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Railway Electrification.*

THE Report of the Committee on Main Line Railway Electrification, of which Lord Weir is chairman, has now been published, and the conclusions reached in it are clear and far-reaching. It is satisfactory to find that several of the consulting and railway engineers examined arrived at practically the same numerical results in making estimates.

The Report states that electric traction has shown itself to possess definite elements of superiority over steam traction, and that the system is extending wherever it has been adopted.

It is pointed out that the progress which is being made by the national scheme for supplying high pressure electricity in bulk and in forming a Central Electricity Board has introduced new factors into the problem of main line electrification. The Committee was justified, therefore, in undertaking a comprehensive review of the economic possibility of changing from steam to electricity. In making this review, it was assumed that the productivity of the country is ever increasing, and so a transport service must be provided capable of expansion both in method and efficiency. The high standard of living adopted in Great Britain has also to be borne in mind.

During recent years the revenues of the railways have diminished most seriously, largely due to the growth of road transport for goods and passengers and to the long period of depression in many industries, but nothing has happened as yet to make it at all likely that the railways will be displaced from their position as the chief agency for the transport of goods and passengers in Britain. Assuming this, the Committee has attacked the problem and made careful estimates of the extent to which a change from steam to electric traction on our railways would be justifiable and economic.

There are many railways abroad operated by electricity and many more are under construction. In nearly every case, investigation shows that there are reasons due to special circumstances which induced the country to adopt electric instead of steam haulage, and few of these reasons apply to Great Britain. The outstanding example of railway electrification is the Swiss Federal Railway system. In Switzerland, 66 per cent of the total mileage is operated electrically and this carries 85 per cent of the total traffic. In this case, the main factors governing the choice were the desire to be independent of foreign countries

* Ministry of Transport. Report of the Committee on Main Line Railway Electrification, 1931. Pp. 57+2 plates. (London: H.M. Stationery Office, 1931.) 3s. net.

for supplies of coal and the abundant water power available. In addition, there are many steep gradients and long tunnels and these made electric traction almost a necessity. It is computed that in 1929 the adoption of electricity effected a saving of £200,000, taking all interest and amortisation charges into account. This saving will doubtless increase rapidly as the traffic increases. It has to be remembered that in Switzerland the power stations were built by the railway and the interest on their first cost is taken into account in the estimate given above of the saving effected.

In France, the main considerations taken into account when electrifying the Paris-Orleans railway were the high price of coal south of Paris and the development of the water power sources of central France. The linking of this large source of power with Paris is in the interests of national policy. It is doubtful whether the railway is yet remunerative. The Midi railway electrification utilises available water power, but it obtains a substantial revenue by selling electrical energy to dwellers near the railway and to factories. When this latter sum is taken into account, it shows a profit. The various electrifications in Germany are due mainly to a desire to utilise available water power. There are also many steep gradients and long tunnels which make electrification desirable. In Italy and the rest of Europe, similar considerations favour electrification. In the United States, there is, in addition, the urgent necessity of increasing the traffic capacity of many of the railways. We also see that in some cases the capital cost can be considerably reduced by utilising the 'air space' in large electric stations by building flats and offices above them. With steam trains this would be impossible.

In Great Britain, the important advantages accruing from the suburban electrification of railways in large towns are now obvious. Taking a group of eighteen stations on the Southern Railway within twenty miles from London, it was found that, four years after they were electrified, the number of season tickets issued had increased by 140 per cent. It is satisfactory to learn that all electrifications of suburban railways in Great Britain have been uniformly successful. The experts calculate that the capital required for the complete suburban electrification of the country, spread over twenty years, would be 45 million pounds. The saving effected by electric over steam haulage would be 13 per cent per annum in the twenty-first year. There would, of course, be a steam-electric period for twenty years. But the increased revenue due to electrification would cover the temporary costs of dual working, in addition to paying the interest charges averaged over the whole programme. We can assume, therefore, that the railway companies will, in due course, extend the electrification of their lines round London and other large centres. The schemes at present in hand strongly support this assumption.

The problem of main line electrification in Great Britain needs to be specially considered, as there is little available water power, coal is cheap, tunnels are few, and there are very few appreciable gradients. The Committee, therefore, had estimates made by independent experts. The major part of the cost of haulage is the cost of the energy expended. In steam haulage, this is represented by the cost of the fuel, which in Great Britain is coal. In electric haulage the corresponding item is the price paid by the railway for electrical energy. The experience gained in only a few other countries is, therefore, applicable. The Committee knows that the energy can be purchased from the Central Electricity Board, and it has adopted the overhead direct current system of electrification at 1500 volts as the standard. Although the substations will be worked by the railway employees, the cost of their erection and maintenance will be paid by the Central Electricity Board.

The essential characteristic of electrification as compared with all other traction systems is the removal of the generation of power from the train. From this fact arises most of the advantages and economies of electrification. Before a line is electrified, a heavy new interest charge is incurred on fixed equipment, and the independent coal-burning locomotives must be replaced by dependent electric haulage units.

Estimates made by H. W. H. Richards, J. M. Kennedy, and Messrs. Merz and McLellan indicate that the total capital cost of railway main line electrification in Great Britain would be 261 million pounds, and that the net savings effected would be nearly eighteen million pounds per annum. Assuming general electrification on a twenty-year plan, and that existing traffics were maintained, this would lead to a surplus of approximately two per cent after paying the fixed charges on the new capital involved. From a business point of view, such a result taken by itself would not warrant the adoption of a scheme of this exceptional magnitude. The Committee points out that it has left out of account many things the money value of which cannot be assessed. For example, were it completed, the railway companies could offer the public

a speedier and much more satisfactory service than they can under steam haulage. Any increase in the service will secure increased savings as compared with steam. It has to be remembered also that British electrical manufacturers have completed many important contracts for railway electrification in many different countries. If the electric scheme is adopted, the experience they have gained would be at once available. With the exception of the raw copper, practically all the expenses would be distributed as wages in Great Britain, and would employ 60,000 men for a period of twenty years. The Committee thinks that notwithstanding the great saving in wage costs effected by electrification, yet there would be little risk of the employees occupying the grades of drivers, firemen, and cleaners being adversely affected because of the considerable intensification of suburban services. The physical conditions under which the traction staff would work would be much more favourable than at present.

Apart from its effect on the railways, an electrification scheme on the lines indicated would most favourably affect the National Grid, which is already proving a boon to Great Britain. As to the risk of some more economical method of generating electricity being discovered by science, this discovery would not affect railway economics much, as they would be purchasing electricity and the efficiency of conversion of electrical machinery now approaches a hundred per cent. We have little sympathy with those who oppose the scheme on the ground that new discoveries are continually being made by science. They remind us of the slothful man in Proverbs xxvi. 13, who was continually saying, "There is a lion in the way; a lion is in the streets".

Prehistory.

Weltgeschichte der Steinzeit. Von Prof. Oswald Menghin. Pp. xvi + 648. (Wien : Anton Schroll und Co., 1931.) 40 gold marks.

PROF. MENGHIN has taken ten years in the preparation of this extremely important book, and he has certainly not wasted his time. Quite probably it is the last serious work, bearing such an ambitious title, which will ever be written. For it is one of the tragedies resulting from the increase of knowledge, that a general survey of a subject becomes less and less possible. Field-workers are, as it were, bricklayers whose position, so close to the small section of wall they are building, makes any general view of the edifice as a whole impossible; and, even for those who are less concerned with the actual building, the structure of knowledge has become so vast and is growing so rapidly as to make a comprehensive study of the whole a very difficult task.

However, Prof. Menghin's book is not only to be welcomed because the Stone Age prehistory of the world is surveyed: quite equally interesting are the new methods of approach to the subject which are here for the first time put forward in print. I say "in print" of set purpose, because in Great Britain several of the same ideas, at least in a modified form, have for some time past been 'in the air', and indeed are already being taught by professional prehistorians. Prof. Menghin, however, has now elaborated and codified these ideas. Briefly, the new schemes depend upon a considerable stressing of the typological method of classification as applied to the Palæolithic and Neolithic cultures as a whole. Prof. Menghin distinguishes, from the earliest times, core, flake, and bone industries, and urges that they are the expression of different modes of life practised by different cultures. The separation of bone-using cultures (such as the Maglemosean) is his own special contribution to the new method of approach and one which leads to interesting results—the distinction in Lower Palæolithic times between core—that is, hand-axe—(Chelleo-Acheulean) and flake (Clactonian, Levalloisean, etc.) industries has been recognised for some time, also the suggestion made that they belong to different cultures.

Prof. Menghin regards flake industries, such as those already named, as being ancestral to the blade industries such as those of the Upper Palæolithic. Yet surely there is a real distinction between the two, and further, Upper Palæolithic blade industries are associated with burins, forming what can well be described as 'Blade and Burin' industries, a fact which is never the case in Lower Palæolithic flake industries. The difference between a flake and blade is no doubt slight; but it does seem to be a real one. The intriguing suggestion is made that hand-axe folk, from the nature of their club-like tools, must have been originally cradled in forest lands, while the dagger and lance points of flake industries postulate a steppe country as the area of origin of the folk who made them. Such generalities are audacious and can sometimes be refuted in detail; but are yet fascinating and often contain important elements of truth.

Another nettle that Prof. Menghin has attempted to grasp is that of Stone Age nomenclature. Quite clearly the world-wide application of terms derived from French place-names such as Chellean—there is

scarcely any true Chellean at Chelles—is absurd. Moreover, the distinction between the Chellean and the Acheulean cultures is only one of evolution, while between the Acheulean and the Mousterian a much greater gulf exists, a fact which is in no way suggested by the older terminology. Again, the classic nomenclature is difficult to apply when the new methods of approach indicated above are adopted. Prof. Menghin has therefore started *de novo*; but his suggested alternatives are somehow not always happy. Nomenclature should be informative, and if possible descriptive, it is true, but need the terms used be in themselves ugly and jaw-breaking? "Chwalibogowician" as a name for certain sub-dune Polish industries has been replaced by the name "Swiderian", partly perhaps as a result of slight discord between certain Polish archæologists, but largely because the former word is difficult to spell and impossible to pronounce. In Prof. Menghin's nomenclature, however, there occur such terms as "Epimiolithic", "Opsimiolithic", "Epiprotoneolithic", and "Epimixoneolithic"—all quite intelligible if time is taken to think out their implications, and each, in itself, more unattractive than the last. Because geologists and petrologists are such sinners in this respect, must prehistorians follow their example? Again, the terms "Protolithic" and "Protoneolithic" are easy to distinguish when written, but can be readily confused in conversation. Compare, in this connexion, the trouble that has so often arisen already in the use of the terms Neolithic and Eneolithic.

The "Weltgeschichte der Steinzeit", though imposing in contents, is in size and shape convenient enough to handle, and is nicely produced. After a brief introduction and a discussion of Stone Age chronology, there is a long chapter on Prof. Menghin's first period, the Protolithic. This includes everything that has hitherto been classed as Lower Palæolithic and Mousterian. The threefold subdivision into core, flake, and bone cultures is explained and adopted, the geographical distribution, evolution, and interaction of each of these groups being considered. Incidentally, the author expresses a fairly general scepticism with regard to the Tertiary eoliths. Chapter iv. contains another detailed account of his next period, the Miolithic, which embraces the Upper Palæolithic and Mesolithic cultures. The core, flake, and bone subdivision is continued and elaborated. Naturally, the world-wide interactions of these three cultures, now become very complicated as influences from surviving Protolithic predecessors, have to be taken into account and the number of possible combinations and fusions is very great. A simple example of such culture-crossing is the Solutrean, which is here discussed and analysed. It is regarded as the result of a mixture of flake and core culture streams, the one a dagger and lance culture addicted to magic rites and having a tendency to naturalistic art, the other a club-culture with a mother-god cult and a preference for schematic decoration. Typically, a Miolithic core-culture is the Campigmian which it is suggested may have been cradled in Iran. Prof. Menghin will not tolerate the idea that essentially it is a northern culture. The Maglemosean and Arctic cultures are, of course, bone-Miolithic.

Next follows a chapter on the Protoneolithic which includes polished axe cultures, as well as those of Anau I. and the Gobi. Here a somewhat different subdivision is suggested, namely, into cultures specially interested in pigs, cattle, and horses ("Reittierzüchterkulturen"). As before, geographical origins, distributions, and interactions are discussed. We are thus prepared for a consideration of what is called the Mixoneolithic (=the older 'full Neolithic'), which is divided into village, town, and steppe cultures. Finally, there are two chapters dealing with ethnographic-linguistic and racial problems in relation to palæo-archæology, followed by general conclusions.

While perusing this really monumental work, one is constantly impressed—almost appalled—by the amount of material that Prof. Menghin has read and absorbed. He has also travelled. Doubtless many of his details will have to be corrected by field investigators working intensively in various countries, and one feels that he has perhaps dismissed too lightly one or two somewhat thorny problems; but the whole work suggests a new and fascinating approach to the study of prehistory.

The typologist is in somewhat the same position as the grammarian. He has to systematise a great deal of material and arrange so far as possible that the rules he lays down agree with the facts of reality. It has lately been recognised that the current grammar of prehistory is increasingly inadequate—our knowledge of the subject having grown so rapidly in recent years. Whether Prof. Menghin's new grammar (1) coincides with reality and (2) is sufficiently workable for the purposes of students, the future alone will show. While it undoubtedly constitutes a great advance on the earlier schemes, certain factors, such as climate, which tend to produce similar needs and therefore similar industries, are not much stressed or allowed for. Moreover, the influence on the final appearance of an industry,

which is exerted by the kind of raw material which is readily available, is a factor which must often be taken into consideration. Industries rich in antler-sleeves do not occur when there are no deer. There is indeed no need to believe that all somewhat similar industries must necessarily be derived from the same originals. For working purposes, the loss of the Mesolithic as a definite stage is perhaps to be regretted. Throughout this period, the conditions of life, in Europe at any rate, differed radically from what came before and afterwards. Arbitrarily to draw the line at the close of the Mesolithic cultures, and not to make a similar division at the end of the Palæolithic, does not seem to be altogether helpful.

But I must reiterate that this is a monumental and remarkable work, which ought to be translated into English. It is full of new ideas, and its perusal rather takes one's breath away. Prof. Menghin is indeed to be congratulated on its production. It contains, by the way, plenty of excellent illustrations.

M. C. BURKITT.

Climate: General and Local.

(1) *Climate: a Treatise on the Principles of Weather and Climate.* By W. G. Kendrew. Pp. x + 329 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 15*s.* net.

(2) *Die Klimate der Erde.* Von Alfred Hettner. (Geographische Schriften, Heft 5.) Pp. iv + 115. (Leipzig und Berlin: B. G. Teubner, 1930.) 5·40 gold marks.

(3) *Klimakunde von Südamerika.* Von Prof. Dr. K. Knoch. (*Handbuch der Klimatologie*, herausgegeben von W. Köppen und R. Geiger, Band 2, Teil G.) Pp. viii + G349. (Berlin: Gebrüder Borntraeger, 1930.) 67·50 gold marks.

THESE three books on climatology, appearing within a short time of each other, meet three different needs. The first is for the general reader as well as the teacher, the second is for the teacher and student, and the third for the specialist and librarian.

(1) Kendrew's "Climate" is an exceedingly well written and well illustrated general introduction to the subject. The distribution of the climatic elements over the globe and the causes of their variation from place to place are described clearly and simply, while the more noteworthy phenomena are illustrated by photographs and quotations in a way which will commend the book to teachers of geography. The later chapters, on local details of climate and some typical climatic regions, are also good, and are supplemented by a valuable series of representative weather charts. The description of the weather of the temperate storm belts and its basis in the storm-building conflict of 'polar' and 'tropical' winds introduce the modern idea of the 'polar front', which, however, the author does not entirely accept.

There are a few slips; for example, "when the path of the sun's rays through the air is doubled the heat received is reduced to a quarter" (p. 9), the theory of the deflection of winds by the earth's rotation on p. 73 is quite inadequate, and the air temperature need not be above freezing point for the formation of glazed frost (p. 213). In Fig. 32 we are shown the old diagram of the planetary winds, which Sir Napier Shaw showed to be inaccurate many years ago; and beneath it, an even more impracticable reconstruction of the upper winds. It is true that the diagrams are followed by a word of warning, but it is high time that these obsolete illustrations were abandoned altogether by the writers of text-books and replaced by something more modern. Most of the book is reliable enough, however, while the general get-up, printing, and indexing are all excellently done. The volume should find a place on the shelves of all those who are interested in meteorology.

