 5h.; range in declination, about 40'.

FORBES'S COMET.—From the three positions given in NATURE of Dec. 1, p. 856, Dr. A. C. D. Crommelin has deduced the following elements of this comet:

$T$	1928 Nov. 7.040 U.T.
$\omega$	198° 32' 6"
$\Omega$	248 59 4
$i$	28 39 26
$\log q$	9.87346

These resemble very closely the elements of Comet 1873 VII, discovered independently by Coggia and Winnecke; the latter again resemble those of Comet 1818 I, discovered by Pons. Argelander and Schulhof had already suspected that these two comets were identical, with a period of either 55 years or some sub-multiple of this; since the observed arcs in both years were very short (4 days and 5 days) it was impossible to deduce the period from them. There is good reason to believe that Forbes's comet is the same object, and to hope that it will be observed long enough at the present return to settle the question of the period. The observed intervals are 55.8 and 54.9 years, which do not differ more widely than planetary perturbations give us a right to expect; the recent revolution of Halley's comet was two years shorter than the one before. If the period is 55 years, the aphelion distance would be  $28\frac{1}{2}$  units, not far inside Neptune's orbit, so that it might be looked on as belonging to that family.

The comet is now out of reach in England, but should be followed in the southern hemisphere for two or three months. In the middle of October it was far north of the equator and comparatively near the earth, so that it is rather surprising that it was not discovered then.



## Research Items.

STONE AGE INDUSTRIES OF SOUTH AFRICA.—A new classification of the Stone Age industries of South Africa is suggested by Dr. Van Hoepen in Part I. of the *Archeologische Navorsing* of the National Museum of Bloemfontein. Incidentally, some interesting suggestions are put forward as to the uses of certain of the implements. The classification is typological. The implements of the Stellenbosch, Vaal, and Pniel are equated with Chellean, Acheulean, and Mousterian respectively. The author had previously suggested the substitution of the Pniel culture for the 'Victoria West' culture. In the Koning culture, which is equated with the Aurignacian, a new industry is recognised corresponding with Upper Aurignacian. This is the Poort, so-called from the locality in which it is found, namely, Commissie Poort, Ladybrand district, and characterised by small thumb-nail scrapers and double hollow scrapers, while for the lower Koning culture, corresponding with the lower Aurignacian, is suggested the name Koning industry. Of the remaining cultures the equations are, Stilbay with Solutrean, Mosselbay with Magdalenian, and Wilton with Azilian. In the newly defined Koning industry, the types here described are the trimmer, the disc scraper, and end scraper, flaying knife and curved point. It is pointed out that the term 'scraper' is being applied to implements never used for the purpose of scraping, while they seem admirably adapted for skinning animals, the point being especially well fitted for assistance when the skin holds very tight. The question is raised whether the grey-weathered and red-weathered implements were made by different peoples, or whether worked by the same people at different times, but it is left over for future discussion.

EXPECTATION OF LIFE AND ALCOHOL.—It has frequently been asserted by extreme temperance advocates that even moderate indulgence in alcohol shortens life, and the experience of insurance companies is that abstainers as a whole are longer-lived than non-abstainers as a class, no distinction being made between moderate and heavy drinkers. Prof. Raymond Pearl (*International Clinics*, vol. 3, Series 38, p. 27) has attempted to assess the possible influence of moderate drinking upon the expectation of life by a critical statistical analysis of two groups of individuals. The first group consisted of 5248 persons whose histories had been detailed in Prof. Pearl's Institute records, the second group of 7500 patients who died in the Johns Hopkins Hospital, whose hospital records were abstracted. Both groups were divided on the evidence available into abstainers, moderate drinkers, and heavy drinkers. For both groups the fact emerges not only that the moderate drinking of alcoholic beverages did not shorten life, but that the moderate drinkers had a slightly greater expectation of life than the abstainers (0.36 year—1.25 years for males at different ages, and rather more for females). Heavy drinkers, as might be anticipated, had an expectation of life some eight years less than moderate drinkers at age thirty years, but this difference diminishes with advancing age.

TUBERCULIN TESTING OF CATTLE.—The Medical Research Council has issued a report by Prof. J. B. Buxton and Dr. A. S. MacNalty (*Special Rep. Series*, No. 122. London: H.M.S.O.) on the intradermal tuberculin test in cattle. The tuberculin test by subcutaneous inoculation, which has usually been employed, is subject to many fallacies and entails the taking of the temperature of the inoculated animal on two or more occasions. As a result of a questionnaire addressed

to a number of veterinary surgeons, the intradermal test is recommended in substitution for the subcutaneous and ophthalmic tests. This consists in injecting into the skin with a special syringe and needle 0.1 c.c. of undiluted 'old tuberculin,' the area of infiltration and thickness of the skin after inoculation being estimated. After forty-eight hours the site of inoculation is again inspected. A positive reaction consists in the appearance of a large diffuse swelling, hot and tender to the touch; if this is the case, the animal is certainly tuberculous. If, however, the swelling consists of a hard pea- or bean-like non-tender infiltration of the derma, the result is inconclusive, and a second similar injection of tuberculin is made into this infiltration. The animal is examined twenty-four hours later, and if negative there is little increase in the swelling; if positive, the swelling becomes large, hot, and tender.

CHINESE FRESH-WATER FISHES.—In the *Bulletin of the American Museum of Natural History*, vol. 58, 1928, Mr. J. T. Nichols gives a provisional check-list of the fresh-water fishes of China ("Article I. Chinese Fresh-Water Fishes in the American Museum of Natural History's Collections." Publications of the Asiatic Expeditions of the American Museum of Natural History. Contribution No. 83), covering material in the American Museum of Natural History up to June 1926. Further collections of considerable importance are expected from the Asiatic expeditions, which have already yielded much that is new. The area investigated is restricted to Old China from the outer limits of Chili Province on the north-east to the outer limits of Yunnan Province on the south-west, and does not include Manchuria, Mongolia, Tonkin, or Tibet. Only strictly fresh-water forms are included in the list, which embraces a very large number of fishes belonging to twenty-four families, of which the Cyprinidæ is the largest with eighty-eight genera and sub-genera and many species. Next in number, but far behind, come the Colobitidæ and the Siluridæ. The list is illustrated by good text figures, including the curiously shaped *Cobitidæ Cobitis*, *Misgurnus*, and *Barbatula*. This should be a valuable help to all those studying Chinese fishes.

LANCASHIRE SEA-FISHERIES INVESTIGATIONS.—The Marine Laboratory and Sea Fish Hatchery at Piel, Barrow-in-Furness, is now closed. This involves the abandonment of several pieces of work. With the present arrangements, however, a certain amount of research in connexion with the local fisheries will still be carried on at the Lancashire Sea Fisheries Laboratory in the University of Liverpool. The present report ("Report for 1927 on the Lancashire Sea Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel," No. 36, 1928, edited by Prof. James Johnstone) contains a preliminary note on the hydrographical data obtained on the Holyhead-Dublin steamer, and a study of the muscles of the mysid *Praunus flexuosus* by Mr. J. R. Daniel, besides a summary by Dr. Johnstone of the results of trawling experiments made by the Lancashire Fisheries Committee since 1892 in various parts of the district. In this last report it is shown that the abundance of some common species of immature fishes runs in cycles—the plaice being usually abundant about 1895, 1910, and 1920—whilst at the present time they are scarcer than usual, as they were about 1915 and 1905. Mr. Daniel's work on the muscles of *Praunus flexuosus* is valuable. It is on the same lines as his former work on *Crangon vulgaris* (No. 35 of the present publication, 1926), and this

subject shows very similar structure, although there are certain differences. The most important point is the concentration on a longitudinal arrangement of the ventral flexor muscles, and with this is correlated "the ability . . . to spring backwards through the water by means of a sudden and violent contraction of the abdomen, whereby the telson is brought rostralwards." Mr. Daniel has also studied the muscles of *Meganyctiphanes norvegica* but reserves the description, with a detailed comparison of those of *Crangon* and *Praunus*, until a future occasion. The longitudinal muscles of *Praunus* are in striking contrast to the transverse type which predominates in *Meganyctiphanes*, in which the abdomen is only incompletely flexed.

**ROOT SYSTEM OF APPLE TREES.**—The Annual Report of the East Malling Research Station, Supplement 2, Oct. 1928, contains some remarkable photographs of the root systems of ten-year-old apple trees. The same scion apples are growing upon different stocks, and the differences in the root habit and extent of these two stock root systems are most convincingly demonstrated. Messrs. W. S. Rogers and M. C. Vyvan describe the methods of root examination employed; they are most laborious. For each tree examined, more than sixty tons of soil had to be finely broken up and moved, a task which occupied four men from seven to ten days. The distribution of the roots was also recorded by methods of grading and weighing. One root stock (Malling IX.) proved to be much more deeply rooting than the other (Malling I.). One point of considerable practical importance is that nearly 50 per cent of the fibre of the root system, the absorbing portion, proved to lie outside a circle five feet distant from the trunk. Thus the common practice of applying manure near to the base of a tree would seem to have little justification. Unfortunately, these laborious investigations can only tell us of the final form of the root system when exposed. At the Dutch experiment station at Wageningen there is an underground glass house above which the trees can be planted so that the growth of the root system can be watched throughout the season. Such growth observations would materially add to the value of such data as are presented in this interesting work.

**ROSETTE DISEASE OF GROUNDNUTS.**—Groundnuts form the staple crop in the Gambia Colony, and the absence of an alternative crop renders its liability to 'rosette' (virus) disease of considerable importance (*Annual Report*, Dept. Agric. for Gambia Colony, 1927-1928). Investigations show that the insect carrier is probably one or both of two new species of Jassidæ which are being determined. This carrier would appear to be most active between mid-July and mid-August, judging by the incidence of disease, and so far no other food plants than groundnuts have been observed. Infection appears to be carried over from year to year by groundnuts left in the soil, and though other means are probable it seems evident that infection is not carried in the seed. The most susceptible period is the first few weeks after germination, but rainfall at this time reduces the incidence of disease, probably by rendering the insect carrier less active. The effect of the disease is to stunt growth, increase empty shells up to 55 per cent, reduce the good nuts to about 36 per cent, or to render the infected plants barren. Control at present consists in destroying all plants showing signs of disease and all groundnuts that germinate between the growing seasons, and also in sowing the crop so as to avoid drought so far as possible during the first few weeks of growth. Fertilisers appear to have no beneficial

effect whatever. Three varieties have been raised which have a high degree of resistance to disease, but so far no fully immune variety has been obtained.

