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Education, Environment, and the Criminal.

EVERY year a considerable sum of public money is expended on the issue of official publications—blue books, which it is to be feared the general public too rarely reads. Yet this is a pity; for blue books are sometimes entertaining and usually instructive. Elsewhere we give some figures taken from the returns of criminal statistics for England and Wales for the year 1928 issued by the Home Office. From the data there given it will be apparent that this official publication is of interest to a wide audience—wider, indeed, than the specialists in the study of crime and the criminal, or indeed in any one branch of social reform which impinges on the criminal world. For criminal statistics are not merely a gauge of the criminal tendencies of our population, any more than they are solely an index of the efficiency of our police organisation in detecting crime. Infinitely more suggestive to regard them as a tabulation of the less gratifying products of our social system—an indication of some defective bearing in the machinery by which the daily life of the community is regulated and carried on.

In a perfect society there would be no crime—not necessarily as a result of the perfection of the individual, but because of the complete adjustment of that society to the satisfaction of the needs of the individual. The primal nature of man remains unaltered through the ages. It is based upon certain fundamental necessities which are perennial and common to all living things. These are the urge to the preservation of the individual and the urge to the perpetuation of the race. When once this postulate is grasped the whole problem resolves itself into a matter of adaptation.

The attempt to secure the full satisfaction of the needs of the individual by moulding the environment to his requirements is the genesis of culture and of society. It lies at the roof of Utopias framed by philosophers from Plato to H. G. Wells; it is the motive power of social reform and the justification of the world-old urge towards democracy. For, unfortunately, even in the earliest stages of man's history as a social being, the environment was imperfectly adapted to the needs of all individuals. Differences of age, physique, sex, and individual character made for imperfect adjustment. There must always have been an under-dog. Even in the simpler societies, whether patriarchal or matriarchal, the exercise of family control entails a cramping of individuality by regulations which sooner or later are regarded by someone as harsh, uncon-

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scionable, or unnecessary. Their transgression inevitably follows and the eyes of authority behold a crime. As society becomes more complex, maladjustments as between individuals and the environment become more numerous and crime increases. For whatever means the individual may adopt to correct that maladjustment, whether it be murder or merely exceeding the speed limit, if it contravene a regulation laid down by the authority of society it constitutes a crime.

Thus 'crime' is purely a relative term and in the history of mankind its connotation has varied with the variations in type and the advance of the social organism.

It must be remembered, however, that to regard society as a means of securing the full satisfaction of individual needs may tell less than half the story. It is obvious that the environment with which a man may find himself at odds is a complex of individuals like unto himself, and in the satisfaction of his own needs he is precluded from impeding the satisfaction of the legitimate needs of others. Just as the patriarch in a primitive community imposes his will upon the members of his group, so in a more highly organised society the will of that society, whether it be embodied in a despot, a constitutional monarch, or in the representative assembly of the people, exercises itself to guard against encroachment by the individual. Hence the paradox that the social organism which was created originally to provide an environment which would admit of the complete self-expression of the individual almost immediately becomes a medium to which he must adapt himself. Self-expression is given a free rein so far, and so far only, as it does not come into conflict with the limitations imposed by society.

It is a matter of importance to stress the fact that crime has no fixed connotation but that it varies at different grades of culture. Even murder, the most serious injury to the person, at certain stages of social development is a private matter for the victim's immediate group and not a concern of the community as a whole. This way of looking at the matter survives even in Europe, where in some of the less advanced communities the family or tribal vendetta survives under a comparatively highly organised system of government. Plural marriage, which is perfectly legitimate in a polygamous society, becomes the crime of bigamy in a society organised on a monogamous basis. Incest, a criminal offence, though only since 1908 in England, has varied in definition in different ages and in different societies according to the forbidden degrees, and a form of union which we would now class as incestuous con-

stituted the primary form of royal marriage in ancient Egypt.

Any contravention of a regulation laid down with communal authority may constitute a crime. In the army a man's 'crime sheet' records behaviour contrary to regulation and may contain no entries in any sense of 'criminal' in common usage. For the purpose of the "Criminal Statistics", crimes in the sense of indictable offences may range from murder and manslaughter to stealing a dog or "inciting an infant to bet". Each year the list of such offences becomes longer. Additions were made to no less than twenty classes of offence by legislation which came into force in England and Wales in 1928. They affected such widely varying matters *inter alia* as fraud, forgery, money-lending, road-transport lighting, and the protection of the lapwing.

Thus legislation, and especially legislation of the grandmotherly or meticulous type, more particularly if it does not have an overwhelming weight of public opinion behind it, leads to an increase of crime. It adds to the number of offences and thereby swells the roll of those who offend. The prohibition laws of America afford a peculiarly instructive example—at least so far as it is possible to judge from the outside. There the union of various interests with ulterior motives—of these perhaps the most potent the desire to eliminate the influence of the saloon-keeper from the sphere of politics—joined with the temperance movement to attain their object through the prohibition laws. These public opinion—the ultimate tribunal—has not merely not been strong enough to enforce, but it would seem as if as a whole it has not even desired to enforce them in their entirety. Hence 'bootlegging' and a whole series of customs offences, with the acts of lawlessness which accompany them, as well as the illicit manufacture and sale of alcohol, now help to swell the list of crimes.

It requires very little consideration of the variety of and variation in criminal statistics to show that those anthropologists who a generation and more ago sought to fix a criminal physical type were attacking a social problem on too narrow a front. In so far as certain stigmata denote physical and mental degeneration they may be taken as indication of potentialities in certain directions, which, given certain conditions, are likely to become actively criminal. The force of heredity is no more negligible in human relations than in animal breeding. But in a modern society the effects of heredity and of environment are almost inextricably interwoven. The study of the evolution of man and his congeners, the great anthropoid apes, points to the

fact that while the latter have survived by an early specialisation adapting them to their environment but limiting their advance, man has survived through an infinite adaptability to varying conditions. Hence it is no longer possible to look upon the criminal, that is, the criminal in the more serious sense of the social outlaw, as a type—a throwback or a survival in any real sense. He is a failure in adaptation. Normally man must be regarded as infinitely educable. The criminal, however, even the criminal of habitual type, is an individual of imperfect inhibition. His conduct may be conformable to an earlier stage of culture; but as things are it is a maladjustment with his social environment. The man who steals to procure food which will save him from starvation takes that which in a more primitive society would be procurable by his own effort or would be given him for the asking. For here the necessities of life are common to the members of the group, or are the product of group activity; but in a society in which his act has come to be looked upon as a crime, he shows that either he has not responded to training or he has been imperfectly educated to survive in the conditions imposed upon him by society.

Criminal statistics, then, serve as an index of the degree to which there is a lack of adjustment as between the individual and the requirements imposed by life in any given community. In the imperfect world in which we live, it cannot be hoped to eliminate crime; but with these data as a starting-point it is possible to probe for the causes which retard progress towards a state of social equilibrium. On one hand, it may be asked whether the incidence of crime is such as to point to an undue proportion in the community of a class congenitally unfitted by physique and mental constitution to acquire a habit of conduct in accordance with the standard of the community—a problem for the expert in the study of delinquents and the eugenist. On the other hand, the number and character of the crimes may suggest an inquiry whether the training by which society seeks to secure that the individual is brought into harmony with, and fitted to survive in, his environment is suitable and effective—the province of the educationist. Moreover, it must not be overlooked that the environment itself may be at fault. Social conditions may be such as to render nugatory all efforts towards individual training, or by force of unduly harsh or unnecessary legal and social restrictions make demands which an appreciably significant proportion of members of the community is unable to meet, constituting a call for social or legal reform which should not be ignored.

### The Great Chemists.

*Das Buch der grossen Chemiker.* Herausgegeben von Dr. Günther Bugge. Band 1: *Von Zosimos bis Schönbein.* Pp. xii + 496 + 42 Tafeln. (Berlin: Verlag Chemie G.m.b.H., 1929.) 24 gold marks.

THE appearance of any work on the history of chemistry which is more than a sketch of the subject is so infrequent that a general expression of satisfaction and a recommendation seem inevitable in all cases, and are usually given to the exclusion of any detailed criticism. There are, however, certain general errors which seem fated to recur in all such works, and it may be useful, in addition to the statement that the present work is one which every chemist should add to his library, to notice some of these here.

The present volume is a composite production and suffers inevitably from the faults of such. The treatment is uneven and the value of the contributions varies rather considerably with the authors. The subject matter as a whole is, however, of high standard, and in the cases where the original sources have been used it contains many points of interest and importance. In many cases, however, the sources have clearly been secondary, or even further removed from the originals. Common and well-known errors, therefore, appear again, in many cases with reference to the secondary or tertiary literature from which they have been taken. It is impossible to refer to all such cases, but a few examples will be given. The statements on pp. 369 and 373 that Dalton was indebted to Richter are not in accordance with the facts as set out in the careful examination of the question published by Meldrum many years ago, and that on p. 391 that Mayer took account of Gay-Lussac's experiments on the expansion of gases into a vacuum is given with a reference to a secondary source. If the author had read Gay-Lussac's work and had seen a criticism of this statement published a few years ago, he would scarcely have repeated this old error. The discussion of the early work on hydrofluoric acid follows the usual incorrect course (p. 284): the facts were published by the reviewer some years ago.

Although an American writer is taken to task (p. 224) for giving Geoffroy's name incorrectly, there are numerous examples of the mangling of names in the present volume, particularly those of Englishmen or English places. On the same page as the mis-statement about Mayer and Joule we find "Sir Dugald Clirs"; on p. 45 we find "Sommerset" (and are, incidentally, told that

Bacon studied in the "Hochschule zu Oxford"); a little further on (p. 46) we find "Brever" for Brewer and the date of Jebb's edition of the "Opus Majus" is incorrectly given; "Wresham" appears for Wrexham, and "Clerc Maxwell" does duty for the name of the great physicist. It would be well to publish a list of errata in the forthcoming second volume.

The treatment, on the whole, is moderately international, but the book is clearly intended mainly for German readers, and its reception in other countries must, in consequence, pay the price of this. As an example we may refer to the statement, after being told that Agricola had 'lifted' [abgeschrieben] large portions of Biringuccio's "Pirótechnia" in the composition of his "De Re Metallica", that, after all, the Italian's name shows that he is of "germanische Abstammung"! The usual sneer at "die englische Pruderie" occurs (p. 410), in this case, however, in connexion with what appears to be a wholly imaginary example, so that perhaps our love of fair play and regard to veracity have been mistaken for prudery. In very few cases do notable English books appear to be known to the writers, and the literature references are seriously incomplete in this respect. Thus, Darmstaedter, in his article on Agricola, refers only to his own edition of the "De Re Metallica", without mentioning Hoover's masterly work, and many other examples could be quoted.

As an example of the lack of knowledge of English and American scholarship on the part of many authors, the article on Roger Bacon may be quoted. The relations of Bacon with the Church are in the old-fashioned mid-Victorian Huxley-Spencerian vein, namely, that of an enlightened experimenter struggling with ignorant bigotry. In reality we know that Bacon's "Opus Majus" was not written until after pressing invitations from the Pope, and that Bacon 'got himself into hot water' not by his scientific views but by his wholly unnecessary personal abuse of highly placed members of his order. It is to be feared that the enlightened modern eminent man of science is often quite sensitive even of scientific criticism: what he would do if he were called a blockhead by his inferiors, and had the same freedom of action as Bacon's superiors, we do not wish to contemplate. All recent studies of Bacon's chemical work, such as those of Little, are completely ignored, and the article is very poor.

The treatment of Zosimos follows the usual lines. After the statement that Berthelot and Ruelle's

edition is very defective, which seems to be regarded as a pious duty by all recent German authors who compile from it, the so-called 'mystical' element in Alexandrian chemistry is stressed. It should be realised that Alexandrian authors in general introduced some complication into their writings which we avoid, in that they attempted to take account of the existence in Nature of God and of the soul. The treatment of a scientific subject gains in clearness and objectivity by ignoring these, but it may perhaps be suggested that it becomes rather one-sided. As philosophers, the Alexandrians were not satisfied by chemical cookery. The contributions made to *practical* chemistry by the early chemists of Alexandria are not made sufficiently clear. The reviewer will show in another place that the theory of the four primary colours of Demokritos, whose authority is invoked by all the early writers on chemistry, probably influenced the first theories in a way which does not seem to have been fully recognised, and that under its influence the theory and practice of the science descended in a perfectly natural way.

The article on Geber adds rather considerably to the complexity of the subject, although here much recent work is carefully considered. We knew from Berthelot that some of the Arabic works of Jabir were quite different from the "Summa" of Geber, but it is now suggested that these Arabic works are not authentic. It may be noticed in passing that the author of the "Summa" might have been English.

The treatment of the medieval writers is generally very unsatisfactory. Recent scholarship is practically ignored and in several cases the chemical aspects are referred to only in the very briefest way. Instead of an attempt to deal with the undoubted interest which some of the great schoolmen showed in chemistry, with careful references to the original sources, we are given merely a mass of undigested rhetoric from which we strive in vain to extract a few grains of objective truth. The general character of these articles may be judged from the following quotation from the later one on Paracelsus (who is treated highly sympathetically): "Über allen Dingen zittert der Abglanz eines fernen Glückes, alles Böse ist transparent und macht das Gute sichtbar, wie alles Nein das Ja, wie das Schwartz das Weiss und wie der Teufel Gott". There is much in this vein.

When the seventeenth century is reached the articles become more interesting and objective and in some cases contain really valuable material. It would perhaps be unfair to select certain articles

as especially good, since so much depends on the particular taste of the reader, but the reviewer found the following of great interest: Glauber, by Walden—an outstandingly good article; Libavius, by Darmstaedter; Klaproth and Mitscherlich, by the editor; Faraday, by Ostwald (apart from the error on p. 424 as to the source of the nomenclature of electrolysis, which is really due to Whewell, and the usual over-emphasis of the opposition of Davy to the laboratory assistant's F.R.S.). Articles which seemed less interesting, and, in some cases, to be more based on secondary sources, were those on Albertus Magnus, Paracelsus, Van Helmont, Lully, Berthollet (scrappy), and on Fourcroy and Vauquelin (merely dull).

The book, which is well printed and reasonably priced, must, like other recent German works on the history of chemistry, be used with caution and in close proximity with the originals. For the general reader who finds no difficulty with the language and is not much concerned with minute accuracy, it will be found very interesting. A second volume, bringing the study down to Emil Fischer, is promised and will be welcomed, but the editor might well impress on his collaborators the necessity of a rather broader outlook, a closer scrutiny of the original sources and less leaning on other historians, and more attention to recent scholarship in other lands than Germany.

J. R. PARTINGTON.

### Cocci and Hæmophilic Bacteria.

*Medical Research Council. A System of Bacteriology in relation to Medicine.* Vol. 2. By C. H. Browning, W. Bulloch, J. H. Dible, A. Fleming, F. Griffith, R. Tanner Hewlett, J. E. McCartney, T. J. Mackie, D. G. S. McLachlan, J. W. McLeod, W. Mair, E. G. D. Murray, G. H. Percival, W. M. Scott, A. L. Taylor, W. J. Tulloch, H. D. Wright. Pp. 420. (London: H.M. Stationery Office, 1929.) 21s. net.

THE volume of the Medical Research Council's "System of Bacteriology" before us deals with "Cocci and Hæmophilic Bacteria". A comparatively brief chapter is devoted to the staphylococci. There is an extremely interesting short note on the history, and Prof. Bulloch has appropriately emphasised the important and really primary work done on these organisms by Ogston in Aberdeen. The whole chapter, though brief, is well written, and gives a sufficiently detailed and accurate account of this group of bacteria.

Chap. ii., on the streptococci, is necessarily a

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long one, and occupies more than double the space given to any of the other cocci. This indicates the vast amount of work that has been done, and particularly during recent years, on this group of organisms. The list of references in itself indicates the amount of work that would require to be expended even to read superficially all the papers that have been published on this subject, and the chapter shows evidence that the reading by some of the authors has not been very carefully done. We think this chapter has also suffered from the multiplicity of authors. The early parts by McLeod are well done, and this can also be said of the section by Mackie and McLachlan. It may be desirable in a volume which is to be one of reference that an account should be written of results recorded by various authors as to the finding of streptococci in certain conditions of the skin, but we do feel that more judgment might have been used in the selection of published work in which there was, to say the least, evidence of some value brought forward to establish a claim to causal relationship. We do not think that judgment has been shown in the section by Percival.

To write above seborrhœa corporis, that "Although the characteristics of the streptococci isolated from these lesions have not yet been investigated, *it is very probable*, from a comparison with the hæmolytic streptococci isolated from impetigo, that the organisms in question are capable of elaborating a diffusible toxin. *If this is the case* the eczema reaction which is provoked may be due to the direct action of such a toxin . . ." without giving any evidence that the streptococci are not mere saprophytes in this condition, is in our opinion not worthy of being published.

The chapter on mouth streptococci seems to be somewhat confused, and we are at a loss to know whether this section is confined to this group, as the heading and the table of contents would suggest. Does the author maintain that the streptococci of rheumatic fever and of subacute endocarditis dealt with here are all mouth streptococci? There is a great deal of valuable information in this chapter, but it is not well arranged, and it is, in our opinion, too much dominated by the personal views of the author. Thus, in referring to the work of Leschke and Auerbach, who think that the best time to examine the blood is when the temperature is high, we are told that there is no convincing evidence that this is so, and the only fact given in support of this statement is that "the writer's experiments indicate that the number of organisms in the circulating blood do not undergo

great or sudden variations". No other evidence is given, and not even a reference to the author's experiments. On the following page, it is stated that "the original infection of the valves must result from an invasion of the blood stream by streptococci", and again, "they enter the blood stream from foci of infection". Surely it is almost certain that this entry and this spread will give rise to temperature, and if blood culture is made at that time the bacteria are more likely to be found than when the organisms have got settled down in the valves.

On rheumatism, in reference to the work of Beattie and Yates, the author states: "If their figures are considered in detail, it will be found that streptococci were isolated from the synovial membranes in 20 per cent of all cases". In answer to this it is stated that the author (1925) has pointed out that "similar organisms can be isolated from the heart blood of a not dissimilar percentage of cases dead from any cause". These statements are no doubt correct, but they are misleading. The author ignores altogether the experimental results obtained with the organisms in the 20 per cent of the cases, the rheumatic history of these cases, and particularly that in double the number of cases done at the same time the synovial membranes contained no streptococci, and that therefore general blood infection was excluded. The remaining parts of this section, on the enterococcus (though we disagree with the differentiation between this and *S. faecalis*), the parts on the anaerobic streptococci and on chemotherapy, are all important contributions which add considerable value to this whole chapter.

The chapter on pneumococcus is a very exhaustive study of this organism, and the authors have given very careful attention to detail. The views of various authors are given with extreme fairness and with excellent critical judgment. On the gonococcus, Tulloch writes with the authority of one who has himself done a considerable amount of work on the subject, and in consequence is quite familiar with the work of others. Nothing but praise can be given to this section, and we would specially emphasise the valuable part on practical diagnosis. The section on meningococcus (and, by the way, we are glad to see the protest against the American name, *Neisseria intracellularis*) is again evidently the work of an expert on the subject. We do not agree with all Dr. Murray has written—and particularly with the emphasis laid on identification by cultural characteristics—but it is a well-written article and gives an excellent

and valuable account of most of the work done in relation to this organism.

Chap. vi. calls for little comment. The confusion which exists in regard to the bacteriology of influenza presents a difficult task to a writer on the subject, and Dr. Scott has done the very best with the material at his disposal. He has given the various views with great fairness, and though apparently he is a convinced believer in *B. influenza* (Pfeiffer) as a cause, he has not over-emphasised the evidence in his favour.

The work by Prof. Hewlett in Chap. vii. gives all the necessary information on the various subjects dealt with in that chapter.

Taking the volume as a whole, we welcome it as a very valuable addition to the bacteriological library. It will be a constant source of reference to all workers on this group of organisms, and they will, we think, generally find some valuable information on any work they may be undertaking.

J. M. BEATTIE.

### Tropical Agriculture.

*A Text-Book of Tropical Agriculture.* By Sir Henry Alford Nicholls. Revised by John Henry Holland. (Macmillan's Manuals for Students.) Second edition. Pp. xxxvi + 639. (London: Macmillan and Co., Ltd., 1929.) 15s.

WITH the need for the development of our resources in the tropical colonies brought so prominently before us in recent years, it is surprising that we have been so long without an up-to-date text-book on tropical agriculture. The want of such a book has long been felt; the reviewer has frequently been asked in recent years to recommend a suitable work of this character to intending settlers and for use in schools and colleges. The demand for the book is further indicated by the fact that Sir Henry Alford Nicholls's text-book, first published in 1892, was reprinted seven times at intervals of about five years. The subject of the present review is the second edition of the same work, which has been revised and partly rewritten by Mr. J. H. Holland, of the Museums staff of the Royal Botanic Gardens, Kew.

To deal with the several groups of subjects included under the general term 'tropical agriculture' is no easy task. To deal with them exhaustively would require a volume for each. The result would be a series of monographs, of which the complete set would not only be too bulky, and too costly for the planter, but it would also be so exhaustive that the average man would not find

time to wade through it, and it would be beyond the ability of the school or college teacher to sift out of this mass of information the facts essential for class-room lessons. It is true that a man who is about to undertake maize-growing on a large scale will be glad to have an exhaustive treatise on the subject, which he can consult from time to time as questions arise. But with the tendency toward reducing the risk of loss by the use of catch-crops, green-manure crops, and rotation crops, the tropical agriculturist would like to have some handy and not too detailed book of reference which will suggest to him crops which are, at any rate, worth experimental cultivation. The book before us is of this character. It is of handy size, limited to 639 pages, well illustrated, with a convenient index in a single series and having the main points of the text indicated by marginal headings which enable one to find quickly the facts which are dealt with.

The text-book is divided into two parts, the first of which, comprising about 100 pages, deals with the elements of agriculture, grouped into thirteen chapters, namely, soils, plant-life, propagation of plants, climate (a bare couple of pages, which might have been enlarged with advantage), manures, rotation of crops (less than four pages; the result of experiments in the Dominions and Colonies, conducted during recent years, might have been recorded to good purpose), drainage, irrigation (here the information is limited to two pages and more might have been said), tillage operations, pruning, budding, and grafting.

The second part, comprising 510 pages, is divided into twenty chapters, dealing with such diverse subjects as coffee, cocoa, tea, sugar-cane, fruits, spices, tobacco, drugs, dyes and tans, tropical cereals, food-plants (for example, cassava, arrow-root, yams, pulses, etc.), fodder-plants, rubbers, fibres, oil-seeds, and volatile oils.

The paragraph on teff-grass (*Eragrostis abyssinica*), p. 465, might have been enlarged to advantage. More than a quarter of a million acres in the Union of South Africa are devoted to this grass as a hay crop, and its use has extended to Northern Rhodesia, Australia, and elsewhere. The value of the crop to South African farmers is placed at more than a million pounds sterling per annum. The very fine seed of the teff plant requires suitable handling if the crop is to succeed, and instructions as to seeding, etc., would have been helpful.

In view of the great importance of maize for stock food, for feeding native labour, and as a cash crop for export, a little more attention might have been given to it. Some of the information supplied

could have been replaced to advantage by the results of more recent work in the Union of South Africa, in Rhodesia, in Kenya, and elsewhere. The writer speaks of 'yellow-dent' as a particular variety of maize, whereas it is a class-name which covers many varieties. It is misleading to speak (p. 405) of a rainfall of about "50-80" inches as "required" for maize; in some countries this proves far more than is good for the crop. The precipitation requirement will vary, of course, with the incidence of the rainfall, and the degree of evaporation and transpiration which, again, are affected by temperature. The Argentine maize-belt, which produces a large part of the world's supply, has an average rainfall ranging from 31.5 in. to 39.4 in. (see Burt Davy, "Maize", pp. 37-42). In Rhodesia, Natal, and the Transvaal, a mean rainfall between 25 in. and 35 in. is the optimum for this crop.

In reading through the pages, one feels that the author of this revision must have been somewhat hampered by the fact that he was preparing a new edition of an old book. The changes which have taken place in agricultural practice, in the more than thirty-five years since the first edition appeared, due in part to increase in knowledge of the fundamental sciences and in part to experience, are so great, and such vast developments have taken place in the Dominions and Colonies in the period referred to, that it would have been better had the book been completely rewritten from cover to cover.

A very minor error, but one too frequently made, is the use of capital letters for the adjectival form of specific names of plants; for example, *Ledgeriana* and *Deeringiana* instead of *ledgeriana* and *deeringiana*. The use of capitals for *Litchi* and *Cavendishii* is correct, these being proper nouns in the nominative and genitive cases respectively. Owing to the difficulty which agriculturists, foresters, and horticulturists must necessarily have in ascertaining whether a word used as a specific name is entitled to a capital letter (on account of the fact that it has been used at one time as a generic name), it might possibly be better to decapitalise specific names throughout, in all technical publications intended for their use.

It is the duty of a reviewer to criticise. In doing so it is far from our desire to belittle a book for which we have long felt the need, and which can be confidently recommended to the would-be settler, the planter, and last, but by no means least, the teachers in schools and colleges who are endeavouring to arouse an interest among their students in the development of the British Empire overseas.

### Our Bookshelf.

*Elements of Optical Mineralogy: an Introduction to Microscopic Petrography.* By N. H. Winchell and A. N. Winchell. Entirely rewritten and much enlarged by Prof. Alexander N. Winchell. Second edition. Part 3: *Determinative Tables*. Pp. xii + 204. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 22s. 6d. net.

THIS edition of Part 3 of Winchell's "Elements of Optical Mineralogy", now published separately, entirely supersedes the earlier edition, which was incorporated with Parts 1 and 2 in one volume. Following a short introduction, five tables for the determination of minerals under the microscope are given. In the first a few of the commoner opaque and semi-opaque minerals are arranged with reference to their colour in reflected or transmitted light. No pretence is made, however, of dealing completely with this group. Minerals transparent in thin section are dealt with exhaustively in Tables 2 to 5. They are first listed with reference primarily to their birefringence. In Table 3 colour is the main determinative characteristic. Next come complete lists of isotropic and anisotropic minerals placed in the order of their refractive indices. In Table 5 the author has arranged the minerals in the order of their power of dispersion, so far as has been possible with the scanty data at present available. This is a useful addition to the methods of classification more usually adopted in determinative tables. Full explanatory notes precede each table.