(2) Hettner's book, "Die Klimate der Erde", is a typical German handbook, very complete, very systematic, and very dry. Along with solar radiation, atmospheric circulation, water vapour and temperature, it even includes chapters on the chemical composition and dust content of the air and on light and the colour of the sky. To cover all this, as well as an outline of the climate of the continents, in a hundred and fifteen pages, requires a very compressed treatment, and while most of the book is clearly written, simplification is sometimes carried too far. Thus, the statement on p. 16, that the warming of the air depends on its density, ignores the preponderant influence of water vapour, and the reader of the paragraph on the chemical composition of the air will be little wiser for his pains. The old-fashioned diagrams of the planetary circulation reproduced by Kendrew are also included by Hettner.

On the climatic side, the author is much more sound, and his bird's-eye view of the climatic provinces is the best part of the book. Its value is increased by the numerous clear illustrations, which will appeal to economic geographers and naturalists seeking to correlate their data with meteorology. There is no index, but in a work of this nature it is scarcely necessary.

(3) The "Klimakunde von Südamerika" falls into quite a different category. It is the first instalment of a comprehensive treatise on the climatology of the globe on a scale never before attempted. For many years, Hann's famous "Handbuch" has stood as the great work of reference on the subject, with authoritative tables, abundant references, well-chosen quotations, and clear discussions of scientific principles. But the third edition of the "Handbuch" appeared in 1911, and in the intervening twenty years many more data have been accumulated and much new knowledge gained. The task of revision was beyond the powers of any single individual and has accordingly been divided among many. The new "Handbuch" will consist of five volumes, one general and four regional; the editors of the whole work are the veteran climatologist, Dr. Köppen, and Dr. Geiger, of Munich; but each region or continent is assigned to the best authority on its climate. The list of authors includes no fewer than thirty-five names, most of them known to all meteorologists. All the regional volumes are to be on a definite plan, especially the collection of tables, which is regarded as an essential feature of the work, of equal importance with the text.

If we may regard Dr. Knoch's treatment of South America as representative, the new "Handbuch" will indeed leave little to be desired. Beginning with the growth of climatology in the continent, he discusses the geographical factors such as orography and ocean currents, describes the distribution of the climatic elements, and concludes with detailed climatological accounts of the various countries. The treatment throughout is wonderfully thorough; the relegation of most of the tables to the end has permitted a very full development of the descriptive side, partly by quotation and partly in concise summary, with full references to a bibliography of 570 entries. There is not a large number of illustrations, but those given are valuable; the distribution of rainfall, for example, is illustrated by no fewer than seven full-page charts. The tables occupy eighty pages and include not only monthly normals of all climatic elements, including the frequency of 'phenomena', but also variations of pressure, temperature, and rainfall from normal at selected stations over long periods. The figures are reasonably up to date, and the collection of all this material must have been a gigantic task. The arrangement, which is by elements, involves much turning over of pages, but, no doubt, arrangement by stations, preferable in theory, would have required too much space.

We owe the utmost praise to Gebrüder Borntraeger for their courage in undertaking the publication of a work of this magnitude, no less than to the editors for the broad lines on which it is planned, and, in this beginning at least, to Dr. Knoch for the generous way in which the plan has been carried out. Few private readers will be in a position to purchase the complete series, but no meteorological, geographical, or reference library can afford to be without it. A stout binding should be provided, for the books will be much handled.

C. E. P. B.

Mathematical Tables and Formulæ.

Standard Four-Figure Mathematical Tables: including many New Tables, Trigonometrical Functions for Radians, Inverse Trigonometrical and Hyperbolic Functions, and an Extended Table of Natural Logarithms. By Prof. L. M. Milne-Thomson and Dr. L. J. Comrie. Edition B: with Negative Characteristics in the Logarithms. Pp. xvi + 245. (London: Macmillan and Co., Ltd., 1931.) 10*s.* 6*d.* net.

THE object of the authors of this volume of mathematical tables is "to supply a comprehensive set of tables of the numerical values of the elementary functions which are in constant use in mathematics and in the applications of mathematics to physics, chemistry, astronomy, engineering and statistics, in those cases where four-figure accuracy is sufficient". To attain this object, nineteen tables, occupying 213 pages, are given. In each table the authors have endeavoured to supply as complete information as possible of the values of related functions of the same argument; for example, at one opening the computer will find the first five powers, square roots, cube roots, and reciprocals of 100 arguments.

A large number of new calculations were made to seven figures and reduced to four figures with the usual convention. Many of the tables are claimed to be new, but these are not specified. The method of building up these tables and of proof-reading was such that computers may be assured that the accuracy of the tables is high. The names of Prof. Milne-Thomson and Dr. Comrie are, in fact, sufficient assurance that the tables have been accurately calculated and printed.

For interpolation purposes, first differences are printed where they are useful; and where these become inconveniently large, an alternative method of interpolation is given in some form at the foot

of the page concerned. In general, the amount of interpolation required is small. For the sake of increased accuracy in working to four decimal places, signs are placed after the tabular results to indicate the possible error involved in the 'cutting down' process. A high 'dot', no sign, and a low 'dot' cover a unit of the last figure for this purpose. If these signs are used, the results will generally be more accurate.

The argument in all the tables has an extensive range and the interval is generally sufficiently small to make interpolation simple. Logarithms, antilogarithms, addition and subtraction logarithms are followed by square and cube roots, powers to the fifth and reciprocals of n from 1·00 by steps of 0·01 to 12·00, with additional columns giving square roots of $10n$ and cube roots of $10n$ and $100n$. A table of several functions of the first 100 integers, including logarithm of the factorial and probable error, follows. Natural and logarithmic trigonometrical tables for arguments at intervals (i) of 0·01° and 0·1°, (ii) of minutes, (iii) of 0·001 radian, are followed by tables of natural and logarithmic hyperbolic fractions, powers of e, and an extensive table of hyperbolic logarithms. Inverse circular and hyperbolic functions, gudermannian and inverse gudermannian, the logarithm of the Gamma function, and the function erf x are the most important of the remaining tables.

The main tables are followed by twenty-six pages of derivatives, integrals, series, formulæ, standard differential equations, mensuration, etc. This part of the volume will be useful for reference purposes, and a detailed index at the end of the volume would have enhanced its value.

An extensive table of proportional parts is provided at the end of the volume and an additional copy can be removed and placed alongside the table in use.

The tables are printed very well with the figures of the standard type in modern tables and on very good paper. Some of the pages appear rather 'crowded', but not sufficiently so to cause undue fatigue in the user of the tables. The book is sold in strong binding.

Notation. Throughout the volume the logarithm to the base 10 is printed 'log' and the logarithm to the base e is printed 'ln'. The choice of notation is not a happy one, for in mathematical textbooks 'log' generally signifies the logarithm to the base e. This will not be a handicap to the computer when he becomes familiar with it. Throughout this edition, negative characteristics are given in the logarithms where necessary, and the writer favours this method of printing the characteristic; a companion edition in which positive characteristics are used is also available.

The work of the authors provides an exceedingly useful collection of tables for the large number of computers for whom four-figure accuracy is sufficient.

Mammalian Genetics.

The Genetics of Domestic Rabbits: a Manual for Students of Mammalian Genetics and an Aid to Rabbit Breeders and Fur Farmers. By Prof. W. E. Castle. Pp. vi+31+13 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1930.) 6*s.* net.

AMONG the fanciers and the commercial breeders of the rabbit, there is an increasing number of those who are inclined to agree that a working knowledge of Mendelism is distinctly helpful in the production of new varieties and in the fixation of those which already exist. So far, their interests have been served, though imperfectly, by frequent articles in those publications which address themselves to the rabbit-keeper; but the need for a small yet comprehensive book on the genetics of the rabbit has, during recent years, become manifest. Prof. W. E. Castle has written a book which is the first serious attempt to include within one small volume all that is known of the genetics of domestic rabbits, and to indicate how this knowledge may be incorporated profitably into breeding practices.

In reading this book, and at the same time continually reminding oneself that the rabbit breeders, of Great Britain at least, are not at all conversant with many of the terms and notions that to the trained geneticist are commonplaces, one is forced to the conclusion that the rabbit breeders of the United States must have a greater knowledge of present-day genetics than those in this country. The book can thus be of value only to a very few of those who seek and need a simple presentation of fact and theory.

To the few, however, the book will prove of very considerable value. There is, for example, a chapter entitled "Criteria of True-Breeding Types and Individuals", containing a table which shows at a glance the hereditary constitution of the different varieties, and an account of the different mutations that have occurred is placed before the reader in a clear and concise manner. No reference is made, however, to the two distinct mutations each of which produces the Rex type of fur, though

this is a matter of considerable importance to the breeder, since it explains how it is that occasionally two Rex rabbits produce normal-coated offspring. The subject of yellow fat is discussed at some length ; but in Great Britain the conclusion of Prof. Castle that it is of little or no economic importance is not correct, for many firms pay a considerably lower price for carcases showing this character. There are thirty-nine photographs of the different types of rabbit, and of these the majority are both clear and helpful. The bibliography consists of only about fourteen references.

It is impossible to recommend the purchase of this book to the average British rabbit breeder ; but to the few who already possess a working knowledge of Mendelism it must prove of very considerable interest. The charge is often made that the geneticist finds it impossible to present that which he has to say in terms so simple that anyone may read and understand. Many have tried to do this and all have failed. It would seem to be far easier to discuss, in everyday language, the origin and nature of the universe than to explain the origin and genetic nature of a new coat colour in the rabbit. An understanding of many new words is demanded. Is it too much to hope that the breeder, being persuaded that there are financial advantages associated with the possession of a new jargon, will acquire it ? F. A. E. CREW.

Our Bookshelf.

The Flora of Northamptonshire : Being a Topographical and Historical Account of the Flowering Plants and Ferns found in the County, with short Biographical Notices of the Botanists who have contributed to Northamptonshire Botany during the last Three Centuries. By Dr. George Claridge Druce. Pp. cxlii + 304. (Arbroath : T. Buncle and Co., 1930.) n.p.

THE veteran British botanist, Dr. G. C. Druce, has published a flora of the county in which he was born. In many respects the work is a model of what a county flora should be, and must rank with the same author's floras of Oxfordshire, Berkshire, and Buckinghamshire as a noteworthy contribution to the floristics of Great Britain.

About 25,000 acres of Northamptonshire are under timber. The concise account of the geology (contributed by Mr. Beeby Thompson) clearly indicates the dominance of Mesozoic formations of Liassic and Oolitic ages, a fact which explains such peculiarities of the vegetation as the absence of extensive heaths. The botanical divisions used by Dr. Druce are conveniently based on the river drainage.

An interesting feature of the book is an extensive "Botanologia", in which appear biographical accounts of all who have contributed to our knowledge of the botany of Northamptonshire. Special attention is directed to those dealing with John Morton, John Hill, and John Clare. These biographical notices, and especially the lengthy one on the poet Clare, are of general interest and should prove useful to historians of British botany.

The flora of Northamptonshire consists of 977 species (1925 estimate), a somewhat smaller number than estimated for the surrounding counties. A list of noteworthy absentees is given. The county has no species peculiar to it, but a number of rarities include *Anemone Pulsatilla*, *Epilobium Lamyi*, *Zannichellia gibberosa*, and *Bromus interruptus*.

The sequence and nomenclature of species in the systematic part are those of the author's "British Plant List" (second edition). Vernacular names are given and alien species are starred. The "grade of citizenship the plant occupies in Northamptonshire", the habitat, the earliest known record for the county, and localities (for all but the common and generally distributed plants) are concisely indicated. The listing of microspecies or varieties of *Bursa* (*Capsella*), *Rubus*, *Rosa*, *Cratægus*, *Taraxacum*, and some other genera, makes one wish that critical studies involving cultural and breeding experiments were more in favour with British field botanists.

The book is well printed, of convenient format, and the proof-reading has been carefully done.

W. B. T.

A Textbook of Plant Physiology. By Prof. N. A. Maximov. Translated from the Russian. Edited by A. E. Murneek and R. B. Harvey. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xvi + 381. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1930.) 20*s.* net.

THIS book has been translated into English from the Russian. It is a pity that such a step should have proved necessary, for, in view of the relatively large number of universally well-known plant physiologists in Great Britain, we should prefer to see such a text-book written for our own universities, although it must be granted that it is difficult to conceive of an average syllabus for the subject, at present. We have our own familiar books, useful, however, only to the research worker for reference, and too exhaustive to be of any value even to the honours student. This probably leads to the state of affairs in the botany schools of British universities, where the student specialises at far too early a stage.

Therefore this book should be welcomed if only as a possible means of stabilising the erratic subject. It is written by a distinguished physiologist who himself specialises in the water relations of the plant ; but he has not allowed such authority to undermine the value of his book by giving it too much prominence. The book thus remains a comprehensive though introductory work to the subject of vegetable physiology. The first part deals with

the absorption of matter and energy in which photosynthesis, the nitrogen cycle, and other growth factors receive adequate consideration. Water relations are examined in the second part from water absorption to transpiration. The third part considers the energy question in all its aspects, and growth movement and reproduction take up the fourth part.

The whole work is written in an attractive style and is well illustrated. All the familiar theories and hypotheses which pervade plant physiology to an inordinate degree are mentioned, but not overworked. British, American, and other physiologists are given a fair hearing. The excellent and well-balanced choice of material, the masterly way with which it is dealt, and the reference books and periodicals mentioned in an appendix, all make the book a splendid acquisition to plant physiological literature, and one to be recommended to students of the subject up to degree standard.

Annual Reports on the Progress of Chemistry for 1930. Issued by the Chemical Society. Vol. 27. Pp. 389. (London: The Chemical Society, 1931.) 10*s.* 6*d.* net.

THE Annual Reports for 1930, issued by the Chemical Society, comprise reviews in the following fields: general and physical chemistry (C. N. Hinshelwood); inorganic chemistry (H. Bassett); organic chemistry (aliphatic, E. H. Farmer; homocyclic, G. M. Bennett and A. W. Chapman; heterocyclic, S. G. P. Plant); analytical chemistry (J. J. Fox and B. A. Ellis); biochemistry (A. C. Chibnall and J. Pryde); geochemistry (A. F. Hallimond); radioactivity and subatomic phenomena (A. S. Russell); and the electrical conductivity of solutions (Sir Harold Hartley, O. Gatty, W. A. Macfarlane, and D. M. Murray-Rust).

It is customary to endeavour in these reports to present a fairly detailed picture of development in phases of the science, rather than to attempt an annual catalogue of even the more outstanding papers in every branch of pure chemistry. They are, in fact, reports rather than summaries, and are in consequence both readable and instructive. Thus the first chapter deals *inter alia* at some length with the quantum mechanical treatment of chemical forces, with the elementary processes of chemical change, and with chain reactions, while it intentionally leaves certain equally important matters for more profitable discussion on a future occasion.

The reporter on inorganic chemistry protests with justice against the tendency towards multiple publication, whereby the journal literature is distended unnecessarily. In the report on analytical chemistry, attention is directed to recent advances in the utilisation of physical methods for analytical purposes, and developments in micro-analysis are mentioned. The report on subatomic phenomena and radioactivity reviews work published in 1929 and 1930, most of which has been physical in character. The main object of the report on the electrical conductivity of solutions, which deals chiefly with researches carried out between 1920 and 1930, is to show how far the Debye–Hückel theory is in accord with the results of conductivity measurements. A. A. E.

Our Catkin-bearing Plants: an Introduction. By H. Gilbert-Carter. Pp. xii + 61 + 17 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 4*s.* 6*d.* net.

THE object of the author in writing this book was to provide a short and concise account of the catkin-bearing trees that could easily be understood by students. That he has succeeded in his endeavour is very evident to those who possess an intimate knowledge of the several families to which the term applies. Although in the space at his disposal he was unable to deal with all the catkin-bearing trees that are hardy in the British Isles, his selection of representatives for each family is such that students should have little difficulty in finding living examples either wild or in parks or gardens. In his preface, Mr. Gilbert-Carter is very careful to point out the urgent need for students of botany acquiring a knowledge of living plants by studying them as they grow, instead of contenting themselves with the examination of specimens in the classroom, and that advice cannot be too strongly emphasised. Mr. Gilbert-Carter's descriptions of willows, poplars, elms, birches, oaks, walnuts, and other trees are excellent in every way. They all appear in easily understood language, and on each page there are explanatory footnotes of the scientific terms used. A number of excellent photographs add to the value of the work, which will be found very useful to both teachers and students.