**CLASSIFICATION OF COAL.**—Scientific investigators have long struggled with the problem of devising some rational system of classification of coals, but the extreme diversity of the properties has made the task difficult. One of the best-known efforts is that of Prof. S. W. Parr, of the University of Illinois, who proposed his scheme twenty years ago. He has republished in the *Bulletin* of the University Engineering Station, No. 180 (pp. 62; 35 cents), his system applied to a large number of analyses of coal from all parts of the world. His method is, briefly, to plot the heating value of the 'unit coal' substance, that is, the pure coal substance free from extraneous or adventitious matter, against the percentage of volatile matter of the 'unit coal.' Classification depends on the area of the chart into which fall the points for individual samples. The results of such classification can be correlated with those obtained by Seyler's method, but confusion results from the different terminology adopted. The *Bulletin* contains a bibliography of the subject and should be of great interest to geologists and chemists interested in the study of coals.

**CARBONISATION TESTS.**—At the Fuel Research Station, Greenwich, a series of tests has been made on the 'Parkfield Large Gas' coal from the Bristol and Somerset Coalfield (Physical and Chemical Survey of National Coal Resources, Paper No. 12. London: H.M.S.O. 1s. 6d.). This forms another of the tests made on typical coals from various coalfields in full scale plant. Carbonisation tests were conducted in Glover-West retorts with moderate steaming, when the coal proved a satisfactory fuel, if due allowance was made for its highly swelling character. Satisfactory tests were made with horizontal retorts also. The yields of products were comparable with those previously recorded with a well-known Yorkshire gas coal. In the vertical low temperature iron retorts, the tests again show that modifications were needed to allow for the caking properties. The cokes produced were tested as fuel for a Lancashire boiler, gas producer, and a water gas generator. In all cases trouble ensued owing to the fusible character of the ash. This again shows how important a factor is the ash of coal and how desirable it is to perfect the methods of cleaning coal and applying them when practicable.

**FOSSIL ISOPOD CRUSTACEA.**—Although probably abundant in past times, isopods are rarely found fossil. An account of all the forms previously known, with descriptions of some new species, is given by V. van Straelen (*Mém. Acad. roy. Belgique*, 9; 1928). The earliest isopod known is from the Middle Trias of Alsace, but its relationship to existing forms is uncertain. A freshwater form occurs in the Rhætic of New South Wales and is referred to the living genus *Phreatoicus*. Marine types belonging to the families Cymothoidæ and Sphæromidæ are found first in the Bathonian. The best-known genus in England is *Archæoniscus*, found in the Purbeck of Wiltshire, which is related to the Sphæromidæ. That family is also represented in the Purbeck by *Cyclospæroma*. Terrestrial isopods begin in the Upper Eocene. At present palæontology gives no evidence concerning the origin of the Isopoda.

**CORRELATION OF THE CAINOZOIC OF VICTORIA, AUSTRALIA.**—The richly fossiliferous Cainozoic deposits of Victoria, Australia, have from time to time received the attention of palæontologists in that quarter of the world. It has been found more difficult

there to zone the series from Oligocene to Lower Pliocene than has been the case in Europe and America. This is due mainly to the equability of conditions of sedimentation and climates in the Australian region compared with that of other countries. One forward step towards the correlation of these beds in various localities is made with the conclusion of an examination of the material of the bore cores at Sorrento by Frederick Chapman, Commonwealth Palaeontologist, at the National Museum, Melbourne. The work has been in hand since 1912, involving the determination of 10,000 specimens of the larger shells and many thousands of microzoa (Foraminifera and Ostracoda). The description of new species has been the conjoint work of the general author and Miss Irene Crespín, resulting in sixty-one forms new to science. In the earlier part of the work assistance was given by R. A. Keble, of the Geological Survey of Victoria, and now of the National Museum. The spot where the bore was put down is ideal for giving a great thickness of strata, for it is on the downthrow side of the great Cape Schanck fault. It is to be regretted, however, that the boring was not continued farther, for it ended at 1696 feet, still in Cainozoic material, correlated with the Balcombian. Taken side by side with the results given in Chapman's monograph on the borings in the Mallee, there is now every prospect of the general and detailed zoning of the Australian Cainozoics being placed on a surer basis. This will prove of great value in the work now going on under the Commonwealth, of defining stratigraphical horizons with the view of ascertaining geological structure in the regions investigated by scout-boring in oil research. The work, which has been issued in the *Records of the Geological Survey of Victoria* (vol. 5, Part 1), is well illustrated by twelve plates of drawings and photographs by the author and his daughter.

NUMBER OF  $\alpha$ -PARTICLES FROM RADIUM.—H. J. Braddick and H. M. Cave, working in the Cavendish Laboratory at Cambridge, have made a new determination of the number ( $Z$ ) of  $\alpha$ -particles emitted from one gram of radium in a second (*Proc. Roy. Soc., A*, 121, Nov. 1). They have used the indirect method of finding the total charge carried by the  $\alpha$ -particles from radium C, the charges collected as the particles were received in shallow copper boxes being measured by the aid of a Compton electrometer. The strength of the sources was found from their  $\gamma$ -ray activity, and in any one experiment the ratio of the  $\alpha$ -ray activity of the radium C to its  $\gamma$ -ray activity was constant to within less than one per cent. As the result of sixteen sets of observations, they found that  $Z$  has a value of  $3.68 \times 10^{10}$ , their estimated error being plus or minus one per cent. This is in close agreement with what would be expected from recent measurements of the heating effects of radioactive preparations, and it therefore appears that there is no need to invoke the existence of any hitherto unrecognised heat-producing mechanism in these processes.

BANDED STRUCTURES IN METAL CRYSTALS.—In a letter to NATURE last year (vol. 120, p. 259), Dr. C. F. Elam pointed out that banded structures can be observed in copper and aluminium, which have the appearance of twins but do not have a correct relationship for the normal type. She has now carried out further investigations on these, and has been able to show that, contrary to what had been believed previously, aluminium does form twins, of a spinel type (*Proc. Roy. Soc., A*, 121, Nov. 1). She also suggests that they are much more common than is imagined, but that they are frequently overlooked because they do not exhibit straight boundaries. Another similar structure which she has studied has been shown, on the contrary, not to be of this type; she has described it as 'mechanical twinning.' It appeared when a

crystal of aluminium in the form of a round bar was pulled in tension, and deformed non-uniformly, with the production of parallel planes running vertically along the specimen, and it seemed most likely to be formed when two possible planes of slip were inclined equally to the axis of strain. In an appendix to Dr. Elam's paper, Prof. G. I. Taylor has pointed out that her observations of the latter phenomenon are consistent with the laws previously recorded regarding the distortion of aluminium crystals. Dr. Elam's observations were made by the usual crystallographic and X-ray methods.

ARC SPECTRUM OF CÆSIUM.—D. A. Jackson, working in the Clarendon Laboratory at Oxford, has made an investigation of the hyperfine structure of the arc spectrum of caesium (*Proc. Roy. Soc., A*, 121, Nov. 1). The difficult problem of obtaining the metallic vapour in a suitable form for excitation was solved by mixing it with helium, and carefully regulating its partial pressure. The containing vessel was exposed to a high frequency oscillator, and the light from it analysed by the well-known method of combining étalons of quartz—by Adam Hilger—with a spectrograph of the Littrow type. The lines of the principal series were found to be close doublets, their separation being about 0.30 per cm. The details of the structure do not appear to be explicable as a result of the interaction of the electrons alone, and to explain this the suggestion is made that it is connected with a spin of the atomic nucleus of one-half quantum, the ratio of the magnetic moment of the latter to its mechanical moment being twice as great as for the electron. The results agree well with those obtained by other workers for the hyperfine structure of some lines due to bismuth, and it has been found possible to devise a selection principle which applies to both elements. The physical meaning of the rule is straightforward—"the greater the change in the relative orientations of the nucleus and electron during the transition, the less probable the transition."

NUCLEAR DISINTEGRATION.—The issue of the *Zeitschrift für Physik* for Nov. 2 contains the reply of Dr. Kirsch and Dr. Pettersson to the criticism of the Viennese experiments upon artificial disintegration that was made recently by W. Bothe and H. Fränz, as the result of their independent researches at Berlin (*Die Naturwissenschaften*, Mar. 23). It is maintained that  $\beta$ -particles do not affect a zinc sulphide screen in any way which would lead to them being mistaken for  $\alpha$ -particles or swift protons, and it is further shown by new experiments, that the reputed disintegration protons still appear when possible stray  $\beta$ -particles would have been swept away by a magnetic field. The suggestion of Bothe and Fränz that certain effects were due to a strongly abnormal scattering of  $\alpha$ -particles is also apparently disposed of by some other experiments which are described, generally similar to those performed at Berlin, but with a scintillation screen used instead of a Geiger electrical atom counter, and finally the Berlin experiments are themselves criticised on the grounds that the electrical counters used were not properly calibrated, and that occluded hydrogen was not removed from some of the materials employed. Drs. Kirsch and Pettersson take an entirely opposite view to Bothe and Fränz as to how the work of the latter is to be interpreted, and consider that it supports their own conclusions as to which nuclei can be disrupted, rather than those of Sir Ernest Rutherford and Dr. Chadwick. They do, however, concur with Bothe and Fränz in the opinion that electrical methods for registering individual atomic particles are likely to be of great value in this connexion, and it is stated that a report upon the applicability of these is to be published shortly.

## Insect Pests in England and Wales.

THE establishment of an advisory entomologist in each of the fourteen provinces of England and Wales as delimited by the Ministry of Agriculture, has provided means for recording the incidence of insect pests that were non-existent at the time the Development Fund Act was passed. Information obtained from such sources, supplemented by that supplied by the Ministry's own officers and other observers, is collated and digested and issued at intervals in the form of reports.<sup>1</sup> The method of presentation aims at chronicling the events of the period under review in such a way as to render them comparable with similar events in the past and future. Observations on the prevalence of a number of the more important insect pests have now been recorded since 1917. Many of the species appear to vary considerably in numbers over long or short periods, conditions being favourable in most years to certain pests and inimical to others. The fundamental causes of these fluctuations are, as yet, not understood, but it is almost certain that climatic factors, with rises or falls in the prevalence of parasites and other biological agencies, play an exceedingly important part. The collection of records of insect abundance or scarcity continued over a period of years, and correlated with meteorological data and such biological factors as can be reasonably accurately evaluated, should be productive of significant information relative to such fluctuations.

The present Report covers the years 1925-27, and during that period certain developments in control measures are noteworthy. The repression of Leather Jackets by the broadcasting of poisoned bran has been tested in many areas in the British Isles, generally with satisfactory results. The Protection of Animals Act, 1911, has been a serious deterrent to the use of this measure, but the passing in 1927 of an amending Act has rendered its application more satisfactory from the legal point of view. The use of naphthalene vapour in glasshouses for the control of red spider attack with special reference to cucumbers and carnations, is an important development from the Lea Valley Research Station. Messrs. Speyer and Owen of the latter institution propose a new method of using sodium cyanide for the fumigation of tomato houses. The mixing of one part by weight of cyanide with three parts of sodium bicarbonate avoids the older method of using sulphuric acid. Paradichlorobenzene, now coming so much to the fore in America, has been found effective for treating dormant bulbs, notably against aphides, while the wider application of this fumigant has evident possibilities. Tar oil winter washes have come much to the fore, but so far they have not given satisfactory control of Apple Capsids and appear to favour an increase of the Red Spider (*Oligonychus ulmi*). The work of Tattersfield and Gimmingham at Rothamsted has shown that 3:5-dinitro-*o*-cresol has powerful egg-killing properties, but this substance and its salts are yellow dyes, which may prove an objection to their general application.