There are also three plates, conveniently held in a pocket at the end of the book. Plate I. is a large coloured diagram showing the relationship between the interference colours of crystals, the thickness of the sections, and the birefringence of the crystals. Plate II. is a graphic representation of the most important minerals, based on their refringence, birefringence, and optic sign. It shows the variation in these properties resulting from variation of composition. The third plate is a copy of Wulff's stereographic plot for use in the study of minerals by the methods of the Federoff universal stage.

The volume is well produced, comprehensive, and up-to-date. It should prove useful to all engaged in the study of microscopic petrography.

*The Acoustics of Orchestral Instruments and of the Organ.* By Dr. E. G. Richardson. Pp. 158 (20 plates). (London: Edward Arnold and Co., 1929.) 10s. 6d. net.

DR. RICHARDSON has followed his recent "Text-Book of Sound" with an attractive book founded on the 1929 Martin White lectures given at the Northern Polytechnic, London. The subject of the lectures was the tone production of the organ and other wind instruments, and forms the basis of the first four chapters. Whilst the treatment is essentially popular, it includes much of the important work done since the time of Helmholtz. A special feature of the book is the profusion and excellence of the illustrations, which include not

only all the various instruments discussed, but also Carrière's striking photographs of eddy formation in the production of edge tone, details of the remarkable Pleyel Hall in Paris, and vibration curves of Milner and Barton and Browning. It is unfortunate that all these curves are of necessity qualitative, since they were obtained with recording apparatus depending upon resonance in which the response was unequal and imperfectly known at the various frequencies.

No special chapter is devoted to the organ, which is "in itself an orchestra", but the scope of the book is extended in the later chapters to deal with percussion, the strings, and *ensemble*. It is a little difficult to understand why church bells are included and the pianoforte excluded. The modern composer uses the pianoforte, and in one work even the gramophone (to reproduce the song of the nightingale), as purely orchestral instruments. There is more detail of architectural acoustics than of the phenomena of hearing, which are equally important in considering the effects of an orchestra in action. Apart from an appendix on the theory of fingering and cross-fingering on the wood-wind, the book is free from mathematics and is therefore of wider appeal. The author has further elaborated some of the topics of his Cantor Lectures (*Jour. Roy. Soc. Arts*, 78, January 1930). W. H. G.

*The Scientific Fundamentals of Gravity Concentration.*

By Prof. Josef Finkey. Translated into German from the Hungarian by Prof. Johann Poesubay. Translated from the German by C. O. Anderson and M. H. Griffiths. (Bulletin of the School of Mines and Metallurgy, University of Missouri, Technical Series, Vol. 11, No. 1.) Pp. 295. (Rolla, Mo.: School of Mines and Metallurgy, 1930.) 1 dollar.

PRIMARILY this work appears to have been written with the view of helping the mining engineer to understand more thoroughly the principles mentioned. Undoubtedly it will clear up many abstruse points for the practical engineer, but the strongly mathematical treatment makes it a work for the specialist, who will no doubt read it as it should be read, that is, in conjunction with the latest published accounts of experimental research on mineral dressing.

Descriptions of machines are not attempted, and the author makes it plain in his preface that it was his wish to treat those parts of the subject which are not adequately treated in the standard works. As it now appears in three languages, this may be taken as some measure of the merit of the work. After the introduction there are four chapters, of which the first deals with the mechanical principles of gravity concentration, and the subsequent chapters deal with the preparation of mineral or ore for concentration, jigging, and concentration on tables respectively.

It will be clear from the above that the scope of the work is limited to the treatment of ores and minerals in water. As is well known, there is a great number of processes in use for the dressing of minerals to-day in which water plays no part



at all, and others in which water is modified to give further benefits. That the latter class is not treated directly, is simply further proof of the special nature of the work. To the student the importance of the work will lie in its supplementary character, while the engineer in charge of a mineral dressing plant will find much new light thrown on the separation of mineral and gangue by water.

C. H.

*Winchester College Natural History Society. The British Palmate Orchids.* By H. Cary Gilson. Pp. 36 + 35 plates. (Winchester: P. and G. Wells, Ltd., 1930.) 3s.

ALTHOUGH much valuable work on the British palmate orchids has appeared in recent years, notably by Dr. G. C. Druce and by the Rev. T. and Mr. T. A. Stephenson, this has been scattered among a number of papers in different journals. It is consequently difficult to find out the general conclusions which have been, or can be, drawn from such work, or even to tell what species are actually recognised as distinct.

Mr. Gilson has attempted in the little book under notice to bring together all this information and to sum up what seem to be the chief conclusions which can be derived. The descriptions of the species are very complete and clear, while full references are given to the sources of information. Each species is illustrated by photographs of the plant *in situ* and of individual flowers. These are good on the whole, but would be more useful if the scale of magnification were given in each case.

In the second part of the book the author describes his own studies on the group as represented in the neighbourhood of Winchester, describing a number of localities and the orchid populations growing there. The most interesting portion of this part of the work is Mr. Gilson's theory of the status and origin of the various forms of the polymorphic *Orchis latifolia* L. as found in Britain. This is very suggestive and is certainly worth following up. As Mr. Gilson properly points out, only definite experimental work can prove what is correct in this and other examples. It is, however, decidedly encouraging to see that this extremely difficult group of plants is being studied along ecological and genetical lines in conjunction with the more orthodox taxonomic methods; for it is only by such means that further progress can be made either in the orchids or in any other group of British plants.

V. S. S.

*Physical Measures of Growth and Nutrition.* By Dr. Raymond Franzen. (School Health Research Monographs, No. 2.) Pp. xii + 138. (New York: American Child Health Association, 1929.) 1 dollar; cloth, 1.25 dollars.

THIS monograph is a statistical study of anthropometrical data obtained from 10-12-year-old children: the work was carried out with the view of devising satisfactory methods of measurement of the state of nutrition of the subjects. No satisfactory agreement between different observers was obtained when only general estimates of nutritional con-

dition were made; greatest agreement was reached between different estimates of the amount and quality of muscle and of subcutaneous tissue.

Certain of the conclusions given in the report may be mentioned to give an idea of the scope of the work; thus it was found that the correlation of height with weight is not nearly so high as that of other skeletal combinations with weight; individual differences in chest dimensions and hips are more important as determinants of variations in weight. Individual variations in weight depend on variations in certain easily determined bodily measurements, and can be almost wholly explained as due to these latter. The methods used and the results obtained are presented in great detail; the work is an important contribution to the determination of the characteristics of the 'normal' boy or girl and to the value of different methods of estimating this normal and the deviations from it.

*Ethnography.* By Prof. Loomis Havemeyer. Pp. vi + 522. (Boston, New York, Chicago and London: Ginn and Co., 1929.) 21s. net.

THERE are few subjects in which the preparation of a text-book presents greater difficulties than ethnography, especially if for various reasons it is necessary to keep within a moderate compass. Prof. Havemeyer's "Ethnography" has been written with the special view of the significance of the facts for the development of social evolution. In order to avoid too great diffuseness on one hand, and, on the other, the effort to be encyclopædic, his plan has been to select a few tribes under the main races about which we know all the typical and significant facts on reliable authority, and then to describe them under the main aspects of their self-maintenance, self-perpetuation, self-gratification, religion, and regulative organisation. On this scheme the black, brown, red, yellow, and white races are described in turn; but the main groups of the yellow and white races are not touched upon for reasons of space, the description of the former being confined to Tibetans and Yakuts, and of the latter to Hindus.

*Races of Africa.* By Prof. C. G. Seligman. (The Home University Library of Modern Knowledge.) Pp. 256. (London: Thornton Butterworth, Ltd., 1930.) 2s. 6d. net.

PROF. SELIGMAN'S book on Africa is almost a *tour de force* in condensation. As an introduction to the study of African peoples and culture it will be of the greatest assistance to students. Apart from its value as a comprehensive, if brief, summary of the present state of our knowledge, it serves to bring home to the public how great are the gaps in our information to be made up before anything approaching certainty in our conclusions can be attained. As the author points out in his introductory chapter, there are still in Africa unsurveyed areas and uncharted tribes. In physical anthropology a beginning has scarcely been made in the anthropometric survey which is an essential condition of valid argument on the racial history and affinities of the African peoples.

Letters to the Editor.

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Artificial Disintegration by  $\alpha$ -Particles.

It is commonly assumed that the process of artificial disintegration of an atomic nucleus by collision of an  $\alpha$ -particle is due to the penetration of the  $\alpha$ -particle into the nuclear system; the  $\alpha$ -particle is captured and a proton is emitted.

On general grounds it seems possible that another process may also occur, the ejection of a proton without the capture of the  $\alpha$ -particle.

Consider a nucleus with a potential field of the type shown in Fig. 1, where the potential barrier for the  $\alpha$ -particle is given by the full line and that for the proton by the dotted line. Let the stable level on which the proton exists in the nucleus be  $-E_p^0$  and the level on which the  $\alpha$ -particle remains after capture be  $-E_\alpha^0$ .

If an  $\alpha$ -particle of kinetic energy  $E_\alpha$  penetrates into this nucleus and is captured, the energy of the proton emitted in the disintegration will be  $E_p = E_\alpha + E_\alpha^0 - E_p^0$ , neglecting the small kinetic energy of the recoiling nucleus. If the nucleus disintegrates without capture of the  $\alpha$ -particle, the initial kinetic energy of the  $\alpha$ -particle will be distributed between the emitted

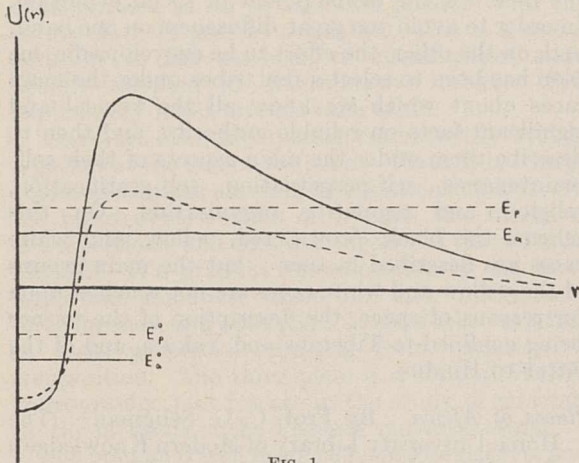


FIG. 1.

proton and the escaping  $\alpha$ -particle (again neglecting the recoiling nucleus). The disintegration protons may have in this case any energy between  $E_p = 0$  and  $E_p = E_\alpha - E_p^0$ .

Thus, if both these processes occur, the disintegration protons will consist of two groups: a continuous spectrum with a maximum energy less than that of the incident  $\alpha$ -particles and a line spectrum with an energy greater or less than that of the original  $\alpha$ -particles according as  $E_\alpha^0 > E_p^0$ , or  $E_\alpha^0 < E_p^0$ , but in either case considerably greater than the upper limit of the continuous spectrum (see Fig. 2).

In some experiments of one of us in collaboration with J. Constable and E. C. Pollard, the presence of these two groups of protons appears quite definitely in certain cases, for example, boron and aluminium. A full discussion of these and other cases of disintegration will be given elsewhere, but it may be noted that the existence of groups of protons has already

been reported by Bothe and by Pose. In general the experimental results suggest that with incident  $\alpha$ -particles of energy about  $5 \times 10^6$  volts ( $\alpha$ -particles of polonium) the process of non-capture is several times more frequent than the process of capture.

It is clear that, if our hypothesis is correct, accurate measurement of the upper limit of the continuous spectrum and of the line will allow us to estimate the values of the energy levels of the proton and  $\alpha$ -particle

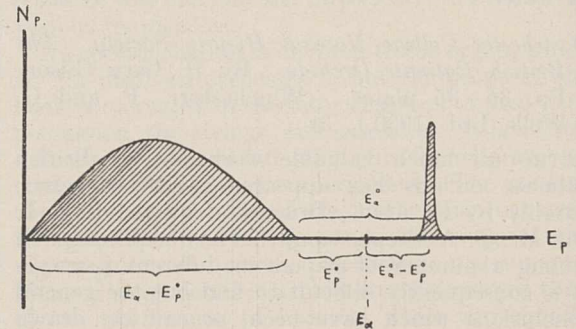


FIG. 2.

in the nucleus. In the case of aluminium bombarded by the  $\alpha$ -particles of polonium the protons in the continuous spectrum have a maximum range of 32 cm. and those of the line spectrum a range of 64 cm. These measurements give the following approximate values for the energy levels:

$$E_p^0 = 0.6 \times 10^6 \text{ e volts, and } E_\alpha^0 = 2 \times 10^6 \text{ e volts.}$$

On the wave mechanics the probability of disintegration of both types is given by the square of the integral

$$W = \iint f(r_{\alpha,p}) \cdot \psi_\alpha \cdot \psi_p \cdot \phi_\alpha \cdot \phi_p \cdot dV \cdot dV' \quad (1)$$

where  $f(r_{\alpha,p})$  is the potential energy of an  $\alpha$ -particle and a proton at the distance  $r_{\alpha,p}$  apart, and the wave functions  $\psi_\alpha, \psi_p$  represent the solutions for the  $\alpha$ -particle and proton before and  $\phi_\alpha, \phi_p$  after the disintegration. In calculating the integral (1) we must develop the incident plane wave of the  $\alpha$ -particle into spherical harmonics corresponding to different azimuthal quantum numbers of the  $\alpha$ -particle, and deal with each term separately.

In the case of capture of the  $\alpha$ -particle the estimation of (1) can be carried out quite simply. It can be shown that the effect of the higher harmonics is very small, and that the disintegration is due almost entirely to the direct collisions. Thus we obtain for the probability of disintegration

$$W_1^2 = \frac{A}{v_\alpha^2} \cdot e^{-\frac{8\pi^2 e^2}{h} \cdot \frac{Z}{v_\alpha}} \cdot e^{-\frac{4\pi^2 e^2}{h} \cdot \frac{Z}{v_p}}$$

where  $v_\alpha$  and  $v_p$  are the velocities of the initial  $\alpha$ -particle and the ejected proton respectively. Since only the first harmonic is important in disintegration of this type, it is to be expected that the protons will be distributed nearly uniformly in all directions.

When the  $\alpha$ -particle is not captured the disintegrations will arise mainly from collisions in which the  $\alpha$ -particle does not penetrate into the nucleus. For disintegration produced in this way the higher harmonics become of importance. The probability of disintegration can be roughly represented by the formula

$$W_2^2 = B \cdot e^{-\frac{8\pi^2 e^2}{h} \cdot Z \left( \frac{1}{v'_\alpha} - \frac{1}{v_\alpha} \right)} \cdot e^{-\frac{4\pi^2 e^2}{h} \cdot \frac{Z}{v_p}}$$

where  $v'_\alpha$  is the velocity of the  $\alpha$ -particle after the

collision, and  $B$  is a function of the angle of ejection of the proton. The protons of the continuous spectrum will not be emitted uniformly in all directions. According to the expression (3) the distribution with energy of the protons in the continuous spectrum will have a maximum value for an energy of ejection of about 0.3 of the upper limit, and will vanish for zero energy and at the upper limit.

More detailed accounts of the experimental results and of the theoretical calculations will be given shortly.

J. CHADWICK.  
G. GAMOW.

Cavendish Laboratory,  
Cambridge, June 18.

### Submarine Cable Interference.

DURING the summer of 1929 measurements were made on interference voltages received on a submarine cable in Trinity Bay, Newfoundland. The interference voltages were impressed on a vacuum tube amplifier capable of a power amplification of the order of  $10^{15}$ . The amplifier and associated apparatus were designed to permit analysis of interference frequencies from 100 to 4000 c.p.s.

The usual types of natural as well as industrial interference were observed. The major part was of atmospheric origin, low frequency, low amplitude kicks being usually present, but at times masked by sharper and stronger static crashes and other types of interference.

During the three months over which tests were conducted, occasional comparisons were made between cable interference and audio frequency atmospherics applied to the amplifier by a large untuned loop. The two inputs were essentially the same regarding types of natural interference, but the higher frequency components of the former were considerably attenuated due to shielding effect of the sea water.

The level of natural interference was as a general rule low during daylight hours. During the evening a gradual increase of static kicks occurred, night level being reached some two hours after sunset. This level was usually held until the beginning of daybreak, when it dropped rapidly, usually reaching the day amplitude in less than thirty minutes. The highest levels of natural interference occurred during the last week of August and the first week of September.

In a few instances the interference in the intermediate frequency range (500 to 1500 cycles) increased considerably. By aural observation this interference appeared as a jumble of hollow rustling or roaring sounds. Another type of interference which often followed and sometimes accompanied periods of high intermediate frequency interference was characterised by swishing sounds, such as made by thin whips when lashed through the air. These 'swishes' were always found to vary in frequency, passing downward during some periods and at other times upward. At times the upward and downward progressions were observed simultaneously. The frequency range covered lay usually between 700 and 2000 cycles, but the individual tones usually did not cover a range of more than an octave. The duration of a 'swish' varied from possibly  $\frac{1}{4}$  second to more than a second. These two types of interference appeared to be independent of time of day or weather conditions. There is some evidence of correlation between them and periods of high magnetic disturbance. It is probable that the tones observed by Barkhausen<sup>1</sup> were the same as swishes of descending frequency. The musical atmospheric disturbances of descending tone described by Ecker-

sley<sup>2</sup> may be of the same nature, although there are several notable points of distinction.

A type of interference frequently observed consisted of a damped oscillation of substantially constant frequency usually starting with a static kick. The audible duration was of the order of  $\frac{1}{8}$  second. The frequency range over which these oscillations could be expected extended from 1600 cycles to 2200 cycles. These oscillations, called 'tweaks' because of their characteristic sound, were observed on nearly all nights. They were never observed during daylight hours. They frequently appeared at dusk, at first very highly damped and spaced by intervals of several minutes. After nightfall the damping gradually decreased and the rate increased, the night conditions usually being reached in approximately one hour. The rate of occurrence during a night was usually between 3 and 30 per minute. Just previous to dawn the rate often increased for a few minutes, then decreased rapidly, reaching zero at the approach of full daylight.

Two independent series of tweaks were often observed, one of high amplitude and of frequency in the general region of 1700 cycles. The other was in the neighbourhood of 2000 cycles, of low amplitude very highly damped. The former often occurred in rapid trains. The latter were always observed singly. These two series of tweaks appeared to be entirely independent, often occurring at random during the same period. Frequent changes were observed in the frequencies of successive tweaks of both series, but the two were never observed to merge.

It is probable that electromagnetic disturbances resulting from static kicks could produce tweaks by multiple reflection between the earth's surface and a Heaviside layer. Considering the high amplitude tweaks, a reflecting layer height of 88 km. would correspond to a frequency of 1700 cycles. This is in fair agreement with Schelleng<sup>3</sup> and others as to the location of the low frequency reflecting layer.

The non-appearance of tweaks during daylight hours might be expected because of an ionised absorbing layer at low altitudes produced by the sun as described by Heising.<sup>4</sup>

The higher frequency tweaks, because of their higher damping, might be expected to originate under less favourable reflecting conditions. They may be produced in a higher latitude where the reflecting layer is lower, as suggested by Heising. They might even result from reflection between two Heaviside layers, the lower one being sufficiently poor in reflecting powers to permit passage of waves to the earth's surface.

EVERETT T. BURTON.

Bell Telephone Laboratories,  
New York, New York,  
May 23.

<sup>1</sup> Barkhausen: *Phys. Zeits.*, 20, pp. 401-3; 1919.

<sup>2</sup> Eckersley: *Phil. Mag.*, 49, pp. 1250-60; 1925.

<sup>3</sup> Schelleng: *Proc. I.R.E.*, 16, pp. 1471-6; Nov. 1928.

<sup>4</sup> Heising: *Proc. I.R.E.*, 16, pp. 75-99; Jan. 1928.

### Electron Diffraction by 'Forbidden' Planes.

SEVERAL experimenters have obtained results which they interpret as showing that electrons can be selectively reflected by crystal planes which would not give a corresponding Bragg reflection with X-rays, for example (100) in the first order for a face-centred cube. In some cases even 'half orders' of reflection are found. Thus in a recent paper<sup>1</sup> Rupp finds reflections from odd orders and half orders of the (100) cleavage plane of rocksalt, and similar face-centred cubic crystals. His experiments, like the others, were

made with electrons of the order of 100 volts energy, detected electrically.

I suggest that some of these extra reflections may be due to the Kikuchi lines, which are caused by diffuse scattering in the crystal followed by selective reflection. Using a single collector and varying angle or voltage, there is nothing to tell an experimenter whether a peak in his curve is caused by a Kikuchi line, or a Laue spot, falling on his collector. Some recent experiments which I have made to look for the half order effect show that the Kikuchi lines may be very prominent. If a piece of rocksalt is mounted so that the electrons, of about 30,000 volts, are incident on a cleavage face, a pattern of lines and spots is formed by the diffracted rays on a willemitte screen (Fig. 1). If the crystal is

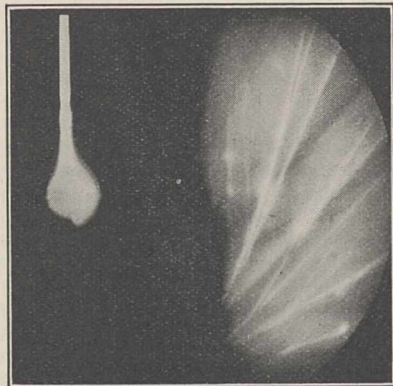


FIG. 1.—Diffraction by rocksalt. The large spot shows the position of the beam with the crystal removed.

rotated about axes in, and perpendicular to, the cleavage face, the lines move rapidly over the screen and the spots flash in and out, forming a brilliant effect. I have measured the spots on the screen and photographed the whole pattern. Even quite complicated and unsymmetrical patterns, such as that reproduced, can be analysed and indices assigned to the planes which cause the various lines and spots, using the distances between the black and white Kikuchi lines to give the spacings. The angles between the lines are approximately those between the planes to which they are due, and this gives a useful check. In no case have I found it necessary to assume reflections from forbidden planes or orders. In an experiment, such as Rupp's, in which the crystal and collector are kept fixed and the voltage varied, the Kikuchi lines would move parallel to themselves. If one of them crossed the position of the collector a peak would be recorded. This event might or might not coincide with the appearance of a spot on the line at this point. If it does not, there will be a peak not explained on the simpler theory.

The measurements of the actual spots fit the simple theory approximately, but there is a slight compression perpendicular to the crystal surface such as might be caused by a refractive index. The corresponding inner potential would be about +10 volts, rather more than Rupp found. There is, however, always some charging up, and I am doubtful if one should regard the 10 volts as a true property of the rocksalt, or merely as an expression of the strength of the charge. Heating removes the charge, but also destroys the spots or greatly weakens them. Blue rocksalt is better than white, probably because of better conductivity.

G. P. THOMSON.

University of Aberdeen,  
June 30.

<sup>1</sup> Rupp: *Annalen der Physik*, vol. 4, p. 1097; 1930.

### A Physical Interpretation of Perturbations in Band Spectra.

THE interesting phenomena of predissociations and perturbations in band spectra are now attributed to interactions of various kinds between certain electronic states in the molecule. As has been shown, especially through a theoretical paper of Kronig (*Zeitsch. f. Physik*, 50, 347; 1928), these phenomena may be considered from a common viewpoint, the characteristics of which are given below.

(1) Two interacting states, having equal energy, must also occupy equal values of  $J$ , the quantum number of the resultant angular momentum in the molecule.

(2) They must further belong to electronic states, of which the resultant orbital angular momenta ( $\Lambda$ ) around the molecular axis agree within zero or one unit in  $h/2\pi$ .

(3) They must finally satisfy every kind of symmetry, to be questioned in cases of diatomic molecules.

Franck and Sponer interpret the predissociation phenomena in a very tangible way (*Göttinger Nachr.*, p. 241; 1928). A molecule, vibrating along the potential gradient  $a$  in Fig. 1, passes through the intersection  $P$  into a new state  $b$ . If the potential energy at  $P$  is greater than the dissociation energy of  $b$  ( $W_P > W_b$ ), the molecule will predissociate through  $b$ , although being perhaps far below the dissociation limit of  $a$ . The conditions to be fulfilled are all included under section 2 and 3 in Kronig's theory above. Franck and Sponer emphasise the probability of the transition  $a \rightarrow b$ , when the intersection  $P$  is situated on the horizontal branch of  $b$  ( $W_P = W_b$ ). Fig. 1 corresponds to a more general condition of predissociation, very recently proposed by Herzberg (*Zeitsch. f. Physik*, 61, 604; 1930). From a wave mechanical viewpoint, predissociation

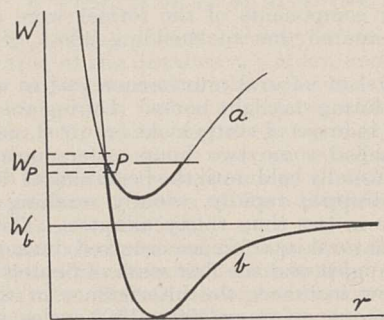


FIG. 1.

will take place even when the molecular energy not exactly agrees with  $W_P$ , as indicated by the dotted lines in Fig. 1.

Now, what happens when the intersection  $P$  falls below the limits of dissociation in  $a$  and  $b$ , as indicated in Fig. 2? Apparently the molecule will synchronise in  $a$  and  $b$ , and as both states now are quantised in discrete levels, all conditions in Kronig's theory have to be fulfilled. These conditions give an expression for the conservation of energy and the resultant angular momentum in the molecule. In addition, our viewpoint brings arguments on the conservation of the nuclear distance and the vibrational impulse during the act of transition in  $P$ .