About Science: a Book for the use of Senior Science Students and those who are going to teach Science. By Dr. B. Millard Griffiths. Pp. v + 142. (London: John Murray, 1931.) 3*s.* 6*d.*

DR. GRIFFITHS has written a pertinent little book, and one which ought to interest educationists and students alike. The unassuming title of the work makes it plain that the author had no intention of giving a complete survey of scientific method, though many of his arguments are framed in an original and persuasive way. In his introduction, Dr. Griffiths very rightly complains that students of science are told little or nothing about the foundations upon which science stands, because the foundations of knowledge form a part of philosophy; and he maintains, with equal reason, that such an omission is a handicap for them in life, because it makes it difficult for them to appreciate the relationship of science to literature, history, and art, which are important things in life. So his book is written mainly for the purpose of interesting science students in the more philosophical aspects of science. We wish him success in his attempt. But we would go further, and suggest that students would have everything to gain and nothing to lose if their science curricula were less crowded, and if they were given in exchange an introductory course in mental orientation and the methods of knowledge. T. G.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Mouth-Posture Forms of Phœnician Cuneiform Symbols.

BY the courtesy of M. Virolleaud, the decipherer of the recently discovered Phœnician cuneiform alphabet of Ras Shamra, I have had the opportunity of studying the twenty-nine symbols (including alternatives) which he has identified, and the phonetic values which he attributes to them. It is therefore possible to compare the form of the symbols with that of the mouth posture (or gesture) which produced the sound for which, it is believed, they each stood. The symbols and their phonetic values and Hebrew equivalents are set out in Fig. 1.

Of the twenty-nine symbols, almost every one is suggestive (more or less) of the mouth posture or gesture (for a mouth facing to the left) which produces the sound symbolised. Thus, of the four vowel symbols, that for a (see Fig. 2) represents a flat tongue posture; those for e, é, and i are consistent with progressively higher postures—the middle stroke of the E-like symbol being symbolic of the tongue at mid-height. Compare the successive cross strokes—corresponding with successive elevations of the tongue posture—in the Ogam vowel symbols, Fig. 2. The comparison of the symbols for é and e with the later symbol E may be noted. There is no symbol for o or u, but the symbol for w is quite suggestive of two protruded lips. Of the symbols for the other bilabial sounds—p, b, m, and ph—p is obviously apposite; b is a double closure; m (two strokes forming a right angle) may symbolise a lip closure, but is not consistent with the p and b symbols. The three primary vertical closures—namely, (voiced) g, tongue to soft palate, d, tongue to hard palate, and b, lip to lip—are represented by comparable vertical symbols, of which the bilabial b has monopolised the two-stroke symbol.

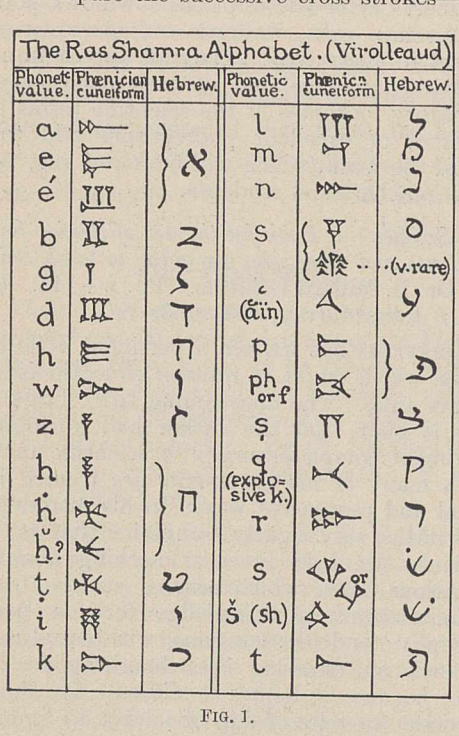

FIG. 1.

The corresponding (so-called) unvoiced consonants, k, t, p, though anomalous in that the strokes are horizontal instead of vertical, are consistent with one another. Compare also the triple-headed sign for the enduring n with the single head of the momentary t-sound. It will be seen that the symbol for n is also closely related to that for d, which is due to a similar tongue posture. The symbol for k may be compared with the funnel-shaped symbol for ʿain—both formed by a (more or less) constricted throat. Of the other consonants due to an elevated tongue posture, l is consistent, so are two at least of the different varieties of s (samekh and tsade) and the z sign (zayin). The rare form of samekh may represent the tongue *between* the upper and lower teeth.

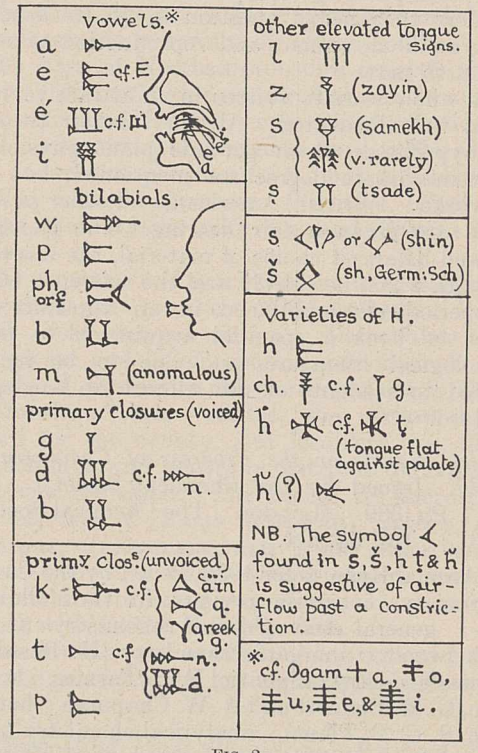

FIG. 2.

There only remain the h sounds, and a ◁-type of symbol found in the letters ḥ (strongly aspirated in the lower throat), ḫ (?), t (flat tongue against palate), ph or f, q (explosive k), s (shin) and š (German sch), and in the symbol for r. The h symbol (three parallel horizontal strokes) is not inapposite to an air flow through the mouth. The three-headed sign for cheth (ch as in German buch) is appropriate for the prolonged sound due to an incomplete g closure—the symbolism of single and triple heads for sudden or prolonged sounds being similar to that already found in t and n, and perhaps also in r. The ◁ sign seems to represent an air flow through a constriction, since all the symbols which contain it (ḥ, ḫ (?), t, ph, q, s, and š) have this characteristic.

The dawning mouth symbolism which I pointed as appearing in Sumerian cuneiform, in a paper (British Association, Sept. 8, 1930) before the publication of the Ras Shamra alphabet, is substantially confirmed by M. Virolleaud's interpretation of it.

Some examples, taken from that paper, are shown in Fig. 3.

In conclusion, I would emphasise that it is not suggested that the scribe who selected the mouth-like cuneiform symbols, whether syllabic or alphabetic, was at all conscious that what he was doing had

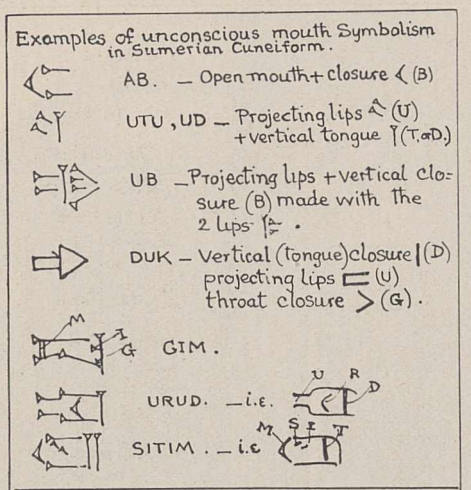

FIG. 3.

any relation to his own mouth gestures. What I do suggest is that, in choosing a symbol for a given sound, he was unconsciously biased in favour of a type of symbol in the making of which his hand followed a track comparable with that which his mouth, tongue, or lips followed in pronouncing the sound of the symbol in question.

R. A. S. PAGET.

1 Devonshire Terrace,
Lancaster Gate, W.2,
April 24.

Mortality among Plants and its Bearing on Natural Selection.

I HAVE followed with considerable interest the recent communications in NATURE of Prof. Salisbury,[14] Prof. Haldane,[1] and Prof. MacBride[2] in connexion with the important matter of mortality among plants and its possible bearing on natural selection.

Prof. Salisbury hopes that other investigators may be induced to record their experiences regarding mortality in young plants, so that it may be possible to judge how general is the phenomenon under consideration. For this reason I refer interested readers to details published by me,[3-13] regarding the mortality in flowers, fruits, young regeneration, and in semi-mature, mature, and over-mature individuals of certain South African forest species—details based upon investigations carried out during the period 1922–27. Close observation of a systematic nature, over a wide area, transect, quadrat, and cultural studies, and instrumental analysis of habitat factors were employed, hence it can be claimed that the data relating to the Knysna forests were collected critically. Furthermore, since 1927 it has been possible to make certain more general observations in subtropical evergreen forest and in savanna vegetation in East Africa; these, while much less critical, in general, support my findings at Knysna.

In the space available I cannot enter into any details, but would refer those interested to the original papers. It is, however, possible to summarise briefly the general nature of the results:

(1) In the species studied—*Podocarpus falcatus* R. Br., *P. latifolius* R. Br., *Olea laurifolia* Lamk., *Platylophus trifoliatus* Don, *Cunonia capensis* L., *Ocotea bullata* E. Mey., *Olinia cymosa* Thunb., *Faurea McNaughtonii* Phill., *Myrsine melanophleos* R. Br., *Apodytes dimidiata* E. Mey., *Gonioma Kamassi* E. Mey., *Virgilia capensis* Lamk.—mortality was found to be greatest in the flowers, fruits, and young regeneration.

(2) Mortality in older-stage regeneration, in saplings, poles, large immature and mature trees, in proportion was much less.

Mortality due to insect and fungus ravages was low in all species investigated, except *Olea laurifolia* and *Virgilia capensis*. In *Olea*—a genus taking probably 200-400 years to attain full dimensions, and possessed of a very hard, small-pored, heavy timber—mortality due to *Fomes applanatus* (Pers.) Gill, *F. rimosus* Fr., and *Stereum hirsutum* Fr. is high, infected trees being broken above ground by windstorms; in addition, owing to its heavy, large crown and flat-root system, this species is wind-thrown in large numbers.

In *Virgilia*, the caterpillar of the Silver moth and parasitic *Cassytha* and *Cuscuta* cause premature death in large numbers.

(3) Considering the host of biotic foes and the physical factors working against the production of regeneration in such species as *Olinia cymosa*, *Platylophus*, *Cunonia*, *Ocotea*, and *Faurea McNaughtonii*, it is somewhat remarkable that there is *any* regeneration resulting from *seed*; undoubtedly all these, except *Faurea*, are assisted in holding ground by the fact that they produce abundant, vigorous coppice.

(4) A careful investigation of the principal biological features of sixty-three of the more important tree and shrub species of the Knysna,[7] together with the ecological conditions of the communities in which these species grow, shows the following factors to be the prime ones responsible for high mortality:

(i.) Inherent low degree of fertility in flowers and fruits; (ii.) defeat in competition for pollination; (iii.) irregular occurrence of flowering and fruiting seasons (some flower crops produce few or no fruits); (iv.) low capacity of germules for lying dormant—young growth often is produced at uncongenial periods, climatic, edaphic, and biotic: conversely, germules of high dormant capacity are subjected to depredations of various enemies; (v.) unsuitable aerial and edaphic conditions, these acting against efficient germination and establishment; (vi.) insects and fungi attacking flowers, fruits, and (vii.) birds and mammals feeding on flowers, fruits, and seeds, and mammals browsing young regeneration; (viii.) certain strong reactions of *biotic* communities upon habitat factors, principal among these being reactions upon light-intensity, soil-moisture content, and *water-supplying power* of the soil (as measured by Livingstone soil-points).

(5) In the East African savannas, mortality in young stages is due not only to large numbers of termites, rodents, and ungulates, but also largely to seasonal or periodic fires that sweep through great stretches of the country.[12] There is, for example, enormous

mortality in the seedlings of the great genera *Brachystegia* (and *Berlinia*), *Acacia*, *Combretum*, *Terminalia*, and *Commiphora*, while loss in first-stage seedling Gramineæ is extremely great in proportion to the numbers produced.

(6) Obviously, mortality factors definitely must influence the general distribution of a species—favouring one, hindering another, and through these reactions automatically favouring or hindering yet other species.

Any careful student working at the ecology of natural communities should be able to adduce data of similar kind.

I have little hesitation in agreeing with Prof. Salisbury that the actual selection among the progeny of individuals seems to take place *largely* in those phases of development showing the *least* divergence morphologically—*the young regeneration stages*. At the same time, I maintain that we must not lose sight of the mortality rates in the flowering and fruiting phases of older plants: this point Prof. Salisbury, of course, has taken into account.

It might not be without interest to record that, unknown to himself, Prof. Salisbury actually was the person who inspired me with a desire to investigate the mortality factors in African vegetation—through the medium of a remark in a letter in 1922: "One is almost accused of having a morbid mind if one emphasises the need for investigation of the factors responsible for mortality in plants".

So much for mortality in plants. Observations made by me since 1922 upon various invertebrate and vertebrate groups in *biotic* communities show that among animals the mortality in the young stages is often extremely great. From general impressions gained in South and East Africa I feel that a statistical study of the mortality rate in infants and younger children, among primitive peoples, too, would support the view that it is in the earlier stages that there is the greatest proportional mortality, apart, of course, from the actually senile classes.

JOHN PHILLIPS.

Kondoa-Irangi,
Tanganyika Territory,
Mar. 1.

[1] Haldane, J. B. S., NATURE, **126**, 883, Dec. 6, 1930.
[2] MacBride, E. W., NATURE, **127**, 55, Jan. 10, 1931.
[3] Phillips, J. F. V., *S. African Jour. Nat. Hist.*, **4** (3), 209-220; 1923.
[4] Phillips, J. F. V., *S. African Jour. Sci.* **21**, 275-292; 1924.
[5] Phillips, J. F. V., *idem*, **22**, 144-160; 1925.
[6] Phillips, J. F. V., *Ecology* (American), **7** (3), 338-350; 1926.
[7] Phillips, J. F. V., *S. African Jour. Sci.*, **23**, 366-417; 1926.*
[8] Phillips, J. F. V., *idem*, **23**, 435-454; 1926.
[9] Phillips, J. F. V., *Trans. Roy. Soc. S. Africa*, **14** (4), 317-336; 1927.
[10] Phillips, J. F. V., *Ecology*, **8** (4), 435-444; 1927.*
[11] Phillips, J. F. V., *Trans. Roy. Soc. S. Africa*, **16** (2), 162-190; 1928.
[12] Phillips, J. F. V., *S. African Jour. Sci.*, **27**, 352-367; 1930.
[13] Phillips, J. F. V., *Bot. Survey Union S. Africa*, 1931; in press.*
[14] Salisbury, E. J., NATURE, **125**, 817, May 31, 1930.

* Contain fuller data.

Thrips tabaci Lind. as a Vector of Plant Virus Disease.

Two years ago, there was discovered in a commercial glasshouse in Cardiff a plant of *Solanum capsicastrum* which was affected with a virus disease in which the symptoms consisted of numerous concentric circles on the leaves. This virus has been investigated at Cambridge; it has been transmitted by artificial means to various hosts, including the tobacco plant, on which it produces a typical ringspot disease.[1]

Further studies have been carried out upon the insect vectors of this ringspot and, out of a number of insects tested, one, *Thrips tabaci* Lind. (Morison det.) has proved itself a most efficient vector of the virus (Fig. 1). This is the first record of plant virus transmission by Thrips in the British Isles.