One of the most difficult problems facing the economic entomologist is the exclusion of pests from other lands. During the period under review, one of the most serious pests that has got accidentally introduced is the Potato Moth (*Phthorimæa operculella*), which occurred chiefly in consignments of new potatoes from the Canaries; fortunately, the insect has not obtained a footing in the British Isles. The frequency of consignments of French cherries infested

with the Cherry Fruit Fly (*Rhagoletis cerasi*) has led to the prohibition in 1927 of such importations between June 24 and Sept. 30. Among other importations, the Chrysanthemum Midge (*Diarthronomyia hypogea*) has almost certainly been introduced from the United States, but adequate measures of repression have been taken. The Colorado Potato Beetle, although established in the Bordeaux district of France, happily finds no mention in this Report as occurring in Britain.

Among the various resident pests recorded, a notable feature has been the relatively slight injuries to cereals due to Frit Fly, while Wireworms are not mentioned. In 1925, Leather Jackets were the most serious of cereal pests, but their attacks were less pronounced in the two succeeding years: in 1926, Wheat Midges were especially destructive, 100 per cent of the ears being attacked in one case in Kent. Among root crops, mangolds suffered to a considerable degree from the minute beetle *Atomaria linearis*, which also attacked sugar beet. Attacks of turnips, rape, and swedes by the Swede Midge (*Contarinia nasturtii*) were, on the whole, above normal, while the Mangold Fly (*Pegomyia hyoscyami*) was severe in 1925, its attacks afterwards declining. The Diamond Back Moth seems to be mainly in evidence along coastal regions, and in 1926 destroyed a considerable area of swedes. This species is frequently checked by parasites, but climatic conditions seem to be the most potent restraint; heavy rain, particularly if accompanied by cold weather for two or three days, serves to prevent any notable increase. The disorder known as 'strangle' in mangolds is becoming more generally recognised and is often associated with the presence of Springtails, especially the minute species *Bourletiella hortensis*. At Rothamsted the pest was controlled by dragging tarred sacks over the field, the Springtails being caught on the tar as they leapt from the rows. Peas suffered considerably from the Pea Moth (*Cydia nigricana*) and the Pea Thrips (*Frankliniella robusta*), both species being extremely difficult to control. Vegetables suffered relatively little from aphides, but the Gall Weevil (*Ceutorhynchus pleurostigma*) attacked *Brassica* crops severely over the greater part of Great Britain during the three years under review.

Among the numerous fruit pests recorded, Capsid bugs merit special mention. The Apple Capsid (*Plesio-coris rugicollis*) is the most serious pest of that fruit in Britain, and is especially prevalent in the Wisbech district. It is, however, assuming greater importance in other fruit areas, and at the present time the only remedy is very thorough nicotine spraying. Another Capsid, *Lygus pabulinus*, has in late years become a serious enemy of bush fruits and quite recently taken to injuring apple shoots; in the past this insect restricted itself mainly to herbaceous plants and weeds, and its spread to bush and top fruits on a large scale is apparently a new development. Among greenhouse pests, an interesting and important development by Speyer at the Lea Valley Station is experiments on the control of the White Fly by intensive breeding of the Chalcid parasite, *Encarsia formosa*.

The Report concludes with a table showing the approximate annual fluctuations in the incidence of some of the major insect pests during the past ten years, with a list of all the pests of chief commercial importance upon which future attention should be concentrated. Mr. J. C. F. Fryer, the Director of the Ministry's Plant Pathology Laboratory, who is responsible for this Report, is to be commended for its practical value and scientific accuracy.

A. D. IMMS.

<sup>1</sup> Ministry of Agriculture and Fisheries. Miscellaneous Publications No. 62: Insect Pests of Crops, 1925-27. (London: Ministry of Agriculture, 1928.) 2s. net.

### Gifts for the University of Cambridge.

THE Vice-Chancellor of the University of Cambridge has announced that in answer to the University's application, a formal letter of gift is being prepared by the International Education Board, offering £700,000 to the University on the conditions and for the objects already announced (*NATURE*, Oct. 20, p. 632). One condition is the raising by the University from other sources of a sum of £229,000, and the Vice-Chancellor is able to announce munificent offers from the Government, the Empire Marketing Board, and the Royal Agricultural Society, amounting to £101,000 in all, of which £85,000 goes towards the sum required. The offers are conditional upon the remaining £144,000 being secured, but they will come as the greatest possible encouragement to the Committee charged with the task of securing to the University the magnificent opportunity presented to it by the munificent offer of the Rockefeller International Education Board.

The Right Hon. Walter Guinness, Minister of Agriculture and Fisheries, in communicating the Government's offer, writes as follows:

"The Board's generous benefaction recognises the position of the University as a great international institution of education and research; His Majesty's Government recognise equally that the University is a great national and a great imperial institution. Again, the particular purposes to which the benefaction is to be applied—primarily the advancement of agriculture and of the fundamental sciences on which agriculture

depends—are such as must command the unhesitating support of His Majesty's Government in relation both to this country and to the interest of the Empire overseas. . . . They believe that the highest national as well as imperial interests demand that the scheme agreed between the Universities and the International Education Board should be fully carried into effect. The Government offer a sum of £50,000 in respect of expenditure directly attributable to the School of Agriculture in the strictest sense."

The Right Hon. L. S. Amery, Principal Secretary of State for Dominion Affairs and for the Colonies, in making an offer of £50,000 on behalf of the Empire Marketing Board, writes as follows:

"In a review which has now extended over more than two years, the Board have come to appreciate the great contribution which the University of Cambridge is already making to scientific agricultural research in the Empire at home and overseas. This offer, they are satisfied, holds out the promise of a development of high significance to every Empire country."

This substantial Government support, taken as an indication of the official attitude to research, will be most gratifying to scientific workers generally.

The Council of the Royal Agricultural Society has also made a generous offer of £1000. Cambridge men may be looked upon loyally to support the endeavours being made to raise the balance remaining, £144,000.

### Structure of the Great Barrier Reef.<sup>1</sup>

THE results being accumulated by the Great Barrier Reef Committee of Australia, the activities of which are directed by Prof. H. C. Richards, are highly creditable, but the task of closely investigating about  $\frac{1}{4}$  million square miles of land, reef, and water is herculean. Investigations have to be governed by finance and the number of researchers available. The result here is a lack of system, which, however, has had its parallel in the investigations of the coasts of Great Britain and elsewhere.

Past earth movements may be studied in the topography of land surfaces, but we are glad to see that in addition a boring was put down near Cairns, a coral island within the barrier reef being selected. The same difficulties were met with as at Funafuti, insufficiently consolidated and irregular material making drilling difficult. The boring log showed coral material to 113 ft., ooze and mud to 213 ft., coral again to 241 ft., followed by ooze to 427 ft., and then glauconitic material with quartz sand to 600 ft. It is suggested that this is to be interpreted as indicating subsidence of 600 ft., but we cannot accept this until we know what were the foraminifera obtained and have certain evidence that they exist only under quite shallow water conditions. The glauconite must have formed at the time of deposition, and the depth at which it occurred appears to us about the usual depth at which it commences to be formed. We trust that this core will be closely compared with the bottom deposits obtained by Dr. Yonge's expedition, which is working in the same region. Either this deposit was formed before the outer barrier grew up or is the filling up of the lagoon behind the same, as subsidence or other change of level took place, and we find difficulty in accepting either interpretation. A comparison with the deposits near Great Sandy Island at the south end of the Great Barrier Reef might perhaps be interesting.

Mr. Stanley's study of the physiography of the Bowen district, 20°-21° S., is an important contribution to the interpretation of the formation of the Great Barrier Reef. Here there are lines of high islands running almost parallel to the mainland with the shelf-like surface of the Great Barrier Reef outside, 33-50 fm. deep. The chief of these islands is Whitsunday, which gives its name to a Passage on its landward side, a trench varying up to 50 fm. deep. The trend lines of the islands, of which seventeen are described, are much interrupted and the channels between the lines may be rather trough-like. The basal rocks are granites and palæozoic volcanics, figuring equally, and this is true of the coastal ranges. Many of the islands are deeply dissected and there are pronounced embayments, the cliffing being relatively small, this suggesting a long period of subaerial erosion followed by submergence. Along some of the trend lines recent elevation is well marked, and, as it may be absent on their western sides, tilting is suggested. In various bays coral reefs are growing, but these would appear to be in process of formation, and not contemporaneous with, or of the same structure as, the barrier formations to seaward.

It is difficult to follow the author without an adequate chart of depths, in addition to his series of plans and drawings. He gives evidence to show that the relative resistance to weathering and to subsurface marine action cannot have acted as producing the systematic arrangement of the island lines. Hence warping is postulated, parallel to the present coast line, accompanied by the formation of huge parallel fault blocks, cross faulting limiting their extension and causing breaks. This took place subsequent to almost mature subaerial dissection, and the barrier flat to the east is hence a drowned land and its even surface due to marine cutting down and filling in of inequalities. Daly's Glacial Control Theory, a former lowering of sea-level by 30-50 fm., is called in to explain its

<sup>1</sup> "Reports of the Great Barrier Reef Committee," vol. 2. Pp. xvi+114+12 plates. (Brisbane: A. J. Cumming, 1928.) 10s.

submergence, but this is of relatively little importance, if the geological evidence from the coast and islands is to be interpreted as postulating crustal movements extending to the steep fall of the outer reef to ocean depths, a matter also considered in a separate paper by Dr. Bryan on the Queensland Continental Shelf.

Excellent as his work is, we could wish that Mr. Stanley had examined the subsurface topography. We want to know the depths off his cliffs, accurate sections, and we would like the angles of slopes of the lands on either side of some of his deep embayments, with his calculations as to the alterations in level that these require. In any case, the area may well prove to be one in which earth movements are in progress, and the author's account of the lands, together with the Admiralty's re-survey of the seas, should enable these to be deduced in subsequent decades.

Captain Edgell, who was in charge of the re-survey, contributes some general remarks on the coral formations. He suggests that individual reefs of the outer barrier may be fitted together to form atolls with comparatively deep water in the midst of each series, the lagoons. His comparison with Ari and other Maldivan atolls appears apt, but he does not make it clear whether his group of five reefs is to be regarded as an atoll in formation or in decay. The narrow gut, two cables or so across, and about 10 miles long by 30 fm. deep, with almost surface reefs on either side, is an extraordinary feature, being apparently kept open by strong tidal streams.