A band series, emitted by raising the rotational energy of the molecule performing an electronic transition  $a \rightarrow c$ , will exhibit perturbations in frequency as well as in intensity for lines corresponding to the region of intersection at  $P$ . An exact determination of  $P$  affords, of course, the construction of

a potential gradient  $V_J(r)$ , resulting from the rotation and nuclear vibration in the molecule (O. Oldenberg, *Zeitsch. f. Physik*, 56, 563; 1929). As shown by Kronig, the frequency perturbations in the band-lines will be of the characteristic 'resonans type', in agreement with empirical results, especially with those of Rosenthal and Jenkins on the spectra of CN and CO (*Proc. Nat. Acad. Sci.*, 15, 381; 1929; 15, 896; 1929). The probability for the molecules penetrating the barrier between the potential gradients is essentially determined by the factor

$$\exp. - \frac{4\pi}{h} \int \sqrt{2\mu(V_J(r) - W)} dr$$

(Gurney and Condon, *Phys. Rev.*, 33, 127; 1929). There will thus be a decrease of intensity in the perturbed region of the band series, due to the 'leaking through'

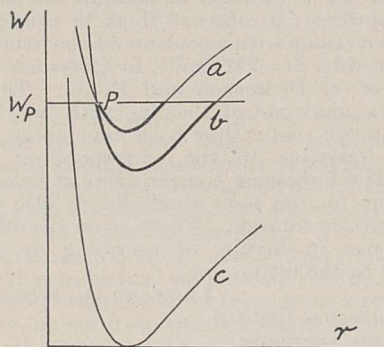


FIG. 2.

of molecules from *a* to *b*. This is a feature of many perturbations observed, and it seems not unlikely that a careful examination of their intensity distributions would admit a determination of the angular intersections at *P*. On the other hand, transitions *b*→*c* are allowed in cases obeying the emission rules ( $\Delta\lambda = 0, \pm 1$ ), and consequently, if our interpretation is correct, sporadic lines belonging to this system will appear in the perturbed region of the system *a*→*c* although the intensity maximum of *b*→*c* may be situated far away in spectrum. In fact, there are numerous perturbations in band spectra which exhibit a large, unsymmetric splitting of lines into two components, which may be interpreted in this way. In certain cases these conditions should also give rise to unequal perturbations in the *P* and *R* branches.

The main purpose of this note is to point out that Kronig's arguments can be graphically illustrated, and that this immediately requires further arguments for the appearance of perturbations in band spectra. As a matter of fact, there are cases known where no perturbations appear, although they might be expected to occur by Kronig's theory.

E. HULTHÉN.

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University of Stockholm,  
May 30.

**Variations with Sidereal Time in the Intensity of the Cosmic Ultra-Radiation.**

PRELIMINARY results of measurements on the cosmic ultra-radiation, or the so-called highly penetrating radiation, as carried out by me using a Kolhörster ionisation chamber in Abisko in Northern Sweden (N. lat. 68° 21', 388 metres above sea-level), have been reported in *Lund Meddelanden*, No. 121. The chamber is placed in an iron shield of 11 cm. floor-thickness and 6 cm. wall-thickness, and the

opening upwards free. During the period Nov. 13, 1929–Jan. 13, 1930, the chamber was observed every second hour except during the nights between 24<sup>h</sup> and 6<sup>h</sup> M.E.T. approximately. Later on, a photographic recording cylinder was placed in front of the microscope of the chamber, and the observations have been performed day and night in connexion with—as before—meteorological, magnetic, and auroral routine work.

The derived values of the intensity of the ultra-radiation as reduced to 760 mm. air pressure have been grouped according to sidereal time, and the mean values for every sidereal hour in fortnightly intervals are shown in Fig. 1, night-part dotted. The curves show considerable changes in their shape, as also in the case with the curves of G. Hoffmann and F. Lindholm as reproduced in *Gerlands Beiträge zur Geophysik*, 20, 12, 1928, and 22, 141, 1929. The means for the total period, however, and especially the means for the period Nov. 13–Dec. 16, 1929, agree essentially with the curves showing variation with sidereal time, deduced from the measurements of W. Kolhörster, G. v. Salis, K. Büttner, and E. Steinke (compare, for example, Corlin, *Zeitschrift für Physik*, 50, 808; 1928; and Steinke, *Physikalische Zeitschrift*, 30, 767; 1929). Only the maximum at 0<sup>h</sup> sidereal time in the measurements of these authors is missing,

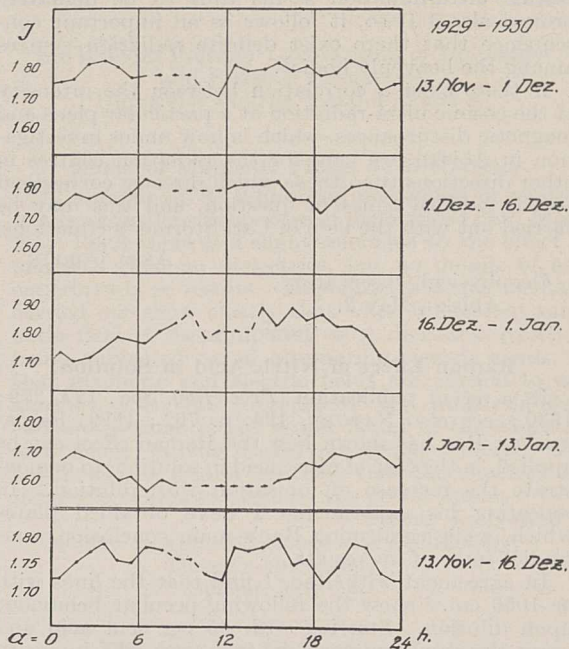


FIG. 1.

which may be caused by the difference in latitude of the places of observation. It is concluded that the daily sidereal curve of the cosmic ultra-radiation can present a very different shape for short intervals of time, but that there is a certain characteristic curve which always appears in the means for longer periods. This curve exhibits principal maxima for 0<sup>h</sup> (except possibly for high northern latitudes), 6<sup>h</sup>, 12<sup>h</sup>–16<sup>h</sup>, 20<sup>h</sup>–21<sup>h</sup>, and principal minima between 8<sup>h</sup> and 12<sup>h</sup> and for 18<sup>h</sup>–19<sup>h</sup> sidereal time.

The measurements of F. Lindholm also show the existence of this underlying characteristic curve, in spite of the very different shape of the curves for different months found by him (*Gerl. Beitr.*, 22, 141; 1929). Thus, by taking the means of the three curves, termed "offen" in Fig. 3 of that paper, the upper

curve of our Fig. 2 is obtained. For comparison, the sidereal curve from the measurements of E. Steinke obtained in November 1926 with the same type of apparatus is shown in Fig. 2 (cf. also *Zeitschrift für Physik*, 50, 808, and *Phys. Zeit.*, 30, 767). It may be emphasised that at present no single set of hourly measurements carried out with allowance for the earth radiation and the air pressure, and with no shield covering the apparatus, has been published without showing this characteristic sidereal curve in the average values for a sufficiently long period. The

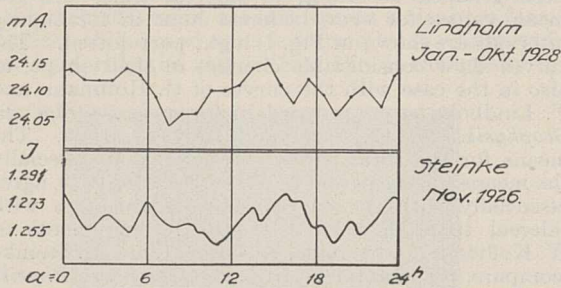


FIG. 2.

existence of a characteristic sidereal curve for the cosmic ultra-radiation seems thus to be definitely proved also. If so, it follows as an important consequence that there exist definite radiation centres among the heavenly bodies.

If there exist a correlation between the intensity of the cosmic ultra-radiation at a particular place and magnetic disturbances, which is now under investigation in Abisko, we look for the radiation centres in other directions than those which directly correspond to the sidereal times in question, and this may be carried out with the help of Carl Störmer's equations.

AXEL CORLIN.

Geophysical Observatory,  
Abisko, May 2.

#### Raman Effect of Nitric Acid in Solution.

In a recent publication (*Proc. Roy. Soc.*, 127, 279; 1930; see also *NATURE*, 124, p. 762; 1929) Ramakrishna Rao has shown how the Raman effect can be applied, in the case of nitric acid in solution, to demonstrate the increase of ionisation with dilution. In repeating his experiments I have obtained plates which, while confirming Rao's main conclusion, contradict some of his results.

In agreement with Rao, I find that the lines with  $\Delta\nu=1050\text{ cm.}^{-1}$  show the following peculiar behaviour upon dilution. Starting with 65 per cent acid and using the same exposure in each case, the intensity increases at first as the acid concentration is reduced, passes through a maximum, and afterwards falls off again. As was pointed out by Rao, this is doubtless due to the increase in the degree of ionisation with dilution, the lines in question belonging to the nitrate ion. Now Rao supposes that the wave-number shifts  $\Delta\nu=623$  and  $673\text{ cm.}^{-1}$  (given by him as 638 and  $685\text{ cm.}^{-1}$  respectively) also belong to the ion. If this be true, the corresponding lines ought to show upon dilution the same type of intensity variation as do those with  $\Delta\nu=1050\text{ cm.}^{-1}$ . From my plates and photometer curves, however, it can be seen that this is not the case. The pair of lines with  $\Delta\nu=623$  and  $673\text{ cm.}^{-1}$  shows in fact a continuous decrease in intensity with dilution, and indeed disappears at a concentration where the lines with  $\Delta\nu=1050\text{ cm.}^{-1}$  are at their strongest. This behaviour is exactly parallel to that of the lines belonging to the non-ionised

$\text{HNO}_3$  molecule, to which therefore  $\Delta\nu=623$  and  $673\text{ cm.}^{-1}$  must be ascribed.

The reason for Rao's error in ascribing these shifts to the ion is probably as follows. At concentrations where the lines with  $\Delta\nu=1050\text{ cm.}^{-1}$  are near their maximum intensity, a new weak single line seems to make its appearance. It is excited by the 4358 Å. mercury line with  $\Delta\nu=707\text{ cm.}^{-1}$  approximately. It lies at 4497 Å. ( $\pm 2\text{ Å.}$ ), that is, not very far from the pair of lines with  $\Delta\nu=623$  and  $673\text{ cm.}^{-1}$  ( $\lambda=4480$  and  $4490\text{ Å.}$  respectively); and it is possible that a confusion between them led Rao to mistake the behaviour of the pair. The continuous spectrum, which masks Rao's plates at these concentrations, seems in my case to be not nearly so strong.

In support of his ascribing of  $\Delta\nu=623$  and  $673\text{ cm.}^{-1}$  to the nitrate ion, Rao states further that these shifts also occur for a solution of sodium nitrate. I am unable, however, to observe them in this case. Instead I find (along with a continuous spectrum) a weak single line with  $\Delta\nu=717\text{ cm.}^{-1}$ , in agreement with the observation of Dickenson and Dillon. This line is clearly the analogue of the line with  $\Delta\nu=707\text{ cm.}^{-1}$  found in nitric acid; they both have about the same intensity (relative to the corresponding  $\Delta\nu=1050\text{ cm.}^{-1}$ ). The frequency concerned must belong to the nitrate ion, for the same single line is also found for calcium nitrate solution. There is, on the other hand, no evidence in favour of ascribing  $\Delta\nu=623$  and  $673\text{ cm.}^{-1}$  to the nitrate ion.

LEONARD A. WOODWARD.

Physikalisches Institut,  
Leipzig, Germany,  
June 10.

#### Vegetable Oils as Fungicides.

SINCE 1914 the chemical and mycological departments of Wye College have collaborated in testing the fungicidal properties of spray fluids, especially those containing sulphur. In this work, accounts of which have been published from time to time, a special technique has been developed, by which it is possible to determine within narrow limits the action of the spray fluid upon the powdery mildew of the hop (*Sphaerotheca Humuli*). The method has recently been applied to the investigation of certain oil emulsions, in particular vegetable oils, which have been found to possess marked toxic properties towards this fungus. Whilst some of these oils, for example, rape oil, have been recommended for insecticidal purposes and are of practical use as solvents for such substances as pyrethrum extract, their value as fungicides does not hitherto seem to have been noticed.

In experiments in which 0.5 per cent soft soap was used as the emulsifier, the following oils (of commercial standard) proved completely fungicidal against the hop powdery mildew: olive oil, 0.5 per cent; sesame oil, 0.5 per cent; cottonseed oil, 0.5 per cent. Rape oil required a concentration of 2.0-3.0 per cent and castor oil at 2 per cent was non-fungicidal. In experiments with other emulsifiers indication was obtained that the type of emulsifier used had a pronounced effect upon the toxic properties of the spray.

The experiments in question have been carried out on plants in the greenhouse, and no injurious effects have been observed on the foliage with many of these vegetable oils when used at a comparatively high concentration.

It is intended to ascertain whether these vegetable oils have a protective as well as a direct fungicidal action.

H. MARTIN.

E. S. SALMON.

South-Eastern Agricultural College,  
Wye, Kent, June 20.

**Weekly Variation in the Intensity of Ultra-Violet Waves of Sunlight in an Industrial Town.**

DAILY records of the intensity of the ultra-violet radiation were made in Huddersfield between 1925 and 1928 by the acetone methylene-blue method.<sup>1</sup> While as a quantitative method this only gives approximate values, comparisons may be made in a qualitative way. The figures obtained here have now been analysed for weekly variations. Since this is one of the very few so-called smoky towns in which such records have been taken, the results may be of wider interest.

The subjoined table shows the mean daily intensity

Season.	Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
June—Aug.	3.6	3.0	3.1	3.2	3.2	3.1	3.4
Sept.—Nov.	1.2	0.8	0.9	1.0	0.9	1.1	1.1
Dec.—Feb.	0.5	0.4	0.4	0.6	0.4	0.4	0.3
Mar.—May	1.8	1.7	1.7	1.7	1.6	1.5	1.6
Annual mean	1.78	1.45	1.53	1.61	1.55	1.57	1.63

on each day in the week for the four seasons and also an annual mean. One 'degree' is approximately sufficient to produce a moderate erythema of a white skin. There is a fairly pronounced maximum intensity on Sunday in all seasons except winter, giving indication of the effect of smoke-screening. The loss on week-days in summer amounts to nearly 15 per cent. Actually it seems that industrial smoke may here be responsible for a greater loss than this: there is an increase in the output of smoke from domestic sources on Sundays which will effect a lowering of the Sunday excess of radiation by an amount not easily ascertainable. The fair constancy of the mid-week figures probably shows that the effect of purely meteorological changes has been mainly eliminated in the analysis.

A similar summary for a country station would form an interesting comparison.

S. MORRIS BOWER.

Climatological Station,  
Oakes, Huddersfield,  
June 20.

<sup>1</sup> Vide Hill: *Proc. Roy. Soc., A*, vol. 116, p. 268; 1927.

**Blood-Groups among Australian Merino Sheep.**

IN this laboratory, from time to time, we come across an anti-sheep cell hæmolytic serum from rabbits which causes rapid agglutination and sedimentation of sheep red blood cells. This is undesirable from the serologist's point of view. A sample of such serum was recently tested against fifteen random samples of sheep cells, and the latter, on the basis of agglutinability, could be sharply divided into two groups. We do not, of course, regard this observation as original, but merely wish to stress its importance for serologists and especially also for commercial firms dealing in bacteriological laboratory material. It might be well to define the group to which belonged the red cell antigen used in preparing a given hæmolysin, two or more groups having been determined on the basis of response to immune agglutinin. Incidentally, we pursued the line suggested by the above observation, and found that there are at least two 'blood groups' amongst pure-bred Australian merino sheep.

J. V. DUHIG  
(Director).

Brisbane and District Laboratory,  
Hospital for Sick Children,  
Brisbane, Queensland,  
April 23.

**Infra-Red Absorption Spectrum of Sulphur Dioxide.**

DICKINSON and West (*Phys. Rev.*, **35**, 1126; 1930) have determined the Raman spectrum of sulphur dioxide; they obtained displacements of 524 (weak), 1146 (strong), and 1340 (medium)  $\text{cm}^{-1}$ . We had already examined the infra-red absorption spectrum of sulphur dioxide between  $2\ \mu$  and  $20\ \mu$  with a Hilger D. 42 spectrometer, using quartz, fluorite, rocksalt, and sylvine prisms, and found bands at 2498, 2321, 1871 (very weak), 1355, 1152, and 606  $\text{cm}^{-1}$ ; of these the band at 1355  $\text{cm}^{-1}$  is most intense and seems to possess a complicated structure. The fundamental frequencies are probably  $\nu_1 = 1355$ ,  $\nu_2 = 1152$ , and  $\nu_3 = 606\ \text{cm}^{-1}$ . The two larger frequencies are in good agreement with those deduced from the Raman spectrum, although the scattered line at 524  $\text{cm}^{-1}$  agrees more closely with the difference between  $\nu_2$  and  $\nu_3$  (1152 - 606 = 546  $\text{cm}^{-1}$ ) than with  $\nu_3$  itself. The other bands can be accounted for as combination- and over-tones.

Careful examination failed to reveal bands reported by Coblenz ("Investigations of Infra-Red Spectra", p. 52; 1905) at 3.18 and 10.4  $\mu$ .

A detailed account of the investigation will be published shortly.

C. R. BAILEY.  
A. B. D. CASSIE.  
W. R. ANGUS.

Sir William Ramsay Laboratories of Inorganic and Physical Chemistry,  
University College, London, June 3.

**Effect of Magnetic Fields on Dielectrics.**

IN a paper by S. Whitehead on dipoles in relation to the anomalous properties of dielectrics (*Phil. Mag.*, May 1930) there is a slight reference to the effect of magnetic field on dielectrics, but no details of any experiments or results. Experiments which we have carried out show clearly that when a constant magnetic field is superimposed on a dielectric which is being subjected to an alternating electric stress, so that magnetic and electric fields are normal to one another, then the presence of the magnetic field causes a change in the power factor of the dielectric and hence in the losses occurring therein. The nature of the results indicates that the effect of the magnetic field is to decrease the power factor.

PHILIP L. BURNS.

Faculty of Applied Science and Technology,  
Queen's University,  
Belfast, May 22.

**The Acquired Characters of *Alytes*.**

IN reply to the letter of Dr. Walker on *Alytes* which appears in NATURE of June 14, he is right in saying that I assume that potentialities of growth are altered by the environment and that the result is handed on to succeeding generations. Proof that it is so exists and could be given in detail were not space in NATURE so precious. Przibram gave five or six such cases when he was in London two years ago.

Dr. Walker's alternative explanation is hard to follow, namely, that 'variations' (produced by chance?) survive. The superstition that selection can call into existence something that was not previously there is hard to kill.

E. W. MACBRIDE.

Imperial College of Science,  
South Kensington,  
London, S.W.7,  
June 17.

## Applied Science in Conference and Display.

THERE has been an opportunity during June to take part in two scientific occasions in Germany, both of first rank significance. The Achema Exhibition, opened in Frankfort on June 10, which continued for a fortnight, was primarily a display of laboratory apparatus and all that pertains to the efficiency and well-being of the chemist in his laboratory. A side issue of a most comprehensive character was an exhibition of chemical plant. Concurrently with the exhibition, a meeting of the Verein Deutscher Chemiker was held in Frankfort, and afterwards other more specialised bodies of chemists were in congress there: the habit of centring such annual meetings round an exhibition seems to be spreading. The meeting of the V.D.C. was of course of purely German interest, but a considerable number of British chemists visited the exhibition.

There can never have been a more comprehensive show of aids to chemical manipulation: to one who remembers the then startling innovations provided in Emil Fischer's new laboratory in the Hessischestr.asse, Berlin, in 1899 on its opening, the progress is as remarkable as that made in any other branch of chemistry, and one does not recollect before to have had an opportunity of seeing it all summarised as it were under one roof. Comment in detail is impossible and so we pass to the chemical plant section, where undoubtedly one of the outstanding exhibits was that of Krupp, designed to show the progress made in the invention of special non-rusting steels or more properly iron. On the principle said to apply to good wine, this exhibit was largely left to speak for itself: it consisted not only of the steels themselves with explanatory literature of real value, but also of all kinds of utensils for the household and for industry, including chemical industry. The exhibit was made by Krupps in conjunction with well-known users of the special VA and VM steels, so that a complete picture was obtainable of the many applications which rustless iron now has. The initial difficulties in working it have been largely overcome, and it appears to be chiefly a question of price which prevents it from being almost universally employed. It should be mentioned that Krupps show household utensils of rustless iron in their own shops in the larger cities of Germany.

Of equal interest was the comprehensive exhibit of the famous Metallgesellschaft of Frankfort, who have not hitherto indicated so clearly in how many different fields they are active. As necessitated by the novelty and interest of the exhibits, a very large force of technical experts was in evidence and no visitor was able to complain of lack of attention. Perhaps the greatest interest was evidenced in the display of the Carbo-Union showing the manifold way in which the remarkable absorbent properties of active carbon are being utilised, as, for example, in the stripping of benzol from gas, the recovery of volatile solvents from air, even when very dilute, the purification of water, the dephenolising of effluent from coke ovens, etc. There only remains

space to mention the extending use of alloys of silicon with aluminium, which appear to have an ever-widening scope of application as their metallurgy is being better understood. The exhibition was adequately and comfortably housed in permanent buildings such as most Continental towns possess and was regarded by exhibitors and visitors alike as a serious and important occasion.

A night's journey in a sleeper, and we were in Berlin for the Second World Power Congress, attended by nearly 4000 delegates from forty-eight or more countries. The Congress, or at least the official delegates, were welcomed in the Reichstag on the evening of Sunday, June 15, by the highest in the land, when the Earl of Derby, the retiring president, handed over the gong of his office to Dr. Oscar von Miller. The little ceremony was both dignified and imposing, and the human touch supplied by the good wishes for the success of Lord Derby duly bore fruit at Ascot.

The official opening took place the next morning in the Kroll Opera House, when, following a short musical introduction, an address of welcome was delivered by Dr. von Miller and responded to by the delegates of the various nationalities, Sir Charles Parsons speaking first on behalf of Great Britain. The speeches were necessarily written and spoken to the microphone, so that the meeting was entirely devoid of personality, oratory, or enthusiasm. At the end we were favoured with more music conducted by a man whose joy, delight, and enthusiasm in what he and his orchestra were giving us was a veritable treat to behold. We must take heed lest in allowing everyone in a large audience to hear what is said we so mechanise what they hear as to make it of no interest. At the subsequent technical meetings, held in two large halls, every seat was provided with earphones and a dial, enabling the hearer to listen either to the original paper or to its translation in either of the three languages—English, French, or German. This arrangement also was only a partial success, in that the effort to speak for the microphone largely destroyed the personality and hence the effect of the orator. At the instance, we believe, of the Americans, the speeches at the World Festival in the evening of June 18 were transmitted by wireless from San Francisco. However attractive the idea, the transmission proved not only inaudible, but also an absolute nuisance, and after a quarter of an hour's patience, the audience ignored it. We have emphasised the terrors of the microphone because we have experienced its devastating effects at banquets at home, where real oratory such as provided by Dr. Nicholas Murray Butler at a recent Pilgrims' gathering is too great a treat to be lightly abandoned to the radio mechanic.

At the technical meetings a very large number of papers were read, discussed, and available in type; but the real value of the meeting, as always, was the contacts made between workers in different lands with kindred interests. Outstanding, as always in Germany, was the official hospitality.



Apart from the reception at the Reichstag, the Congress was entertained by Germany, by the State of Prussia, and by the town of Berlin, in addition to a gala night at the Opera and the usual public and private hospitality. Fortunately, the English delegation was not only the largest, but also most thoroughly representative in character, and it played an important part in the deliberations. It was all the more to be regretted that Mr. Dunlop, the prime mover in the Conference, was himself prevented by ill-health from being present.

Naturally, the opportunity was not lost to show the visitors at the great evening festival some of the modern tendencies of Germany. Chief amongst these is the outdoor movement with a minimum of clothing and the cultivation of physical fitness. Most charming displays were given by girls and by young men. Of extraordinary interest was the final display of representatives of the German States in their national costumes and dances: the subordination of Prussia and the accentuation of the Rhine, of the Franks, of the Bavarians, scarcely seemed accidental. The enthusiasm when the president joined his native Bavarians was a fitting climax to a most remarkable evening, which to the knowledgeable gave much room for thought, both retrospective and prospective.

Members of the Congress were provided with a quite unusual amount of literature, much of it of a permanent nature, giving information as to the power projects of Germany and of Europe. We have become used to the amazing development of cheap electric power either from coal or from water in the United States or in Canada: what the Congress should bring home is that similar developments are

taking place on the Continent. Cheap electricity can do so much for the needs and comfort of mankind that no country of the first rank can afford to let its citizens be without it—it should be available in every village, in every farmhouse, throughout the land, as will soon be the case in France; it should be possible to carry out every power operation on the farm and in the living house, as well as in the factory, by its aid. The presence of so many of our leading electricians at the Congress shows that they are alive to the problems, but we fear the country as a whole fails to realise how far behind Britain is in the use of electricity per capita. We have very little water power, but our engineers are at least capable of emulating the remarkable results achieved at Chicago, where something less than a pound and a half of coal per kilowatt hour is required.

It is often forgotten that the production of electric power is as much a water as a coal problem, about 400 tons of cooling water being required for every ton of coal burnt, so that suitable sites for very large stations are not always easy to find.

The scope of the Congress stretches of course far beyond electric power; the carbonisation of coal either at high or low temperatures; the problems of oil, its refining and cracking, all come within its scope. In the end the goal is the same, to turn the heat latent in coal or oil, lignite or peat, with the highest degree of efficiency into energy, into power. The transformation in early days was not an easy one, and as represented in percentages highly inefficient. Amazing progress has been made in improving the efficiency; the World Power Congress can but accelerate this. E. F. ARMSTRONG.