Recently I received from the neighbourhood of Cardiff some tomato plants also affected with a virus. Experiments carried out upon these plants showed

FIG. 1.—A tobacco plant infected with ringspot by *Thrips tabaci*. Note the concentric rings, surrounded by a halo, developing close to the feeding marks of the insect, which appear as whitish dots.

them to be infected with a very serious virus disease known in Australia as 'spotted wilt'. The disease is transmitted in that country by the Thrips, *Frankliniella insularis* Frankl.[2] The symptoms of spotted wilt on tomato consist of bronzing of the young leaves,

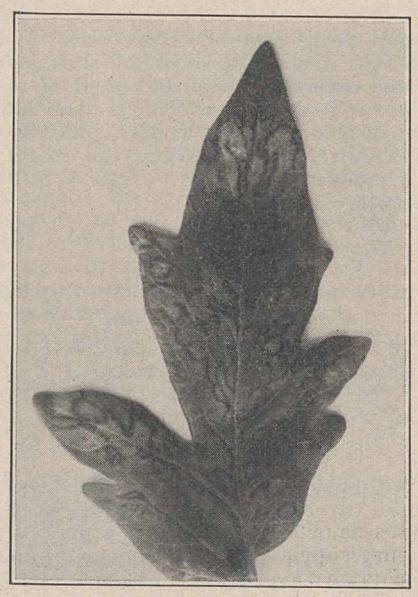

FIG. 2.—Tomato leaf showing one of the symptoms of spotted wilt, in this case ring-like markings on the leaves.

the development of ring-like markings on leaves and fruit (Fig. 2), and cessation of growth—occasionally the plant is killed. Experiments at Cambridge have shown that *Thrips tabaci* transmits this virus also.

The similarity in the mode of transmission between spotted wilt of tomato and the *S. capsicastrum* and

tobacco ringspot, together with certain other factors, suggested the possibility that the two viruses might be the same. A comparative study of the host range and symptom expression on differential hosts of the respective viruses offers almost conclusive evidence that both diseases are due to the same entity. There seems, also, to be little doubt that the dahlia plant acts as another host for the virus. Dahlias affected with a virus disease, which expresses itself in concentric circles on the leaves (Fig. 3), occur commonly in the neighbourhood of tomatoes infected with spotted wilt. Inoculation from such dahlias to tobacco and *Datura* produces symptoms indistinguishable from those produced in tobacco and *Datura* by spotted wilt and the *S. capsicastrum* ringspot.

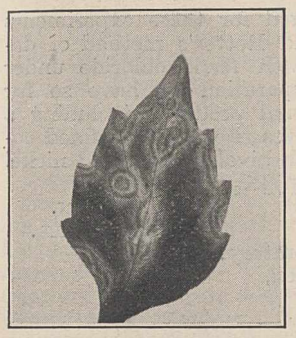

FIG. 3.—Leaf of dahlia infected with the ringspot virus.

The insect vector of tobacco ringspot as it occurs naturally in the tobacco fields of America and elsewhere does not appear to be known. In the light of these new facts, it is worth while to suggest that here also the insect vector may be a species of Thrips; whether there is any connexion between the tobacco ringspot of America and tomato spotted wilt which has recently been discovered there,[3] is still to be proved.

As spotted wilt is a disease of great economic importance in Australia, this announcement of its appearance in the British Isles is of some moment. The Thrips which transmits the virus in England occurs very commonly in glasshouses but, owing to its minute size, is easily overlooked. Its presence can, however, be recognised by the feeding marks of the insect, which consist of silvery-white patches on the leaves accompanied by minute granules of excreta. Without in any way wishing to be an alarmist, I would suggest that tomato growers should be on the look-out for the appearance of spotted wilt in their glasshouses.

I have pleasure in acknowledging my indebtedness to Mr. John Rees, Adviser in Agricultural Botany, University College, Cardiff, who sent me the affected plants.

KENNETH M. SMITH.

Potato Virus Research Institute,
School of Agriculture,
University of Cambridge, May 16.

[1] Smith, Kenneth M., *Ann. Appl. Biol.*, **18**, No. 1.
[2] Samuel, G., Bald, J. G., and Pittman, H. A., *Bull.* 44, Coun. Sci. Indust. Res. Australia.
[3] Doolittle, S. P., and Sumner, C. B., *Phytopath.*, **21**, No. 1.

The Photosensitised Explosion of Hydrogen-Oxygen Mixtures in the Presence of Chlorine.

A RESULT of some interest has recently been obtained relative to the explosion of hydrogen and oxygen by the photosensitising action of chlorine in light from the mercury vapour lamp transmitted by glass. The experiments were initially carried out at a temperature of about 300° C. with the view of testing the possibility of the initiation of a hydrogen-oxygen chain mechanism by the hydrogen atoms produced in the hydrogen chloride synthesis. When 280 mm. of a mixture ($2H_2 + O_2$) was exposed in a cylindrical glass reaction vessel to light from a mercury lamp, no effect was observed. If chlorine in increasing quantities was added, a sharp limit of chlorine pressure was found, above which a practically instantaneous and quantitatively complete explosion of the hydrogen and oxygen to form water occurred. Below this limit a rapid reaction between the hydrogen and chlorine occurred, which was complete in a few minutes, only a trace of water formation, if any, being observable. The limit of chlorine pressure was exceedingly sharp and could be fixed with precision to one or two mm. In the particular apparatus used it was 135 mm. at 300° C. The experiments were then carried out at other temperatures, the quantity of hydrogen-oxygen mixture always being adjusted to a constant molar concentration in the reaction bulb. It was found, contrary to initial expectation, that the hydrogen-oxygen explosion could be sensitised down to room temperature, though a much greater chlorine pressure was required at this lower temperature. In the accompanying graph (Fig. 1) is plotted the limiting

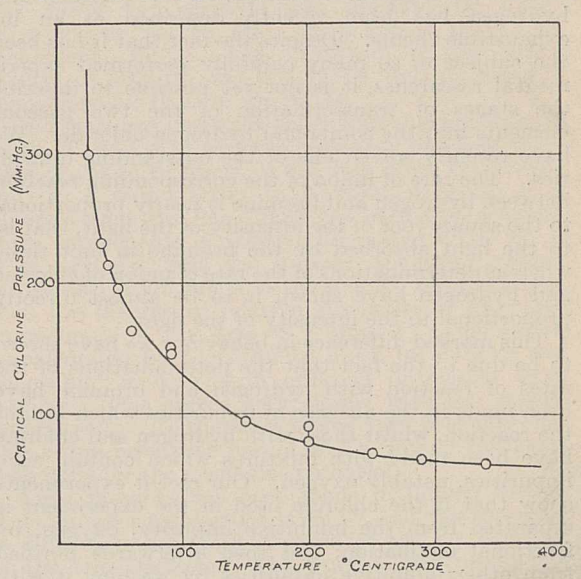

FIG. 1.

chlorine pressure, reduced to 0° C., required to sensitise the explosion of ($2H_2 + O_2$) at constant molar concentration corresponding to a total pressure of 156 mm. at 0° C.

At constant temperature, the limiting chlorine pressure is, roughly, directly proportional to the total pressure of the system, but variation of the hydrogen-oxygen ratio does not markedly affect the limit.

The explosions at the higher temperatures were sharp but not violent, and nearly quantitative. At the lower temperatures they were never complete, and often seemed to partake of the character of a violent detonation.

It is clear that the photosensitising function of the chlorine cannot be solely attributed to the initiation of reaction centres for the hydrogen-oxygen reaction. These, in any case, would be incapable of projecting reaction chains at low temperature. More probably its function is twofold. We may suppose that in the first instant of illumination there is a rapid reaction of hydrogen with chlorine, and that some small element of the system is adiabatically raised to the explosion temperature of hydrogen and oxygen. The hydrogen atoms of the hydrogen-chlorine chains then form plentiful starting-points for the hydrogen-oxygen chains, and the combination of hydrogen and oxygen spreads out from this point by flame propagation.

This view is borne out by the fact that at a given temperature the explosion always appeared to be connected with a Draper effect (pressure increase), of

limiting magnitude in the mixtures with just less than the critical chlorine pressure. Further, while the explosion was more usually apparently instantaneous on admitting the light, there was sometimes a delay of about one second in mixtures close to the limit, when a Draper effect of similar magnitude was observable.

A more detailed account of this reaction and a theory of the kinetic mechanism will appear at an early date.

R. G. W. NORRISH.

University Chemical Laboratory,
Cambridge, April 29.

Photochemical Interactions of Hydrogen with Chlorine and Bromine.

THE photochemical interaction of chlorine and hydrogen has been recently described as an inexhaustible theme. Despite the fact that it has been the subject of so many carefully performed experimental researches, it is not yet possible to describe the stages of transformation of the two gaseous elements into the compound hydrogen chloride. We have recently solved one of the outstanding difficulties. The rate of union of the corresponding reaction between hydrogen and bromine is nearly proportional to the square root of the intensity of the light, that is, to the light absorbed by the bromine in unit time, whereas determinations of the rate of union of chlorine and hydrogen have shown it to be almost directly proportional to the intensity of the light.

This marked difference in behaviour we have shown to be due to the fact that the determinations of the rates of reaction with hydrogen and bromine have been made in the absence of impurities which inhibit the reaction, whilst those with hydrogen and chlorine have been made with mixtures which contain such impurities, notably oxygen. Our recent experiments show that if the chlorine used in the experiment is separated from the inhibitive impurity, oxygen, by fractional distillation, and then afterwards purified from other inhibitive impurities by washing it with pure water, the rate of reaction in question is, like that of the reaction between hydrogen and bromine, no longer directly proportional to the intensity of the light, but more nearly to its square root. Moreover, it was shown in this laboratory by E. R. Boller, almost two years ago, that if a mixture of hydrogen and bromine contains a very small quantity of nitric oxide—an impurity which had previously been shown to be a powerful inhibitor—the rate of formation of hydrogen bromide became proportional to the intensity of the light. Therefore, so far as the influence of the light is concerned, these two analogous photochemical changes show the expected correspondence.

D. L. CHAPMAN.
F. B. GIBBS.

Leoline Jenkins Laboratories,
Jesus College, Oxford,
May 9.

Optical Activity dependent on Co-ordinated Nickel.

IN continuation of our researches on co-ordination compounds containing $\alpha\alpha'$-dipyridyl (dipy) we have prepared the following pink complex nickelous salts: the chloride $[Ni\ 3dipy]Cl_2, 6H_2O$; the corresponding hexahydrated bromide, iodide, and nitrate, and the thiocyanate $[Ni\ 3dipy](CNS)_2, 3H_2O$.

From the chloride and ammonium *d*-tartrate was obtained a readily soluble dextrorotatory tartrate, $[Ni\ 3dipy]C_4H_4O_6, 6H_2O$, which on double decomposition with ammonium chloride furnished an optically active tris-$\alpha\alpha'$-dipyridyl nickelous chloride. When viewed in the polarimeter illuminated by a mercury arc using the yellow line, a 0·5 per cent aqueous solution of this chloride in a 2 d.cm. tube gave a maximum rotation of +5·5° which at 20° decreased to +0·08° in one hour. The rate of diminution of optical activity between these limits was that required for a unimolecular reaction. The maximum activity corresponds with a specific rotation $[\alpha] + 550°$ and with a molecular rotation $[M] + 3877°$.

Analogous complex salts have been obtained with bivalent manganese and similar cobaltous compounds are under examination.

The $\alpha\alpha'$-dipyridyl required for these experiments was obtained by Hein and Retter's method of dehydrogenating pyridine with ferric chloride under pressure, and in this preparation we have so far isolated some ten additional products, including a tripyridyl (tripy) which gives rise to well-defined co-ordination compounds with bivalent iron and nickel of the general type $[M\ 2tripy]X_2$.

G. T. MORGAN.
F. H. BURSTALL.

Chemical Research Laboratory,
Teddington, Middlesex,
May 16.

Emission Bands in the Mercury Spectrum under Low Excitation.

IN a letter published under the above title in NATURE of May 2, it was stated that the series of bands which appear in absorption of the unexcited vapour in the region from λ2943 to λ2614 could be obtained in fluorescent emission by exciting with the iron arc in the region on the long wave side of the resonance line λ2537. It is not necessary to excite close to the resonance line in order to get them. This band series accordingly forms part of what I have called the 'wing effect'.

A further very definite result is now to be communicated. The 'core effect', that is, the fluorescence obtained when stimulation is by the exact wave-length of the atomic resonance line as given by a cooled mercury lamp, also includes a band series in the same region of the spectrum, but it is not identical with, or, so far as can be seen at present, definitely related to, the previous band series forming part of the wing effect.

It is identical with the series which I formerly measured in electrically stimulated vapour.[1] I then called it the emission series of the less refrangible region, to distinguish it from the other series in the same region which had only been obtained in absorption of the unexcited vapour. These names are no longer distinctive, and I shall speak for the present, and quite provisionally, of the core series and the wing series, according to the mode of excitation in fluorescence.

The wing series is related to the apparently continuous maximum around λ3300 at its tail end by the fact that both are greatly enhanced by superheating the vapour.

The core series, on the other hand, seems to be related to the apparently continuous maximum around 2650 at its head, which latter forms part of the core effect, but not of the wing effect. Neither the core series nor the maximum 2650 at its head are at all enhanced by superheating.

These various relations come out very strongly in the photographs, which it is hoped to reproduce, and which will make them clearer than a short written account can be expected to do.

RAYLEIGH.

Terling Place,
Chelmsford, Essex,
May 25.

[1] *Proc. Roy. Soc.*, A, vol. 116, p. 703; 1927.

Fine Structure in the Arc Spectra of Bromine and Iodine.

Bromine.—The fine structures of a number of bromine arc lines have been previously reported by Hori.[1] By assuming that the lines λλ6632, 6560, 6351, 6149 have identical structures, De Bruin[2] inferred that the nuclear spin is $\frac{3}{2}$. The fine structure measurements have been considerably extended, using a high frequency (15 megacycles) electrodeless discharge in pure bromine vapour and a Fabry-Perot interferometer. All the observed structures arise from the $4p^4 5s$ electron configuration, as was to be expected. Although the lines employed by De Bruin have not identical structures, as he supposed, the value of $i = \frac{3}{2}$ has been confirmed. There is evidence that the two isotopes of bromine (79, 81) have the same nuclear spin.

Iodine.—Fine structures have been previously recorded only in the iodine spark lines,[3] but by employing similar experimental arrangements to those used for bromine, fine structures have been observed in the region λ4700–λ8000. The arc lines are mostly regular quartets and sextets degrading to the violet in both intensity and interval. The simple regularity of the structures is such that they are obviously characteristic of only one j term in each line. The observed structures arise from the $5p^4 6s$ electron configuration, that is, that corresponding to the $4p^4 5s$ in bromine. This is in agreement with the partial analysis of the spectrum made here by S. F. Evans (unpublished). As $2i + 1$ is the maximum multiplicity attainable, the existence of sextet terms proves that i is at least equal to $\frac{5}{2}$, which had been previously inferred from the absence of appreciable alternating intensities in the absorption band lines of I_2.

Since with j less than i the full multiplicity is not attained, the application of the interval rule must decide the value of i (in the absence of Zeeman effect measurements). The best line observed is λ4862, which is a quartet and thus involves $j = \frac{5}{2}$ in the $5p^4 6s$ term (this is confirmed by the analysis). The intervals are 123, 103, 83 (cm.$^{-1} \times 10^{-3}$), that is, $6 \times 20{\cdot}5$, $5 \times 20{\cdot}6$, $4 \times 20{\cdot}7$. A value of $i = \frac{5}{2}$ must be invoked to fit these exact ratios (6 : 5 : 4), and this value is supported by the interval ratios in other lines.

The most probable values of i for the halogens are shown in the table below :

Halogen . . .	Fluorine.	Chlorine.	Bromine.	Iodine.
Number of Protons	19	35 (37, 39)	79, 81	127
Nuclear Spin . .	$\frac{1}{2}$	$\frac{5}{2}$	$\frac{3}{2}$	$\frac{5}{2}$

No apparent regularity exists, but the large and small i values are associated with a single isotope. Full details of the fine structure measurements will be published elsewhere.

S. TOLANSKY.

Physics Department, Armstrong College
(Newcastle-on-Tyne),
Durham University, May 5.

[1] Hori, *Mem. Coll. Sci. Kyoto*, vol. 9, p. 307 ; 1926.
[2] De Bruin, NATURE, Mar. 15, 1930, vol. 125, p. 414.
[3] Wood and Kimura, *Astroph. Jour.*, vol. 46, p. 181 ; 1917.

The Resonance Potential of Trebly Ionised Bismuth.