The topography of the Townsville littoral and other areas shows, according to Mr. Jardine's observations, prolonged denudation, together with coastal drowning, these followed by a slight emergence of 10-20 ft., that has materially added to the coastal plains. This is supposed to be due to a comparatively recent retreat of the sea-level, as seen also in the beaches of the volcanic Bramble and Darnley islands. Bramble Reef also has a small sand cay of foraminiferous tests, coral and shell fragments, much of it consolidated into surface rock by the droppings of birds, as on so many guano islands.

J. S. G.

### University and Educational Intelligence.

GLASGOW.—Prof. Andrew Hunter, of the chair of chemical physiology in the University of Toronto, has been appointed Gardiner professor of physiological chemistry in the University. Prof. Hunter has contributed much to our knowledge of the metabolic products of protein, and of dietary defects and deficiency diseases. He will come into residence in Glasgow next year. It will be recalled that his colleague in the University of Toronto, Prof. J. R. R. MacLeod, has recently been appointed to the chair of physiology at Aberdeen.

Sir Frederick C. Gardiner and his brother, William G. Gardiner, have established a fund, amounting to some £20,000, for the endowment of a chair of music in the University. The professor will hold simultaneously the post of principal of the recently formed Scottish National Academy of Music in Glasgow.

LONDON.—The following doctorates have been conferred: D.Sc. in anthropology on Prof. F. G. Parsons, University professor of anatomy, for a thesis entitled "The Englishman of the Future"; D.Sc. in biochemistry on Mr. William Robson, King's College, for a thesis entitled "The Metabolism of Tryptophane, The Mechanism of the Mode of Formation of Kynuronic Acid from Tryptophane in the Animal Organism"; D.Sc. in physiology on Mrs. Norah Edkins (Bedford College), for a thesis entitled "A Study of Absorption in the Stomach and small Intestine"; D.Sc. in psychology on Mr. J. W. Cox (University College), for a thesis entitled "Mechanical Aptitude: its Existence, Nature, and Measurement."

A SPECIAL course of lectures by Prof. H. Dingle on the technical applications of the spectroscope is to be given in the Technical Optics Department of the Imperial College of Science and Technology next January. The institution of the course follows a suggestion by Sir Herbert Jackson, and is an attempt to revive interest in the spectroscope among scientific workers in general, particularly chemists and biologists, so that its uses may be applied to problems in their own domains.

THERE will be an election to not more than three Beit Fellowships for scientific research in July next. These fellowships are tenable for two years at the Imperial College of Science and Technology. Candidates must be less than twenty-five years of age, of European descent by both parents, and of university degree standing. Forms of application, to be returned by April 16, and all information may be obtained, by letter only, addressed to the Rector, Imperial College, South Kensington, London, S.W.

At the annual meeting of the Court of Governors of the London School of Hygiene and Tropical Medicine held on Nov. 30, the Board of Management of the School presented its fourth Annual Report. Substantial progress has now been made towards the completion of the organisation of the School, of the building, and of its equipment. The work of the old School of Tropical Medicine which was taken over in 1924 continues to make most satisfactory progress, and the Director reports that there is an increase of no less than 17 per cent in the proportion of students sitting for the Diploma in Tropical Medicine and Hygiene who were successful. Advanced courses in bacteriology have been established in temporary quarters in Gordon Square, and all of the five students who sat for the new University Diploma were successful in obtaining it. Special courses in epidemiology and vital statistics have also been established. The professors of public health, of bio-chemistry, and of chemistry as applied to hygiene have been appointed, and will enter upon their duties next year. It is hoped that the handsome building in Portland stone which is being completed in Bloomsbury to the design of Mr. Morley Horder and Mr. Verner O. Rees will be ready for the formal opening next summer.

THE committee of award of the Commonwealth Fund Fellowships announces that it is now prepared to receive applications for the fellowships to be awarded in 1929. After four years' working, the scheme has been so successful that the directors of the Fund in New York have increased the number of ordinary fellowships from twenty to thirty. The ordinary fellowships are tenable at an approved American university for two years. They are open to persons of British descent domiciled in England, Scotland, Wales, or Ireland who are graduates of recognised universities therein and are unmarried and not more than thirty years of age. Women as well as men may apply. Provision amounting to approximately £600 per annum will be made for the total expenditure involved during the tenure of a fellowship. Applications must be forwarded through the authorities of the university or college of which the candidate is, or was, a member. The committee also announces this year five fellowships for graduates of Dominion universities and three fellowships for persons of British descent holding appointments under the British Government, the Government of India, or the Government of a British Dominion, Colony, Protectorate, or Mandated Territory. All information can be obtained from the secretary to the Committee of Award at 50 Russell Square, London, W.C.1.

## Calendar of Customs and Festivals.

December 13.

**PICROUS DAY.**—The second Thursday before Christmas Day was observed by the miners in the Blackmore district of Cornwall as a feast celebrating the discovery or first smelting of tin by a man named Picrous. It was the occasion of a merry-making, to which the owner of the tin stream made a contribution of one shilling per man.

December 17.

**SOW DAY**, at one time observed in Scotland and so called from the custom of every family killing a sow on this day—one of several customs round about Christmas suggesting the sacrificial meal, of which the pig was the victim, sacrificed to the sun or one of the deities of the Nordic pantheon.

**SATURNALIA.**—This, the most widely known and frequently mentioned feast of Roman antiquity, took place on Dec. 17–23. It commemorated the reign of Saturn over Italy, who, as god of sowing and of husbandry, settled mankind on the land, taught them husbandry, brought them to live in peace, and made the earth bring forth abundantly. The festival was supposed to reproduce the conditions of his reign—the Golden Age. Feasts and revelry prevailed, all regulations were abrogated, and schools were closed. Most remarkable of all its features and most frequent subject of comment among ancient writers was the licence allowed the slave population. All distinctions between free and servile were temporarily abolished. Not only was the slave free to behave with the utmost freedom, and even with insolence, towards his master and to sit at his table, but also the master actually served the slave at table and waited until he was fed before satisfying his own needs. In each household the slaves held the high offices of State, consul, prætor, and the like, in a mock republic. Among the freemen a mock king was elected by lot, who issued playful or ridiculous orders to his subjects.

Sir James Frazer has suggested that in the mock king and his derivatives, the lords of misrule, abbots of unreason, and similar offices, we have a survival of the primitive ruler who was sacrificed periodically for the promotion of fertility as a representative of the vegetation spirit, and that winter festivals, of which the Saturnalia was one, reproduced in modified form the spirit and ritual of these occasions. He bases this view of the Saturnalia on a life of St. Dasius, who suffered martyrdom at Durostorum on Nov. 24, A.D. 303. According to this narrative, it was the custom of the Roman soldiers on the Danube under Maximian to elect one of their number to act as King Saturn. After thirty days' complete licence in every form of indulgence, he cut his throat on the altar of Saturn at the time of the Saturnalia. The parallel with primitive custom elsewhere, for example, Mexico, is exact (see Frazer's "Golden Bough," Abridged Edition, pp. 583-4). Both theological and antiquarian writers in England in the seventeenth and eighteenth century commented on the similarity between the Saturnalia and the celebrations at Christmas, while some also derived the ancient Feast of Yule of the north from the Roman festival. The comparison was supported by the recognised licence sometimes granted persons of low life, such as that in the official proclamation which permitted card players, prostitutes, and others to frequent the city of York during the period of twelve days' holiday.

December 21.

**ST. THOMAS.**—A method of divination was practised by girls with 'St. Thomas Onion.' An onion was

peeled and wrapped in a clean handkerchief and placed under the head. After appropriate verses had been repeated, the inquirer slept lying on her back.

St. Thomas's Day is especially associated with the practice of 'thomasing' or 'gooding'—a custom which was not necessarily confined to this day, as it was usually kept up until Christmas, and in some localities began in some form, though not necessarily under this name, so early as Martinmas. Women called from house to house collecting gifts in kind, flour, corn, or wheat, later often commuted for a money gift. When the gifts were in kind, the material thus collected was saved up until Christmas time, when it was made into a cake. This was marked with one or more crosses, and it was ceremonially cut on Christmas Eve, and everyone entering the house during the Christmas celebrations was required to partake. Sometimes the cake was marked with crosses with a knife at the time of cutting.

In Warwickshire the custom was known as 'going a ciorning,' and in Herefordshire as 'mumping.' It was usual for a sprig of holly or mistletoe to be given in return to the donors. At Biddenham, in Bedfordshire, an annual payment of £5 from an estate formerly belonging to the family of Boteler was made to the overseers of the poor for the purchase of a bull to be killed and the flesh distributed among the poor on this day. At Wokingham, in Berkshire, bull-baiting used to take place on St. Thomas's Day, the flesh here also being distributed among the poor. This custom continued down to 1821. The bull was purchased out of the proceeds of a bequest of 1661. For many years after the abolition of the bull-baiting, attempts were made by the people to revive it. The bulls continued to be purchased for the distribution of the meat, the offal being sold to buy boots for women and children, and the tongues—for by this time the money was sufficient to buy two bulls—being reserved for clerk and aldermen.

Similar endowments existed in other parts of Great Britain, though some have been transferred to Christmas Eve or Christmas Day. At Farnfield the interest on £50 was divided among poor old men and women who could repeat the Lord's Prayer, the Creed, and the Commandments before the vicar or his representative, and at Arundel and Nevern, in Pembrokeshire, there were doles of a similar character; while at Tainton, in Oxfordshire, a quarter of barley was provided annually to be made into small loaves called 'cobbs,' which at one time were distributed in the church to the poor children of Burford. However pious or philanthropic the aims of the founders of these charitable gifts, in common with other Christmas doles, they are derived ultimately from the communal sacrificial meal.

A custom is said once to have existed in York, which was instituted to commemorate the betrayal of the city by two friars when it was besieged by William the Conqueror. On St. Thomas's Day a friar of St. Peter's should ride through the city with his face to the tail of his horse, holding in one hand a rope, in the other a shoulder of mutton, a cake hanging at his back and another on his breast, and his face painted like a Jew. He was to be preceded by the officers of the city proclaiming that on this day the city was betrayed, and followed by the youth of the city shouting 'youl, youl.' After the dissolution of the monasteries, the custom was kept up by artisans.

In the Isle of Man the people used to go to the mountains on St. Thomas's Day to catch ducks and sheep for Christmas, and in the evening light a fire on every 'fingan' or cliff. At the time of cutting turves, a large one was always laid aside for 'Fingan's Eve' (see St. Finnan, Dec. 12).

## Societies and Academies.

LONDON.