### Irregularities in the Annual Variation of Temperature in London.\*

THE average temperature of London is lowest about the middle of January and highest towards the end of July, but in any one year the temperature rises and falls irregularly, and the coldest day may occur in February or March instead of January, the warmest in August or September instead of July. Even when thirty or forty years are combined, some of these irregularities remain, and it is an interesting question whether, as the record is extended, the curve of temperature will tend more and more to a smooth annual variation, or whether certain irregularities are inherent in the climate and will always remain. This question was first examined in detail for Britain by Alexander Buchan, who recorded his conclusions in 1869 as follows:

"Deductions from all observations hitherto made show that . . . there are certain periods more or less well defined, when the temperature, instead of rising, remains stationary or retrogrades; instead of falling, stops its downward course, or even rises; and at other times falls or rises respectively for a few days at a more accelerated speed than usual."

\* Synopsis of a paper read at the Royal Meteorological Society on June 18, by Dr. C. E. P. Brooks and S. T. A. Mirrlees, with some references to the subsequent discussion.

Buchan picked out six cold and three warm periods, as follows:

<i>Cold Periods.</i>	<i>Warm Periods.</i>
1. February 7-14	1. July 12-15
2. April 11-14	2. August 12-15
3. May 9-14	3. December 3-14
4. June 29-July 4	
5. August 6-11	
6. November 6-13	

Buchan's work was based in the first place on data for Scotland about 1860, but his results have been tacitly assumed to apply over the whole of the British Isles, and the 'Buchan cold and warm spells' have attained some celebrity. A repetition of the investigation seemed to be called for, using a long series of records for London.

Daily means of temperature at Kew Observatory based on hourly readings were formed for the two nearly equal intervals 1871 to 1900 and 1901 to 1929. These showed many small irregularities, and as warm and cold 'spells' were being sought rather than individual days, it seemed advisable to smooth the data. This was done by forming overlapping five-day means, for example, January 1-5, 2-6, etc., each five-day mean being entered against the middle day. The two curves obtained

in this way were compared with a standard curve representing the generalised annual variation, which was obtained by harmonic analysis of the twelve monthly means; the first two terms, representing the annual and semi-annual waves, were found to be sufficient for this purpose. The results are shown in the main curves of Fig. 1.

This figure shows that the five-day means of temperature during both periods oscillate irregularly about the smooth curve, but in general keep rather close to it. In most months the irregularities in 1871-1900 are quite different from those in

warm spells, for though the third, December 3-14, is not supported, the first two fall on dates when both curves are definitely high. An examination of the average temperatures at Kew Observatory for 59 years therefore accords no support for any of Buchan's cold spells, but suggests that the first two warm spells may have been well founded.

Apart from this, the curves show several points of interest. In December and January the average temperature since 1901 has been about 2° F. above the average for 1871-1900, a difference associated with the prevalence of warm winters during the

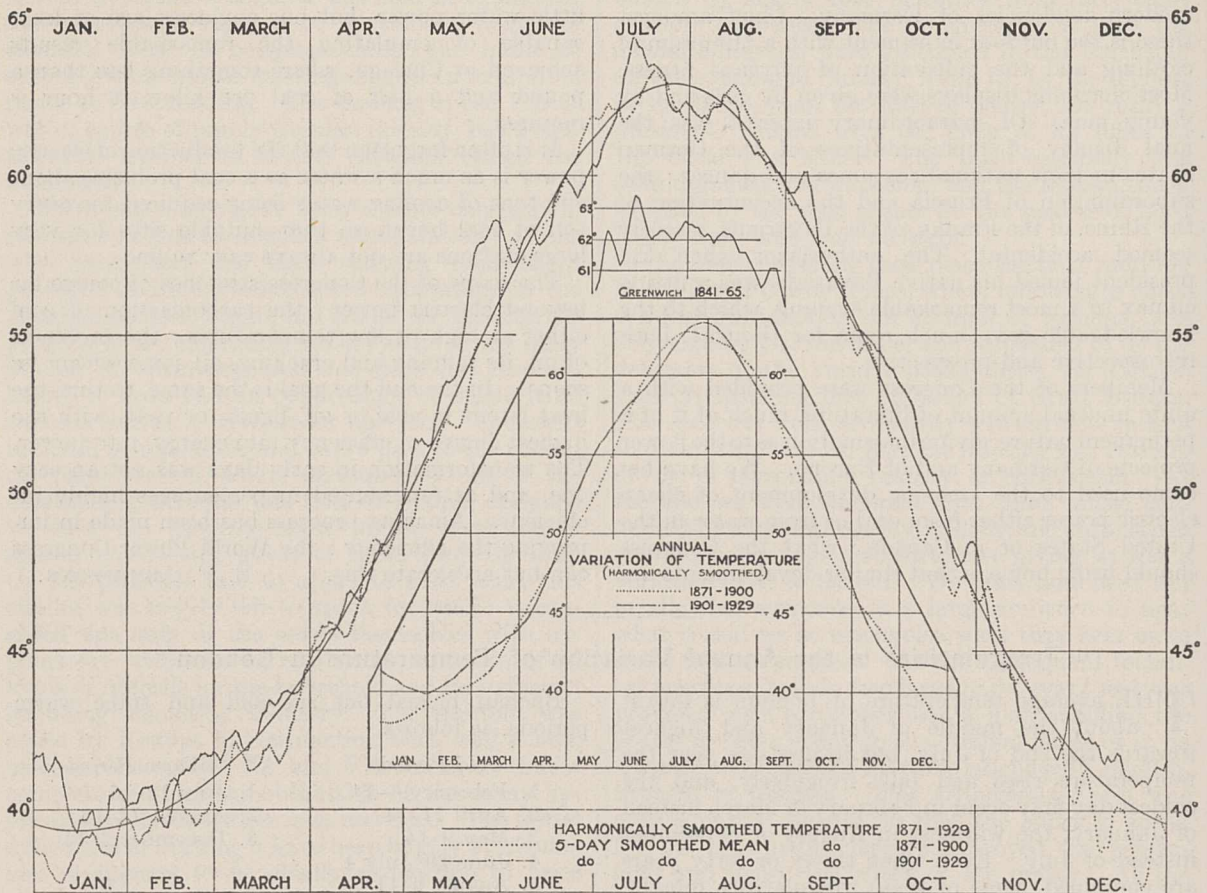


FIG. 1.—Temperature curves derived from Kew observations. (Reproduced by courtesy of the Royal Meteorological Society.)

1901-1929, showing that they represent temporary or 'accidental' abnormalities and not permanent features of the climate. In particular, the curves seem to show quite definitely that the 'Buchan cold spells' do not recur regularly in London. The first, February 7-14, is represented, it is true, by a marked dip in 1901-1929, but the curve for 1871-1900 during those days rises rapidly to a maximum. In April 11-14 and May 9-14 neither curve shows any abnormal feature. In June 29-July 4 the curve for 1901-1929 is low but rising steadily, while that for 1871-1900 is definitely high, indicating a warm rather than a cold spell. In August 6-11 both curves are rising steadily, and again in November 6-13 neither shows any special anomaly. The figure is rather more favourable to Buchan's

present century. The magnitude of this change is clearly brought out by the lower inset diagram, which shows the results of harmonic analysis of the two periods separately. Not only have recent winters been warmer, but also the generalised minimum has been displaced from early in January to the end of the month, while at the same time the generalised maximum has been retarded from the middle to the end of July and the annual range has decreased, all indications that the climate has become more oceanic. Again, in 1901-29 temperature rose very rapidly during the latter half of May, and on May 30 the curve reaches a level which is not found again until June 17, a truly remarkable feature to occur in the 29-year averages for a season during which temperature should be rising

steadily. A somewhat similar distortion, though less pronounced, occurs in early October, when the curve for 1901-29 shows a definite slackening of the autumn fall of temperature.

The third point of interest concerns the temperatures of high summer. Both curves show a marked swing, with a range of 2° F., from a maximum in mid-July to a minimum early in August and back to a second maximum in mid-August. This feature was of such interest that the five-day means of temperature at Greenwich during July and August were extracted for the period 1841-1865, and are shown in the upper inset of Fig. 1. Here the July maximum is again shown, but the minimum early in August does not appear and the August maximum is reduced to very small proportions. The impression left by a comparison of these three curves is that there is a definite tendency for a warm spell to occur in mid-July, after which there is a period during which temperature oscillates irregularly until the autumn fall sets in after the middle of August.

Although the comparison of curves showing averages over a number of years is the simplest method of approaching a problem of this nature, the results are sometimes misleading. The more interesting abnormalities revealed by Fig. 1 were accordingly studied year by year, in order to determine whether they are regular characteristics of the climate or whether they merely reflect a few outstanding events. In the first place the 'Buchan cold spells' in February, April, and May were examined to determine if there was any definite tendency for temperature in individual years to fall to minima on those dates. The results were entirely negative; the chance that one of these periods will be unseasonably cold is exactly equal to the chance that it will be unseasonably warm. If we allow a 'grace' of two days on either side, the individual curves show that temperature actually rose to a maximum more often than it fell to a minimum.

The warm period in mid-July affords an example of the fallacy sometimes introduced by reasoning from averages. During the whole 59 years the average temperature was highest on July 15-19, but when the individual years were examined, this predominance was found to rest entirely on four years, 1876, 1881, 1900, and 1921, while temperature was below the smooth curve on 30

occasions out of the remaining 55. The second crest on the curve occurs on August 14-18, and this period was abnormally warm on 32 occasions, cool on 27, a negligible difference.

The general conclusions drawn from the investigation were summed up as follows: "On the whole it seems improbable that there exists in our climate an abiding tendency for any part of the year to be either abnormally warm or abnormally cold for the season. It does seem, however, that such tendencies may spring up suddenly, persist for ten or twenty or thirty years, and as suddenly and mysteriously vanish. Any positive conclusions as to these spells are valid only for the time and place of their occurrence, and cannot be applied to other times or places. Thus, while Buchan's cold and warm spells were probably true for Scotland in the 1860's, they are certainly not true for London in the twentieth century."

In the discussion which followed the paper, Mr. D. Brunt objected that 'cold spells' were on some occasions limited to one or two days, and these would be masked by the use of five-day means. He also thought that the investigation should have dealt with individual years rather than with averages over long periods. It was suggested that a possible explanation of the persistent belief in Buchan's cold and warm spells was that when they did occur, they had a tendency to fall on or near Buchan's dates, though in many years they were absent. On the other hand, Mr. Mirrlees thought that the belief had persisted because meteorologists had devoted a great deal of effort to explaining the occurrence of such spells, and little or none to finding out whether there was anything to explain. Apart from this, a few of the explanations advanced were sufficiently plausible, for example, pressure changes set up by differential warming of the earth's surface, and outbreaks of polar ice, but as usually happens when theorising loses touch with facts, some of the theories were merely absurd. They included cosmic dust from meteor showers in the earth's atmosphere, cometary matter between the earth and the sun, the latent heat of freezing and thawing of Russian rivers, the varying absorption of radiation owing to changes of humidity, and *mirabile dictu*, the meteorological effects of newly expanded foliage in spring.

C. E. P. BROOKS.

### Crime Statistics of England and Wales.

CRIMINAL statistics, apart from their primary purpose, usually afford some interesting sidelights on social habits and in particular on any changes which are taking place in the daily life of the community with which they deal. For example, in the criminal statistics of England and Wales for the year 1928 (Cmd. 3581, H.M. Stationery Office, price 4s. net) an attempt has been made to gauge the effect of the coming of the 'motor age' on crime. Taking the year 1928 and comparing the figures for the crime of 'breaking in' with those of 1911 it appears that, while the figures for the

metropolitan area are practically stationary, in the home counties they show an increase of 437.8 per cent, and over the whole of England and Wales outside the metropolitan area the increase in boroughs and cities is 87 per cent, but in the counties it is 137 per cent. This is attributed to the increased use of the motor-car, which is thought to have acted in two ways. Greater numbers of the population have been enabled to live outside urban areas and premises are more often left unoccupied, while an increase in the 'all in' policy of insurance has tended to reduce precaution. On the other

hand, the burglar is also able to avail himself of the car and thus to travel with greater speed and further afield.

A preliminary analysis of the crime statistics in the return contains some interesting remarks relating to variations in the character and volume of crime. The quinquennium 1910 to 1914 is taken as a basis of comparison, as representing a normal average of criminality. Since this period the rise in population has been 9.26 per cent, and the normal rise in crime is therefore taken to be round about 9 per cent. Only figures over this percentage are taken as indicative of any real increase in crime. It may be noted in passing that both in the years after the Boer War and after the Great War there was a marked increase in criminality.

Taking the principal classes of crime, that is, indictable offences, as a whole the figures of 1928 show an increase of 33 per cent over those of 1910-1914. The highest increase in any individual class is under the head of offences against property with violence—80 per cent—while crime against the person increases by 22 per cent. Malicious injury to property falls by 57 per cent. But to bring out the significance of these figures a further analysis is necessary. Taking the class of offences against the person, these fall into two categories—sexual offences and offences generally of violence against the person. In the latter, after making allowance for the rise of 9 per cent, the only offence that shows an appreciable rise is that of procuring abortion. Such crimes as murder and attempts to murder, manslaughter, cruelty to children and child-stealing are among those that show a decrease. The net decrease over all is 4 per cent. In sexual crimes the greatest increase is in indecent assault and defilement of girls between 13 and 16. In the case of rape, defilement of very young girls, and in procurement and abduction there are decreases. Bigamy showed a very high figure—an increase of 120 per cent; but there is a decrease as compared with the period 1920-24. Offences between males increased.

In the class which shows the next greatest increase over 1910-14—crime against property with violence—a heavy increase in offences of 'breaking in', attempts at entering and being in possession of housebreaking tools far outweighs decreases in burglary and robbery. Reference has already been made to the motor-car as a factor in this section of crimes. It is to be noted in this connexion and also in connexion with certain other classes of crime, that the increase is in part due to the fact that a number of cases previously unreported are now brought to the notice of the police. For this the increase of insurance is to some extent responsible as such cases are now reported in order to obtain compensation.

Some interesting points are raised in an attempt to ascertain how far crime is affected by certain social factors, such as education, improved social conditions, and the old age pension, the after effects of war service, and the increased activity of women.

For the purpose of investigating the bearing of education on crime, the figures of 1928 are compared with those of 1882, when the results of the

Education Acts of the 'seventies were beginning to bear fruit. It is sometimes said that the criminal now works with brains not brawn; but the figures in those classes of crime in which education is the primary requisite scarcely seem to bear this out. Since 1882 the population has increased by 50 per cent, but the increase in indictable offences is 30 per cent only. The incidence in offences against the person was about the same, but malicious injury to property and forgery and currency offences, the most likely to be affected by education, showed a decrease of 46 per cent and 3 per cent respectively. On the other hand, larceny of post letters increased; but this was owing in part to the immense increase in the volume of correspondence and the greater number of people handling the mails. Frauds also show a heavy increase, but this is a matter of recent years, and up to 1900 the figures show little variation.

Significant facts emerge in an examination of male age groups which bears upon the question of the effects of war experience and social conditions. The opinion is frequently expressed that war experience has led to a disregard to the rights of property and a disposition among war service men to take whatever is wanted and whenever it is wanted. But as a matter of fact the age groups in 1928 of those men who passed through the War compare very favourably with their seniors and juniors except in respect of obtaining by false pretences, frauds, etc. The group 21-30, however, which during the war would have ranged in age from 7 to 16, shows a relatively high rise in incidence of convictions and has obviously suffered from absence of parental control and other social conditions during the War. Again, the effect of improved social conditions and of the old age pension is seen in the older groups of 50 and over, where there is a fall in the incidence of convictions of 52 per cent.

As regards crime among women, the figures as a whole show that the increasing activities of women have not resulted in any serious rise in crime and have been accompanied by a great fall in the less serious and petty offences. Non-indictable offences have fallen 34.5 per cent, while the number of women has increased by 11 per cent. Cases of simple drunkenness have fallen from 12,219 to 5249, and aggravated drunkenness from 26,045 to 5489. Cases of cruelty to or neglect of children fell from 1424 to 362.

The figures for non-indictable offences present certain points of considerable social interest and significance. While there is an increase in less serious offences under Customs, Excise, and Inland Revenue laws, and a huge increase in motoring offences, proceedings for all offences denoting criminality or debased conditions of life have fallen considerably.

Studied comparatively, the statistics as a whole tend to show a more orderly and law-abiding population, living in improved social conditions. The most serious problem they reveal, as indicated by the incidence of crime in the age-groups, is that of the care and training of the adolescent.

## Obituary.

MR. E. A. SPERRY.

THE death on June 16 of Mr. Elmer Ambrose Sperry, announced from New York, removes one of the best known of American inventors and electrical engineers and one who will always be remembered for his development of the gyroscopic compass and its application to all classes of vessels, including submarines, battleships, and passenger liners. But he did important work in many branches of engineering, and in 1925, when he was made an honorary doctor of science of the North-western University, Illinois, he was referred to as "an electrical engineer and a physicist who has shown remarkable skill in applying scientific methods and knowledge to the solution of practical problems; inventor of the Sperry gyro-compass; of many valuable aeronautic instruments; of the highest power search-light; of fire control apparatus for the United States Navy; a pioneer electrical manufacturer in America; and a founder member of the Society of the American Institute of Electrical Engineers."

Mr. Sperry was sixty-nine years of age, having been born at Cortland, New York, on Oct. 12, 1860. Educated at the State Normal and Training School at Cortland and at Cornell University, at the age of twenty he founded the Sperry Electric Co. of Chicago. Electric arc lamps, electric mining machinery, and electric traction engaged his attention in turn, and he founded the Sperry Electric Railway Company of Cleveland, which in 1894 was bought by the General Electric Company of New York.

For the development of his invention, the gyro-

compass, in 1910 he founded the Sperry Gyroscope Co., Brooklyn, and the following year fitted one of the compasses in the U.S. battleship *Delaware*. Subsequent inventions have added to the accuracy and the utility of his compass, and to-day ships are kept on their course day by day by the compass acting as helmsman.

Sperry's work was acknowledged by many societies, and in 1926 the engineering societies of the United States awarded him the medal which commemorates the work of the great iron-master John Fritz (1822-1913), among previous recipients of which have been Westinghouse, Noble, Edison, Kelvin, and Bell.

WE regret to announce the following deaths:

Mr. Victor Branford, editor of the *Sociological Review* and author of "Science and Sanctity" and other works on sociology, on June 22.

Mr. W. J. Greenstreet, editor of the *Mathematical Gazette* and honorary member of the Mathematical Association, on June 28, aged sixty-nine years.

Mr. C. E. Siebenthal, who was responsible for the annual reports on lead and zinc issued by the U.S. Geological Survey from 1907 until 1924, on Mar. 1, aged sixty years.

Prof. Frederick Slate, emeritus professor of physics in the University of California, known for his work on analytical mechanics, on Feb. 26, aged seventy-eight years.

Dr. W. E. Story, emeritus professor of mathematics at Clark University, fellow of the U.S. National Academy of Sciences and a vice-president in 1896 of the American Association for the Advancement of Science, on April 11, aged seventy-nine years.

## News and Views.

In his recent presidential address to the Institute of Mining and Metallurgy on "Periodical Variations in the Prices of Minerals and Metals", Mr. James G. Lawn pointed out that variations in the price of minerals and metals over short periods of years affect the mining engineer very closely and bring numerous difficulties in their train. Many efforts have been made, therefore, to secure the stabilisation of such prices, and this of necessity generally means control over supply, since the demand side cannot be so easily regulated. Sometimes, however, successful efforts have been made to stimulate demand; the most notable example being that of nickel. After the War the demand for nickel fell off rapidly, but as a result of research and propaganda, the producers were able to obtain the absorption of their whole output for commercial purposes and later on to increase considerably the consumption. Control over supply can sometimes be effected where known deposits capable of profitable working are limited in number and extent. In other cases, metallurgical difficulties in extracting a marketable product afford a basis for control. In the former category would fall diamonds, nickel, cobalt, potash, and nitrate, and in the latter, aluminium and magnesium. In the diamond mining industry, everyone connected with it, whether in South Africa, Congo

Territory, Angola, or West Africa, recognises the necessity of control, and, despite many ups and downs in the trade, prices have been maintained for forty years. In the production of cobalt, an agreement between the producers in Ontario and Katanga to supply a half share each has maintained the price at 10s. per lb. Aluminium ores are plentiful, but since metallurgical treatment of the ores is costly the business is in comparatively few hands and control has been secured by agreement for some eighteen years.

In his presidential address to the Devonshire Association on June 24, Mr. R. Hansworth Worth gave a detailed and stimulating account of the physical geography of Dartmoor. The address will appear in due course, with an admirable series of illustrations, in the *Trans. Devon Assoc.* for 1930. A good account is given of the vegetation of the moor and of its conversion into peat. It is shown that since the Early Bronze Age some two feet of peat have accumulated in the Erme valley. Decay is also going on, especially in the hill-top bogs, as for example in the ground around Cranmere Pool. From the coincidence of the planes of pseudo-bedding in the granite with the slopes of the hillsides and from other evidence, it is argued that the present topography of

Dartmoor is close to the original surface of the granite. The china clay of the moor is referred to the action of vapours derived from the cooling granite-magma co-operating with meteoric water which obtained access to the granite surface through the then overlying cover of sedimentary rocks. Unusually wide partings in some of the tors are thought to be due to wedges of ice forcing the blocks apart when the climate was much colder than at present. The rock-fields known as 'clitters' are compared with similar erosional features in Spitzbergen, where they are probably due to hill-creep actuated by deep frost action. Rainfall and climate, rivers and border hills are given detailed treatment, and the address concludes with a brief survey of the geology of the area.

MR. WORTH protests against the methods of recent geologists who have "blazed a trail of unnecessary disfigurement across the whole face of the Moor". The perpetrators of this alleged damage may, perhaps, not unreasonably claim that their exertions have been amply justified by the harvest of results attained. Mr. Worth, however, does not refer to these beyond stating that he cannot accept the idea of differentiated types of varied age. He thinks that the intrusion of the granite took place in one operation. He also suggests that the attempt to make tectonic capital out of the direction of the joints is mistaken, since the joints are local in their origin and orientated in all directions. He believes that the granite came into place as a wedge-like intrusion operating along the whole length of the axis from Dartmoor to the Scilly Isles, and that "there exists an elongated mass of granite, irregular in shape, isolated and self-sufficient, not fed by any lower reservoir through either necks or dykes, and that the upper protuberances of this mass now reach the surface and form the granite bosses of Devon and Cornwall".

ON July 1 a large party of archaeologists began a four days' pilgrimage along the Roman Wall, assembling at Hexham, and proceeding along the whole 73 miles' length of the Wall from Wallsend-on-Tyne to Bowness-on-Solway in Cumberland. The expedition was organised by the Society of Antiquaries of Newcastle-on-Tyne and the Cumberland and Westmorland Antiquarian Society. A similar pilgrimage, but on a small scale, was made in 1920, and it is twenty-four years since a visitation of the extent and thoroughness of that of this year has been attempted. The first day's expedition covered the Wall from its eastern extremity to the Roman bridge at Chollerford, 21 miles west of Newcastle, when Mr. F. Gerald Simpson, Mr. Parker Brewis, and Mr. R. C. Bosanquet acted as guides. On the second day, Chesters (Cilurnum), the sixth fort on the Wall, and the museum with its remarkable collection of antiquities from the Wall were visited. Sir George Macdonald and Mr. R. G. Collingwood acted as guides. The second day's pilgrimage also extended to the great fort at Housesteads, to Peel, and to Chesterholme with its milestone. On Thursday Carlisle was reached after a

journey of which the most notable feature was a visit to Birdoswald, where Mr. Richmond's excavations were examined in detail and the many problems raised by his work were thoroughly discussed. On Friday the pilgrimage came to an end at the seaboard. On Thursday, the party had received a large accession in numbers, in part, no doubt, owing to the attractions of the Birdoswald fort, but also without question owing to the fact that the itinerary for that day included the stretch of the Wall which is now threatened by quarrying operations.

ALTHOUGH the pilgrimage was independent of any movement in connexion with the attempt to save the Wall, we may expect with confidence that a visitation such as this will not fail to make its influence felt, both in the present issue and in formulating safeguards against similar vandalism in future. Apart from this possibility, the most striking feature of the pilgrimage was the way in which was brought out the great significance for Roman studies in Britain of the work of excavation and research in the neighbourhood of the Wall—notably at Cilurnum, Chesterholme, and Birdoswald—since the last occasion the Wall was visited.

THE annual exhibition, the eighth, of the antiquities obtained from Ur during the excavations of the past season by the Joint Expedition is now open at the British Museum. The exhibits, which are arranged in chronological order, are representative of every period of the city's history from the earliest to the latest times. The plans and drawings which illustrate the architecture of the temples, etc., at various periods are a revelation of the technical skill attained in Mesopotamia at this early age. Especially to be noted is the system of canals and walls discovered last winter, dating from about the time of Abraham. A photograph of a column of bricks from the temple ruins of the Third Dynasty (about 2300 B.C.) affords authentic evidence of the use of this architectural element at so early a date. The exhibits from the Royal City naturally take first place in interest and importance. A case of clay sealings is of particular significance, as it not only illustrates the early art and beginning of writing among the Sumerians, but it also provides material in the stratigraphical sequence of the sealings for fixing the dating of the Royal cemetery, which has been in dispute. A sectional drawing illustrates the sequence in the great pit in which were unearthed the remains of the city destroyed by the Flood. Cases contain reproductions of the actual graves in which lie the painted pottery side by side with the crushed skeletons. Above these cases is ranged pottery and clay figures from the graves and ruins below the flood level which illustrate the earliest art of Sumeria yet discovered, antedating by some centuries the magnificent wild boar carved in stone which was mentioned in Mr. Woolley's reports and is now exhibited here.