USING the known data of the spectra Hg I,[1] Tl II,[2] and Pb III,[3] and extrapolating by means of the irregular doublet law, the predicted values of the wave numbers of the important combinations $6s6s\ {}^1S_0 - 6s6p\ {}^3P_1$ and $6s6s\ {}^1S_0 - 6s6p\ {}^1P_1$ of Bi IV are approximately 76,000 and 115,000.

In a list of wave-length measurements of the vacuum spark of bismuth in the Schumann region, for which I am indebted to Dr. R. J. Lang, there are very strong lines at 75923 (λ1317·12 A.) and 114601 (λ872·59 A.). If these are assumed to be the above-mentioned combinations, then $6s6p\ {}^3P_1 - 6s6p\ {}^1P_1$ would be 38678. A distinctive feature of the spectra Hg I, Tl II, and Pb III is the appearance with great intensity of lines arising from intercombinations between singlet and triplet terms. One would therefore expect to find the wave number difference 38678 recurring a number of times in the Schumann region. At least five pairs of lines with this difference have been found in approximately the expected positions. However, in spite of this apparent corroboration, I have been somewhat doubtful of the validity of the foregoing identification, because the line 75923 had already been included by Lang[4] in a scheme for Bi III. In a recent paper[5] by McLennan, McLay, and Crawford on the spark spectra of bismuth, the line 75923 finds no place in the scheme for Bi II or for Bi III.

Still more significant evidence that this line belongs to Bi IV, and is in fact the resonance line $6s6s\ {}^1S_0 - 6s6p\ {}^3P_1$, is to be found in the data given by Arvidsson[6] in a recent letter to NATURE, in which it is reported that the line 75923 has been resolved into three components of relative intensities 6 : 5 : 5. If it is assumed that the nuclear quantum number of bismuth is 9/2 and that the $6s6s\ {}^1S_0$ term is single, then the theoretical relative intensities of the three components of the $6s6s\ {}^1S_0 - 6s6p\ {}^3P_1$ combination as calculated by the formulæ given by Pauling and Goudsmit[7] is 6 : 5 : 4 in order of decreasing wave number. This agrees very closely with the experimental ratio. It therefore seems very probable that this is the resonance line of Bi IV, giving the value 9·36 volts for the resonance potential.

Some progress has been made in finding further wave number regularities in Bi IV, but the spectrum is difficult to interpret because of the $j\ j$ coupling of the two electrons. The work is still proceeding and it is hoped that a detailed report will be made elsewhere at a later date.

STANLEY SMITH.

University of Alberta,
Edmonton, Canada,
April 10.

[1] Fowler, A., " Series in Line Spectra ", p. 148 ; Fleetway Press (1922).
[2] McLennan, J. C., McLay, A. B., Crawford, M. F., *Trans. Roy. Soc., Canada*, **22**, p. 241 ; 1928. Smith, S., *Proc. Nat. Acad. Sci.*, **14**, p. 951 ; 1928.
[3] Rao, K. R., Narayan, A. L., Rao, A. S., *Indian Jour. Phys.*, **2**, p. 467 ; 1928. Smith, S., *Proc. Nat. Acad. Sci.*, **14**, p. 878 ; 1928.
[4] Lang, R. J., *Phys. Rev.*, **32**, p. 737 ; 1928.
[5] McLennan, J. C., McLay, A. B., Crawford, M. F., *Proc. Roy. Soc., A*, **129**, p. 579 ; 1930.
[6] Arvidsson, G., NATURE, **126**, p. 566 ; 1930.
[7] Pauling, L., and Goudsmit, S., " Structure of Line Spectra ", p. 140 and p. 214 ; McGraw-Hill (1930).

Impact Figures on Polished Rock Salt Surfaces.

IF a small steel ball is dropped from a height of a few inches on a polished rock salt surface, the imprint of the ball on the crystal surface remains as a circular depression of one or two millimetres in diameter. The surface is deformed, however, over a region many times the area of the circular depression. If an optical test plane (a piece of ordinary plate-glass will do) is placed on the crystal and the surface examined in monochromatic light, the interference pattern shows a number of families of 'loops' extending away from the imprint of the ball.

If the crystal surface approximates a 1, 0, 0 plane, the depression will be surrounded by eight sets of

loops, as shown in Fig. 1. A 1, 1, 0 plane also shows an eight 'looped' figure, but in this case the pattern is no longer symmetrical but appears as Fig. 1 would appear if the page was stretched to $\sqrt{2}$ of its present width. This, as well as the fact that a 1, 1, 1 plane shows a six 'looped' figure, is to be expected from the atomic spacing in these planes.

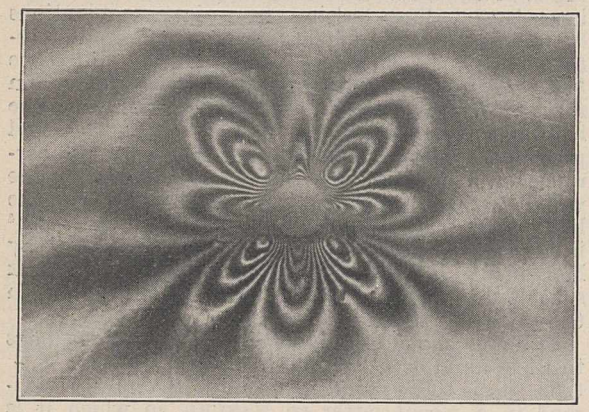

FIG. 1.

The loops, of course, are simply contours either of depressions or of elevations of the crystal surface. In Fig. 1, the borders are parallel to the sides of the elementary crystal cube; in this case, families of loops having axes parallel to the sides of the cube represent depressions, while those with axes parallel to the diagonals represent elevations.

SINCLAIR SMITH.

Mount Wilson Observatory,
Pasadena, California,
April 23.

Photographic Effects of Vitamins A and B.

THE biological effect of vitamins is well known, but their chemical nature is most elusive. We have recently been investigating their physical effects, and some results obtained may be of interest.

Photographic plates were covered with aluminium foil and letters were cut out of the foil covering the glass side. Extracts of vitamins A and B, biologically tested, were used to paint the letters VA and VB on the glass side. The vitamin A used was ether extract of dried ox-liver, the solvent being removed in nitrogen. Vitamin B was water extract of purified brewers' yeast. The plates, wrapped in black paper, were left for three days; on development, clear images of the letters were obtained.

To confirm the results, vitamins A and B were sealed in two separate glass tubes, and the experiment was repeated. Very sharp images were again obtained.

An extract of vitamin A prepared in a Paris research laboratory was investigated in the same way. It also gave positive results.

Vitamins destroyed but not carbonised did not affect the plates.

Two solutions, one ten times stronger than the other, of vitamin A in paraffin oil and vitamin B in water, were compared. The plates showed clearly difference in strength. Control experiments of pure solvents gave unfogged plates.

It is interesting to note that the effect of vitamin B is similar to that of vitamin A, although the two vitamins are of different origin.

The experiments were repeated several times, and the same definite effect was present. We are proceeding with our research into these effects.

SOPHIE BOTCHARSKY.

London.

ANNA FOEHRINGER.

Laboratoire d'Électrochimie,
École des Hautes Études, Paris.

Isomeric Thiosulphuric Acids.

IN continuation of an investigation of thiosulphatocobalt complexes,[1] it has been found possible to isolate two very interesting isomeric modifications of thiosulphato-penta-cyano cobaltic acid $H_4[(CN)_5 . Co . S_2O_3]$; the difference between which lies in the constitution of the thiosulphate radical. The two acids differ in their chemical behaviour and form two corresponding series of crystalline isomeric salts. Both the complex acids hydrolyse in warm water, liberating two different varieties of free thiosulphuric acid. One of the latter decomposes as usual into sulphur dioxide and sulphur, whereas the other gives rise to sulphuretted hydrogen and sulphuric acid. This furnishes a positive and direct evidence of the existence of two isomeric forms of thiosulphuric acid, and has indeed led to their isolation in solution. The two different ways in which the constitution of thiosulphuric acid has been represented in many text-books correspond, therefore, in reality to these two isomeric forms. In fact, Piccard and Thomas[2] obtained an indication of the synthesis of thiosulphuric acid from sulphur trioxide and hydrogen sulphide.

The constitution of the two forms is best represented by the well-known formulæ:

$$S{=}SO\begin{matrix}OH\\OH\end{matrix} \quad \text{and} \quad O_2S\begin{matrix}OH\\SH\end{matrix}$$

PRIYADARANJAN RÂY.

University College of Science,
Calcutta, April 15.

[1] Rây, *Jour. Ind. Chem. Soc.*, **4**, 64, 326; 1927.
[2] *Helv. Chim. Acta*, **6**, 1032; 1923.

Ravens Flying Upside-down.

IN NATURE of Dec. 20, 1930, p. 956, Mr. Sydney Evershed has described an observation relating to ravens flying upside-down. From this note one gets the impression that the habit is rather rare; from my observations, however, this is not the case. For some years I have had the opportunity of seeing many hundreds of these interesting birds in Iceland, where the number of individuals of this species apparently is rapidly increasing, probably because the refuse from the fisheries affords food for very large numbers of them. In some places—as Westmannaeyer and Hnifsdal in Isafjord—I have seen about a hundred of these birds performing evolutions in the air round favourite resting places, and here it is a rather common appearance to see the birds flying upside-down in the manner described, though I do not think I have seen them flying for so long a distance as 1000 metres, as recorded by Mr. Evershed. The upside-down flight is, so far as I can judge, not particularly connected with the courtship, though it is most often seen at the time of courtship, when air acrobatics are especially performed by the birds.

Å. VEDEL TÅNING.

Copenhagen,
May 4.

Photosynthesis and Solution in Formation of Coral Reefs.*

By Prof. J. STANLEY GARDINER, F.R.S.

THE old writers on coral reefs such as Chamisso, Darwin, Dana, Semper, L. and A. Agassiz, Murray, and, perhaps, Wharton could scarcely be labelled as belonging to any particular science in a modern sense. In contrast, the investigator of the 'coral reef problem' to-day is usually either a geologist or a zoologist, for the botanist has not understood, up to the present, that he may claim an equal partnership. Unfortunately, the geologist rarely has sufficient knowledge of biology, although well acquainted, perhaps, with the shapes of organisms and the possibilities of earth movements. The biologist, on the other hand, has views as to the disappearance of Gondwanaland; but his writings indicate his incredulity as to any suggested existence of similar earth fluctuations to-day. The mobile crust of the earth allows of movements in the earth's surface; but these are more often supposed to be activated by chemical processes in the inner material than by alterations in the land and sea above. In addition, there are the physical and chemical reactions of the water of the ocean, and the possibilities of these, little understood even to-day, are almost unconsidered.

I claim that there are two primarily biological forces found together on all coral reefs and assisting to shape them. Photosynthesis gives an extraordinary biological efficiency to the reef-building organism and, as a result, causes an incredible rapidity of formation of limestone and thus of reef growth. This is countered by the solution of limestone by boring organisms, superficially appearing small in itself, but actually a main factor in that fight between death and life that is visible on every reef.

The photosynthetic method of carbon feeding in most plants, depending on their chlorophyll, is too well known to require further reference. There are many halophilous phanerogams which hold the sand of surface reefs together and thus add materially to their permanency. Bare rock surfaces are covered by about forty species of low-growing, mostly blue-green algæ that prevent their destruction.

A few seaweeds such as *Halimeda*, with precipitated lime in their fronds, assist in forming deposits in the sea and may even be the chief material filling up parts of lagoons. But the main reef-builders are about twelve species of five genera of Lithothamnioneæ, which possess dense skeletons of lime in the composition of which magnesia up to about 20 per cent may play a part. Only a thin surface film is living, the light being unable to penetrate deeply through cells which are ever depositing lime in their walls. The encrusting forms thicken slowly, but push out their edges rapidly, more than 20 mm. being recorded in four weeks. *Goniolithon*, as finely branching growths, affects the surfaces of barrier and atoll reefs, behind the actual edge zone, which is covered almost entirely by incrusting *Lithophyllum*, pushing up into branching but rounded masses. This genus is abundant in places down to 10 fathoms on the seaward slopes, but gradually *Lithothamnion* becomes the dominant plant-builder, its deeper species, small-branched but rather delicate detached growths, often completely covering the whole surface. All genera belong to the encircling reef, atoll, or barrier, not occurring on lagoon shoals or floor.

The sedentary animal builders are all cœlenterates. Of first importance are corals (*Madreporaria*), the builders here being all massive or branching forms, each a single animal but with vast numbers of feeding and breeding organs in its polyps. Then there are the stinging hydroid (*Millepora*) and the blue coral (*Heliopora*) which grow generally to form massive upstanding plates, the animal matter forming a surface film perpetually depositing its lime below. The last is an alcyonarian and there must be added a series of forms from this group, the organ-pipe coral (*Tubipora*) and the soft corals (*Sarcophytum*, *Sclerophytum*, *Lobophytum*, and *Xenia*), all of which form their lime in spicules which may play a considerable part in sand formation.

In animals, feeding is not so simple as in plants, and consists of three processes concerned with oxygen, carbon, and nitrogen. Oxygen seems to be the hydrogen-acceptor in the respiration of both animals and plants. A complication here is the considerably greater motility of animals, even in sedentary forms, and this implies the necessity of a more bountiful supply of oxygen, as well as the casting out of waste products. The last has been met by the evolution of nephridial kidneys in higher animals, but the excretion is probably a function of all free surfaces in sedentary cœlenterates, calling for a special water circulation to remove such poisonous materials.

These special difficulties in respect to the nutrition of coral-building sedentary animals in tropical waters have been met by the 'taming' of unicellular green flagellates (*Zooxanthellæ*) by the polyps—or the polyps being adopted by such plants—housing them as symbionts in their endoderm cells. In 1896, at Rotuma I found corals from which oxygen was being given off, and subsequent observations in the Maldives and on the Sladen Expedition convinced me of the importance of this phenomenon, of which Dr. C. M. Yonge, of the Great Barrier Reef Expedition, has recently given experimental proof. Such oxygen production on the part of these symbiotic algæ implies the formation of much carbohydrate material, and in the absence of specially rapid fission in the algæ we may infer the passage of much of this to the polyps. Thus we may suppose the alga to be largely responsible both for the oxygen and for the carbohydrates required by the polyps. But it is possible that the alga is of even greater importance as a scavenger which

* Substance of a lecture before the Linnean Society of London on Mar. 19.

thrives on the waste products of its animal. The utilisation of the animal's carbon dioxide is probably of small importance, for its disposal is easy, and the polyp during the daylight, in which the alga's chlorophyll is alone functional, is largely quiescent. The utilisation of the animal's nitrogenous waste products probably provides the alga with its sole available source of nitrogen, the other salts required quite likely existing as such in the protoplasm of the polyp. In this connexion, the absence of other non-infected kinds of cœlenterates and of Polyzoa, from the shallower waters of coral reefs, is significant.

The depth from which our coral reefs of to-day grow is that at which photosynthesis is active. This is about 60 fathoms for plants and 45 fathoms for the plant animals as maxima. These depths fluctuate in accordance with the turbidity of the water, which increases in the proximity of land masses and decreases in the Pacific and Indian Oceans from east to west, probably in correlation with the eastern influx of polar waters. This turbidity is largely due to unicellular algæ, and a second factor is introduced by their utilisation of any carbon dioxide in the water to the detriment of reef-building organisms. That plants would be affected is clear and it is hard to believe that polyps would provide sufficient carbon dioxide both for their symbionts and for their lime skeletons. On reefs, the presumption is that their extra requirements are met by their algæ breaking up the bicarbonates of the lime-saturated sea-water; thus amorphous lime may be found precipitated on the tissues of the free parts of the polyps. Where there are active water movements, it is presumably swept away in the consequently heavy mucous lubrication of the surfaces; but in the deeper lagoons and in other areas of still water, the lime clings to the polyps and kills them. This, up to the present, is the only suggestion which explains why lagoons have singularly little coral and algal growth on their floors, and that upgrowing shoals do not occur in lagoons except in the proximity of the passages into them.