Royal Society, Dec. 6.—A. E. Boycott, C. Diver, S. Hardy, and F. M. Turner: The inheritance of sinistrality in *Limnaea peregra*. This snail is normally dextral; a sinistral variety, in which the spiral twist of body and shell is completely reversed, is very rare. Sinistrality behaves as a Mendelian recessive, but the appearance of any change of twist imposed by crossing is delayed one generation. Albinism is also a simple Mendelian recessive but inherited directly. The delayed inheritance of sinistrality may be due to the twist of animal and shell being determined before the spermatozoon has time to be fully effective.—R. H. Burne: A system of 'fine' vessels associated with the lymphatics in the cod (*Gadus morrhua*). These vessels follow the chief arteries (except those to viscera). They have minute connexions with efferent branchial vessels, and peripherally they break up in skin and mucous membrane of the mouth and pharynx, there communicating with the capillary plexus of lymphatics. It is suggested that the lymphatics evolved from a blood vascular system containing both arteries and veins; the venous component became definitive lymphatics, whereas the arterial component vanished. In Teleosts the arterial component persists as the 'fine' vessels.—E. Hindle: Further observations on Chinese kala-azar.—Eric Ponder: Hæmolysis by brilliant green and serum.—A. V. Hill, Grace Eggleton, and P. Eggleton: The coefficient of the diffusion of lactic acid through muscle.—C. H. Best, K. Furusawa, and J. H. Ridout: The respiratory quotient of the excess metabolism of exercise.—A. V. Hill and W. Hartree: The energy liberated by an isolated muscle during the performance of work. A new point of view is presented in connexion with the thermodynamics of muscle. Extra energy is given out, when work is performed, only if work be done during continuance of stimulus. The muscle behaves like a gas suddenly brought in contact with a reservoir of heat and allowed to expand. If such contact be maintained during expansion, extra energy, equal to work, will be taken from reservoir and work will be greater. In muscle some 'intensity' factor is increased by the stimulus; if the stimulus be continued, 'intensity' is maintained at full value, more work can be done and extra energy set free.—A. V. Hill: The diffusion of oxygen and lactic acid through tissues. The diffusion of dissolved substances through tissues is considered for certain cases—a plane sheet, a semi-infinite solid, a cylinder—which are mathematically soluble.—D. Keilin: Cytochrome and respiratory enzymes. Cells of aerobic organisms contain four hæmatin compounds, an unbound hæmatin and the three hæmatins (*a'*, *b'*, and *c'*) of cytochrome, and a thermolabile indophenol oxidase. The latter takes an important part in cellular respiration. Cytochrome (especially *a'* and *c'*) is oxidised by it and is reduced by dehydroases. Cytochrome acts therefore as a carrier between two activating mechanisms of cells: dehydroases and oxidases. Autoxidisable component *b'* of cytochrome and free protohæmatin can act as carriers between the dehydroase system and molecular oxygen, and also as direct catalysts.—F. R. Miller and N. B. Laughton: Myograms yielded by Faradic stimulation of the cerebellar nuclei.—D. Burk: The free energy of glycogen-lactic acid breakdown in muscle.—F. C. Smith: The ultra-violet absorption spectra of certain aromatic amino-acids and of the serum proteins. *Amino-acids*.—In tyrosine, two new bands have been found, at wave-lengths 2240 Å. and 1940 Å. *Serum Proteins*.—Samples of exceptional purity were em-

ployed. True absorption occurred. Though proteins are precipitated by ultra-violet radiation, exposure for photography causes no measurable change. Contrary to the work of Judd Lewis, horse and human serum-albumin spectra are found to be identical within experimental limits. The ratio of extinction coefficients at head and foot of curve may be taken as index of purity of protein.—A. S. Parkes: The functions of the corpus luteum. (Pts. 1-3).

Geological Society, Nov. 7.—Sydney George Cliff and Arthur Elijah Trueman: The sequence of non-marine lamellibranchs in the Coal Measures of Nottinghamshire and Derbyshire. The succession of the genera *Carbonicola*, *Anthracomya*, and *Naiadites* is discussed. In general features, the sequence is similar to that of the South Wales coalfield. The lowest horizons are rich in large specimens of *Carbonicola*. Above them, but below the horizon of the Barnsley Seam, occur species of *Anthracomya* and *Carbonicola* characteristic of the zone of *Anthracomya modiolaris*. The zone of *Carbonicola similis* is not separately recognised in the area. The sequence of faunas, and particularly the range of *Carbonicola* and *Naiadites* within the '*Similis-Pulchra*' zone, appear to be of value in determining horizons above the Barnsley Seam.

Physical Society, Nov. 23.—G. Temple: The physical interpretation of wave mechanics. The principles are illustrated by discussions of the propagation of free electric waves in uniform electromagnetic fields, of bound electric waves in the hydrogen atom, relativistic wave mechanics (prior to the work of Dirac and Darwin) and the Compton effect.—Allan Monkhouse: The effect of superimposed magnetic fields on dielectric losses and electric breakdown strength. Both are seriously affected by superimposed magnetic fields. A theoretical explanation is suggested by a paper read by Prof. A. Smouloff before the International Mathematical Conference at Bologna in September last.—Albert Campbell: A new A.C. potentiometer of Larsen type.—E. F. Herroun and E. Wilson: Ferromagnetic ferric oxide. The authors confirm the observation by Messrs. Sosman and Posnjak that lepidocrocite, but not goëthite, yields on dehydration a strongly ferromagnetic ferric oxide. As all the specimens of lepidocrocite examined contained 3 or 4 per cent of manganese oxide, this substance may be an essential constituent of this crystalline form of the hydrate. The temperature at which the ferromagnetic oxide is permanently transformed into the common paramagnetic kind is largely dependent upon its mode of preparation. Although copper ferrite has a higher maximum permeability than ordinary precipitated magnetic oxide of iron, it falls far below that of the purer forms of native magnetite. The different susceptibilities of ferric oxide resulting from the oxidation of natural magnetites are attributed to impurities, particularly magnesia, which forms a magnetic ferrite.

Linnean Society, Nov. 29.—T. A. Sprague and E. Nelmès: The herbal of Leonhard Fuchs. Identifications of the 511 plants figured, with a general account of the herbal. The classification is mainly (1) pharmaceutical and economic, but sometimes (2) philological: thus (1) *Campanula Rapunculcus* L. is classed with the swede and the beet, because it has an edible root, and is widely separated in consequence from *C. Trachelium* L., which was used as a remedy for ulcers; and (2) *Momordica Balsamina* L. and *Impatiens Balsamina* L. are placed in the same chapter (genus) because the former was called *Balsamina* and the latter *Balsaminum*.



## PARIS.

Academy of Sciences, Oct. 29.—Ch. Fabry: The rôle of the atmospheres in the occultations of stars having an apparent sensible diameter. Excepting the passage of one of the satellites of Jupiter behind the planet, phenomena of this class are rare. An occultation of the satellites of Jupiter by Mars would be much easier to observe, but such an occultation is unfortunately very rare.—R. Bourgeois: The work carried out by the geographical service in 1926 and 1927. An outline of the work included in the last published report.—Pierre Weiss and G. Fœx: The atomic moments. Theories relating to atomic moments attempt to connect the moments deduced from magnetic measurements with the principles of atomic mechanics and the electronic models of the atom, either for comparing the moments obtained in other ways, especially from spectrum analysis, or to study the effects of atomic linking, polar or complex, on the atomic moment. Adopting the value 1126.5 as the number for the experimental electron, the atomic moments of various ions and elements are recalculated.—Charles Nicolle and Charles Anderson: A new recurrent spirochæte, pathogenic for the guinea-pig, *Sp. sogdianum*, transmitted by *Ornithodoros papillipes*. This organism has its origin in Russian Turkestan. White rats, white mice, and the ape (*Macacus*) can be infected, but not so seriously as the guinea-pig. As regards its specificity, a first attack confers immunity, but *Sp. hispanicum*, *Sp. duttoni*, *Sp. crociduræ*, *Sp. normandi* do not confer immunity against *Sp. sogdianum*.—Piazzolla-Beloch: Surfaces of the third order possessing curves with connected branches.—Bertrand Gambier: Sub-groups of the group of homographies. Application to the study of skew curves.—Walter Saxer: The structure of normal families of meromorph functions.—R. Mazet: The commencement of the flow through a thin-walled weir.—L. Escande: Flow on overflow weirs.—Jean Ulmo: Polarisation in the theory of light quanta.—Adolpho T. Williams: The ultimate lines of mercury and aluminium.—M. Prettre and P. Laffite: The ignition temperature of hydrogen and air. The figures given are about 100° C. lower than those of other workers, with the exception of Dixon.—A. Travers and Malaprade: A new fluoboric acid. Boric and hydrofluoric acids react instantaneously, giving a fluoboric acid which differs from  $\text{HBF}_4$ , as its salts are easily decomposed by alkalis.  $\text{HBF}_4$  is formed slowly, a state of equilibrium between the two fluoboric acids being finally reached.—Raymond Delaby and Pierre Dubois: The formation of allyl alcohol. The preparation of the forms of glycerol.—L. Maume and J. Dulac: Correlation between positive antagonism and absorption by the plant. Studies on the amounts of lime absorbed by wheat in the presence of sodium salts.—Charles Pérez: The evolutive cycle of *Rhizocephalus* of the genus *Chlorogaster*.—J. Legendre: The psychology of *Culex pipiens*. The final act of reproduction in females of *C. pipiens* is not due to a physiological automatism. The emission of the eggs is delayed if the necessary water is not present.