FROM the brief reports so far received, it would seem that the Indian earthquake of July 3 was much inferior to its great predecessor on June 12, 1897. Buildings were, indeed, damaged in many

places, some persons were injured by their fall, but as yet, though the earthquake occurred at 3 A.M., no loss of life is reported. In two sections of the Eastern Bengal Railway, bridges are unsafe and the lines are damaged. The centre of the earthquake is said to be at Gauhati on the Brahmaputra, about 320 miles north-east of Calcutta. As some slight damage was caused in that city, the shock must have been strong over an area of 300,000 square miles, and the disturbed area cannot be much, if at all, less than half a million square miles. That the shock should have been felt over so wide an area without attaining greatly destructive strength within it shows that the focus must be unusually deep. In his admirable memoir on the earthquake of 1897 (*Mem. Geol. Surv. India*, vol. 29, pp. 1-379; 1899), Mr. R. D. Oldham has outlined its epicentral area, and it is of some interest to note that Gauhati lies close to its eastern margin, showing that, after the lapse of nearly forty years, the centre of activity has shifted some fifty miles or more towards the east.

THE British Arctic Air Route Expedition sailed on July 6 in the *Quest* for East Greenland via the Faroes and Iceland under the leadership of Mr. H. G. Watkins. The main object of the expedition, as explained by the leader in an article in the *Times*, is to investigate the possibility of an air route across Greenland as a link in the route from London to Canada. This would be predominately a land line. No stretch of sea more than some three hundred miles would have to be crossed in one lap. The expedition is provided with two De Havilland Moth aeroplanes and fifty dogs and will be absent about a year, the *Quest* returning to Norway during the winter and leaving the fourteen explorers in Greenland. Journeys by dog sledge will be made on to the ice cap to north and south from a base about the Arctic Circle. Trial flights across to the west coast are contemplated. Perhaps the most important scientific aspect of the expedition will be the station which it is planned to found on the highest part of the ice cap for meteorological purposes. This will give the first winter observations from the interior of Greenland. Mr. Watkins thinks it not improbable that the best flying route across Greenland will be by the depression in the ice cap which seems to exist between about lat. 66° N. on the east and lat. 70° N. on the west. If this is so, air bases might be established in the vicinity of the settlements of Angmagsalik on the east and Disko on the west.

THE annual report of the Empire Marketing Board for the year 1929 has just been published (H.M. Stationery Office, price 1s.). Although the Board is of a non-political character, a change in government led to alterations in personnel, but it happily remains representative of all three parties. The experience during the past year has been most encouraging, and the outlook seems full of promise. The shipment of a number of Empire-grown foodstuffs into Great Britain in 1929 has in many cases surpassed all previous records, some such commodities being dried fruit from Australia, dairy produce and pork from New Zealand, fruit, sugar, and wines from South

Africa, tea from India and Ceylon, and poultry from the Irish Free State. It is realised that no amount of good marketing will sell poor goods, and considerable attention is being devoted to the promotion of fundamental research work. Scientific investigations are being carried out both at home and overseas, the long lists of grants supplied for problems very varied in nature being evidence of the extent of the field under the auspices of the Board. The ullest co-operation has been, and is still being, sought between the Board and wholesale and retail traders. Encouraged by the goodwill already shown, and in order to utilise trade experience to the fullest advantage, a new main committee of the Empire Marketing Board has been appointed, to be known as the Marketing Committee. Its aim will be to secure a regular contact between itself and the complicated distribution system of Empire products among the consumers. The methods by which the Board attains publicity are many and various. Nearly two million leaflets were distributed during the past year, and the value of exhibitions, lectures, the cinema, etc. is becoming increasingly apparent. The publication of weekly intelligence notes giving full marketing information for fresh fruit and dairy produce has been extended, statistics of approximately ninety per cent of the butter held in cold storage now being included. In addition, statistical surveys of the world position as regards production and consumption of various food-stuffs are being issued.

The need for a closer co-operation between the breeder of domestic stock and the geneticist was the burden of Prof. F. A. E. Crew's address on "Genetical Methods of Livestock Improvement" to the Royal Society of Arts (*Jour. Roy. Soc. Arts*, May 16, 1930). He pointed to the difficulties of creating an ideal standard to which any breed should conform, since no single purpose could be imposed on any breed, independently of the fundamental necessities of healthy life and prolific breeding. The case of sheep was instanced as an example of the attempt by one set of interested persons, the manufacturers of wool, to set up a standard of fleece purity without reference to the primary purpose of the fleece as a protection for the sheep itself during the successive stages of its development. The geneticist is already in possession of a vast mass of knowledge of vital importance to the breeder, and although the breeder seems loth to take advantage of these facts, harmonious collaboration between the two is sure in the future to lead to the revisal and definition of standards, the analysis of excellence, the purification of stocks, and the removal of the menace of sterility. Prof. Crew looked forward to a time when added knowledge of the influence and working of the ductless glands would enable rate of growth, fertility, fat deposition, and so forth to be removed from the slow methods of selective breeding and to be controlled by the administration of the appropriate endocrine products prepared by the biochemist.

STREET traffic luminous signals have been widely adopted in many cities abroad and experiments with them are being made in many towns in Great Britain.

Many of the most efficient police officers in almost every country in the world are being used as semaphore machines, and the fatigue of continual arm movement must be considerable. As traffic supervisors they will probably always be required, but in our opinion considerable economies and higher efficiency could be obtained by the use of luminous signals. At many of the street crossings in Berlin there are conspicuous red, yellow, and green lamps visible to the traffic moving in one of the streets and simultaneously green, yellow, and red lamps visible from the other. Only one lamp is alight at the same time. The green and red mean proceed and stop, the yellow when it follows red indicates to the motorist or pedestrian that he is to get ready to proceed and when following green that he is to begin to stop. With one-way traffic in one street, as in the Unter den Linden in Berlin, this arrangement answers admirably. In the *Illuminating Engineer* for June there is an interesting paper on luminous traffic signals by T. Austin. He points out that the improvements made in glass moulding and in the production of coloured glass and the use of gas-filled electric lamps have immensely improved daylight colour signalling. For railway signalling, signal lamps can now be made which have a range of visibility of 4000 feet in bright sunshine. For street signalling economy can be effected by using automatic signals. When these are used, however, it will be necessary that motorists and others should be warned by a suitable sign when entering a district which uses them.

THE annual reports of the council and director of the Norman Lockyer Observatory for the year ended March 30 have just been issued. They show a very satisfactory year's work in spite of unfavourable weather conditions. Only 134 nights during the year were sufficiently clear for work to be done, and 124 of these were utilised. The Council considers, nevertheless, that at no observatory in Great Britain are the weather conditions more favourable for observation than they are on Salcombe Hill. The determination of spectroscopic parallaxes of early-type stars and the investigation of bright hydrogen line stars continue to form the main part of the work of the observatory. The equipment is about to be increased by a generous gift from Mr. Robert Mond, chairman of the observatory corporation, of an equatorial mounting for the Zeiss triplet lenses now in the possession of the observatory and a dome to house it. The work is in the hands of Messrs. Cooke, Troughton, and Simms, and is well under way. The Council remarks that if sufficient income were at its disposal, the observatory would be able, with present equipment, to keep another assistant or research student fully employed on valuable work. This, however, cannot be contemplated until further funds are available, and under existing conditions of depression in industry there seems little promise that the Council will be able to provide for any extension of the staff. During the year there has been a decrease of almost £160 in subscriptions and donations, but this has been offset by savings in salaries and maintenance and

increased income from investments. The net result is a credit balance of £75 6s. 4d. carried to capital account as against £98 7s. 11d. in the previous year. A survey of the contents of the library has been undertaken, and shows that the observatory possesses a total of 5370 volumes and 7500 pamphlets, etc.

IN honour of the seventy-fifth birthday of Prof. Bohuslav Brauner, of the University of Prague, a special jubilee number (May-June) of the *Collection of Czechoslovak Chemical Communications* has been issued. This number contains more than twenty original contributions by friends and pupils of Prof. Brauner, together with a complete bibliography of his own original works and a lengthy account of his association with D. I. Mendeléeff. This communication is of unusual interest, since it makes available for English readers many fresh details concerning the varied and full life of the Russian savant, who died in 1907. From this intimate account of Mendeléeff's life and many-sided interests it becomes apparent how much he was indebted to Prof. Brauner for bringing his views and the periodic classification of the elements before Western men of science. Indeed, many of Prof. Brauner's earlier researches (for example, the proof that beryllium is a bivalent metal, the separation of didymium into praseodymium, neodymium, and samarium, and the attempted fractionation of iodine and of tellurium) were all directed towards the substantiation of the Periodic Law. Among the other contributions to this issue of *Collection* are three from Prof. J. Heyrovský and his collaborators, who continue the series of polarographic investigations with the dropping mercury cathode. These researches have now been in progress for ten years, and the method has been found of service in attacking problems in inorganic, physical, analytical, and now in organic chemistry. Prof. J. Štěrba-Böhm and Dr. Písaříček describe certain new cerium compounds, particularly the double oxalates of the alkali metals with trivalent cerium. The existence of these compounds has revealed the cause of the difficulties encountered in attempting to precipitate cerium oxalate with alkali oxalates. Prof. B. N. Menšutkin and M. B. Wolff have also communicated a paper on the transformation of the cyclohexane ring into that of benzene.

IN the *Times* of July 1 reference is made to the recent purchase in London, by Dr. A. S. Rosenbach, the book dealer of Philadelphia, of a manuscript relating to the discovery of America. The manuscript is more than four hundred years old, and is thought to have been written by a friend of Columbus, Andreas Bernaldez, who was born about 1450 at Fuentes le Leon, Spain, and in 1488 was made curate of the village of Los Palacios near Seville and afterwards became chaplain to the Archbishop Diego de Deza, a friend of Columbus. When Columbus was on his way to the court of Ferdinand and Isabella to report on his second voyage he was the guest of Bernaldez, with whom Columbus left some of his writings. Until recently the manuscript, which is entitled "The Story of Christopher Columbus and the



ship in which he crossed the ocean until he discovered the Indies where they found gold" has lain disregarded in a Spanish library.

THE *Himalayan Journal*, the annual publication of the Himalayan Club, has made its second appearance. The current issue is full of well-illustrated articles on various aspects of mountaineering in the Himalayas. Lieut.-Col. H. W. Tobin reviews the history of exploration among the glaciers and peaks of the Sikkim Himalayas, and Lieut. J. B. P. Angwin gives an account of an expedition into the little known Kagan valley of the Kunhar River to the west of Kashmir. Several other articles treat of exploratory expeditions, and there is a useful account of the German attempt on Kangchenjunga in 1929. We note that among many spellings the Survey of India has adopted Kinchinjunga as the official spelling. In relation to the Shyok flood of last year, Major K. Mason discusses the likelihood of the Chong Kumdan glacier dam reforming and impounding another flood.

BARON GERARD JAKOB DE GEER, of Stockholm, and Prof. Tullio Levi-Civita of Rome, were elected foreign members of the Royal Society at a meeting of the Society on June 26.

HIS ROYAL HIGHNESS THE DUKE OF YORK has been elected an honorary member of the Royal Institution.

THE Bruce Prize of the Royal Society of Edinburgh for the period 1928-30 has been awarded to Mr. N. A. Mackintosh for his researches into the biology of whales in the waters of the Falkland Islands Dependencies. This prize is awarded by a Joint Committee consisting of representatives from the Royal Society of Edinburgh, the Royal Physical Society, and the Royal Scottish Geographical Society.

At a meeting of the Royal Society of Edinburgh, held on July 7, the following were elected honorary fellows: *British Honorary Fellows*—Sir Arthur Stanley Eddington; Sir William Bate Hardy; Sir Arthur Keith; Prof. J. E. Marr; Prof. R. Robinson; Dr. D. H. Scott; *Foreign Honorary Fellows*—Prof. V. F. K. Bjerknes, Bergen; Prof. W. B. Cannon, Cambridge, U.S.A.; Prof. M. Caullery, Paris; Prof. G. Fano, Rome; Prof. E. H. O. Stensiö, Stockholm.

THE following appointments in the Colonial Agricultural Services have recently been made by the Secretary of State for the Colonies: Mr. W. J. Blackie, to be government chemist, Fiji; Mr. M. H. Grieve, to be assistant agricultural officer, Kenya; Mr. F. W. Thomas, to be district agricultural officer, Tanganyika Territory.

ARRANGEMENTS have been made with National Flying Services, Ltd., for the visit of a party to Hanworth Park on Wednesday, July 16, under the auspices of King Edward's Hospital Fund for London. Buses will be in readiness at Victoria Embankment (outside Charing Cross Underground Station) at 2.30 P.M. On arrival the visitors will be received by Capt. F. E. Guest, chairman of National Flying

Services. Flying will be in progress during the afternoon, when all the latest types of light aeroplanes will be on view, and passenger flights will be available to visitors at a charge of 5s. Hanworth Park is the centre of private flying in Great Britain, and has been described as the most beautiful aerodrome in the world, as well as the most active civil flying training organisation. The estate was once a hunting-seat of Henry VIII. Tea will be obtainable on the club premises at a small charge. Application for tickets (price 10s.) should be made to the Secretary, King Edward's Hospital Fund for London, 7 Wallbrook, E.C.4.

IT was decided at the International Congress of Orientalists held at Oxford in 1928 that the next meeting should take place in Holland. In accordance with that decision, preparations are now being made for the Congress to be held at Leyden on Sept. 7-12, 1931. Leyden was the place of meeting of the sixth Congress, which was held in 1883. An influential committee of organisation has been formed at Leyden, to which the preliminary arrangements have been entrusted. The secretary of the committee is J. H. Kramer, and the secretarial headquarters are at the Musée ethnographique, Rapenburg, 67, Leyden, to which inquiries and communications should be addressed.

WE have received a further notice of the second International Congress of Experimental Cytology, which is to be held at Amsterdam, on Aug. 4-9, in conjunction with the Anatomical Congress. As indicated by the preliminary programme, the questions discussed will relate mainly to problems which can be investigated by tissue culture methods. One symposium is concerned with the relations between blood and connective tissue, another with growth and differentiation in their reciprocal relations. Several of the papers will be illustrated by kinematograph film demonstrations. These include the function of osteoclasts, the phenomena of nerve stimulation, the functioning of heart muscle in tissue culture, and experiments on early chick and duck embryos. Papers will also be given on micro-dissection and other technical methods, and a discussion will be held on mitogenetic and other biological forms of radiation. Dr. Rhoda Erdmann will introduce a proposal to found an International Association of Experimental Cytology. Further information may be obtained from the Bureau of the Congress, 108 Sarphatistraat, Amsterdam.

At the first ordinary meeting of the Microscopical Society of Wales, held on July 3, the biology of Roath Park, Cardiff, was discussed. Roath Park, through which a brook flows, has an area of more than 160 acres, and comprises a recreation ground, pleasure garden with bowling-greens and lawn-tennis courts, etc., a botanical garden, rock garden, flower and Cactus conservatories, lake, wild garden, and Llandennis gardens. As the largest park or open space in Cardiff it attracts many visitors. During the past two or three years, however, bathers using the lake have been affected by their skin being punctured, after which intense irritation sets in, and Roath Park Lake

has thus become a topic of conversation from a point of view other than that of its amenities. From the botanical point of view the park is notable amongst provincial parks and open spaces: the birds breeding in or frequenting it have been studied for about a quarter of a century, and many mammals have been recorded. As a field for microscopical study and research little has been done, but the meeting of the Society on July 3 directed attention to the many and varied interests which the park offers to microscopists. Although it is less than three months since the first move towards the formation of the Microscopical Society of Wales was made, its membership already exceeds a hundred, and the formation of local branches in other parts of Wales is under consideration.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A research assistant at the Imperial Forestry Institute, University of Oxford—The Secretary, Imperial Forestry Institute, The University, Oxford (July 15). An assistant lecturer in botany in the University of Birmingham—The Secretary, The University, Birmingham (July 23). A lecturer in biology at the

Cheshire School of Agriculture—The Principal, Cheshire School of Agriculture, Reaseheath, Nantwich (July 26). Five electrical inspectors of factories for inspection of factories and other places under the Factory Acts—The Industrial Division, Home Office, Whitehall, S.W.1 (July 28). A professor of biochemistry in the University of Liverpool—The Registrar, The University, Liverpool (Sept. 29). A junior assistant under the Directorate of Metallurgical Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A director of the Rubber Research Institute of Malaya; also a head of the botany division of the institute—The Secretary, London Advisory Committee, Rubber Research Institute of Malaya, 2 Idol Lane, Eastcheap, E.C.3. A temporary lecturer in biology or botany at Lincoln Training College—The Principal, Training College, Lincoln. A part-time lecturer in chemistry and experimental physics at Queen's College, London—The Secretary, 43 Harley Street, W.1. A lecturer in malignant disease in Aberdeen University and radium officer at the Aberdeen Royal Infirmary—The Secretary, The University, Aberdeen.

### Our Astronomical Column.

**The Spectroheliograph.**—Descriptions of the spectroheliograph and of typical observations made with this instrument for solar research have been given by Dr. Hale in NATURE during the course of his experiments (118, Supplement, July 3, 1926, 1-8; 119, 708-714; 121, 676-680). A detailed account of the instrument is also given in the *Astrophysical Journal*, December 1929; and more recently, in the March issue, Dr. Hale describes some rapidly moving hydrogen flocculi which he has observed near sunspots—in particular several flocculi representing active prominences connected with a large group of sunspots from Sept. 16 to 26, 1926. The typical phenomenon described in the paper is a curved dark filament descending into the spot (either into the umbra itself or terminating at the edge of the penumbra as a small black head) with velocities of the order of 50 or even 100 km./sec. The bearing of those observations on the structure of the hydrogen vortices of the solar atmosphere is left for discussion in a future communication to the *Astrophysical Journal*. Photographs of rapidly changing flocculi are but seldom secured with the spectroheliograph—not that such flocculi are infrequent, but that their active phase appears to be usually of short duration, and so are usually missed at the time of exposure of the daily spectroheliogram. Moreover, high radial velocities pertaining to a flocculus would, owing to the Doppler effect, cause a displacement of the spectral line from the second slit of the spectroheliograph and so prevent, partially or entirely, the flocculus from being recorded. It is one of the ingenious features of Dr. Hale's design for his spectroheliograph that flocculi with large radial velocities, especially differential velocities along their length, can be picked up and their velocities quickly measured by means of the 'line-shifter'.

**The Planet Pluto.**—The *Scientific American* for July contains an article by Prof. H. N. Russell describing Prof. P. Lowell's prediction of the elements of a trans-Neptunian planet and the search that has

been carried on at the Lowell Observatory, resulting last January in the detection of Pluto.

Lowell's only notable error in predicting was his exaggeration of the mass and magnitude of the body. He assigned to it a mass 6 times that of the earth and a magnitude of 12-13. This error was responsible for the delay of 15 years before the prediction was verified. Instruments of insufficient light-grasp were used in the search until the president of Harvard (Prof. P. Lowell's brother) gave a specially rapid triple objective of 13 inches aperture. Mr. Tombaugh began a systematic search with this instrument about a year ago, and six months later he discovered Pluto.

Prof. Russell notes that Lowell's memoir (dated 1915) is now procured with difficulty. He therefore reproduces facsimiles of three pages of it. One is given as a specimen of the nature of the analysis; the other two are the final pages, giving a summary of the whole, and the elements of the two predicted orbits. The closeness of the prediction is shown by comparison of Lowell's first orbit with the following elements of Pluto deduced by Dr. A. C. D. Crommelin from the observations of 1919, 1927, 1930. This is practically identical with that given by Nicholson and Mayall using 1919, 1930, thus confirming the identity of the 1927 object with Pluto.

Perihelion Passage . . .	1991.2	1989 Jan. 15.8 U.T.
Longitude of Perihelion . . .	205°	221° 44' 1.0"
Asc. Node . . .	Not predicted	109 21 35.0 } 1930.0
Inclination . . .	10° (conjectural)	17 9 1.8 )
Eccentricity . . .	0.202	0.2529548
Period . . .	282 y.	250.753 y.
Perihelion distance . . .	34.3	29.706
Computer . . .	Lowell (1915)	Crommelin

The close agreement in the four independent elements of date of perihelion, longitude of perihelion, eccentricity, and period is beyond what can reasonably be ascribed to chance. It is noteworthy that Prof. Russell's article was written before he knew of the 1919 and 1927 images: they have justified him in the estimate that he had already formed of the value of Lowell's work.

## Research Items.

**Monoliths in Assam.**—Mr. J. P. Mills, and Mr. J. H. Hutton in vol. 25, No. 1, of the *Journal and Proceedings of the Asiatic Society of Bengal* describe a series of five groups of remarkable monoliths in the Cachar Hills not previously recorded in print. The monoliths are pear-shaped, artificially dressed, and each contains a cavity in the bulbous end. They are now recumbent, though they appear at one time to have been erected on their narrow ends. They fall into two distinct types which may be regarded as male and female. The former constitute the whole of a large group at Kartong, and a smaller group between Kartong and Kobak. Most of the stones are incised with geometric designs and forms of men and animals, such as the pig and the mithun. While the monoliths may be interpreted as embodying the phallic principle, assisting the fertilising of Nature, the hollows seem to have been meant for some specific purpose not easy to discern. It may be that they were intended to hold water to promote rainfall, or they may have been intended to contain offerings on the analogy of holes recently scooped out in ancient monoliths at Kasomari. It is concluded that the North Cachar hollowed monoliths must be regarded as a specialised development of a phallic ancestral cult typical of Assam. It is clear that they were not erected by the Nagas and old Kukis who are the present inhabitants of the area. Local tradition assigns them to the Mikirs. This may be the case, subsequent invasion having overwhelmed the Mikirs and left them in isolated communities too weak to provide the labour requisite to carry on the custom. It is more probable, however, that it is to be associated with the Khasi Synteng group of tribes and that it has disappeared owing to their migration into an unsuitable environment.

**Tasmanian Crania.**—Dr. W. L. Crowther describes in the *Papers and Proceedings of the Royal Society of Tasmania* for 1929 two crania (immature) of the extinct Tasmanian race. Immature crania of the Tasmanians are comparatively rare. Of these two, Skull A, that of a child of seven years of age, was found in 1908 by the author and Dr. Inglis Clark at Oyster Creek. It was in a cemetery near the Government Station where the last thirty or forty of the race were buried and was at least sixty years old. Skull B, that of a child 7-12 years old, was found by Mrs. Legge on the west coast in 1927. No trace of any other human bones was found with it, and the mandible was missing. Skull A from its fragility was judged to be female. Rings of short bronze-coloured hair still adhered to the scalp. Posthumous distortion of the left side was probably due to the body having been laid on that side. The glabella is not prominent. The orbits are almost equal in height and breadth, markedly contrasting with those of the adult. The mandible is in position and the face shows marked prognathism. The six-year molar is erupted and the twelve-year molars are *in situ*. Skull B, probably male, shows little or no prominence of the glabella and supra-ciliary ridges. The supra-orbital notch is wide and shallow. The nasal bones are not projected forward and upward as is seen in the adult. The orbits again are almost equal in height and breadth. There is no suggestion of the heavy overhanging eyebrows of the adult. The face is not so prognathous as Skull A. The vault of the skull is flattened rather than of the typical carinate form. Generally, both the skulls conform to the adult type and could be distinguished by their Tasmanian characteristics; but in both the typical carination is absent. In early life it appears that the marked width of the face at the

expense of its height is not pronounced. The orbit and nasal apertures appear to expand laterally as the result of growth and mastication, and with the normal heavy development of the glabella and supra-orbital ridges give rise to the facial characteristics of the adult skull.

**Growth Rate of Young Gorilla.**—Dr. C. V. Noback is reported to have made a study of the development of a young gorilla received at the New York Zoo some time ago (Science Service, Washington, D.C.). He found that it grew more slowly than a boy of the same age, the rate of growth during the first three years of life being measured in terms of adult weight. But the bones and teeth matured more rapidly than those of a human child, for the full set of milk-teeth was developed at approximately eighteen months, and the permanent teeth began to be acquired at the age of two and a half years. The study will be reported in full in the *American Journal of Physical Anthropology*.

**The Swallowing of Feathers by Grebes.**—It has often been observed that different species of grebes contain quantities of their own feathers in their stomachs, and the frequency of this curious habit suggests that it has some functional significance. Mewes thinks that the purpose is to protect the lining of the stomach from abrasion, Biedermann that the feathers perform a function similar to that of pebbles in granivorous birds. Neither of these suggestions is altogether acceptable, and Dr. Josef Jirsik has made a new attempt to solve the problem (*Bull. de l'école supér. d'agriculture Brno, CSR.*, 1929, Sign. D. 15). He found a young great-crested grebe (*Podiceps cristatus*) only a few hours old to contain 13 feathers, and another of the same brood 93, all the feathers having been plucked from the mother—an instinct apparently present at birth. The young birds began to swallow their own feathers as soon as they appeared amongst the down, and the adults took their own or each other's feathers almost indiscriminately throughout the whole year. Further, when the stomachs contained only small insects feathers were few, when fishes had been devoured they were many; so that the quantity of feathers seems to be regulated by the quantity of food swallowed. Hard and indigestible fragments of food were surrounded in the stomach by feathers, and the actual observation, made by means of a powerful binocular telescope, of vomiting movements on the part of the grebes similar to those of herons, strongly suggests that the feathers enable the birds to reject, in the form of a cast, the indigestible portions of a meal. Here apparently is a close analogy to the swallowing of fur by owls and other birds of prey.

**Conditioned Responses in Fishes.**—Mr. H. O. Bull (*Jour. Mar. Biol. Assoc.*, N.S., vol. 16, No. 2, 1930) has published the results of his further work on the capacity of fishes to form conditioned responses towards definite stimuli. He found that the wrasse is able to form stable conditioned motor responses to the note of a tuning-fork sounding the note lower *C* or to an electric buzzer giving a note approximately *F* in the second octave, when either was used singly. The fish was, however, unable to discriminate between them as sounds when both were used simultaneously but differentiated them by their position. The author was also able to build up conditioned responses involving visual stimuli in the plaice, cod, and coalfish. Two species of *Blennius* were able to form stable conditioned responses towards gustatory stimuli, such as sea water extracts of natural food substances, but

did not respond to an artificial olfactory stimulus such as artificial musk. The author concludes, as a result of his series of experiments, that the essential similarity between the responses built up in fishes and the conditioned reflexes in dogs becomes more emphasised as the data accumulate.