The rapidity of growth of coral-building organisms is well known and independent estimates agree that a reef might grow up from 14 fathoms to the surface in a thousand years; but the speed of its deposition is not material to our hypothesis. The horizontal outgrowth of reefs is considerable; but it depends on the extension of their foundations by their own talus material. On the earth's crust below the reef, there is a weight of $2\frac{1}{2}$ times that of the sea-water replaced by the coral reef, an increase of 150 per cent. Can these or the analogous weight alterations found in the formation of many geological strata be reacting on the earth's crust to produce subsidences? We can give no reply, for we have few data as to the strength of the earth's crust and as to the detailed topography of the oceanic slopes off coral reefs; but no one with experience of the Pacific Ocean can doubt the activity of crustal movements, even to-day. This question must be tested and it is not beyond the scope of the geophysicist, who should be able to tell us at what depths, below atolls, limestone is underlaid by igneous and other rocks.

Solution of limestones is largely a physico-chemical matter and this side has been sufficiently dealt with in respect to the coral reef problem by many workers. Lagoons are supposed to be formed by solution and by the removal of mud in suspension. Generally organisms are only mentioned as providing carbonic acid gas by their decay to help the solution. The mud is accepted as an expected formation wherever land or reefs occur, few observations on its production having been made. Yet this is of great importance, since it entails the study of the decay and grinding up of coral rock in which nearly all the facts are biological, current action not being considerable on reefs that are clothed by living organisms. Every mass of limestone is visibly bored into by organisms—molluscs, worms, sipunculids, sea urchins, and certain barnacles. Some of these grind their tunnels, while others dissolve them out, most using both methods.

As a result of the examination of many specimens, I believe it is seldom that more than 40 per cent of the mass is thus removed by these animals. Larger figures were obtained from sponges, but on the whole they are not such important boring organisms in tropical as in temperate seas. But on coral reefs, I find that all limestones, massive rocks, corals, nullipores, stones, and pebbles are penetrated by a network of the finest threads, which are clearly algal in nature. These are the chief boring organisms of coral reefs and the primary cause of the reduction of limestone to pebble, sand, and mud, a whole sequence of organisms aiding them. They bore solely by solution, and while molluscs probably bored primarily for protection, many other forms may well have been seeking for the nutriment these algae provide.

In living corals, the boring hyphæ advance in the corallum so close to the polyps that we can even imagine the latter being thrown down to fend them off. In nullipores, they enter the skeleton less easily and their action is slower and less marked. I have tried by various means to estimate their actions, but the error factor is too great to make any figures of real value, partially because I have not found bored and unbored parts of the same coral skeleton. In undisintegrated coral skeletons, of which the polyps were living, our figures vary from 10 to 60 per cent of the coral dissolved away; while in dead corals of the same species the figures are 40 to 83 per cent. The last figure is exceptional, because usually the coral breaks up into pebbles long before it becomes so reduced; but the boring algæ still live in these, until smothered by mud or consumed by sand-feeding organisms. In any case, the solution of limestone by boring algæ is a primary feature in shaping coral reefs and one deserving of the closest investigation by modern methods applied upon the reefs themselves. In particular, it would be useful to ascertain whether the importance of these forms, observed by me on Maldivan material, is applicable generally to the formation of all coral reefs.

The Nature and Origin of Ultra-Penetrating Rays.

THE meeting of the Royal Society, held on May 14, was devoted to a discussion on ultra-penetrating rays. In his opening address * Prof. H. Geiger outlined three main lines of experimental investigation, referring first to the results of direct absorption measurements, and in particular to the very beautiful measurements of Millikan and Cameron, and of Regener, which together furnish a complete series of ionisation measurements from an altitude of 5 km. down to a depth of 240 metres below the surface of Lake Constance. Since, in traversing 240 m. of water, a particle will make many hundreds of collisions with oxygen nuclei, it is highly improbable that the ionisation at these great depths is produced by corpuscular radiation. On the other hand, the shape of the lower portion of the absorption curve is in good accord with the assumption that the ionisation is produced by photons. Appropriate analysis yields the value $\mu = 0{\cdot}02$ metre^{-1} for the true absorption coefficient of the hardest component; which, according to the generally accepted formulæ, corresponds to a quantum energy of about $3{\cdot}7 \times 10^9$ electron volts.

According to the Einstein mass-energy relation, the emission of this amount of energy is necessarily accompanied by a loss of mass equal to that of two protons. This fact naturally suggests that the radiation in question may arise through a new type of disintegration, taking place in a heavy nucleus, in which two protons and two electrons unite in self-annihilation. If we assume that the annihilation takes place in free space, then it would appear that momentum can only be conserved during the process by the simultaneous emission of two quanta of equal energy. The appearance of quanta of energy $3{\cdot}7 \times 10^9$ electron volts would in this case signify the annihilation of four protons and four electrons, that is, a helium atom. As is well known, astrophysical data appear to indicate that matter is being annihilated continuously within the stars. There are, however, strong arguments against the hypothesis that ultra-penetrating radiation is of stellar origin.

It was pointed out in discussion by Prof. F. A. Lindemann that only the penetrating radiation generated in the surface layers of the star is able to escape, so that even if the rate of generation of energy at the centre is no greater than at the surface, the amount of energy escaping as penetrating radiation ought to be an infinitesmal fraction of the whole, whereas the energy reaching the earth's surface in the form of the hard component alone is more than 1 per cent of the total energy of starlight. Several attempts have been made to obtain evidence of penetrating radiation coming from the sun. Dr. G. M. B. Dobson referred to the recent investigation by Hoffman and Lindholm, who made a very careful series of measurements extending over about a hundred days, and found that the intensity was 0·5 per cent greater during the day than during the night. Attributing the additional effect during the day to the sun, we obtain a more reasonable value for the ratio of the emission in the form of penetrating radiation to the total emission, but there still remains the problem of accounting for the enormously increased emission of the stars.

If penetrating radiation is of cosmic origin, it is therefore likely to originate not in the stars, but in the extremely diffuse matter in inter-stellar space, a conclusion which might account for the absence of any marked variation of intensity of the radiation coming from different directions in space. It has indeed been a very real difficulty of the hypothesis of stellar origin, that in spite of the relatively high density of matter in the galactic plane, no increased intensity is observed from this direction. Prof. F. Regener ventured to speculate upon the possibility that the radiation which we are observing now comes principally from our own galaxy—but was generated in a previous cycle of the universe, some 10^9 years ago. If the universe is closed, as Einstein supposes, such radiation might be refocused, as it were, upon the galaxy, but with sufficient blurring of the image to account for the observed uniformity of intensity.

Commenting on this communication, Sir Arthur Eddington said he doubts whether the universe is sufficiently accurately spherical for the necessary degree of focusing. Prof. Regener claimed that at least this hypothesis had the merit of doing away with all difficulties concerned with the mode of generation of the radiation, for, in a complete cycle, the physical conditions may have changed entirely, so that interaction between matter and radiation of a kind now unknown may have been possible in a previous epoch. While we may share Prof. Regener's enthusiasm at the prospect of turning back a page in the history of the universe, the immediate line of advance must clearly be to endeavour to reach a solution by extending our knowledge of the universe accessible to experiment.

If helium is being annihilated in interstellar space, it is just possible that the process might be detectable under laboratory conditions. Lord Rutherford described how he had investigated this point by placing a number of cylinders containing helium at a pressure of 100 atmospheres round a high pressure ionisation chamber. The presence of the helium certainly did not increase the ionisation by so much as 1 per cent of that due to penetrating radiation. Since the mass of helium surrounding the chamber was equal to a layer of water 0·4 cm. thick, it is easy to calculate, using Eddington's estimate of the total amount of diffuse matter in interstellar space, that if this matter consisted entirely of helium and was disappearing at the same rate as under the conditions of the laboratory experiment, it would only account for about one-fiftieth of the observed effects of penetrating radiation. While it is possible that the complete annihilation of helium may only take place under the conditions of temperature and pressure existing in outer space, it is well to

* NATURE, May 23, p. 785.

remember that, in ascribing this origin to the hard component of penetrating radiation, we are presupposing the validity of the formula by which the absorption coefficient of the radiation was interpreted. This formula, which only takes into account the scattering of quanta by the extranuclear electrons, has been tested very thoroughly for quantum energies up to two million volts, and found to account accurately for the observed absorption. Is it not likely, however, as Lord Rutherford emphasised, that the more energetic quanta may interact also with the nucleus ?

Although this question is only just coming within the reach of experimental investigation, it appears almost certain that even quanta of two and a half million volts energy show a very marked interaction with the nuclei of the heavier elements. The evidence for this interaction has emerged from a study of the γ-rays emitted by thorium C″. As is well known, when a quantum is deflected through an angle θ by an encounter with an electron, its wave-length is increased by an amount $\Delta\lambda = \frac{h}{mc}(1 - \cos\theta)$. Thus, however great the energy of the incident quantum, the wave-length after scattering through, say, 120° will be greater than 36 X.U. It has been shown by Chao that if thorium γ-rays are allowed to fall on lead, and the absorption curve of the radiation scattered in a backward direction is analysed, there is, in addition, a hard radiation of wave-length about 20 X.U. A more detailed investigation (unpublished), by G. T. P. Tarrant and L. H. Gray, has shown that at a 120°, in addition to the soft scattered radiation, there are also present at least two other radiations of much shorter wave-length, namely, $\lambda \sim 20$ X.U. and $\lambda \sim 12$ X.U. Similar radiations were also found when tin was used as scatterer in place of lead. Moreover, by using a very inhomogeneous source of γ-rays, it was found that only quanta of energy greater than about two and a half million volts were capable of exciting the new radiation.

These facts appear to confirm very fully the conclusions reached independently by Chao, Meitner, and Tarrant from direct absorption measurements, that part (at least 10 per cent) of the absorption of the thorium C″ γ-rays in heavy elements must be ascribed to the nucleus. As the energy of the quantum increases, there is reason to believe that the contribution of the nucleus to the total absorption will become commensurate with that of the extranuclear electrons. It is most important that this point should be settled experimentally, for it is difficult to believe that the ionisation produced at great depths is due to any other than quantum radiation, and even if this radiation is of secondary origin, its wave-length would set a lower limit to the energy of the primary corpuscular radiation. At present this limit is about 4×10^9 electron volts.

The second type of experiment to which Prof. Geiger referred in his opening address is most naturally explained in terms of a corpuscular hypothesis. It consists in observing the simultaneous discharge of two 'tube counters' by a suitable relay system. Since it has been shown experimentally, using radioactive sources, that every β-particle passing through a counter produces a discharge, whereas only about 2 per cent of the γ-ray quanta are recorded, the simultaneous discharge of two counters will, apart from chance coincidences, be taken to indicate the passage of the same particle through both tubes. In the experiments of Bothe and Kolhörster, two counters were arranged vertically above one another, and the number of coincident discharges was noted. The ratio of this number to the total number of discharges of either counter was in rough agreement with the value calculated from geometrical considerations, so that the immediate ionising agent in the case of penetrating radiation has an efficiency in discharging the counter of something like unity. On introducing a 4 cm. block of gold between the counters, a reduction in the number of coincidences of only 24 per cent was observed, which is approximately the reduction that this block would produce in the total ionisation. Bothe and Kolhörster concluded that since, in this case, the corpuscular radiation was of the same penetrating power as the total radiation, whereas throughout the region open to experiment a secondary corpuscular radiation is always observed to be much less penetrating than the quantum radiation which generates it, the ultra-penetrating radiation was corpuscular.

Referring to a possible origin of radiation of this penetrating power, Prof. C. T. R. Wilson pointed out that thunderstorms are capable of generating electrons of energy 10^9 electron volts or even considerably more, and in numbers which should be far more than sufficient to account for the observed ionisation—in fact, the problem is rather to understand why we do not observe radiation of very much greater intensity arising in this way. For, from the known proportion of radioactive atoms in the air, we know that about ten β-particles will be emitted per cubic metre per second, and of these, some will be ejected in such a direction as to be accelerated by the electric field of the thundercloud. From time to time the accelerated β-particle will make a close collision with another electron in which the minimum energy necessary in order that the second electron should be accelerated by the field is transferred to the latter. The number of fast particles thus increases with astounding rapidity—a single β-particle making one close collision every 10 metres would generate 10^{30} particles in a distance of 1 km. Though the currents through thunder-clouds do not reach this figure, the total energy of all the thunder-clouds in action at any instant is about 100,000 times greater than that necessary to maintain the supply of penetrating radiation reaching the earth's surface.

Experiments have been performed, however, which appear to give evidence against the view that penetrating radiation consists of streams of very energetic β-particles. Thus Rossi, and quite recently Mott Smith, using the coincidence counting method, have attempted to deflect the rays by a magnetic field. In each case, the experiment

gave a negative result, though in the experiments of Mott Smith a 10^9 volt electron should have been deflected through 2 cm. on reversing the field—a deflection that would have been easily measurable. Since the momentum of a proton of 10^9 volts energy is only double that of an electron of the same energy, the negative result of this experiment conflicts also with the suggestion of Prof. Geiger that the radiation consists of streams of protons.

Considering that the range of energy open to experimental investigation is only a few million volts, however, it is scarcely surprising that no satisfactory hypothesis can be framed to account for phenomena exhibited by radiation of 1000 million volts energy. L. H. G.

Obituary.

PROF. ALFRED WEGENER.

THE death of Prof. Alfred Wegener, leader of the German expedition to Greenland, has now been confirmed. By this event the sciences of meteorology and geophysics have lost a very valuable worker.

Alfred Wegener was born on Nov. 1, 1880. He studied at the Universities of Berlin, Heidelberg, and Innsbruck, obtaining the degree of Ph.D., at Berlin, with an astronomical thesis. He took part in a Danish expedition to Greenland under Mylius-Ericksen in 1906–8, taking charge of the meteorological work, including upper air observations with kites and captive balloons, and later summarising the observations for publication. He was a brother of Kurt Wegener, well known as a balloonist, and he took an active interest in his brother's work. From 1906 until 1908 the two brothers held the world's record for duration of balloon flight with a flight of $52\frac{1}{2}$ hours.

Wegener accompanied Col. Koch to Greenland in 1911–13. As an officer of the reserve, he served in the German army during the war of 1914–18, and was awarded the Iron Cross of the second class. In 1916 he was appointed to the meteorological service of the German army, and was meteorological adviser on a number of Zeppelin flights. After the War he joined the Deutsche Seewarte at Hamburg, and in 1925 he was appointed professor of geophysics and meteorology at the University of Graz.

Wegener's expedition to Greenland in 1929 was preparatory to the fourth, in which he perished. He set out from Kamarujuk in lat. 71° N., on the west coast, on April 1, 1930, and by the end of July had established a station on the central ice, about 250 miles from the coast. Wegener again set out in September with Dr. Loewe and a party of thirteen Greenlanders, with supplies and instruments for the observers at the central station, and he started with one Greenlander, Rasmus, on the return journey to Kamarujuk on Nov. 1. His non-arrival at the coast caused no uneasiness at first, as he was thought to have stayed at the central station, and it was only in late April that a search party was sent out. Wegener's body was found buried in the snow, but so far his companion, Rasmus, has not been found.

Wegener's contributions to meteorology included a number of papers on the investigation of the upper atmosphere, but his best known contribution to pure meteorology was a text-book, "Thermodynamik der Atmosphäre", which appeared in 1911, and of which a third edition appeared in 1928. This is a particularly valuable book, in that it emphasises the physical aspects of meteorology. At the time of its first appearance it was almost the only text-book which gave a physical account of the processes of weather, and it remains a valuable part of the literature of a subject in which good text-books are rare.

In recent years Wegener has been better known as the author of the theory of 'continental drift', which was set forth in 1915 in the first German edition of "The Origin of Continents and Oceans". Later editions of this book appeared in German in 1920, 1922, and 1929; it was translated into English in 1924, and has also been translated into French, Russian, Swedish, and Spanish. Wegener claims that the continents are rafts of granitic rock floating in a heavier basaltic magma, and therefore free to move relative to each other and to the poles. He maintains that the continents have changed their positions considerably during geological times, and so accounts for the great apparent variations of geological climates and especially the glaciation of regions now within the tropics. The climatological aspects of the theory have been set out very clearly by W. Köppen and Wegener in "Die Klimate der geologischen Vorzeit". It cannot be said that general agreement has been reached on this subject, as can readily be seen by reference to the report of a discussion on this and kindred topics held at the Royal Society on March 27, 1930 (see *Proc. Roy. Soc.*, B, vol. 106, p. 299; NATURE for April 5, 1930, p. 546). Wegener's ideas have, however, stimulated research in a marked degree, and his early death is a great loss to geophysical science.