Nov. 5.—Ch. Fabry: Remarks on the diffusion of light and of Hertzian waves by free electrons.—H. Douvillé: The Pic de Rébenacq and its eruptive rocks.—J. Costantin: A fungus station recently started in the forest of Fontainebleau. An account of experiments on the culture of *Pleurotus Eryngii* in the forest of Fontainebleau. The possibility of the culture of this edible fungus on the large scale has been proved.—H. Vincent: The toxic index of the strains of *Bacillus coli*. New remarks on the basis of anticolibacillus serotherapy. The toxic power of coli bacilli is independent of the strain and of the

biological peculiarities (secretion of indol, fermentation of lactose, action on neutral red). Both true coli and para coli bacilli have the common property of fabricating a neurotropic toxin.—Charles Nicolle, Charles Anderson, and Jacques Colas-Belcour: Experimental study of the spirochæte of the gondi (*Ctenodactylus gondi*).—Charles Nicolle, Charles Anderson, and Jacques Colas-Belcour: First attempts at the adaptation of a spirochæte of fowls to various species of *Ornithodoros*.—A. Th. Masloff: A class of *W* congruences.—G. C. Moisl: Functional varieties.—Mandelbrojt: Some new theorems on the singularities of Dirichlet's series.—K. Abramowicz: Transformations of automorph functions.—Georges Valiron: The values of a meromorph function in the neighbourhood of a singularity.—R. Swyngedauw: The relations which connect the various kinds of slip to be distinguished in belt transmission.—Paul Ditisheim: Correction for the effect of the magnetic field on the rate of watches.—Carl Störmer: An echo of short electromagnetic waves arriving several seconds after the emitted signal: its explanation according to the theory of the aurora borealis. In the autumn of 1927, J. Hals noted an echo of the radio-signals emitted from Eindhoven, arriving about three seconds after the original signal. In an attempt to repeat this observation, after a long series of negative results, a series of echoes was observed on Oct. 11 last. The delay in the echo varied from three to fifteen seconds, averaging eight seconds. These echoes have their origin in space beyond the moon's orbit. A theory is developed to account for the phenomenon based on the supposition of the existence of swarms of electrons under the influence of the earth's magnetic field: this gives a delay in hearing the echo of the order of those observed (see NATURE, Nov. 3, p. 688).—H. Deslandres: Remarks on the preceding communication.—Mario Bossolasco: The ellipticity of the terrestrial equator.—H. Roussilhe: The correct restitution of a figure in three dimensions. Application to aerial photographs.—Th. De Donder: Relativist generalisation of the new theory of Einstein.—A. Féry: The variation of the specific resistance of thin layers of platinum as a function of the thickness and of the temperature. The specific resistance of thin films of platinum deposited by cathode dispersion is a function of the thickness, and the experimental results can be expressed by two equations:  $2 \log (\rho/\rho_0) = 11.48 - 0.0135a$  and  $2 \log (\rho/\rho_0) = 3.245$ , where  $\rho$  is the specific resistance given by experiment,  $\rho_0$  the specific resistance of ordinary platinum, and  $a$  the thickness in  $\text{mm} \times 10^{-6}$ . For a thickness greater than  $287 \text{ mm.} \times 10^{-6}$ , the specific resistance becomes independent of the thickness, but still has a resistance 40 times that of ordinary platinum. If the film is heated to 340° C., its resistance falls to that of ordinary platinum.—G. Fœx: The crystallisation of mesomorphic substances in the magnetic field. The preparation of a solid with oriented molecules. L. Décombe: Electrified spherical pellicles and the privileged orbits of Bohr-Sommerfeld.—P. Daure: Study of the secondary radiations observed in the molecular diffusion of light by fluids (Raman effect).—M. Ponte and Y. Rocard: The Raman effect in the domain of the X-rays.—Paul Gaubert: The structure of the crystals of heulandite.—Henri Mémyer: The summer of 1928 and the solar variations. Two facts are emphasised, that the year 1928 is the maximum of the solar period commencing in 1923, and that an important recrudescence of sunspots and faculae occurred between June and October 1928. With rare exceptions, such as the summers of 1900 and 1911, corresponding to a small number of sunspots, the cause of nearly all abnormal temperature variations on the earth can be traced to variations in

solar phenomena.—Léon Aufrère: The orientation of sand dunes and the direction of the wind.—C. Dauzère: A storm observed at the Pic du Midi and the formation of hail.—J. Chaze: The localisation and disappearance of alkaloids in the epidermis of the tobacco leaf. The theory which regards alkaloids in plants as excretory substances is now generally admitted. New experiments are described of morphological and microchemical order which support this view.—Marc Simonet: The number of chromosomes in the common iris (*Iris germanica*).—Marc André: Researches on the post-larval development of *Leptus autumnalis*.—Serge Youriévitch: A new method of recording ocular movements. The ocular cinematograph.—Georges Bourguignon and Henri Laugier: The variations in chronaxy in fatigue by sustained voluntary contraction in man.—R. Leriche and R. Fontaine: Experimental indication of peripheral vaso-motive regulation independent of the general circulatory regulation.—Philippe Fabre: The production of a rectangular wave for researches in chronaxy.—Mme. M. L. Leroux-Legueux: Some points concerning reproduction in amphipod Crustacea: the temporary ovisacs, their formation and their function.—Mlle. D. Van Stolk, E. Dureuil, and Heudebert: The conditions of formation and destruction of vitamin-D during the irradiation of ergosterol. A continuation of the work of Heilbron, Kamm, and Morton on the action of ultra-violet light on ergosterol. The destruction of the vitamin in the course of the reaction is regarded by the authors as due to oxidation, and this can be prevented, or at least retarded, by working in an atmosphere of nitrogen.

## LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 22).—D. A. Grave: Evaluation of the true influence of the electric hyper-atmosphere on terrestrial magnetism.—B. P. Titov and A. A. Levin: A method of determination of the variations in the volume of the arm due to the pulsations of heart. An apparatus for observing and recording the variations is described.—L. S. Berg: New data on the problem of the origin of the fauna of Lake Baikal. The endemic fauna of Baikal consists of two elements: (1) forms which developed in the lake itself during its long geological history; (2) relics of a fresh-water (and brackish-water) fauna which inhabited northern Asia (and North America) and parts of central Africa during the late Tertiary. A large number of forms which have been for a long time considered peculiar to Lake Baikal are now known from other places.—A. I. Argiropulo: The systematic position of the Turkestan rat (*Rattus turkestanicus* Satunin). The Turkestan rat is distinct from *Rattus rattus* (L.), but conspecific with the Indian *R. vicereus* (Bonh.), though representing another race. A diagnosis of *R. turkestanicus turkestanicus* Sat. and the characters separating it from *R. turkestanicus vicereus* (Bonh.) are given.—K. K. Flerov: The seasonal variations in the hairs of *Capreolus*. Detailed descriptions of colour changes in the hairs during different seasons are given. The winter coloration is caused by the gradual loss of the lustre and by the brown and fawn shades of colour being replaced by grey, owing to the rubbing off of some hairs.—J. P. Kravetz: Magnetic anomalies. The paper by D. A. Grave (*Comptes rendus*, No. 16-17; 1928) on the subject is discussed, and the arguments of that author stated to be founded on a misunderstanding.

## VIENNA.

Academy of Sciences, July 12.—R. Weiss and J. L. Katz: Triphenylmethanes with linked benzol nuclei.

Preparation of an imino-phenylene-acredine-derivative, and the dependence of the colour of the compound upon the nature of the atomic groups forming the rings.—O. Brunner: The amyrynes. Dehydrogenating experiments with amyryn.—J. Pollack and E. Gebauer-Fülnegg: Coupling reactions.—E. Gebauer-Fülnegg and J. S. Reese: The directing influence of carbethyloxy groups in phenols.—E. Gebauer-Fülnegg and E. Neumann: Note on sulphur-containing derivatives of *p*-dichlor-benzol.—E. Gebauer-Fülnegg, W. H. Stevens, and E. Krug: Sulphuric acid esters of the carbohydrates.—E. Riess, F. Berndt, and G. Hirschmann: Phenol and cresol sulpho-chlorides.—E. Riess and F. Pilpel: Determination of the constitution of cresol disulpho-chloride.—E. Späth and F. Breusch: The electrolytic reduction of cyclic acid imides to hydrated cyclic bases.—E. Späth and E. Kruta: The synthesis of berberine-like bases from compounds of the type of tetra-hydro-papaverine.—F. Sigmund and F. Haas: The reduction of the secondary hydroxyl group in ricinoleic acid.—A. Kieslinger: Geology and petrography of the Kor Alps. (9) The structure of the Kor Alps and their relations to neighbouring regions.—F. Bothe: The influence of the substratum and some other factors on the luminescence and growth of *Mycelium x* and *Agaricus melleus*. Alkali chlorides and sulphates promote luminescence, alkali nitrate in 2 per cent solution still more, but ammonium salts weaken. Zinc increases both growth and luminescence. An addition of dead fungus material of the same or other species, also in varying order fructose, glycerine, cane-sugar, promotes the effects. The optimum temperature is about 16°.—E. Chwalla: The stability of centrally and excentrically compressed rods of construction steel. The invalidity of the Euler formula has led to further inquiries about slender rods.—K. Höfler: Visible alterations in living protoplasm evoked by salts. Onion scales were placed in various innocuous neutral salts in isotonic or plasmolysing solution. With favourable cell material the resulting appearance depends on the special salt. The appearances due to alkali salts are different from those due to cane sugar or to the alkaline earths.—W. Leopold: The genus *Cardamine* with special reference to the question of hybrids in the section *Dentaria*.—F. Weiss-Tessbach: Communications of the Radium Institute. (224) Micro-calorimetric measurement of the absorption of  $\gamma$ -rays from radium-C. An ether calorimeter was used.—G. Kirsch and H. Pettersson: Communications of the Radium Institute. (225) The question of the yield in atomic disintegration experiments.—F. Urbach: Communications of the Radium Institute. (225a) The theory of the form of the bands in absorption of light and emission from solid bodies. By one argument the oscillating atom would give a spectral line with minimum intensity at the mean frequency; by another argument a superposition of many such abnormal frequency curves would give a normal frequency distribution.—A. Basch: The error-tensors and the law of transfer of error in the elementary operations of vector algebra.—F. Emich: The observation of streaks in chemical work. By observing the streaks with a microscope when a drop of one liquid enters another it is possible to tell which liquid is optically denser.—F. Hölzl: Organic acids and bases in non-aqueous solutions. (4) Phenols and amines. Electric conductivity measurements made it possible to trace the combining proportions of ammonia and the amines with the phenols.—O. Ampferer and W. Hammer: Results of the geological exploring expedition in West Servia. (3) Tectonics and morphology of the Zlatibor massiv.—R. Wagner: Symmetry relations of the panicles of *Paulownia Rehderiana*.

## Official Publications Received.

## BRITISH.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1163 (Ae. 327): On the Convection of Heat from the Surface of an Aerofoil in a Wind Current. By L. W. Bryant, E. Ower, A. S. Halliday and V. M. Falkner. (T. 2614.) Pp. 24+36 plates. 1s. 3d. net. No. 1166 (Ae. 330): The Force acting on a Body placed in a Curved and Converging Stream of Liquid. By Prof. G. I. Taylor. (T. 2604.) Pp. 10+1 plate. 9d. net. (London: H.M. Stationery Office.)

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 30, Part 1, Session 1927-28. Pp. viii+65+8. (Edinburgh.) 7s. 6d.

The University of Leeds: Department of Leather Industries. Report of the Advisory Committee on the Work of the Department during the Sessions 1926-27 and 1927-28. Pp. 10. (Leeds.)

University of Cambridge. Department of Agriculture: Farm Economics Branch. Report No. 11: An Economic and Financial Analysis of Five Eastern Counties Farms in 1927-28. By R. McG. Carslaw and W. H. Kirkpatrick. Pp. 13+6 tables. (Cambridge: W. Heffer and Sons, Ltd.) 1s. net.