**Young Stages of *Conus*.**—The apex of *Conus* is not commonly found in a good state of preservation, while complete immature individuals are rare and that of *Conus adversarius* Conrad has hitherto been unknown. Mr. Burnett Smith is now fortunately able to describe and figure three specimens (*Proc. Acad. Nat. Sci. Philad.*, vol. 81). In the youngest of these a slight yet definite constriction serves to distinguish the whorl proper from the anterior canal, and this the author considers to be a significant suggestion of a pleurotomoid ancestry for the genus *Conus*.

**South American Fish Poisons.**—Messrs. E. P. Killip, of the U.S. National Museum, and A. C. Smith, of the New York Botanical Garden, in a botanical exploration of Peru and Brazil, paid attention to the plants used by the natives as sources of fish poisons, as such plants are possible sources of new insecticides. The most successful fish poison appears to be prepared from the roots of a plant which was frequently cultivated on this account and, curiously enough, was never seen anywhere in flower or fruit. They identify this plant as *Lonchocarpus nicou* (Aubl.) DC. after comparison with the specimen in the British Museum (Natural History). Two other species of this genus are also described as sources of fish poisons; one species from the lower Amazon River with an exceptionally powerful poison they decide is new and describe under the name of *L. urucu*.

**Virus Diseases of Plants.**—Henderson Smith summarises the literature on two obscure problems connected with virus diseases of plants in *Biological Reviews*, vol. 5, April 1930. The spread of the virus from the point of inoculation can take place from cell to cell, but the rate of spread seems high for such a process though low for transport in the water stream; Henderson Smith concludes that transport is probably mainly effected by the phloem. He also discusses the abnormal inclusions, the X bodies, characteristic of many virus-infected plants. He points out that some recent observations (F. M. L. Sheffield and Henderson Smith, *NATURE*, Feb. 8, p. 200) support the more commonly accepted view that these bodies are not living organisms, but a reaction product of the cell to the virus irritant.

**Soil Formations in the Tropics.**—Researches in recent years have shown that in mature stages of soil formation the characteristics of the parent material are obliterated and the soils are expressions of climate irrespective of origin. A low temperature with rainfall greater than evaporation and constant bleaching by cool water leads to a podsolised soil or podsol of a light colour and high silica content. Podsol is typical in Canada and northern Europe. In order to investigate its occurrence in high altitudes in the tropics, Mr. M. W. Senstius explored soils in the Dutch East Indies and the Philippine Islands. His results are given in a paper on weathering and soil formation in *Proceedings of the American Philosophical Society* (Vol. 69, No. 2). Many of the conditions favourable to the development of a podsol occur in the heights of those islands. Analyses of the soil samples showed that podsolisation takes place in much the same way as in the lowlands of middle latitudes, though the bleached layer below the dark humus is much thicker. Nevertheless, the author did

not find in any of the areas visited a true podsol containing little else but silica. The investigation, on the whole, supports the principles of soil classification on a climatic basis.

**Helium and the Origin of Petroleum.**—M. N. Rogers discusses a "radioactive hypothesis of petroleum formation" in the *N. Zealand Jour. Sci. and Tech.* for April, 1930. He suggests that methane, arising from the decomposition of the organic substances in sedimentary rocks, is condensed as a result of the ionisation due to the radioactive constituents in the same rocks. Lind and Bardwell have already shown that the effect of  $\alpha$ -rays on methane is to produce the higher saturated hydrocarbons and liquid olefines. Rogers assumes that the extent to which such a process has operated in a sandstone may be indicated by the content of helium in the latter. Experiment indicates that for each cubic foot of helium generated nearly two tons of liquid hydrocarbons could be formed. In the Colorado oilfield of Kansas 70 million cubic feet of helium per annum have been produced. In the Sedan field of Kansas several million cubic feet of gas with about one per cent of helium escape daily. The Petrolia gas-field originally contained more than 1000 million cubic feet of helium. It is further pointed out that radon is about fifty times more soluble in petroleum than in water, and that this might lead to a localisation of radioactivity which would bring about partial elimination of hydrogen and the production of solid hydrocarbons.

**Apatite Deposits of Chibina Tundra.**—In one of the Scientific Chemo-technical Publications of Leningrad (in Russian, 1929) A. E. Fersmann, the leading geo-chemist of Russia, gives a concise summary of the work done during the last ten years in exploring the Chibina Tundra for apatite. The area is a massif of rocks belonging to the nepheline-syenite family situated north of the Polar circle in the Kola Peninsula not far from the Murmansk railway. The intrusions are laccoliths or ring-complexes in the Pre-Cambrian gneisses of the Fennoscandian shield. Apatite-nepheline rock occurs in two bands. The one now being exploited has an apatite-rich upper part (average thickness, 50 metres;  $P_2O_5$ , 30 per cent.) and a lower part poorer in apatite (average thickness, 150-180 metres;  $P_2O_5$ , 10-15 per cent.). Parts of the rock range as high as 85 per cent of apatite, and the estimated reserves of the latter amount to more than 500 million tons. The ore was formed at a late stage in the igneous cycle from a residual magma rich in volatile fluxes. It constitutes the greatest of all the Russian phosphate deposits. Preliminary prospecting by borings and construction of roads is now completed and the yield of ore next year is expected to be 200,000 tons. The by-products—nepheline and titanium ore—will be utilised in the ceramic and chemical industries.

**Types of Bridges.**—An ingenious and original map appears in *Petermann's Mitteilungen*, Heft 5/6, 1930, showing the distribution throughout the world of various kinds of bridges classified first by the material and secondly by the method of construction. The classifications that are mapped include eight types ranging from the simple hanging bridges of lianas and other plants to modern bridges of metal built in spans. Dr. H. Winkler adds a short article to his map. A certain correspondence with forest growth appears in the distribution of all types of wooden bridges, those made of lianas being confined to the region of equatorial rain forests. The Mediterranean forests, how-

ever, do not seem to help bridge construction, for in their area stone bridges in the main predominate. On the whole, the wood bridge in one form or another is found in more than half the land area of the world.

**New England Floods.**—During the last century, New England has experienced some ten storms resulting in flooding of unusual severity. One of the worst of these was on November 3 and 4, 1927, and it is the subject of a report by Mr. H. B. Kinnison (U.S. Geological Survey, *Water Supply Paper*, 636-C). Torrential rain fell over much of New England, causing very severe floods, and loss of life and destruction of roads, bridges, and houses in Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island. The storm was caused by somewhat exceptional meteorological conditions. A tropical storm appeared on the weather map over Cuba on Oct. 29, and started to move northward three days later, developing unusual severity. By Nov. 3 the storm centre was off the lower end of Chesapeake Bay. It was then expected to continue up the coast with moderately heavy, but not excessive, rains over New England. However, an area of high pressure to the north-east prevented the storm moving in that direction, and at the same time there was another high-pressure area north of New York State. The moving low-pressure area was caught between the two high-pressure areas and was forced upwards. Torrential rain resulted. Over 500 square miles there was a fall of 9 inches, while over another 36,000 square miles more than 5 inches fell. Several power reservoirs in the area were not full at the time and held some of the flood waters, but the ground was saturated by previous heavy rains, and lakes and swamps were almost full, a state of affairs which led to rapid flooding.

**Light Rays as null Geodesics.**—Einstein's general theory of relativity was based upon several postulates, which subsequent writers have tried to simplify. Thus Whittaker, in vol. 24 (1927) of the *Proceedings of the Cambridge Philosophical Society*, showed that to obtain the equation of light rays as space-time geodesics of zero length, we need only combine the ordinary theory of partial differential equations and of their characteristics (which may be roughly described as loci of singularities) with the simple postulate that a light ray is a line of singularities. Levita-Civita, in vol. 11 (1930) of *Rendiconti della R. Accademia Nazionale dei Lincei*, has carried the simplification a stage farther by eliminating all reference to electromagnetism. He shows that the light rays can be obtained as characteristics directly from the gravitational equations, independently of any electromagnetic theory of light.

**Collisions of  $\alpha$ -Particles with Nitrogen.**—Prof. W. D. Harkins and Mr. A. E. Schuh have contributed a paper to the *Physical Review* for April 1, in which an account is given of some investigations of the production of oxygen from nitrogen, presumably those to which reference was made recently in NATURE (April 19, p. 611). It appears that 39,000 photographs of 390,000 tracks of  $\alpha$ -rays from thorium C and C' were taken in a Wilson cloud apparatus containing nitrogen. Two 'disintegration-syntheses' were observed, in which it appeared that oxygen ( $O^{17}$ ) had been formed by the addition of an  $\alpha$ -particle to nitrogen ( $N^{14}$ ), with simultaneous expulsion of a proton. One of the two photographs has been reproduced. The number of collisions per million  $\alpha$ -rays of range 8.6 cm. in which reorganisation of the nuclei took place was only one-quarter of the number previously obtained by Mr. Blackett, but the number of elastic collisions in which the  $\alpha$ -particle was deflected through more

than  $90^\circ$  was 100, compared with Mr. Blackett's 32. With such small numbers, no importance can be attached to apparent differences in yield of this order, but the numbers in question are definitely less than would be expected from the researches of Drs. Kirsch and Pettersson.

**Melting-Point of Pure Tellurium.**—With the view of a closer study of the strange behaviour of fused tellurium dioxide towards platinum, especially under the influence of a direct electric current, Prof. A. Šimek and Dr. B. Stehlik, at the Masaryk University of Brno, have prepared some elementary tellurium in the purest possible state. These authors then made an accurate determination of the melting-point of this 'metallic' tellurium by an electrical method whereby the temperature of a resistance furnace was raised steadily and uniformly by two, three, or four degrees C. each minute. The temperature was measured by means of thermo-elements of 'Heraeus' platinum and a ten per cent rhodium-platinum alloy. The thermo-electric force of the couple was measured by a calibrated double potentiometer connected to an aperiodic mirror galvanometer giving a deflection of 1 mm. for one microvolt, corresponding to  $0.1^\circ$  C. in the temperature range used. The melting-point *in vacuo* was  $452.0^\circ$  C., but was lowered by about  $0.15-0.2^\circ$  C. in hydrogen and in carbon dioxide at one atmosphere pressure. This the authors explain as being due to the solubility of the gases in fused tellurium.

**Chemistry of Menthone.**—In an article on recent progress in the menthone chemistry in *Chemical Review*, vol. 7, No. 1, Prof. J. Read explains how much light has been thrown in recent years upon the constitution of products derived from oil of peppermint by researches upon the ketone *piperitone*, which can be obtained in dextro-rotatory, lævo-rotatory, and racemic forms from *Eucalyptus*. The genus *Eucalyptus* which abounds in Australia embraces about 300 species and is of immense scientific and economic importance on account of its timbers, essential oils, exudations, and dyes. By reduction of piperitone in contact with colloidal palladium one molecular proportion of hydrogen is added and a mixture of menthones of reversed and enhanced optical rotatory power is produced. Thus *l*-piperitone, of which  $[\alpha] = -51.5^\circ$ , gave on reduction a mixture of *d*-isomenthone and *l*-menthone with  $[\alpha]_D = +65.1^\circ$ . By the action of heat or of alkalis, racemisation of piperitone is effected through enolisation which destroys the asymmetry, whereas menthone under similar conditions undergoes an apparent 'inversion'. In this case, however, enolisation affects only one of two asymmetric carbon atoms, so that the product remains optically active, though reversed in sign, and the problem is complicated by the superposition of geometrical upon optical isomerism. Thus the actual product is not the enantiomorph of menthone but its geometrical isomer and the term 'inversion' has been erroneously applied. Study of the menthylamines has furnished interesting data for the development of the principle of optical superposition, the main obstacle to the solution of which problem lies in the great difficulty of gaining access to complete stereoisomeric series of suitable substances. The last section deals with speculations upon the biogenetic origin of different natural oils from related species. In this difficult field the author finds that striking relationships centre around piperitone. The very delicate control of molecular transformations which may result in producing dextro-rotatory and lævo-rotatory isomers in different plants appears to be still inseparably associated with the vital process.

### The Department of Animal Genetics, University of Edinburgh.

THE scheme formulated in 1911 by the Development Commission for the further development of agricultural education and research included the creation of a number of research institutions. To Edinburgh was allotted an Institute of Research in Animal Breeding, and in 1913 a Joint Committee, including representatives of the University and of the College of Agriculture, was called into being. Its activities were completely interrupted by the War, and it was not until 1919 that they were resumed. It

public bodies, including the Development Commission, the Empire Marketing Board, the Highland and Agricultural Society, and the University Court, this sum was raised or guaranteed. Plans of a new building were prepared by Messrs. Lorimer & Matthew, and building operations were commenced in September 1928.

The new building is situated to the west of the Chemistry block and has the form of a T with the cross-bar and the main entrance frontage, 91 feet long,

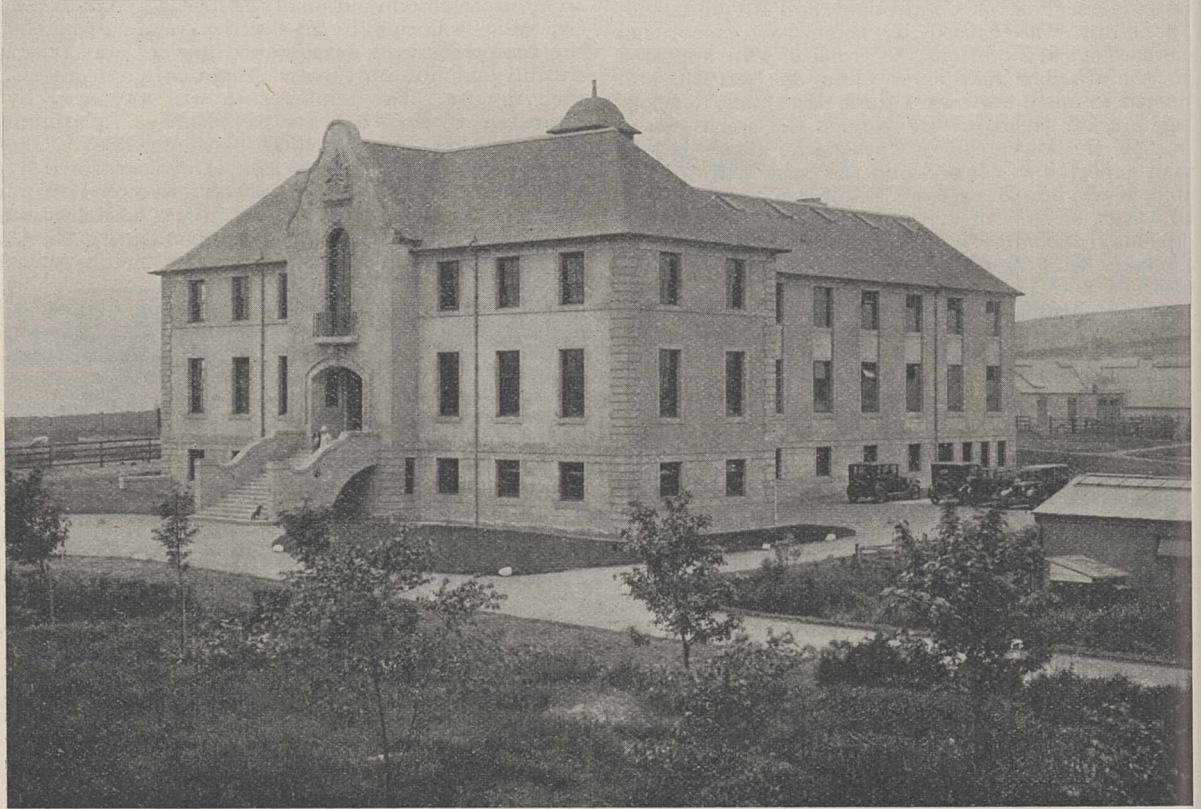


FIG. 1.—Department of Animal Genetics, University of Edinburgh.

was decided, owing to the general uncertainty which prevailed at this time, to make a very unambitious beginning.

The first home of the Department was an old fever hospital in the High School Yards, placed at the disposal of the committee by the University authorities, but by 1924 this accommodation had become entirely inadequate, not only for the experimental animals, but also for the staff and their guests. Emeritus Professor Sir James Walker placed seven rooms in the new Chemistry Department at King's Buildings at the disposal of the Joint Committee, and the University Court granted the use of seven acres of grass land.

In 1927, as a result of a report made by its representative, the International Education Board of America granted a sum of £30,000 toward the building and equipment of the Department, and the endowment of a chair in animal genetics in the University. This offer was conditional on a like amount being raised from other sources, and on the provision of funds adequate for maintenance. Through the generosity of private individuals, notably Lord Woolavington, Lord Forteviot, and others, and of

facing due east. It measures 140 feet from east to west, and consists of four floors, including a so-called basement and excellent attic accommodation, these being as well lighted and serving as useful purposes as do the ground and first floors. A feature has been made of the centre of the symmetrically treated front. The entrance doorway is recessed under a wide low arch and is approached by a flight of steps and flanked by shaped parapet walls, the whole being surmounted by a shaped gable after the Dutch style, having carved upon it a symbolical group representing the continuity of life.

The building is harled with stone facings and corners and the roof is covered with Ballachulish slates. All the floors are of reinforced concrete and in the corridors they are covered with terrazzo. The lecture theatre with its barrel vault carried up into the roof space is well lighted and is seated for 120. The principal staircase is constructed in synthetic stone and has a simple but very fine wrought iron railing with ornamental panels.

On the ground and first floors are the rooms of the staff and of the guests. In the basement are the

constant temperature and X-ray rooms, animal rooms, staff common room, workshop, store room, lavatories, and also an unloading room in which packages can be transferred from a lorry directly into the electric lift which serves all floors. A caretaker's house of five rooms occupies the west end of the floor. In the attic, which runs the whole length of the building, are the aquarium, aviary, terrarium, and store room.

In the entrance hall are panels framed in oak with the names of students who have taken higher degrees whilst guests of the Department. At the top of the panels there is carved "De fructibus suis agnoscebantur." Under this honours panel there is an oak table and stools.

The heating of the Department is by low pressure steam.

In addition to this main block there lies, to the south-west, a sheep building provided by the Empire Marketing Board and equipped with operating theatre,

sterilising and instrument rooms, food stores, and sheep pens. To the north-west there is a large brick intensive poultry house accommodating 200 birds. To the north there are the large pig building and goat house provided by the Department of Agriculture for Scotland. Several wooden buildings house the rabbit, rat, and mouse colonies, whilst others accommodate the monkeys and fowls.

The new building was officially opened on Monday, June 30, by the first chairman of the Joint Committee on Research in Animal Breeding, Sir Edward Sharpey-Schafer, president of the Royal Society of Edinburgh. At the opening ceremony, the degree of Doctor of Laws, *honoris causa*, was conferred by the Vice-Chancellor, Sir Thomas Holland, upon Mr. T. B. Macaulay, the president of the Sun Life Assurance Company of Canada, a Canadian with strong Scottish connexions, who has shown considerable interest in the affairs of the department and has endowed therein a lectureship and several assistantships.

### The Museums Association and Museum Extension.

THE forty-first annual conference of the Museums Association, which met at Cardiff, on June 23-27, by invitation of the Lord Mayor and Corporation and of the National Museum of Wales, was successful in all aspects. It was attended by more than 230 delegates and other members from all parts of the British Isles, as well as from the United States, Germany, and Sweden; these represented all classes of museums, from the great national institutions to the smallest village museums. The last statement strikes the main note of the conference: the knitting up of the museum service of the country and its extension to the remoter districts, a subject on which valuable discussions took place. The National Museum of Wales has itself set a brilliant example of such work, and, with its beautiful building and admirable arrangement, formed an inspiring focus of the proceedings. The guidance of its officers, the hospitality of the Lord Mayor, of the Mayors of Newport and Merthyr Tydfil, of Lord Treowen, and of numerous friends combined with the fine weather and the charm of the surrounding country to make the stay of the visitors as delightful as it was profitable.

The president, Sir Henry Miers, referred in his address first to the Report of the Royal Commission on National Museums and discussed the suggestions which it made for the co-operation of the Museums Association. In the event of a Standing Commission being appointed, it was hoped that the Association would have official representation on it. The proposed enlargement of the Circulation Department to include all suitable classes of museum material would be an important factor in co-ordinating museums, while the extension of the method of affiliation adopted by the National Museum of Wales should assist in their co-operation. Plans for a training course, as desired by the Royal Commission, were already published in the *Museums Journal*, and it was hoped that municipal bodies would assist their junior officers to attend. The scheme for a National Open-Air Folk Museum was making good progress in the hands of a strong committee.

Turning to the proposals of the Carnegie Trustees, the president said that the advice of the Association would be asked when grants were allotted to museums; it was necessary that museums should fulfil the conditions laid down in his own published report to the trustees; meanwhile museums might consider plans of work to which they might apply any possible grant. For the Association to perform the duties requested of it by the Royal Commission and by the Carnegie

Trustees, it was necessary that it should acquire a legal status; as a first step it was proposed "that the Museums Association be converted into a Company limited by guarantee and not having a share capital." This, with the consequent changes in the constitution of the Association, was accepted by the subsequent general meeting, which fixed the amount of the guarantee at 10s. for each member.

Finally, the president repeated some of his previous recommendations, as that the museums of a district should combine to hold a district loan exhibition; that museums should distribute their surplus material, and render their research material more available for workers; and that they should prepare educational exhibits for circulation to schools and to towns or villages unprovided with a museum.

This last was the subject of two papers by Dr. T. W. Woodhead, of Huddersfield, and Mr. W. C. Sprunt, of Batley, who described the kind of exhibits sent out, the mode of packing, and the system of distribution. It was pointed out in the discussion that museums had been doing this work long before the libraries took it up. There has, however, been no systematic attempt to provide branch museums in the villages for those of more mature years, at least so far as Great Britain is concerned. The numerous rural museums in Sweden, of which Dr. Klein of the Northern Museum gave an entertaining account, are independent folk museums of high value in promoting local patriotism but not educational in the formal sense. The same may be said of the *Heimatmuseen*, now springing up all over Germany, of which the ideals were eloquently expounded by Dr. Otto Lehmann.

The more usual type of small museum was in the minds of Dr. F. J. North and Mr. H. A. Hyde, who showed what it might usefully exhibit in geology and botany respectively. The affiliation of such museums to a central museum was discussed by Dr. Cyril Fox, from his experience as director of the National Museum of Wales. He had found the chief difficulty in any scheme to be the lack of a permanent and competent curator; the parent museum could neither lend nor give material to a museum that was unable to care for it.

The Carnegie Trustees had sent their assistant secretary, Mr. A. B. Hyslop, to glean suggestions that might help towards some scheme of museum extension to rural areas. They were hoping to take counsel with the County Directors of Education and with the Circulation Department of the Victoria and Albert Museum; but it is clear that the burden of the work

must fall on local museum curators, just as that of library extension has been borne by public librarians. There can be no question of the willingness of curators to help; many of them have been doing the work for years, sometimes with the co-operation or at least the sanction of the educational authorities, sometimes in spite of their lethargy, and out of their own slender resources. If the Carnegie Trustees can induce the

educational authorities in any one area to co-operate whole-heartedly with the museum curators, an example will speedily be set which the rest of the country will feel bound to follow. It is, however, to be hoped that the benefits will not be confined to school-children, but that the needs and interests of others, especially the adolescent, will be kept prominently in view.

### International Congress of Actuaries.

THE ninth international congress of actuaries was held at Stockholm on June 16-20 and was largely attended by actuaries from all over the world. The arrangements were made by the Swedish Society of Actuaries and the Swedish Association of Assurance, and the presidents for the time being of those bodies (Dr. Phragmén and Mr. Sven Palme) being the joint presidents of the Congress. Several subjects were chosen for discussion and the papers submitted were printed in English, French, or German, at the author's choice, with abstracts in the other languages. Each subject was then introduced by a short speech by a Scandinavian actuary and a general discussion followed.

One of the subjects of most general interest discussed at the Congress was the treatment of sickness and disability in social insurance or in connexion with pensions or life assurance, and it was apparent that the granting of these benefits on invalidity has led to far heavier rates of invalidity than those prevailing prior to the institution of the schemes. This effect is noticeable whether we look at State or private schemes of insurance. Attention had already been directed to the point in England, and most other countries are having to face the same difficulties. It is probably inevitable that, even if definite malingering be excluded, some such result should appear, but it makes the actual expense of such schemes greater than the estimated expense on the basis of older experience acquired in different conditions. The subjects of general scientific rather than professional interest were

the statistical evidence available with regard to the influence of tuberculosis on mortality and the application of modern statistical treatment to problems of risk. In connexion with the latter, non-Scandinavian actuaries had the opportunity of considering Lundberg's interesting new theory of risk, and it was satisfactory to find a paper giving a definite warning against the assumption of the normal curve, in connexion with the discussion of deviations in assurance work, when Poisson's law would be a proper assumption.

On the strictly actuarial side, the fair distribution of surplus was discussed by many actuaries in written and verbal communications, while on the practical life assurance side the comparison of 'participating' with 'non-participating' assurances and the relative advantages of assurances that merely cover risk, as compared with those that are largely for purposes of saving, evoked a good discussion.

The meetings were held in the new concert hall and the arrangements were excellent. The interpreting was remarkably good; thanks partly to the choice of linguists with a first-class knowledge of the subjects under discussion.

The Congress was graciously received at the Royal Palace for tea by H.M. the King, and the Crown Prince, as *Président d'honneur*, attended and spoke at the opening meeting. It only remains to record the generous hospitality of our Swedish hosts to the members of the Congress and their wives: it would be hard to imagine greater kindness. W. P. E.