Wegener's expedition to Greenland was part of a co-ordinated scheme of British, German, and American co-operation in an investigation of the weather conditions over the great inland ice-sheet of Greenland. The British expedition made a similar attempt to that of Wegener to set up a station in the centre of Greenland, but farther south, in the latitude of Angmagssalik. The narrow escape from death of Mr. Courtauld shows the dangerous nature of these attempts to solve the problems of the meteorology of Greenland. It is anticipated that the meteorological results obtained from the centre of Greenland and from the American station at Upernivik, on the west coast, will have important bearings upon the weather of Europe and America, as well as upon the practical problems of possible air-routes to Canada, which was a special subject of study by the British expedition. D. B.

DR. THOMAS ASHBY.

WE regret to record the death of Dr. Thomas Ashby, the leading English authority on the archæology of Rome. Thomas Ashby was born on Oct. 14, 1874, and was educated at Winchester and Christchurch, Oxford, where he took first-class honours in Classical Moderations and Literæ Humaniores. He won the Craven Scholarship in 1897, and in 1906, the year in which he took his doctorate of letters, he was also awarded the Conington Prize.

As Ashby's father resided in Rome, his interests were almost inevitably directed towards the antiquities of the city in which he spent his vacations. Under the guidance of Commendatore Lanciani, at that time the foremost authority on Rome, he became an enthusiastic student of the topography and history of Rome and the Campagna. When the British School at Rome was founded in 1901 he became a student. In 1903, he was appointed Assistant Director, and in 1906 became Director in succession to Stuart Jones. He continued to hold this position until certain administrative changes were made in 1925, and his appointment, which was triennial, was not renewed. Afterwards he resided in Rome without any official appointment. During the War, Ashby served with the Red Cross on the Italian Front, where his knowledge of Italian was invaluable, and afterwards was interpreter to the British Military Mission with the Italian Supreme Command.

Ashby's position as an authority on the archæology of Rome from the earliest times to the Renaissance was universally recognised as unrivalled. His annual contributions to the *Times Literary Supplement* on the year's archæological work in Italy were packed with information concisely expressed, which showed that he had every detail of Italian archæology at his finger ends. His knowledge of his subject was encyclopædic. This characteristic grasp of detail, which, however, never failed to evolve a logically reasoned general plan, was particularly to be remarked in the accounts of his work of exploration which it was his custom to contribute to the proceedings of the British Association at its annual meetings. For many years he carried out excavations on Roman sites in Britain for a Committee of the British Association, and was responsible for their excavation of Caerwent (Venta Silurum).

Ashby was the author of many papers which appeared in the *Papers* of the British School and in the periodicals of learned and scientific societies. In 1927, he published "The Roman Campagna in Classical Times", and revised and edited "The Topographical Dictionary of Ancient Rome" left unfinished by Prof. G. B. Platner. He was the author of several works on the archæology of Roman Italy, of which the most notable was perhaps "The Aqueducts of Ancient Rome". He also published a volume of Turner's studies of Rome in which the letterpress was worthy of the painter's genius, and a book on Italian festivals and folklore. Ashby was elected a fellow of the British Academy in 1927, and since last year had been a research student of Christchurch, Oxford. Those to whom he gave his friendship could appreciate a warmth of nature which was not apparent on the surface, and they will long mourn their loss.

PROF. E. P. CULVERWELL.

BY the death on April 15 of Edward Parnall Culverwell, the scientific side of the University of Dublin loses one of its most untiring supporters. E. P. Culverwell was born in 1855. He was the youngest son of Joseph Pope Culverwell. He won a mathematical scholarship in Trinity College, Dublin, in his twentieth year, and a senior moderatorship in mathematics and experimental science in 1877. He was elected to a fellowship in 1883.

By his marriage with Edith, daughter of the Rev. Wm. Fitzgerald, Bishop of Killaloe, Culverwell became connected with George Francis Fitzgerald; a connexion which may have been in some part influential in the life-long interest of Culverwell in applied mathematics and in education, Fitzgerald being a very great exponent of both.

Culverwell's earlier publications were a series of papers on the "Calculus of Variations". These appeared consecutively in 1892, 1893, and 1895 in the *Journal* of the London Mathematical Society. In 1895 he contributed to the *Geological Magazine* two papers on "A Criticism of the Astronomical Theory of the Ice Age and of Lord Kelvin's suggestion in Connection with a Genial Age at the Pole". These papers will be in the recollection of many who may read these lines. They criticise the earlier views of Croll and of Sir Robert Ball as regards the origin of the Ice Age. They brought their writer into notice as a clear-headed and incisive critic. It is unnecessary to recapitulate the controversy. Culverwell's arguments against the adequacy of Croll's theory as explanatory of the origin of the Great Ice Age appear to the present writer as convincing. They are also inimical to the adequacy of Ball's views. Culverwell rightly refers to the necessity of taking into account, as additional to direct solar heat, the considerable convective transport of heat at the surface of the globe. An interesting résumé of the whole subject and of the nature of Culverwell's criticism will be found in "The Quaternary Ice Age", by Dr. W. B. Wright (Macmillan and Co.) of the English Geological Survey.

Later in life, in the year 1913, Culverwell published "The Montessori Principles and Practice" (Bell and Sons). Culverwell at this time was professor of education in the University of Dublin. This book—now out of print—is a most interesting study of a very great subject. Indeed, the book is in itself so educational that the writing of it confers on its author the status of a most effective educationist.

In 1890, Culverwell published a little book on "Mechanics and Dynamics", intended as an introduction to these subjects. It contains many ingenious suggestions helpful to beginners. J. J.

News and Views.

THE King's birthday Honours List contains the names of the following men of science and others associated with scientific work: *Order of Merit:* Sir William Bragg, in recognition of his eminent services in the advancement of science. *Knights:* Dr. J. B. Baillie, vice-chancellor, University of Leeds; Col. S. R. Christophers, director, Central Research Institute, Kasauli; Dr. W. C. D. Dampier-Whetham, fellow of Trinity College, Cambridge; Dr. P. C. Varrier-Jones, founder and Medical Director of Papworth Village Settlement for the Treatment of Tuberculosis; Prof. S. R. Krishnan, King George V. professor of philosophy, University of Calcutta; Prof. H. Lamb, emeritus professor of mathematics in the University of Manchester; Mr. C. R. Peers, president of the Royal Society of Antiquaries; Mr. R. L. Robinson, vice-chairman and technical commissioner, Forestry Commission. *C.I.E.:* Dr. L. C. Coleman, director of agriculture, Mysore State; Mr. A. McKerral, director of agriculture, Burma; Mr. C. A. Malcolm, chief conservator of forests, Central Provinces, India. *C.B.E.:* Dr. Kate Barratt, principal of Swanley Horticultural College, Kent; Mr. W. J. Hadfield, city engineer and surveyor, Sheffield, a pioneer in modern developments of highway engineering and road surfacing; Prof. H. M. Hallsworth, David Dale professor of economics, Armstrong College, University of Durham; Dr. Alice Werner, lately professor of Bantu languages at the School of Oriental Studies, London. *I.S.O.:* Mr. W. H. Moorby, assistant civil engineer-in-chief, Admiralty; Mr. J. B. Scrivenor, director, Geological Survey, Federated Malay States.

SIR ARTHUR KEITH, of the Royal College of Surgeons, has kindly forwarded to us the following cable addressed to him and dated May 26: "Child's skull found in Mousterian Breccia by MacCown of our expedition.—Garrod." Miss Dorothy Garrod is in charge of excavations at the caves of Mount Carmel for the British School of Archæology in Jerusalem, and the party have evidently found a child's skull of Mousterian date. The only human remains of this date previously known from Palestine were the fragments of the Galilee skull found by Mr. Turville Petre in 1925, and two isolated teeth found by Miss Garrod in 1928 and 1929. The race represented by these fragments was the Neanderthal, and presumably the child's skull now found will also prove to be Neanderthal.

ON May 27, Prof. A. Piccard, of the University of Brussels, accompanied by Herr Kipfer, ascended at 4 a.m. from Augsburg, Bavaria, in an airtight aluminium sphere, about 2 metres in diameter, raised by a balloon which was stated when fully inflated to have the enormous capacity of half a million cubic feet. Anticyclonic conditions prevailed at the time, and the balloon after remaining in the air for 18 hours fell at a spot about 160 kilometres to the south. Prof. Piccard succeeded in reaching a height of about 15½ kilometres, probably penetrating into the stratosphere by some four kilometres, and beating all previous records of a manned balloon or aeroplane. On the descent, trouble occurred with the gas valve, and after long delay the balloon landed safely on a glacier in the Austrian Tyrol, both aeronauts fortunately escaping unhurt.

THE physical problem of raising a weight of perhaps a third of a ton to a height of 16 kilometres by means of a balloon is not in itself unduly difficult; it primarily reduces itself to a question of expense. But to carry observers and bring them back alive is a very different proposition, and Prof. Piccard and his assistant are to be congratulated on a very notable achievement. The air in the cabin was renewed by two oxygen cylinders, each capable of maintaining a good atmosphere for eight hours. As was to be expected, the aeronauts suffered considerable discomforts, and one strange anomaly was that at times the temperature inside the sphere was most unpleasantly high while the external air was 55° C. below freezing point, due to intense solar radiation in the rarefied atmosphere. Prof. Piccard states that the balloon rose 15 kilometres in the first 25 minutes. It is somewhat startling to learn that the stratosphere can be reached by observers after only 20 minutes' travel from the ground. Of the scientific results obtained it is too early to speak.

PROF. PICCARD hoped to obtain evidence of the cosmic rays under more favourable conditions than have previously been possible, and his contributions in this field will be awaited with interest. Meteorologists will be anxious to know if he has anything to tell them about the composition of the atmosphere within the stratosphere; even the amount of water vapour present there is not known, and more knowledge would be welcome regarding carbonic acid and ozone. Observations with self-recording instruments on unmanned balloons have already been made of cosmic radiation, atmospheric electricity, relative humidity, etc., but it is almost certain that in these cases very much better data could be obtained by eye observations, and in addition it should be possible to study the absorption of solar radiation of different wave-lengths by the atmosphere at these great heights. So successful an initial attempt would lead one to hope that much useful scientific information may be gained by this method in the future.

SIR FLINDERS PETRIE gave his first lecture on the results of his past season's work in southern Palestine at University College, London, on May 28. The excavations have now reached a stage which reveals Ajjul as the home of the Hyksos or Shepherd Kings. The Hyksos can no longer be regarded as mere nomads living in tents. For centuries they held this city, strongly fortified and a key position on the road from Palestine to Egypt, and twenty times as large as Troy. It must long have been a centre of commerce between Asia and Africa, for it had developed harbours and a system of weights and measures. At one point of the excavations, three storeys of buildings were penetrated. Eighty rooms full of debris, but

with doorways intact and walls also intact and eight feet thick, were brought to light. In the tombs, human beings, horses, and asses are buried together. Among them the 'great horses', which were imported for riding, were buried with special care. Among the material found in the tombs was a quantity of flat-bottomed pottery of a shape entirely non-Egyptian. It would appear that the city was abandoned about 2000 B.C., probably, it is thought, owing to malaria. Sir Flinders considers that there is still work for the next fifty years on Ajjul, but financial support for the work is needed.

IN this connexion, we may refer to a letter which appeared in the *Times* on May 27 over the signature of forty students whose careers "have been moulded under the Professor's guidance". Directing attention to Sir Flinders Petrie's position as a pioneer in archæological discovery and its methods and aims, whether in field work or in research at home, they remind the public of his annual expeditions to Egypt, of which the results have been published fully for the use of students and popularised by lectures and in the press. Beginning with his triangulation of the Pyramids, they go on to point out, his excavations in the Delta, Upper and Middle Egypt, and in Sinai and Palestine through the Badarian, prehistoric, and dynastic ages have linked up Egypt and Europe and have revealed ancient civilisations as a connected whole. This tribute, no more than is merited by a lifetime devoted, with brilliant results, to archæological research, in which a wide circle will concur, is made the ground of an appeal for financial support for the continuance of training of archæological students. The two existing scholarships, one for biblical research, the other in memory of Gertrude Bell, are in need of maintenance, and money is urgently required for the actual digging in the field.

FOUNDED in 1881, the Society of Chemical Industry this year celebrates its jubilee. The celebrations, which will be held in London and will occupy the seven days commencing July 13, begin with a meeting at the Guildhall at which additional guests may attend provided application is made for a ticket in advance; in the evening there will be a reception by the president, Sir Harry McGowan, and Lady McGowan, at the Great Central Hotel. On the following day, the annual general meeting will be held at the Royal Academy of Music, Marylebone; it will be followed by luncheon by invitation of the London section, and a garden party at Teddington. The evening will be devoted to receptions and a lecture. On July 15, the Society's medal will be presented to Dr. Herbert Levinstein, who will deliver an address; meanwhile a party will visit places of interest in London. Six alternative industrial visits are planned for the afternoon; members may visit the General Electric Research Laboratories, Messrs. Watney, Combe, Reid and Co.'s Mortlake Brewery, the works of the Wallpaper Manufacturing Co., Ltd., Achille Serre, Ltd., the British Drug Houses, Ltd., or the South Metropolitan Gas Co. The annual dinner will be held in the evening, when the principal guest will be H.R.H. Prince George. Since this function is reserved for gentlemen, the ladies accompanying members will be the guests of the Society at dinner and at an entertainment. Various alternative engagements have been made for July 16. A party will spend the day at the Rothamsted Agricultural Research Station; other members have the choice of attending meetings for the reading and discussion of papers, or of listening to addresses delivered by two of the new honorary members. One of these addresses will be delivered by Dr. H. Sørensen on "Hydrogen Ion Concentration".

CHEMICAL industry includes the important branch of food manufacture and control, and a party of members of the Society will be invited by Messrs. J. Lyons and Co., Ltd., to luncheon, followed by visits to Cadby Hall and to Greenford. In the meantime, other parties will, in the afternoon of July 16, pay visits to the National Physical Laboratory and Chemical Research Laboratory, Teddington, to the research station of the Distillers' Co., Ltd., at Epsom, to the laboratories of Messrs. Burroughs Wellcome and Co. at Dartford, to the Fuel Research Station at Greenwich, or to the Pyrene Co. and the Firestone Tyre and Rubber Co. In the evening, a reception will be given by the president and Lady McGowan. On July 17, there are three all-day excursions: to Messrs. Huntley and Palmer's biscuit factory at Reading, to the Research Station of the Anglo-Persian Oil Co. at Sunbury-on-Thames, or to Windsor Castle and Eton College; in each case the arrangements include a river trip. The evening function is a reception and dance by invitation of the directors of Imperial Chemical Industries, Ltd., at Imperial Chemical House, Millbank, Westminster. Oxford will be visited by road on July 18, opportunity being afforded for the inspection of the Bodleian Library, the colleges, and the chemical laboratories. On Sunday, July 19, Canadian and American visitors will leave for their tour of the Midlands, the Lake District, and Scotland. Arrangements will be made for those who so desire to attend morning service at St. Paul's Cathedral, whilst the afternoon will be occupied by visits to Hampton Court or to the Zoological Gardens. Throughout the week there will be an exhibition of chemical plant and research instruments at the Central Hall, Westminster. Applications for participation in the celebrations, with the appropriate fees, will be accepted until June 30. The office of the Society of Chemical Industry is at 46 Finsbury Square, London, E.C.2.

MMES. SOPHIE BOTCHARSKY and Anna Foeringer in a short letter on page 856 of this issue describe some photographic effects of vitamins A and B observed by them. It has been suggested by several observers that certain substances give off radiations to which their biological activity may be ascribed; thus Kugelmass and McQuarrie (*Science*, vol. 60, p. 274; 1924) found that when cod-liver oil was made alkaline and oxygenated it affected an air-tight photographic plate through a quartz window. Other workers failed to confirm this result. Drummond and Webster (NATURE,

vol. 115, p. 837; 1925) state that many substances undergoing autoxidation will fog a plate, vapour being given off. They suggest that in Kugelmass and McQuarrie's experiments the plate was not in an air-tight container, or alternatively that the fogging was due to the fused quartz emitting a phosphorescence. Daniels and Fosbinder (*Science*, Sept. 18, 1925, p. 266) repeated Kugelmass and McQuarrie's experiments and were unable to confirm them. Peacock found that cod-liver oil became fluorescent on exposure to a bright light and that there was possibly some relationship between its vitamin A activity and fluorescent power but none between the latter and its vitamin D content (*Lancet*, vol. 2, p. 328; 1926, and also Samson Wright, *J. Physiol.* vol. 61, p. 36). More recently Hugounenq and Couture (*Compt. rend.*, vol. 188, p. 349; 1929) found that cholesterol obtained from cod-liver oil darkened a photographic plate when in contact with it or separated by a quartz (but not a glass) plate.