An Investigation of the Milk Yield of Dairy Cows: being a Statistical Analysis of the Data of the Scottish Milk Records Association for the Years 1908, 1909, 1911, 1912, 1920 and 1923. By Dr. J. F. Tocher. (From *Biométrica*, Vol. 20B, Part 2, September 1928.) Pp. 105-244. (London: Biometric Laboratory, University College.)

Livingstone College. Annual Report and Statement of Accounts for the Year 1927-28. Pp. 24. (London: Leyton, E.10.)

The Quarterly Journal of the Geological Society. Vol. 84, Part 3, No. 335, October 31st. Pp. 381-584+15 plates. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

University of Bristol: Department of Agriculture and Horticulture. Bulletin No. 3: The Effect of different Balanced Rations on the Yield and Composition of Milk from Dairy Cows. By A. W. Ling, C. A. MacEachern and C. Comely. Pp. 19. (Bristol.)

Treatment of Tuberculosis: Costs at Residential Institutions. (Memo. 122B/T). Pp. 21. (London: Ministry of Health.)

Memoirs of the Geological Survey of India. Vol. 50, Part 2: Descriptions of Mollusca from the Post-Eocene Tertiary Formation of North-Western India. Gastropoda (in part) and Lamellibranchiata. By the late E. Vredenburg. Pp. xiii+351-506+xxi+plates 14-33. 6.10 rupees; 10s. 9d. Vol. 51, Part 2: The Geology of Poonch State (Kashmir) and adjacent portions of the Punjab. By D. N. Wadia. Pp. 185-370+xxxiv+plates 2-11. 7.6 rupees; 11s. 9d. (Calcutta: Government of India Central Publication Branch.)

The Rhodes Scholarships: Statement for the Academic Year 1927-1928. Pp. 12. (London: The Rhodes Trust.)

The Research Association of British Paint, Colour and Varnish Manufacturers. Second Annual Report, submitted to the Statutory General Meeting held at Teddington, 17th October 1928. Pp. 24+2 plates. (London.)

## FOREIGN.

Smithsonian Miscellaneous Collections. Vol. 73, No. 5: Opinions rendered by the International Commission on Zoological Nomenclature. Opinions 98 to 104. (Publication 2973.) Pp. 28. Vol. 81, No. 5: The Relations between the Smithsonian Institution and the Wright Brothers. By Charles G. Abbot. (Publication 2977.) Pp. 27. (Washington, D.C.: Smithsonian Institution.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 87: Notes on the Buffalo-Head Dance of the Thunder Gens of the Fox Indians. By Truman Michelson. Pp. v+94. (Washington, D.C.: Government Printing Office.) 65 cents.

Papers of the Mount Wilson Observatory. Vol. 3: Revision of Rowland's Preliminary Table of Solar Spectrum Wave-Lengths, with an Extension to the Present Limit of the Infra-Red. (Publication No. 396.) Pp. xxi+238. (Washington, D.C.: Carnegie Institution.) 2.75 dollars.

Cathodo-Luminescence and the Luminescence of Incandescent Solids. By E. L. Nichols, H. L. Howes and D. T. Wilber. (Publication No. 384.) Pp. vii+350. (Washington, D.C.: Carnegie Institution.) 4.00 dollars.

Archaeological Investigations in Kamchatka. By Waldemar Jochelson. (Publication No. 388.) Pp. viii+88+19 plates. (Washington, D.C.: Carnegie Institution.) 2.75 dollars.

San Luis Catalogue of 15333 Stars for the Epoch 1910. Prepared at the Dudley Observatory, Albany, New York, under the direction of Lewis Boss (1908-12) and Benjamin Boss (1912-), assisted by Richard H. Tucker, Arthur J. Roy and William B. Varnum. (Publication No. 386.) Pp. lviii+307. (Washington, D.C.: Carnegie Institution.) 3.25 dollars.

The Mosquitoes of America. By Dr. Harrison G. Dyar. (Publication No. 387.) Pp. v+616 (123 plates). (Washington, D.C.: Carnegie Institution.) 5.00 dollars.

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 179: Forest Insurance and its Application in Michigan. By Paul A. Herbert. Pp. 34. Special Bulletin No. 182: Strawberry Growing in Michigan. By R. E. Lorie. Pp. 29. Technical Bulletin No. 93: Observations on the Pathology of Bacterium Abortus Infections. By E. T. Hallman, L. B. Sholl and A. L. Delez. Pp. 19+17 plates. Technical Bulletin No. 95: Studies in Flax Retting. By Antoinette Trevithick, B. B. Robinson and R. M. Snyder. Pp. 49. (East Lansing, Mich.)

The University of Chicago: Publications of the Yerkes Observatory. Vol. 4, Part 7: Astrometric and Photometric Statistics of certain of Hagen's Fields Photographed with the 24-inch Reflector. By Harriet McWilliams Parsons. Pp. v+32+2 plates. (Chicago: University of Chicago Press; London: Cambridge University Press.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1569: Earthworms as Pests and otherwise. By W. R. Walton. Pp. ii+14. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 74, No. 8: Five new Parasitic Flies reared from Beetles in China. By J. M. Aldrich. (No. 2753.) Pp. 7. (Washington, D.C.: Government Printing Office.)

Proceedings of the Imperial Academy. Vol. 4, No. 8, October. Pp. xxix-xxx+445-512. (Tokyo.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 6: The Intersecting Twin Earthquake of Tango Hinterland in 1927. By Dr. Bunjiro Kotô. Pp. v+265-329+plates 53-65. 2.40 yen. Vol. 2, Part 7: Pliocene Shells from Hyuga, by Matajiro Yokoyama; Neogene Shells from the Oil-Field of Higashiyama, Echigo, by Matajiro Yokoyama. Pp. 331-362+plates 66-69. 1.00 yen. (Tokyo: Maruzen Co., Ltd.)

## CATALOGUES.

Catalogue de livres anciens et modernes, rares ou curieux, relatifs à l'Orient. (No. 8.) Pp. 64. (Paris: Libr. Adrien-Maisonneuve.)  
Rheostats and Resistances. Pp. 26. (London: Isenthal and Co., Ltd.)

Rare and Interesting Books; 17th, 18th and 19th Centuries. (No. 22.) Pp. 82. (Newcastle-on-Tyne: William H. Robinson.)

India: its Arts and Architecture, Natural History, Religions, Sports, etc. (Catalogue 512.) Pp. 71. (London: Francis Edwards, Ltd.)

Choice Books, mostly in Contemporary or Fine Modern Bindings. (Catalogue 513.) Pp. 57+10 plates. (London: Francis Edwards, Ltd.)

## Diary of Societies.

FRIDAY, DECEMBER 14.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department, Imperial College of Science), at 2.30.—Prof. P. Groom: The Antiseptic Preservation of Wood.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Lord Olivier: The Improvement of Negro Agriculture.

ROYAL ASTRONOMICAL SOCIETY, at 5.—G. Shajn and O. Struve: On the Rotation of the Stars. Prof. B. A. Milne: Ionisation in Stellar Atmospheres: Part II. Absolute Magnitude Effects.—H. Zanstra: The Excitation of Line and Band Spectra in Comets by Sunlight.—M. Minnaert: The Distribution of Energy near the Limb of the Sun.—C. Easton: A Photographic Chart of the Northern Milky Way.—J. Evershed: High Dispersion Prism Spectra.

BIOCHEMICAL SOCIETY (in Laboratories of J. Lyons and Co., Ltd., Hammer-smith Road), at 5.—Prof. J. C. Drummond and L. C. Baker: Further Chemical Studies of the Vitamin A Fraction of Liver Oils.—B. Russell-Wells and Dr. P. Haas: The Hydrolysis of Carrageen Mucilage.—C. R. Harington: The Resolution of *d*, *l*-thyroxine.—M. W. Goldblatt: The Action of Insulin in Young Rabbits.—E. Clenshaw and I. Smedley Maclean: The Nature of the Unsaponifiable Matter from the Lipoids of Spinach and Cabbage Leaves.—L. H. Lampitt and P. Bilham: The Effect of Some Constituents of Milk on its Hydrogen Ion Concentration.—D. H. F. Clayton: The Diastatic Digestion of Raw Wheat Starch.—L. H. Lampitt and J. B. Bushill: Some Observations on the Determination of Surface Tension by the Ring Method, with Special Reference to Egg Albumin.—E. B. Hughes: Some Observations on the Production of Liesegang Rings.

IMPERIAL COLLEGE CHEMICAL SOCIETY, at 5.—H. L. Riley and others: Informal Discussion on the Problem of Molecular Structure.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Clinical Meeting) (at Royal Westminster Ophthalmic Hospital), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. Ezer Griffiths: A Survey of Heat Conduction Problems (Lecture).

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.—G. C. Robson: Remarks on the Evolution and Classification of Octopoda.—L. R. Cox: Notes on the post-Miocene Ostracode and Pectinidae of the Red Sea Region with Remarks on the Ecological Significance of their Distribution.

INSTITUTE OF MECHANICAL ENGINEERS, at 6.—E. G. Herbert: Cutting Tools Research Committee: Report on Machinability.

INSTITUTE OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—T. H. Lockett: The Applications of Electricity in the Printing Industry.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section), at 7.—Prof. F. M. Rowe and Dr. C. P. Bean: The Effect of After-treatments on the Degree of Aggregation and Fastness Properties of Insoluble Azo Colours on the Fibre.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—E. J. H. South: Locomotive Boiler Washing Plant.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Prof. W. A. Scott: Commercial Paper.

INSTITUTE OF ELECTRICAL ENGINEERS (North-Western Centre) (at College of Technology, Manchester), at 7.—Ll. B. Atkinson: How Electricity does Things (Faraday Lecture).

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—Prof. F. M. Rowe and Dr. C. P. Bean: The Effect of After Treatments on the Degree of Aggregation and Fastness Properties of Insoluble Azo Colours on the Fibre.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at Municipal College, Burnley), at 7.15.—S. Stanworth: Comparison of English and French Moulding.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—N. E. Box: The Dismantling, Transportation, and Erection of Heavy Machinery.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Temperance Institute, Keighley), at 7.30.—J. H. Lee: Conveying.

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Department of Applied Science, Sheffield University), at 7.30.—L. Wright: Chromium Plating.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—R. A. Bellwood: Present Day Methods of Oil Extraction.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. C. A. Robinson: The Treatment of Pelvic Inflammation by Diathermy.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group).—N. Swindin: The Air and Gas Lift as a Chemical Appliance.

SATURDAY, DECEMBER 15.

- INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.
- NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—J. F. C. Friend: Roof Control on Longwall Faces.—*Papers open for discussion*:—Extracts and Recommendations from the Report of the Water Dangers Committee, T. G. Davies; Notes on the Conversion of Main Pumping from Steam to Electricity, with Special Reference to the Plant Installed at Messrs. The Stella Coal Company's Clara Vale Pit, L. H. Forster.—Exhibition and Description by M. Jordan of A Patent Drag for Pit Tubs.
- ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Bayes: The Gulf between Painter and Public (II).
- BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at Royal Anthropological Institute), at 3.—Miss P. Holman: Habit and Repetition.
- PHYSIOLOGICAL SOCIETY (in Department of Physiology, London (R.F.H.) School of Medicine for Women), at 3.30.—W. Leyshon: Cathode Ray Oscillograph Records of Discharge Current in Neon Tube Circuit.—M. Lowenfeld and S. T. Widdows: Factors Influencing the Secretion of Fat in Human Milk.—H. Dyrreer: The Action of Atropine on the Elasmobranch Heart; Evidence Suggesting the Presence of Cardio-acceleration Fibres in the Vagus (Preliminary Communication).—H. A. Dunlop: The Nature of the Depressor Action of Adrenaline.—Prof. Swale Vincent and J. H. Thompson: A Respiratory Autocoid from the Adrenal Cortex Discharged into the Circulation via the Lymphatics.—B. E. Gaissinsky and M. I. Lewantowsky: Changes in Striped Muscle after Sympathectomy.—G. T. Popa and F. Popa: The Sympathetic Innervation of the Skeletal Muscle in the Wing of the Pigeon: its Function and Morphology.—Demonstrations:—G. Briscoe: Experimental Co-ordination of Muscular Movements. (a) Grading in Skeletal Muscle; (b) Reciprocal Contraction in Antagonistic Muscles; (c) Threshold Reaction to Stretch.—G. Briscoe and W. Leyshon: Fork Controlled Neon Lamp Circuit for Excitation of Nerve (a) with Induction Coil, (b) by Direct Method.—G. Briscoe: (a) Friction Gear Apparatus for Driving at any Speed; (b) A Class Exercise in Reciprocal Contraction.—E. E. Hewer and M. F. L. Keene: The Parathyroid and the Pineal at Various Stages of Development in the Human Fetus.
- INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at College of Technology, Manchester), at 7.—G. Mohn: The Application of the Microscope to the Study of Metals and Alloys.
- HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—J. W. Beaumont: The 'Sentinel' Engine and its Application Railway Work.

MONDAY, DECEMBER 17.

- INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.30.—J. R. Duggan: Suction Gas as an Automobile Engine Fuel.
- INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Section) (at the College, Loughborough), at 7.—C. K. Spied: 'Servo-Equipment.'
- NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (Newcastle-upon-Tyne), at 7.15.—J. Neill and others: Could the Method of Conducting Measured Mile Trials be Improved?
- INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Technical College, Glasgow), at 7.30.—Dr. H. J. Gough: Recent Developments in the Study of the Fatigue of Materials.
- RAILWAY CLUB (57 Fetter Lane), at 7.30.—J. Pelham-Maitland: Recent Developments in Main Line Electrification in France.
- ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—B. Ionides: Modern Glass.
- ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Papers to mark the Bicentenary of Captain Cook, including an Appreciation of his Life written by Sir Henry Newbolt.
- SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Leeds).—Dr. E. G. Ritchie: The Storage of Steam in Industrial Plants.

TUESDAY, DECEMBER 18.

- ROYAL DUBLIN SOCIETY, at 4.15.—J. T. Donnelly, C. H. Foot, and Prof. J. Reilly: A Note on Gas Analysis.—Dr. W. R. G. Atkins and Dr. H. H. Poole: The Integration of Light by Photo Electrolysis.
- ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
- INSTITUTION OF CIVIL ENGINEERS, at 6.—J. H. Nicholson: The Reconstruction of the New Holland Pier.
- INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates' Branch—Manchester and District) (at Milton Hall, Manchester), at 7.—A. B. Crompton: Drying in Laundries.
- ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—B. H. Crawford: Photographic Methods in Nature Study.—Dr. W. Clark: Exhibition of some Kinematograph Films (subject to their arrival from America in time for the meeting).
- INSTITUTION OF AUTOMOBILE ENGINEERS (at Broadgate Café, Coventry), at 7.15.—L. H. Dawtrey: Automobile Brakes.
- INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—H. A. D. Acland: The Kitson-Still Locomotive.
- INSTITUTION OF AUTOMOBILE ENGINEERS (at Engineering and Scientific Club, Wolverhampton), at 7.30.—L. H. Pomeroy: Modern Problems of Engine Lubrication.
- ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Miss R. M. Fleming: A Study of Growth in Children: its Ethnological and Educational Significance. An Analysis of Six Years' Consecutive Measurement.

WEDNESDAY, DECEMBER 19.

- SOCIETY OF GLASS TECHNOLOGY (at University College), at 2.30.—W. R. Lyttleton: A Brief Outline of the History, Development, and Methods employed in the Manufacture of Laminated Glass.—J. Randall and R. E. Leeds: (a) A Simple Test for the Detection of Iron Oxides in Glass Sands, and (b) Note on the Reduction of Glass in Hydrogen.
- ROYAL METEOROLOGICAL SOCIETY, at 5.—L. H. G. Dines: The Dines Float Barograph.—Dr. J. Glasspool: The Distribution of the Average Seasonal Rainfall over Europe.

- NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.—E. C. Curwen: Prehistoric Agriculture in Britain.—H. O. Clark: Notes on French Windmills.
- GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. C. A. Matley: A Visit to the Crater of Papandajan (Java).—Dr. W. J. Pugh: The Geology of the District between Llan-y-Mawddwy and Llanuwchllyn (Merioneth).
- INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—I. W. G. Freeman: The Harbour Improvement Scheme at St. Peter Port, Guernsey.
- LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 6.30.—J. D. G. Taylor: Some Aspects of Railway Construction in Benguela.
- INSTITUTION OF AUTOMOBILE ENGINEERS (at Engineers' Club, Manchester), at 7.—J. O. H. Norris: The Design of a Town Carriage.—F. H. Paul: Suggestions relating to the Design of Automobiles.
- INSTITUTION OF ELECTRICAL ENGINEERS (Teesside Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.
- ALCHEMISTS' SOCIETY (in Chemical Lecture Theatre, Glasgow University), at 7.30.—Dr. H. Hepworth: The Chemist in Industry.
- INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Section) (at Queen's Hotel, Birmingham), at 7.30.—W. G. Copestake: Two-stroke Engines.
- ROYAL MICROSCOPICAL SOCIETY, at 7.30.—E. Heron-Allen and A. Earland: Some Further Notes on the Pesticide.—Prof. E. Ghosh: A New Parasitic Ciliate from the Intestine of the Bengal Monkey (*Macaca rhesus*).
- BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London), at 8.30.—Dr. E. Glover: The Psychology of the Psychotherapist.

THURSDAY, DECEMBER 20.

- ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.
- INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. Swinburne: The Work of Sir Joseph Swan (Lecture).—E. B. Wedmore, W. B. Whitney, and C. E. R. Bruce: An Introduction to Researches on Circuit Breaking.
- CHEMICAL SOCIETY, at 8.—Prof. C. K. Ingold and C. C. N. Vass: Influence of Poles and Polar Linkings on the Course Pursued by Elimination Reactions. Part II. Mechanism of Exhaustive Methylation (continued).—G. W. Fenton and Prof. C. K. Ingold: Influence of Poles and Polar Linkings on the Course Pursued by Elimination Reactions. Part III. A Decomposition of Dialkylsulphones.—Prof. G. T. Morgan and R. A. S. Castell: Researches on Residual Affinity and Co-ordination. Part XXXI. Molybdiyl bis- $\beta$ -diketones.—Prof. G. T. Morgan and F. H. Burstall: Interactions of Selenium Oxochloride and Phenols.—Prof. C. K. Ingold and E. Rothstein: Influence of Poles and Polar Linkings on Tautomerism in the Simple Three-Carbon System. Part I. Experiments illustrating Prototropy and Aniotropy in Trialkylpropenylammonium Derivatives.—Dr. S. Sugden: The Parachor and Chemical Constitution. Part X. Singlet Linkages in Chelated Co-ordination Compounds.
- INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).
- INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—E. G. Herbert: Cutting Tools Research Committee: Machinability.
- INSTITUTION OF MINING AND METALLURGY (at Geological Society).

FRIDAY, DECEMBER 21.

- JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.—C. H. Hudson: Oils for Cutting and Quenching Purposes.

PUBLIC LECTURES.

MONDAY, DECEMBER 17.

- EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—F. L. Engledow: The Breeding and Growing of New Kinds of Corn.

TUESDAY, DECEMBER 18.

- UNIVERSITY OF LEEDS, at 8.—R. G. Collingwood: Recent Progress in our Knowledge of Hadrian's Wall.

CONFERENCE.

FRIDAY AND SATURDAY, DECEMBER 14 AND 15.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at University College).

Friday, Dec. 14.

At 10 A.M.—E. C. Barton Wright and J. E. Boswell: The Biochemistry of Dry Rot in Wood.—R. K. Cannon: Glutathione Considered as an Oxidation Reduction Catalyst.—K. Pinhey: Tyrosinase in Crustacean Blood.—A. M. Copping and Prof. J. C. Drummond: Comparative Experiments on Bios and Yeast Growth.—R. N. Salmond: Adventitious Buds and Mutations in the Potato.

At 2.15.—Dr. H. A. Harris: The Contrast between Vegetative Proliferation and Differentiation in Function.—Dr. E. Bozler: Some Relations between Structure and Function in Muscle Fibres.—Prof. J. B. Gatenby and S. Wigoder: Notes on the Cytology of X-radiated Cavy Testes.

Demonstrations.

A. N. Mukerji and Prof. J. B. Gatenby: Golgi Bodies, Vacuome and Mitochondria *intra vitam*.—Dr. E. Bozler: The Relations between Structure and Function in Muscle Fibres.—Miss E. M. Renton: The Rearing of Marine Animals.—Dr. H. P. Hacker and Dr. H. S. Pearson: The Position Assumed by Anopheline Larvae at the Surface of Water and its Mechanism.—Dr. H. A. Harris: Vegetative Proliferation and Differentiation in Function in Bone.—Prof. P. A. Buxton and Dr. V. B. Wigglesworth: Methods of Rearing Blood-sucking Reduviidae in the Laboratory.

At 4.45.—P. Gorer: The Crustacean Neuromuscular Apparatus.—Miss S. M. Mills: The Effect of pH on the Ingestion of Food by Colpidium.

At 6.—Annual Meeting.

Saturday, Dec. 15.

At 10 A.M.—C. F. Marrian and Dr. A. S. Parkes: The Effect of Anterior Pituitary Injections on Dietary Sterility.—E. A. Spaul: The Biological Activity of the Anterior Pituitary and the Phosphate Content.—H. O. Bull: Experimental Study of Fish Behaviour.—B. P. Wiesner: Pseudopregnancy. Its Biological Significance and Mechanism.—V. J. Clancey: Exhibition of Biological Cinema Films.