### Rayleigh Collection at the Science Museum.

AMONG recent additions to the Science Museum, South Kensington, is a most interesting collection of apparatus used by the late Lord Rayleigh in the course of his scientific research. On the occasion of the unfortunate fire, last year, at Lord Rayleigh's home at Terling, Essex, a considerable quantity of apparatus was destroyed, but the historical apparatus was fortunately undamaged and the bulk of it has been generously given by the present Lord Rayleigh to the Science Museum, where it should prove a continual source of interest and inspiration to professional and amateur scientific workers alike. It is scarcely necessary to remind readers of *NATURE* of the extent and importance of the late Lord Rayleigh's contributions to science. During a period of more than fifty years he published no fewer than 446 papers, every one of which made a distinct addition to our knowledge of the subject and was characterised by that lucidity and elegance of expression for which its author was renowned.

On viewing this collection, one is struck very forcibly—as were visitors to the laboratory at Terling—by the extraordinary simplicity of the bulk of the apparatus. The ability to attain results of the highest accuracy and importance by the aid of odd bits of wood, glass tubing, wire, and sealing-wax was undoubtedly bound up with Rayleigh's unerring instinct in discriminating between the essential and the non-essential. It is

doubtless true that some branches of modern physical research cannot profitably be pursued without the use of expensive apparatus. At the same time, many workers who are apt to grow despondent after a perusal of the price-lists of the scientific instrument makers should find a tonic in the Rayleigh collection, which also serves as a salutary reminder that the man is more important than his tools.

The present collection is thoroughly representative of the vast field which Lord Rayleigh covered, and is exhibited in six cases, two dealing with acoustics, while the remainder come under the headings of optics, magnetism and electricity, argon, and miscellaneous. It is impossible in a short notice to deal adequately with the whole of the exhibits, but a few representative examples may perhaps be mentioned. The acoustics section includes apparatus used in experiments on reflection and interference and on the intensity of aerial vibrations; also the apparatus by means of which it was demonstrated that our lateral perception of the direction of a sound depends upon the phase-difference at the two ears. One of the most important exhibits in the optical section is the apparatus used for the determination of the constant of the magnetic rotation of light in carbon disulphide, while there is also a reminder that, so early as the year 1902, Rayleigh made an attempt to detect motion through the æther. Prominent in the electrical section will be found



apparatus for determining the laws of resistance of periodic currents. The argon collection gives an excellent idea of the course taken in that classical series of investigations extending from 1892 to 1895 in the latter part of which Sir William Ramsay collaborated, while under 'Miscellaneous' the chief exhibits

deal with capillarity, fluid motion, and cognate problems. Every piece of apparatus has been provided with a full explanatory label giving references to the original source and to the "Collected Scientific Papers," and public lectures on the exhibits will be given from time to time.

### South-Western Naturalists' Union.

THE eighth annual conference of the South-Western Naturalists' Union, attended by individual members and representatives from affiliated societies in the six south-western counties, under the presidency of Dr. F. A. Bather, was held at Gloucester, on June 13-15, at the invitation of the Cotteswold Naturalists' Field Club. Members were welcomed by the Mayor of Gloucester (Councillor S. J. Gillett) and the president of the Cotteswold Field Club (Prof. H. L. Hawkins), and were entertained at a reception in the Museum, where, in addition to the other exhibits, several beautifully executed ancient charters of the city were specially displayed. By the courtesy of the mayor and corporation, meetings were held in the Guildhall, and on the morning of the second day a long business agenda was tackled. A suggestion put forward that the management of the Union's affairs should be entrusted for limited periods to local committees appointed by the affiliated societies in circumscribed areas in rotation was remitted for future consideration.

Dr. Bather in his address, entitled "Evolutionary Enigmas", first sought to make the idea of organic evolution more precise, and, by examples drawn from fossil invertebrates, to present a series of proofs gradually increasing in force. Modern studies in palæontology and in genetics had, in his opinion, thrown doubt on the older phylogenetic conceptions and on the origin of life-forms from a homogeneous material. He preferred to start with a multitude of diverse units, which by combination produced a great number of organisms differing in qualities and potentialities.

These, he thought, had been sifted and assorted by a succession of varied environments, a process which, strictly speaking, was not evolution. Evolution came in when change in the constitution of one or other heritable unit provided new material for sifting. There was reason to believe that such change could be produced by change of outer conditions, though it had not been proved that the change was necessarily in harmony with the conditions. This whole conception was opposed to Herbert Spencer's definition of evolution.

Two excursions were made. On the afternoon of the second day a number of ancient buildings were inspected under the guidance of Mr. Roland Austin, City Librarian; afterwards the party was conducted over the Cathedral by the Archdeacon, the Ven. C. H. Ridsdale. On the concluding day a portion of the Cotswolds was toured by motor cars. A halt was made at 'The Chandlers', Witcombe, where Mrs. E. M. Clifford exhibited and explained in detail numerous Neolithic, Palæolithic, and Romano-British finds from the Barnwood gravel pits. Many of the objects form the subjects of papers prepared for publication in scientific journals. The special aims on the excursion were a survey of the geological conditions in an area lying between the courses of the Severn and the Thames, particularly with regard to river development, and the inspection of certain exposures, notably a fine one in the Great Oolite at Foss Cross. The physical features of the region were most ably demonstrated and interpreted by Dr. D. E. Finlay, the honorary secretary of the Cotteswold Naturalists' Field Club.

### Annual Inspection of the National Physical Laboratory, Teddington.

ON Friday, June 27, the General Board of the National Physical Laboratory made its annual inspection of the laboratory. As is usual on this occasion, a large number of visitors, including representatives of scientific and technical institutions, government departments, and industrial organisations, were present and were received by Sir Ernest Rutherford, chairman of the General Board, Sir Richard Glazebrook, chairman of the Executive Committee, and Sir Joseph Petavel, Director of the Laboratory.

In the duplex wind tunnel in the Aerodynamics Department a large-scale model aerofoil complete with engine nacelle was under test to determine the best position of the nacelle on the leading edge of the aerofoil. To determine the effects of airscrew slipstream on the resistance of the model, it was fitted with its own airscrew operated by an ingenious three-phase motor of small size incorporated in the nacelle. Tests were made with and without the airscrew in operation. The results of the work will be used in the design of a large-size machine of the monoplane type, a complete model of which will then be subjected to further tests to improve it in detail.

A method has been evolved in the department for rendering visible by the use of the dense vapour from titanium tetrachloride the character of fluid motion round bodies used in aerodynamic research. For this purpose a small wind tunnel has been constructed in which models can be placed, the titanium tetra-

chloride being spread in a thin film along the length of the wing. By suitable means the flow picture can be projected on to a screen, while instantaneous photographs of very short duration can be recorded by focusing a camera on the vapour, which is illuminated by a spark gap and a suitable optical system. By this means photographs showing the departure from laminar to turbulent flow can be obtained.

Of interest also was a method of calibrating the standard pitot tube at low speeds. For this purpose the tube is carried on a small whirling arm and can rotate in a closed circular annulus of mean diameter about eight feet and of one square foot sectional area at controlled speeds, revolutions being recorded electrically. To transmit the pressure difference to the manometric balance the axis of rotation is fitted with a special oil seal. A very sensitive form of manometer embodying the Chattock tilting principle has been designed to measure the small pressures involved. The two cups to which the pressures are communicated are joined by a circuit, which incorporates a length of capillary tube in which an air bubble serves as an indicator, the latter being viewed by a micrometer microscope. The whole instrument can be insulated thermally to avoid temperature effects. With this instrument it is hoped to calibrate the standard pitot tube to a high degree of accuracy at speeds so low as two feet per second.

In the Engineering Department apparatus was

shown for the investigation of the stress distribution in a reinforced concrete column, a matter of interest owing to the complications introduced by the effect of shrinkage on the stress distribution and by the slow yielding of new concrete when stressed. The column was tested in the floor and column testing machine with axial and eccentric loading. The loads are applied through special knife edge end platens to ensure virtual point loading, any desired load up to fifty tons being obtained by means of a hydraulic ram. The load is measured by means of a system of levers and a jockey weight, and specially designed extensometers are used to determine the small changes in length both in the concrete and also in the steel reinforcing bars.

Other work in progress included an investigation into the effect of surface irregularities and surface conditions in general on the fatigue strength of spring steels. In this investigation specimens are subjected to stresses in rotating cantilever machines running at about 2000 revolutions per minute, in high-speed repeated bending machines or in a torsional fatigue machine. It has been found that surface irregularities, surface decarburisation during manufacture or heat treatment and surface cracks formed during heat treatment have the effect of lowering materially the fatigue strength of specimens, and that their resistance to fatigue can be increased by removal of the surface layer. The research has been conducted in conjunction with the Metallurgy Department, and for the study of the effect of decarburisation a specially designed vacuum furnace has been constructed in which specimens can be hardened and tempered by quenching without contact with the air. Specimens of a spring steel treated in this manner have shown fatigue resistance closely approaching that of corresponding ground and polished specimens.

Among the researches in progress in the Metallurgy Department mention may be made of an investigation into the effects of different forms of heat treatment on the permanence of dimensions of heat-treated aluminium alloys. As a consequence of such treatment, internal stresses may be set up leading to distortion in specimens during machining. Slowly cooled alloys are free from such stresses, and those which are quenched with moderate rapidity are less liable to them than those which are subjected to rapid quenching, and attention is being given to the quenching operation. Specimens quenched in cold water, cold oil, or boiling water have been machined and afterwards examined for distortion by the Metrology Department. The exhibit illustrated the effect of such treatment and of the composition of the alloys on their behaviour.

Work was also in progress in connexion with steels for use at high temperatures, and one object of the work is to ascertain their resistance to scaling when exposed to flame gases. In the investigation in progress, steel wire in the form of a spiral coil is exposed to contact with typical flue gases at various high temperatures, and the effect on it is determined by measurement of the changes in its weight and electrical conductivity. Suitable arrangements are made for the control of the temperature and composition of the gas.

Of interest also was an exhibit showing the effect of the presence of high phosphorus and silicon in wrought iron on the  $\gamma$ - $\alpha$  transformation. This transformation is suppressed and grain refinement prevented if these impurities are present in excessive amounts. This phenomenon has been found to have an important bearing on the strength of wrought-iron chains and hooks in which a coarse structure impairs impact strength.

In the Metrology Department a new primary standard barometer was on view. The design of this instrument is such that the height of the barometric column can be compared directly with a line standard. The barometer, which is of stainless steel and provided with optically flat and parallel windows, and the line standard are mounted on a heavy base, and a pair of micrometer microscopes mounted one above the other on a vertical column can be focused alternately on the mercury column and the line standard. A mercury vapour pump is used to produce the vacuum above the mercury column, any residual pressure being measured by means of a M'Leod gauge. Means are provided for determining the temperature of the mercury column.

Of interest also were two pieces of apparatus for the testing of surface plates. In the first the surface plate to be tested is compared with one whose errors in flatness have been determined. It consists of a metal plate fitted with three adjustable ball feet and equipped with an indicator the ball foot of which is in line with and midway between two of those of the plate. By placing the apparatus first on the known and then on the unknown surface and noting the corresponding indicator readings, it is a simple matter to determine the errors in the plate under test. In the second piece of apparatus the test plate is submerged under mercury and the depth of its surface below that of the mercury is measured at various points by means of the apparatus, which takes the form of a tripod with a central vertical micrometer screw. The legs of the tripod are of ebonite fitted at the bottom with hardened steel balls, and the contact of the micrometer screw with the mercury is indicated electrically. The apparatus has been found to be accurate to 0.0001 in.

In connexion with research work for the Food Investigation Board, a distant reading hygrometer has been developed in the Physics Department for humidity measurements in the holds of ships carrying frozen lamb. The instrument is essentially a wet and dry bulb thermometer in which the conventional thermometers are replaced by thermojunctions arranged differentially. The potential difference between the thermojunctions can be measured on a millivoltmeter the readings of which can be converted to temperature differences by previous calibration. Provision is made for wetting one set of thermojunctions.

Of interest also was a sensitive method of detecting the dew point by the employment of a photo-electric cell mounted below a polished steel plate which serves to collect the dew. The plate is illuminated by a small lamp in such a manner that in the absence of dew the reflected light does not affect the cell. Formation of dew results in light scattering and consequent illumination of the cell. The latter is incorporated in a valve circuit including a telephone earpiece, and the design of the circuit is such that the presence of dew is indicated by cessation of sound in the telephone. The temperature of the steel plate is determined by thermocouples fixed to its upper surface.

For the measurement of noise a portable instrument has been designed in the Sound Division. In this instrument a buzzer supplies alternating current to a telephone, the strength of the current being controlled by a potentiometer. The current is adjusted until the sound in the telephone is judged to be equal in intensity to the noise, or alternatively is just masked by the noise. The sound intensity can be varied in fourteen steps from extreme loudness to an intensity below that of ordinary speech.

In the Radiology Division, an X-ray investigation on the effects of heat treatment on tungsten magnet

steels was in progress. Arrangements have been made for the study of such effects up to a temperature of about 1200° C. The specimen is provided with its own heating coil in the X-ray spectrometer, and provision is made for the adequate cooling of the photographic film by means of a suitable water jacket. The investigation has shown that under appropriate conditions of heat treatment crystals of at least two carbides are present, their amount depending on the quenching temperature.

In the Optics Division various apparatus for the evaluation of total energy flux was shown. The exhibit included horizontal and vertical test benches for the comparison of lamps used as standards of radiation, or of radiometric instruments such as thermopiles, bolometers, radio-balances, etc. The instruments shown comprised various thermopiles, both air-exposed and vacuum types, sunshine receivers both of the bolometric and thermoelectric pattern, gas fire bolometers, and two Callendar radiobalances for absolute measurement of radiation intensities. Special electrical measuring circuits for use in testing these various instruments were also shown. These included a portable equipment for use out of doors with either bolometric or thermoelectric instruments for solar work.

For precision testing of voltage transformers, a new shielded resistor for 30 kilovolts has been designed and constructed in the Electrotechnics Division. In this piece of apparatus the importance of keeping phase errors to a minimum has been the main consideration. The resistor is divided into six sections rated at 5000 volts each, every individual section being composed of forty elements, each of 2500 ohms resistance. To eliminate capacity errors so far as possible, each section is enclosed in a metal container which is maintained at the mean sectional voltage by connexion to a suitable point of a similar unshielded resistor in parallel.

Of interest also was a method of determining the electrical resistance of small irregular samples of metals and alloys. A measured current is led into the specimen through two very small steel balls 9 mm. apart, and the voltage between two selected points is measured by means of a low reading potentiometer, the voltage leads making contact with the specimen through two needles 3 mm. apart. The resistivity is determined by making similar measurements on a piece of metal of known resistivity and of similar shape.

In the High Voltage Building demonstrations were given of flash-over tests on transmission line insulating systems under dry conditions and when sprayed with artificial rain. For the latter tests rain water is collected in a special tank, tap water being unsuitable owing to its conductivity being approximately three times that of pure rain water.

In the Electric Standards Division a method of determining the properties at audio frequencies of alternating current milliammeters incorporating copper oxide rectifiers was demonstrated. Such milliammeters are known to possess frequency errors, and these have been found to be of an unusual type and to be due to the capacity of the rectifiers. It has been found possible to compensate for these errors by providing the instrument with a suitably designed inductive shunt.

In the Wireless Division an automatic method of recording bearings from a rotating beacon transmitter was demonstrated. The transmitter, which is situated at Orfordness, consists of a frame coil rotating uniformly once per minute, the rotation being controlled by a tuning fork and phonic motor. The output from the receiver is supplied to a selective tuned audio-frequency amplifier followed by a rectifier,

in the anode circuit of which a relay is included. A magnetically operated pen traces a record on a rotating drum the speed of which is maintained at the rate of one revolution per minute by the same means as in the case of the transmitter. A special signal is sent out when the normal to the coil of the rotating beacon lies in the north and south meridian, and the pen is automatically lifted when the two minima occur. Then since the signal strength is proportional to the cosine of the angle between the plane of the transmitting coil and the direction from it of the receiver, the mid-point of the two minima gives the bearing with respect to the north, which can be read off with a protractor or by degree lines printed on the drum.

In the Photometry Division a new type of high precision spectrophotometer has been developed in which there are no moving optical media. Two tungsten gas-filled lamps are used as light sources, and the photometric scale of the instrument is determined in terms of sector discs of known transmission and the voltage-intensity relation of one of the lamps at a standard wave-length. The voltage intensity relation for other wave-lengths can be computed from that at the standard wave-length. The Maxwellian field of view is utilised to obtain adequate illumination in those parts of the spectrum where visibility is low.

Attention has been given to the measurement of the reflection factor of diffusing surfaces under completely diffused illumination, and a small integrating reflectometer has been designed and constructed for this purpose. The instrument consists of a small internally whitened sphere with two small apertures to admit a beam of light and to allow of observation of the brightness of the sphere wall respectively. A third and larger aperture may be covered by a specimen or by a standard plate coated with the same material as the sphere walls, or left open. Relative brightness measurements of the interior under these three conditions as determined with a Lummer-Brodhun contrast photometer, suffice to determine the reflection factor of the specimen. The advantage of the instrument lies in the fact that direct observation or illumination of the specimen is avoided.

Another interesting exhibit was apparatus for the automatic control of picture gallery illumination. The method involves the use of a photoelectric cell; the current variations in the latter are amplified by means of a valve in the plate circuit of which is included an adjustable relay controlling the gallery lighting. To prevent hunting of the relay due to passing clouds, suitable means are incorporated for introducing a time lag before the relay puts in operation the gallery lights, at the same time avoiding any lag in extinguishing them.

In the William Froude Tank a model of a single screw cargo boat was shown under test in waves. The model was fitted with its own propeller and inboard motor for self-propulsion and equipped with apparatus for recording the speed of the model, the propeller revolutions, and the propeller thrust and torque. The latter were measured by the deflection and torsion respectively of suitably calibrated springs coupled to the propeller shaft and operating recording pens through lever systems. Of interest also was a telescopic pitot-tube for making velocity measurements in connexion with an investigation on ship's wake resistance. The tube is capable of swivelling and is provided with its own ship side valve. With this instrument the velocity of the ship relative to the wake can be measured at various distances from the ship's side and the velocity distribution in the wake thereby determined.

### The British Polar Exhibition.

**D**URING the past few years there has been a remarkable revival of expeditions to the polar regions, and it is to this revived interest in polar lands and seas that the idea of holding a British Polar Exhibition in London is largely due. In opening this exhibition at the Central Hall, Westminster, on July 2, Col. Sir Charles Close, president of the Royal Geographical Society, pointed out that Great Britain had been intimately associated with exploration in the Arctic regions for the past 400 years and in the Antarctic regions for 150 years. It was therefore an opportune moment to recall the great deeds of the past and to direct attention to the possibilities of the future by bringing together a collection of relics, pictures, maps, and documents; to demonstrate more particularly modern means of scientific exploration, especially through aerial methods, and to assist, if possible, the Scott Polar Research Institute at Cambridge with funds for further research work.

Commander L. C. Bernacchi, the organising director of the exhibition, and Capt. L. W. G. Malcolm, assistant director, have been extraordinarily successful in collecting some hundreds of exhibits, every one of which has some personal interest attached to it, and they have arranged the exhibits particularly well so that the ordinary visitor may examine each object without difficulty. The personal kit and notebooks of individual explorers occupy the widest space, and among the numerous interesting exhibits may be mentioned Shackleton's boat in which he made his famous journey of 750 miles from Elephant Island to South Georgia, thus saving the lives of twenty-two members of the crew of the *Endurance*; the sledge used by Shackleton in 1908 when he got within a hundred miles of the South Pole; a large Antarctic camp scene showing the ship *Discovery* in the background; a large group arranged by the Hudson's Bay Company to illustrate Arctic Canada. One room is mainly devoted to the relics of Franklin and Scott; these relics include Sir John Franklin's signature, his sextant and medicine chest; the autograph journal of Capt. Scott showing the last entries he made in it; Scott's camera, satchel, Bible, and many others. Exhibits such as these naturally appeal to human feeling, and are undoubtedly of great value in stimulating interest in exploration.

The various models of Arctic scenes, together with the Arctic products, will enable the visitor to realise to some extent what the polar regions are actually like. The economic importance of the northern seas can be studied from the large map of the north polar region, showing the fishing grounds from which in 1929 Great Britain obtained 280 million pounds weight of cod, 110 million pounds of haddock, and large quantities of other kinds of fish. These statistics are shown on a large chart. For the scientific student, instruments such as thermometers, compasses, and chronometers used on polar expeditions may be examined. A programme of lectures on polar subjects has been arranged by the exhibition committee, and among the lecturers are Commander Bernacchi and Mr. Stefansson. On certain days some of Ponting's films of the Scott expedition are being shown. The educational advantages of the exhibition are still further augmented by the "Polar Book" which has been compiled specially for this purpose; in concise book form, the various aspects of polar work have been brought together in a series of articles written by well-known experts in Arctic knowledge, and two of Bartholomew's maps showing the polar regions are bound up with the book.

In passing through the various parts of the exhibition, one cannot but be impressed by the enterprise,

courage, endurance, and achievements of the men who faced the dangers and hardships of polar exploration; also of the changed conditions under which explorers now set out and of the difference in outlook of men taking part in expeditions at the present time. The economic aim of a Frobisher searching for gold in his *Meta Incognita*, the scientific expedition of Sir James Ross studying magnetic conditions in the Antarctic regions, the spirit of adventure which urged Shackleton to explore polar lands and seas, are still powerful motives. With the more extensive knowledge of the Arctic regions, due to the work of these early explorers, two new ideas have been gradually coming into prominence since the beginning of the present century. First a political factor has begun to present itself with regard to the ownership of polar lands, and secondly a search for suitable stations for air transport. In fact, some recent expeditions have had as their main or partial object the claiming of new territory and the examination of areas for the establishment of landing-places for aeroplanes. Not only then does the Polar Exhibition remind us of the wonderful deeds of men in past times, but it also provides accurate knowledge of the vast regions around the poles at the present day, and suggests some of the problems that still await solution.

### University and Educational Intelligence.

**CAMBRIDGE.**—The vice-chancellor has given notice that a meeting of the electors to the Woodwardian professorship of geology will be held on Friday, Aug. 1. The stipend of the professor is £1200 a year, or, if he holds a fellowship with dividend, £1000 a year. The professor, as head of the Department of Geology, is paid £200 a year in addition to his stipend as professor, or, if he holds a fellowship with dividend, not more than £100. Candidates are requested to communicate with the vice-chancellor on or before Tuesday, July 22.

The Faculty Board of Economics and Politics has received from Mr. Montague Burton an offer to endow a professorship in the University to be called the Montague Burton Professorship of Industrial Relations. The Faculty Board proposes that the duties of the professor should be defined as "to study and give instruction upon the conditions of employment and the relations between employers and employed, with special reference to the causes of industrial disputes and the methods of promoting industrial peace".

The Harkness Scholarship for 1930 has been awarded to Miss K. M. N. Paterson, of Newnham College, and the Wiltshire Prize to R. N. Quirk, of King's College.

The governing body of Corpus Christi College has awarded to Dr. R. Hilton, assistant physician, St. Bartholomew's Hospital, the Copeman Medal for research in medical and biological sciences. This medal was presented by Dr. S. Monckton Copeman, formerly a scholar of the College. The present award is the first which has been made.

**DUBLIN.**—The honorary degree of Sc.D. was conferred upon Sir James Jeans on July 4, and the honorary degree of Litt.D. upon Mr. C. Leonard Woolley.

**DURHAM.**—Honorary degrees were conferred on June 26 as follows: *D.C.L.*—Lieut.-Gen. H. B. Fawcus, director-general Army Medical Services, and Baron Alexander Meyendorff, London School of Economics. *D.Sc.*—Dr. F. G. Donnan, professor of inorganic and physical chemistry at University College, London; Mr. Wilfred Hall (of Newcastle), and Dr. R. E. Slade. *D.Litt.*—Dr. N. Kemp Smith, professor of logic and metaphysics in the University of Edinburgh.

LONDON.—At the meeting of the University Court on July 2, the offer of Prof. S. Smiles and Prof. A. J. Allmand to found a medal to commemorate the services rendered to King's College and to chemical education by Prof. John Millar Thomson was accepted with thanks by the University. Prof. Thomson first became a member of the staff of the department of chemistry at King's College in 1871 and retired in 1914, after having served for twenty-seven years as Daniell professor and head of the department of chemistry. The medal will be known as the John Millar Thomson Medal for chemistry, and will be awarded annually to the student of King's College who most distinguishes himself in the final year of the special honours course in the department of chemistry.

A University postgraduate travelling studentship of the value of £275 for one year has been awarded to J. E. Keyston. Mr. Keyston obtained the B.Sc. (special) degree with first-class honours in physics as an external student from University College, Nottingham, in 1929, and was awarded the Heymann research scholarship. He proposes to carry on research in physics in Germany.

ST. ANDREWS.—The Senatus Academicus has resolved to confer the honorary degree of LL.D., in October, on Prof. J. A. C. Kynoch, emeritus professor of midwifery in the University. Prof. Kynoch was appointed to the midwifery chair in 1898 and retired in 1928. He was for many years dean of the faculty of medicine.

REVISED regulations for the award of Whitworth scholarships in engineering have been issued by the Board of Education (London: H. M. Stationery Office, 3*d.*). The awards for 1931 are two Whitworth Senior Scholarships (£250 a year for two years), six Whitworth Scholarships (£150 a year), and up to 25 prizes (£10) for unsuccessful competitors for Whitworth Scholarships. All the candidates must have been engaged in handicraft in a mechanical engineering workshop for periods amounting to 30 calendar months and must have spent a certain portion of this time at fitting or erecting. Work at the lathe may be counted but is no longer required. The age limit for the Senior Scholarships is twenty-six. Of the Whitworth Scholarships, five are tenable for three years and are open only to part-time students; for them the age limit is twenty-six instead of as hitherto twenty-two. One of these scholarships (ultimately three) is tenable for one year only and is open to students less than twenty-four years of age who may be attending full-time courses.

THE PRINCE OF WALES attended a dinner on July 7 and spoke in support of an appeal which has recently been issued by the National Union of Students for £30,000 for the purchase and endowment of the headquarters in London of the Union and for a hospitality fund. The Prince described the activities of the Union, referring particularly to the hospitality and travel departments. The former makes arrangements for Dominion and foreign students visiting England, either as study-groups or individuals, and £5000 is urgently required for secretarial expenses. The latter acts for British students proceeding abroad, arranging for their reception by the national unions of students of the countries visited. Another important activity of the Union is the arrangement of student exchanges. The present appeal is for sufficient money to purchase the London office at 3 Endsleigh Street, W.C.1, and to provide for its maintenance. The growth of the Union during the seven years of its existence is proof of the need it fulfils, and there is little doubt that, with the powerful aid given by the Prince of Wales' support, funds will quickly be forthcoming to consolidate and extend its work.

## Historic Natural Events.

July 13, 1788. Hailstorms.—Hailstorms of unexampled severity and destructiveness raged along two parallel stretches from the Pyrenees to the Baltic; in France 1039 communes were devastated and damage caused to the extent of 24,690,000 francs.

July 13, 1910. Highest Temperature in United States.—Death Valley, a depression below sea level in south-eastern California, is noted for its high summer temperatures, and the shade reading of 134° F. on July 13, 1910, is the highest on record in America. From July 8 to 14 inclusive the thermometer exceeded 127° F. every day.

July 13, 1927. Meteorite near Tilden, Illinois.—About 1 p.m. a brilliant meteor fell with detonations like loud thunder. At a distance of more than one hundred miles it was described as "a piece falling off the sun". At a height of 15 or 20 miles it burst, showing green and then purple, and after a second bursting became invisible. One stone, weighing nine pounds, fell in the village of Tilden, and was glimpsed for an instant as "a dark streak, like smoke". It was recovered at once, and to the surprise of the finders was not hot but "noticeably cold". The largest piece weighed 110 pounds, and another 46 pounds.

July 14-15, 1911. Typhoon Rainfall in Luzon.—During a typhoon which crossed the northern part of Luzon, Philippine Islands, the rainfall in 24 hours, commencing at noon on July 14, amounted to 45.99 in. This is probably the greatest known fall of rain in twenty-four consecutive hours. In the four days, July 14-17, the total fall was 88.14 in.

July 15, 718. Thunderstorm and Hail.—About this date the Saracen fleet, after raising the siege of Constantinople, was struck by a severe hailstorm mixed with fire, so that only twenty (according to another authority five) ships could save themselves.

July 15, 971. St. Swithin's Storm.—Swithin, Bishop of Winchester, died in 862 and was buried in the churchyard of Winchester, having asked, says William of Malmesbury, to be laid where passers-by might tread on his grave, and where the rain of the eaves might fall on it. A century later he was canonised, and a splendid tomb was constructed within the cathedral for the reception of his remains, but it is related that on the day appointed for their removal, July 15, 971, he manifested his displeasure at the disturbance by sending a great storm of rain, followed by forty wet days. No contemporary writers mention this storm, however, and probably it is a later invention to account for the well-known proverb which, referring to July 15, became associated with his name.

July 15, 1558. Thunderstorm and Whirlwinds in France.—About this date part of France was visited by severe thunderstorms and whirlwinds. A great cloudburst occurred in Thuringia and a powerful whirlwind at Nottingham, which unroofed numerous houses and churches, lifted a child in the air, and raised a great waterspout on the Trent; hailstones said to be 15 inches long fell.

July 15, 1808. Hailstorm at Gloucester.—During the night, after several days of oppressive heat, a violent thunderstorm passed over Gloucester from south to north, accompanied by a hailstorm which did a great deal of damage. The hailstones were very irregular, broad, flat and ragged, and many measured from 3 to 9 inches in circumference. They appeared like fragments of a vast plate of ice, broken into small masses in its descent to the earth.

July 15, 1888. Eruption of Bandai-san (Japan).—After remaining practically dormant for more than a thousand years, the volcano Bandai-san in central

Japan suddenly burst into brief activity. A few earthquakes were felt and then a great explosion occurred that rent the north-eastern wall of the crater. It is estimated that the total volume blown away was three-tenths of a cubic mile; it descended the mountain-side with a velocity of 48 miles an hour and devastated an area of 27 square miles at its foot. The total land-area covered by the falls of dust was 790 square miles. The explosions were accompanied by wind-blasts that tore up trees by their roots and levelled houses with the ground. The number of lives lost was 461, mostly from the fall of rocks and debris.

July 16, 1494. Hurricane off Santa Cruz.—According to Southey's "Chronological History of the West Indies", during his second voyage Columbus anchored off Cape Santa Cruz, and while there "upon the 16th July a violent hurricane occasioned the Admiral to declare that nothing but the service of God and the extension of the monarchy should induce him to expose himself to such dangers".

July 16, 1565. Thunderstorm at Chelmsford.—In Stow's "Annals" it is recorded that on this date "about nine of the clocke at night, began a tempest of lightning and thunder, with showers of hail, which continued till three of the clocke the next morning, so terrible that at Chelmsford in Essex 500 acres of corn were destroyed: the glass windowes on the east side of the Church were beaten downe with also the tiles of their houses: besides diverse barnes, chimnies and the battlements of the church which were overthrowne."

July 17, 1921. Low Thames.—During the great drought of 1921 the flow of the River Thames at Teddington fell on July 17 to little more than a quarter of the normal flow in July. (See Feb. 7, 1921.)

July 17, 1925. Thunderstorms at Hong Kong.—Very severe thunderstorms, accompanied by heavy rainfall, passed over Hong Kong during several days in the middle of July. The most intense storm occurred on the morning of July 17, when a fall of 10.24 in. occurred in 11 hours. The water poured down from the high ground of Victoria Peak in great streams; floods and landslides were general and much damage was caused, especially in the Chinese quarter. In one part of the Chinese district a high retaining wall collapsed, demolishing a row of five houses, and most of the inmates, numbering 150, were killed.

July 18, 1794. St. Petersburg Haloes.—A remarkable display of haloes occurred during the morning. There were visible the haloes of 22° and 46°, the tangent arcs on both haloes, circumzenithal arc, five mock suns, and a number of other unusual features. This display has long been a standard of reference in works on atmospheric optics.

July 18, 1820. Mirage on Greenland Coast.—The coast of Greenland in 71° 20' N., 17° 30' W., as observed by Scoresby through a telescope from a distance of 35 miles, presented a curious appearance. The hills were drawn out vertically and distorted into the semblance of pagodas and other fantastic erections.

July 19-22, 1515. Floods in Central Europe.—On July 19 six weeks of rain began over the whole of central Europe, causing very extensive floods, especially on July 22. On July 24 there was a violent thunderstorm followed by great floods in Duisburg, and on Aug. 3 a cloudburst in Prussia.

July 19, 1926. Heavy Rain in Hong Kong.—During the filling up of a typhoon which crossed the coast about 100 miles to the eastward, a heavy thunderstorm broke over Hong Kong, and continued for nine hours, during which time the rainfall amounted to 20.43 in., 3.96 in. of which fell between 3 and 4 A.M. The city was flooded and great damage was done.

## Societies and Academies.

LONDON.

Royal Society, June 26.—A. V. Hill and P. S. Kupalov: The vapour pressure of muscle. There is a considerable increase of osmotic pressure in muscle as the result of stimulation. This was measured by observing the change of vapour pressure. The osmotic pressure of resting muscle is exactly accounted for by assuming all the known soluble constituents of muscle to be dissolved in its observed 'free' water. The osmotic pressure of fatigued muscle is in excess of that calculated on the same assumption: presumably some substance, hitherto unrecognised, is liberated as the result of activity.—A. V. Hill: The state of water in muscle and blood, and the osmotic behaviour of muscle. The 'free' water fraction (defined as the weight of water in 1 gm. of fluid or tissue which can dissolve substances added to it with a normal depression of vapour pressure) has been determined in blood, in protein solutions, and in muscle (resting and in rigor). The amount of 'bound' water in these is very small. The osmotic behaviour of muscles immersed in hypo- or hypertonic solutions is considered.—W. Sucksmith: The gyromagnetic effect for paramagnetic substances. A method of measuring the gyromagnetic ratio for paramagnetic substances is described. Hitherto, measurements have been made only on various ferro-magnetic materials, all of which show that the source of magnetic moment is entirely due to the spin of the electron. For a paramagnetic substance, the angular moment produced by a change in magnetic moment is very small, and it has been necessary to utilise low-frequency resonance for building up the resulting impulse to a measurable magnitude. Errors of measurement are discussed in detail, and shown to be eliminated.—J. C. McLennan and R. Turnbull: The absorption of light by gaseous, liquid, and solid xenon. The inert gases are probably monatomic in the solid and liquid states, as well as in the gaseous. Hence a study of the resonance lines in absorption for the gas at various pressures, and in the solid and liquid states, should reveal important features relating the atoms of the gas to the atoms in the liquid and solid state. The absorption band corresponding to the line  $\lambda$  1469 A. of xenon is the only one belonging to the inert gases that can be readily investigated; niton is too rare, and all the other resonance lines lie beyond the limit of transparency of any substance which is required to contain the gas or liquid. Liquid xenon is clear and colourless; solid xenon is transparent and like glass. The limit of absorption on its long wave-length side was determined for liquid and solid and found to be between  $\lambda$  1770 A. and  $\lambda$  1850 A. The asymmetrical type of absorption obtained with xenon, corresponding to  $\lambda$  1469 A., is similar to that obtained with mercury vapour, corresponding to  $\lambda$  2536.72 A., and both these wave-lengths are given by a frequency-formula  $h\nu = {}^1S_0 - {}^3P_1$ .—L. E. S. Eastham: The embryology of *Pieris rapae*—organogeny. The development of the main systems of organs, with the exception of the germ cells, from gastrulation stage to that of completely developed caterpillar is described.—K. Clusius and C. N. Hinshelwood: Homogeneous catalysis of gaseous reactions.—I and II. The decomposition of isopropyl ether,  $C_3H_7OC_3H_7 = C_3H_6 + CH_3CO.CH_3$ , is catalysed not only by iodine, but also by various alkyl iodides, and to a smaller extent by alkyl bromides. Chlorides have little influence. Hydrogen bromide is also good catalyst. During decomposition of the ether the alkyl iodides are themselves decomposed even when stable in absence of the ether. The decomposition reaction, whereby a hydrogen atom is

transferred under influence of catalyst from one part of the ether molecule to another, with accompanying rupture of molecule, is a general one. Every collision between ether and iodine in which kinetic energy of approach exceeds 34,300 calories probably leads to decomposition. Heats of activation of this and similar reactions are lower than those of corresponding uncatalysed reactions, and mechanism of activation simpler. Catalyst seems to attack molecule at one specific point.—C. N. Hinshelwood, K. Clusius, and G. Hadman: Homogeneous catalysis of gaseous reactions.—III. The assumption that energy of activation is supplied by collisions between aldehyde and iodine molecules leads to a calculated rate of reaction ten times smaller than the observed. The assumption that energy is also derived from one internal degree of freedom brings calculated and observed rates into agreement.—R. H. Fowler: A possible explanation of the selective photo-electric effect. A theory of the selective photo-electric effect is proposed, which refers the effect to a selective transmission coefficient of the surface layer for incident electrons of a certain energy. Such a selectivity is found theoretically when the potential energy curve near the surface contains two hills separated by a fairly deep valley. Experimentally, retentive emission is only found for surfaces covered with a rather complicated surface layer with first electro-negative and then electro-positive material deposited over the original metal. The proposed theory seems to be in full accord both with the nature of the effect and the peculiar conditions of its occurrence.—Lord Rayleigh: The ultra-violet transmission band of metallic silver as affected by temperature. The ultra-violet transmission band of metallic silver at  $\lambda$  3200 is examined at various temperatures. Heating shifts it towards the red. The shift from  $-180^{\circ}$  C. to  $+254^{\circ}$  C. is 120 Angströms.—L. H. Gray: The scattering of hard  $\gamma$ -rays. Tarrant has shown that the absorption coefficient of hard thorium-C  $\gamma$ -rays in certain elements is considerably greater than the value predicted by the Klein-Nishina formulæ, while in other elements the measured absorption coefficient is in good agreement with theory. To test whether the extra energy absorbed by the abnormal elements was re-emitted as quantum energy, the secondary radiation emitted between  $16^{\circ}$  and  $90^{\circ}$  by aluminium (abnormal) was compared with that from sulphur (normal) using as a primary beam radium-C  $\gamma$ -rays filtered through 4 cm. of lead (mean quantum energy about  $1.7 \times 10^6$  e-volts). Taking into consideration probable experimental error, it is unlikely that secondary radiation from aluminium exceeds that from sulphur by more than 0.25 per cent. Having regard also to the fact that the same  $\gamma$ -ray beam produces equal ionisation per unit volume in chambers of which the walls are composed of carbon, aluminium, and sulphur, it appears that the new absorbing mechanism is almost entirely inoperative in aluminium, in the case of quanta of energy  $1.5 \times 10^6$  e-volts, and only becomes of considerable magnitude as quantum energy approaches close to that of the hard thorium line ( $2.65 \times 10^6$  e-volts).—G. Temple: The operational wave equation and the Zeeman effect. This paper gives a treatment of the Zeeman effect based on the operational wave equation discussed in two previous papers.—H. Dingle: The spectrum of ionised fluorine (F II). The spectrum of ionised fluorine from the infra-red to the Schumann region has been obtained by passing discharges of appropriate intensity through silicon tetrafluoride, and 469 lines have been obtained and measured. The spectrum has been analysed and 173 lines have been classified as term combinations. The analysis has been discussed in relation to theoretical expectations.

## ADELAIDE.

Royal Society of South Australia, April 10.—Chas. Fenner: The major structural and physiographic features of South Australia. One of a series of papers dealing with the general geography of South Australia. Maps and diagrams were presented to illustrate the various earth movements whereby the coastlines, mountains, valleys, and plains of South Australia have been formed, with plans and sections to show the way in which the work of wind and running water have modified the landscape as we now know it. A modified theory of the origin of the Mount Lofty Ranges was put forward in the endeavour to account for the complex features of that region.—H. K. Fry: Physiological and psychological observations on the Australian aborigines. Tests of visual spatial perception showed that the natives reacted to standard illusions similarly to Europeans, but that visualisation of perspective depended on school training. Numerical sense of natives was excellent in guessing differences in contrasted groups of numbers, but ability to arrange a sequence of numbers was a result of arithmetic education. Various problems were solved more or less effectively. Visual acuity of native children was abnormally keen. Tactile and pain sensation, contrary to expectation, were found to be almost the same as that of whites.

## COPENHAGEN.

Royal Danish Academy of Science and Letters, Jan. 17.—Johs. Lindhard and Jens P. Müller: On the origin of the initial heat in muscular contraction. The usually accepted explanation of the initial heat curve of an isometric muscle cannot be maintained; the deformation of the muscular fibre during contraction may be responsible for the surplus of heat in the first phase of heat production.

Feb. 14.—O. B. Bøggild: The structure of mollusc shells. Previous examinations of the structure of calcareous shells were of a rather sporadic kind, and a more systematic investigation has been undertaken. The examination essentially includes the distribution of the two substances, calcite and aragonite, and the manner in which they are arranged in the shells.

April 11.—Harald Bohr: The variation of the argument of an almost periodic function.

May 9.—Martin Knudsen: Radiometer pressure and coefficient of accommodation. Radiometer forces have been investigated under such conditions that all the quantities on which the radiometer force may be conceived to depend have been measured, more especially the differences of temperature. The importance of the coefficient of accommodation for the radiometer pressure is shown, and from measurements at low pressures it is found that, in the case under investigation, the coefficient of accommodation for the internal energy (rotational energy) of a diatomic gas may be put equal to the coefficient of accommodation for the translation energy.

## SYDNEY.

Linnean Society of New South Wales, April 30.—Ida A. Brown: The geology of the south coast of New South Wales. Pt. 2. Devonian and older Palæozoic rocks. There is a progressive increase in the intensity of the folding from north-east Gippsland, Victoria, through the Eden district northwards to Yalwal, near the Lower Shoalhaven River, while the arcuate arrangement of the trend-lines suggests compression against the mass of older rocks lying to the east. Rocks of proved Silurian age are only known to occur in the Bendibora-Wyanbene belt, west of the Deua River. Ordovician graptolite-bearing slates outcrop near Cobargo; the age of the

slates, cherts, and schistose rocks outcropping over the greater portion of the south coast area is not definitely known.—A. L. Tonnoir: Notes on the genus *Apistomyia* (Diptera) and description of a new species. A key is given to the species of *Apistomyia*, one of which, from Mt. Malabar, Java, is described as new.—H. J. Carter: Australian Coleoptera: notes and new species (7). Nineteen species are described as new. The Buprestidæ described testify to the continuous value of close co-operation with the British Museum. The remaining descriptions are chiefly the result of correspondence with various Australian collectors.—W. L. Waterhouse: Australian rust studies. (2) Biometrical studies of the morphology of spore forms. Spore measurements of æcidiospores, uredospores, and teliospores of physiological forms of varieties of *Puccinia graminis*, and of uredospores of *P. triticina*, revealed striking morphological likenesses and differences between certain of the forms, but parallelism between physiology and morphology does not necessarily exist.

### Official Publications Received.

#### BRITISH.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 5, May. Abstracts Nos. 902-1121. (London: H.M. Stationery Office.) 9d. net.

Records of the Geological Survey of India. Vol. 62, Part 4. Pp. 391-455 + xxxvii + plates 10-20. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5s.

Bulletin of the Raffles Museum, Singapore, Straits Settlements. No. 3: The Reptilia and Amphibia of the Malay Peninsula from the Isthmus of Kra to Singapore, including the adjacent Islands. (A Supplement to Dr. G. A. Boulenger's Reptilia and Batrachia, 1912.) By Malcolm A. Smith. Pp. xviii + 149. (Singapore.) 1 dollar; 2s. 6d.

Survey of India. General Report, 1928 to 1929, from 1st October 1928 to 30th September 1929. Pp. iv + 79 + 6 plates. (Calcutta.) 1 rupee; 1s. 9d.

Nigeria. Eighth Annual Bulletin of the Agricultural Department, 1st August 1929. Pp. 316. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 5s.

The Lister Institute of Preventive Medicine. Report of the Governing Body, 1930. Pp. 27. (London.)

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1929. Pp. 125. (Harpenden.) 2s. 6d.

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 2, No. 13: On some curious Fossils from the Downtonian and Lower Old Red Sandstone of Scotland. By Dr. R. Crookall. Pp. 175-178 + 1 plate. 6d. Vol. 50, Part 2, No. 14: Maturity in the Female Mouse. By L. Mirskaia and F. A. E. Crew. Pp. 179-183. 1s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Ministry of Health. Second Report of the Joint Advisory Committee on River Pollution: The Reception of Trade Effluents into the Sewers of the Local Sanitary Authorities. Pp. 29. (London: H.M. Stationery Office.) 6d. net.

The British Research Association for the Woollen and Worsted Industries. Publication No. 127: Scientific Aid for the Wool Industries. By S. G. Barker and Arnold Frobisher. Pp. ii + 36 + 12 plates. (Leeds.)

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1929. Pp. 17. (Birmingham.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 41, Part 1, 27th June. Pp. 116. (London: Edward Stanford, Ltd.) 5s.

The Journal of the Armstrong College Mining Society. Vol. 6. Pp. 69 + xxv. (Newcastle-on-Tyne.) 1s.

#### FOREIGN.

Bulletin of the American Museum of Natural History. Vol. 59, Art. 3: Tertiary Land Mammals of Florida. By George Gaylord Simpson. Pp. 149-211. (New York.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Numéro jubilaire en l'honneur de M. Bohuslav Brauner. Année 2, No. 5-6, Mai-juin. Pp. 209-440. (Prague: Regia Societas Scientiarum Bohemica.)

Zentralanstalt für Meteorologie und Geodynamik. Publikation Nr. 134: Klimatographie von Österreich. 10: Der jährliche Gang der meteorologischen Elemente in Wien (1851-1920). Von Arthur Wagner. Pp. 88. (Wien: Gerold und Co.)

A Series of Eight Radio Talks on Science in the Kitchen: the Selection, Care and Service of Foods. By Dr. Lawrence W. Bass, Dr. George D. Beal, Dr. R. F. Beard, Dr. Gerald J. Cox, Dr. W. W. Duecker, E. R. Harding, Dr. E. W. Morrison, Dr. R. N. Wenzel. (Radio Publication No. 58, University of Pittsburgh.) Pp. ix + 82. (Pittsburgh, Pa.: Mellon Institute of Industrial Research.) 60 cents.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 19, Nos. 1, 2 and 3. No. 1: Marine Mollusca of Guadalupe Island, Mexico, by A. M. Strong and G. D. Hanna; No. 2: Marine Mollusca of the Revillagigedo Islands, Mexico, by A. M. Strong and G. D. Hanna; No. 3: Marine Mollusca of the Tres Marias Islands, Mexico, by A. M. Strong and G. D. Hanna. Pp. 22. (San Francisco.) 50 cents.

Ergebnisse der Internationalen Pflanzengeographischen Exkursion durch die Tschechoslowakei und Polen 1928. Redigiert von E. Rübel. (Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich, Heft 6.) Pp. 328. (Bern und Berlin: Hans Huber.) 16-50 francs.

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 132: June Beetles or White Grubs in Michigan. By R. H. Pettit. Pp. 10. Circular Bulletin No. 133: Soft Scales injurious to Deciduous Ornamentals. By E. I. McDaniel. Pp. 17. Special Bulletin No. 196: The Farm Woodlot in Michigan. By A. K. Chittenden and P. W. Robbins. Pp. 28. Special Bulletin No. 197: Oat Tests at the Michigan Experiment Station. By E. E. Down, H. M. Brown and F. H. Clark. Pp. 12. Technical Bulletin No. 105: The Results of a Five Year Mineral Feeding Investigation with Dairy Cattle. By O. E. Reed and C. F. Huffman. Pp. 63. (East Lansing, Mich.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 245: Experimental Studies on Form and Structure of Sparks, Part 7. By Torahiko Terada, Ukutiro Nakaya and Ryūzō Yamamoto. Pp. 207-230 + plates 19-33. (Tokyo: Iwanami Shoten.) 70 sen.

Annotations Zoologicae Japonenses. Vol. 11, No. 4, December 20, 1928. Pp. 269-417. Vol. 12, No. 1, July 25, 1929. Special Number dedicated to Professor Goto. Pp. 385. (Tokyo: Zoological Society of Japan.)

Publications of the Washburn Observatory of the University of Wisconsin. Vol. 15, Part 3: The Constancy of the Light of Red Stars. By Joel Stebbins and C. M. Huffer. Pp. 137-174. (Madison, Wis.)

Publikationer fra det Danske Meteorologiske Institut. Communications magnetiques, etc., No. 10: On Tides of the Upper Atmosphere. By J. Egedal. Pp. 15. (København: G. E. C. Gad.)

República Argentina: Ministerio de Agricultura de la Nación. Anales de la Dirección de Meteorología. Tomo 18: Conteniendo las observaciones practicadas en los años 1924, 1925, 1926 y 1927. Vol. 1: Precipitación e Hidrometría. Pp. 116 + 101 plates. (Buenos Aires.)

First Annual Report of the Museum of Science and Industry founded by Julius Rosenwald, July 1, 1928-December 31, 1929. Pp. 34. (Chicago.)

Publications of the Allegheny Observatory of the University of Pittsburgh. Vol. 8, No. 3: Wave Lengths in the Spectra of the Vacuum Copper Arc. By Kevin Burns and Prof. Francis M. Walters, Jr. Pp. 27-35. (Pittsburgh, Pa.)

#### CATALOGUES.

The Nickel Bulletin. Vol. 3, No. 6, June. Pp. 177-208. Publication L3: The Progress of Nickel Deposition in Recent Years. By D. J. Macnaughtan and R. A. F. Hammond. Pp. 27. (London: The Mond Nickel Co., Ltd.)

A Catalogue of Books on Zoology and Allied Subjects, including Ornithology, Entomology, Conchology, Anthropology and Naturalists' Travels, also Geology and Medical Books. (No. 7.) Pp. 60. (London: Henry Cook.)

Cambridge Alternating Current Instruments for High Frequencies. (List No. 162.) Pp. 40. Some Methods of Measuring Inductance, Capacitance and Resistance. (Supplement to List 162.) Pp. 16. (London: Cambridge Instrument Co., Ltd.)

Catalogue of Fine Chemical Products for Laboratory Use: including Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators. (July.) Pp. 130. (London: The British Drug Houses, Ltd.)

Electrically Heated Laboratory Apparatus. (List No. 231F.) Pp. 24. Small Electric Furnaces for Laboratory and Works. (List No. 75G.) Pp. 20. Addenda List for General and Industrial Laboratory Apparatus Catalogue, Eighth edition. Pp. 40. (London: A. Gallenkamp and Co., Ltd.)

### Diary of Societies.

#### MONDAY, JULY 14.

INSTITUTION OF NAVAL ARCHITECTS (Summer Meeting) (at Liverpool). (Continued until July 18.)

#### TUESDAY, JULY 15.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

#### ANNUAL MEETING.

JULY 14 TO 19.

SOCIETY OF CHEMICAL INDUSTRY (at Birmingham).

July 15, at 11 A.M.—Dr. H. Levinstein: Only an Apprentice in Nature's Workshop (Presidential Address).

July 16, at 11 A.M.—Dr. A. E. Dunstan: The Chemical Aspect of Petroleum.

July 17, at 10.30 A.M.—Presentation of the Messel Medal to Lord Brotherton of Wakefield.—Lord Brotherton: Fifty Years in Chemical Industry.

#### COLLOQUIUM.

JULY 19 TO 30.

ST. ANDREWS MATHEMATICAL COLLOQUIUM (in University Hall, St. Andrews).

Prof. H. F. Baker: Rational Curves and Surfaces.

Dr. H. W. Richmond: Arithmetical Properties of Curves and Surfaces.

Prof. C. G. Darwin: The Wave Mechanics.

Prof. H. W. Turnbull: Elementary Mathematics from the Higher Standpoint.

Dr. A. C. Aitken: Recent Developments in Symmetric Functions, Determinants, and Algebraic Equations.

Theory of Functions.

Prof. E. T. Whittaker and others: Informal Talks.