ON June 1 the survey ship, H.M.S. *Challenger*, built by the Admiralty for the Ministry of Agriculture and Fisheries, was floated out of dock at Chatham. The ceremony was performed by Miss Addison, daughter of the Minister of Agriculture and Fisheries. The construction of this ship is the outcome of an interim report of the Fisheries Committee of the Economic Advisory Council, which recommended that His Majesty's Government should undertake an organised search for new fishing grounds. The ship, which has been specially constructed for exploratory work in northern waters, is an oil-burning vessel; 220 ft. in overall length, having a displacement of 1400 tons and a sea endurance of 9500 miles. The Hydrographic Department of the Admiralty will undertake the survey work, and it is hoped that important new fishing grounds will be discovered and charted. The name *Challenger* has very appropriately been chosen for the ship, to perpetuate the memory and the traditions of the famous voyage of H.M.S. *Challenger* in the years 1872–1876. That voyage is justly regarded as having laid the foundations of scientific research at sea. Although the new ship is not expected or intended to carry out, like her famous predecessor, a circumnavigation of the world, anyhow at present, and her immediate objective may make less appeal to the imagination, she starts with enormous advantages in the form of the most up-to-date equipment for scientific research, and may be counted on to maintain the high traditions associated with her name.

MR. A. COURTAULD'S own account of his five months' stay alone on the Greenland ice-cap was published in the *Times* of May 29. The party that arrived at the station to relieve the occupants in December was faced with the alternatives of abandoning the station or leaving only one man, since the supplies of food and fuel were not sufficient for more. Mr. Courtauld then offered to stay alone. The station was a tent, ten feet in diameter, with double walls and covered with snow, through which a metal ventilator protruded. Two snow houses reached by a snow tunnel contained stores, and an outer snow wall enclosed the whole. Until March, all went well in spite of heavy winds and frequent gales, but on March 21 the station was completely snowed up, and from then until the relief on May 5, Mr. Courtauld was unable to leave the tent, in which he lived in darkness, without even sufficient light to see what he was eating. Observations, of course, had to cease when he was cut off from his instruments. Mr. Courtauld notes that the temperature in January was not very low, and that on one occasion it rose to 20° F. By the end of February colder and finer weather set in. Fifty degrees below zero was frequently observed. The lowest temperature recorded was 64° below zero. The strong winds were generally from the north-west. The station was so completely buried that Mr. Watkins' relief party found it only by the remains of its flag and its ventilator shaft projecting above a uniform plain of snow.

THE Very Rev. Dr. W. R. Inge, Dean of St. Paul's, delivered a Friday evening discourse at the Royal Institution on May 29 on "The Future of the Human Race". Dr. Inge described in outline the England of a thousand years hence as he would like to see it. The population has been stabilised at about twenty millions, and certificates of bodily and mental fitness are required of would-be parents. London remains as a large city, but the majority of the people live in villages and small towns. Mental and physical tests form a regular part of school and university training, and the results, with family histories, are registered. Physical perfection confers the prestige now given to social position. Most nations are nearly self-supporting and food is cheap and abundant. There are no wars and the functions of the central government are almost nominal. There are no opportunities for making large fortunes, and indeed there is no longer any motive for living pretentiously. Hours of labour are short, but serious hobbies are encouraged. Broadcasting has partly superseded lectures and concerts, and air travel has much extended, so that intercourse with foreign people is easy. Dr. Inge warned us, however, that civilisation contains the seeds of its own dissolution. Physical evolution seems to have come to a standstill. While the human brain was very immature, man began to use tools, and, if we do not take care, we are in grave danger of becoming parasites of our tools.

IN his Ludwig Mond lecture at the University of Manchester on May 19, Prof. William McDougall directed attention to the laggard progress in the biological sciences as compared with the rapid rate at which physical science had progressed since Galileo. Psychology, economics, political science, jurisprudence, sociology really mark gaps in our knowledge or fields of possible sciences that have as yet scarcely begun to take shape or being. These regions, in which chaos still reigns, must be reduced to order if our civilisation is to endure. The responsibility for the backwardness of the human sciences was apportioned by Prof. McDougall partly to the opposition of the churches, which he asserted still largely shape and control our

universities; to biological studies, which revealed man as a part of Nature, and to studies of his beliefs, superstitions, and customs; and partly to the general acceptance of the mechanistic theory. The discoveries of physical science have multiplied mankind and added immensely to the delicacy, intimacy, and importance of relations between men and groups, but have given no guidance in the handling of the new complexities. Prof. McDougall considers that only the biological, and especially the social sciences founded on biology, can save us from the grave disorder and chaos that threaten us. Social sciences must be actively developed into real sciences, and a science of human nature must be created. Our most powerful intellects should be diverted from physical sciences into research on the biological, human, and social sciences, the attack being concentrated first upon anthropology, and an attempt should then be made to build the social sciences—especially the science of economics—on the results of such anthropological research.

THE progress report issued by the Radiostat Corporation is of value, as it shows that considerable advances have been made in the development of Dr. Robinson's invention. To the general public the 'Stenode Radiostat' wireless receiving set will be of great interest, as it provides an instrument of high selectivity which will permit the hearing of broadcasting stations the wave-lengths of which are very close together. When put on the market, it will provide a means of largely increasing the number of stations receivable with good quality and without interference in a given locality. Under the broadcasting scheme adopted in Europe, the number of channels available between 200 and 550 metres is approximately a hundred, but the number of stations actually in use is greatly in excess of this. The difficulties arising from interference are surmounted to a certain extent by assigning certain channels to groups of stations all working upon the same frequency. In the United States, where there are far more broadcasting stations than in Europe, group working is only a partial remedy. It has been found necessary, in addition to grouping stations, to assign to each certain hours during which it is allowed to be in operation. The rapid increase in the number of high-power stations, both at home and abroad, is introducing still further complications. These stations have a considerable 'spread' at short and medium ranges. A receiving set designed for a nine-kilocycle selectivity may be completely paralysed if it is operated within twenty miles of stations like Brookman's Park, Daventry, or Moorside Edge. The owner of a large and expensive set of the older type will probably find, when the projected nine high-powered transmitters are working in Great Britain, that possibly Rome and Stockholm will be the only foreign stations that will be heard without interference.

THE third annual general meeting of the British Society for International Bibliography was held in the Science Museum, South Kensington, on April 16. The Society exists to promote the study of bibliographical methods and the classification of information; to secure international unity of bibliographical procedure and classification; and to foster the formation of comparative and specialist bibliographies of recorded information. The Society is particularly interested in facilitating the adoption of the Universal Decimal Classification of the Institut International de Bibliographie, Palais Mondial, Brussels, of which Institut the Society is the British National Section. This system of classifying books and articles in periodical literature has been referred to in previous issues of NATURE. During the past year the Society has enjoyed very close relations with the Association of Special Libraries and Information Bureaux, and a Joint Committee of the two institutions is actively promoting the adoption of the Universal Classification. The membership of the Society includes representatives of most of the specialised branches of pure and applied science. Ordinary meetings are held from time to time, but the Society makes a special feature of assisting members by personal contact and correspondence in any problems of indexing literature with which they are concerned. Particulars may be obtained from the Secretary, British Society for International Bibliography, Science Library, Science Museum, South Kensington, S.W.7.

IT is announced in *Science* for May 15 that the American Association for the Advancement of Science, and about twenty-five other scientific societies, will hold scientific sessions at Pasadena on June 15–20. This will be the eighty-eighth meeting of the Association and the first of a new series of annual summer meetings. The meeting will be under the presidency of Prof. Franz Boas, of Columbia University, who is known for his contributions to anthropology, and in his honour a special symposium on "The Antiquity of Man" has been arranged. Prof. Boas's presidential address will be on "Race and Progress". On June 17, Dr. Arthur Day, director of the Geophysical Laboratory of the Carnegie Institution of Washington, will speak on "The Present Status of Seismology"; on June 18, Dr. C. A. Beard, the historian, will speak on "Scientists and History"; and on June 19, a symposium on "The Impact of Science upon Civilisation, Past, Present, and Future", will be held. Another interesting symposium has been planned on "Oceanographic Problems", and will be conducted by Dr. T. Wayland Vaughan. A special session of the zoologists and biologists in honour of a former president of the Asociation, Dr. David Starr Jordan, who has just celebrated his eightieth birthday, has been arranged.

THE Annual Report for 1929–30 of the Scottish Marine Biological Association shows the laboratory of the Millport Marine Station to be in a flourishing condition. So much have its activities increased that more accommodation will almost certainly be required in the near future. Already four new tanks for live specimens have been added and more space has been made available for storage. Much good work has been done, as is shown by the list of published work. Miss S. M. Marshall and A. P. Orr have continued their researches in diatoms, studying for another year the spring increase in Loch Striven. H. B. Moore has been

investigating the sea mud in the Clyde sea area, with important results; and R. G. Neill has completed and published a paper on the habits and feeding mechanisms of the polychæte *Nephthys cœca*. Dr. J. A. Cranston and Dr. B. Lloyd have isolated one of the denitrifying bacteria from the Clyde sea area, the cultural characters of which do not conform entirely with those of any known species. This has been studied in detail and a type culture has been lodged with the National Collection of Type Cultures at the Lister Institute. Researches have also been made on the spat fall and rate of growth in certain molluscs, and shore surveys have been continued. Vacation courses for students are steadily growing in importance, and demonstrations or addresses have been given by the staff to classes and parties from various organisations.

A PROPOSAL for the institution of national parks in Africa for the preservation of wild life is made by Major R. W. G. Hingston in a paper in the *Geographical Journal* for May. The spread of cultivation, the demands of trade, and the activities of the sportsman are seriously depleting the fauna. Several large animals have been exterminated by human agency. They include the blaubok, the quagga, and Burchell's zebra. The white rhinoceros, the gorilla, the nyala, and Grevy's zebra are on the verge of extinction. Game reserves, of which several exist in Africa, are useful but not entirely effective, because they have not a permanent status. At present there are only two areas that have the status of national parks. These are the Kruger National Park in the Transvaal and the Parc National Albert in the Belgian Congo. Major Hingston outlines a scheme of nine other national parks. These are (1) South Central park, including the Kasungu game reserve in Nyasaland; (2) Nyala park, two small areas in the south of Nyasaland which are both reserves; (3) Selous park, now the Selous game reserve of Tanganyika, especially for the preservation of the elephant; (4) Serengeti park, to the south-east of Victoria Nyanza, which would shelter many species of grassland animals; (5) Kilimanjaro park, at present a game reserve; (6) Kenya park, to the south-east of Lake Rudolf; (7) Bongo park, on the Aberdare mountains north-west of Nairobi; (8) Bunyoro-Gulu park, now a reserve, on the north-east of Lake Albert, around the Victoria Nile; and (9) Gorilla park, in the Kivu district, for the preservation of the gorilla.

"THE Animal Year Book," vol. 1, 1931, is a work of information and of reference issued by the University of London Animal Welfare Society, the object of which is the furtherance of a "proper understanding of the right relationship between man and the lower animals". It contains an excellent summary of the law of Great Britain relative to cruelty to animals, a series of short notices of the state of animal welfare in some foreign countries, and useful articles upon various aspects of the cruelty problem. Occasionally there is a tendency to push propaganda at the expense of truth, as when the suffering of trapped fur animals is stated to be roughly comparable to crucifixion (p. 90), or when the snaring and trapping of rabbits are said to be on a par with the medieval torture of human beings (p. 104); but such statements are exceptional, and the definite aim of the Society to deal with the prevention of cruelty in a reasonable way will commend itself to many sympathisers. In one of the book reviews—a special feature of the Year Book—reference is made to recently invented, and presumably effective, humane rat traps (p. 152). May we suggest that the illustration and description of such implements would make a most informative and useful appendix to such a work as this.

THE introduction of the fur-bearing musquash to Scotland for breeding purposes, and the subsequent escape from captivity of some of the animals, may have serious consequences. T. M. Munro states, in the *Scottish Naturalist* for May, that in three different areas musquash have escaped and have made themselves at home in the open. Indeed, in one area, near the banks of the Allan, as many as sixteen musquash 'houses' were in existence, until floods in 1929 washed most of them away. Other localities are at Thornhill, Dumfries, and on the Bervie water in Angus; but the present writer failed to trace any wild musquash in the latter district during a recent visit. The risk of the introduction is that the creature may find the climate congenial and may spread, to the destruction of river embankments and crops. On the other hand, it may find it difficult simply to keep up the standard numbers. We cannot tell; but it is wise in such a case to err on the safe side.

THE preservation of photographs of scenery and of natural history events has become an acknowledged part of the business of the great museums, and such collections may become invaluable for reference in the future. But their present value also is often very great. What could be more informative in its own line than the series of photographs published in the *Natural History Magazine* for April, illustrating the shelters and beds built by gorillas for their nocturnal rest? Few people have seen these simple structures and photographs of them are real additions to scientific knowledge. The pictures form part of an album of enlargements of photographs taken in the Beringa mountains, north-east of Lake Kivu, by Mr. Marius Maxwell, and they were presented by him to the Department of Zoology of the British Museum (Natural History).

THE conquest of a fatal disease, leukæmia, appears to be within sight. This disease is not common, though every hospital of any size is likely to have at least a case or two every year; it is characterised by an enormous increase in the leucocytes or white corpuscles of the blood. According to a recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., Dr. Hueper and Miss Mary Russell, working in the Cancer Research Laboratory of the University of Pennsylvania, have grown the leukæmic leucocytes in tissue culture outside the body, and treating rabbits with these cultures a serum is obtained which inhibits the increase of white cells *in vitro* and also in the body. One human case of the disease has been treated with this 'anti-leukæmic' serum, with remarkable improvement.

THE report of the Irish Radium Committee for 1930 was presented before a meeting of the Royal Dublin Society held on April 28. The recent purchase of an additional half gram of radium has rendered possible a large increase in the amount of radon available, with a consequent increase in the number of patients treated. The death of Dr. W. Stevenson, who was one of the pioneers of radium treatment, has, however, prevented the publication of his report on several hundred patients who were treated by him in 1930. Reports by other users give particulars of the treatment of 311 malignant and 44 non-malignant cases. In many cases highly satisfactory results were obtained. The difficulty of obtaining any information as to the state of patients who have returned to their homes in the country after treatment in Dublin hospitals presents, however, a serious problem.

REFERRING to the population problem of Tyneside, we suggested (NATURE of May 16, p. 756) that the situation might possibly be readjusted by revival of local industries instead of by loss of population. In this connexion, it is of interest to learn that the Department of Economics of Armstrong College, University of Durham, has undertaken, at the request of the Government, an economic survey of the industries of the north-east coast of England. The purposes of this research are to examine the existing industries of the area and to determine whether any of them are ever again likely to employ the same amount of labour as in the past, and to inquire into the possibilities of establishing new industries to absorb surplus labour. The conclusions arrived at will be put before the Council of Armstrong College towards the end of the year and forwarded to the Government. The Universities of Glasgow, Manchester, and Wales (Cardiff) have been asked to conduct similar surveys of their areas.

THE eighty-fourth annual meeting of the Palæontographical Society was held at Burlington House, London, on May 29, Dr. F. A. Bather, president, being in the chair. The annual report recorded the publication of instalments of the monographs on Corallian Lamellibranchia, Gault ammonites, Palæozoic Asterozoa, and macrurous Crustacea. It also announced the completion of the macrurous Crustacea in the next annual volume, and the publication of a second supplement to Girvan Trilobites. Prof. P. G. H. Boswell, Prof. H. L. Hawkins, Dr. C. J. Stubblefield, and Mr. W. E. Swinton were elected new members of council, and Dr. F. A. Bather, Mr. Robert S. Herries, and Sir A. Smith Woodward were re-elected president, treasurer, and secretary respectively. The president delivered a brief address on phylogeny and classification, during which he expressed doubts as to the value of a classification based on phylogeny.

THE Thomas Young Oration of the Optical Society will be delivered at the Imperial College of Science and Technology, South Kensington, on Thursday, June 11, at 8 P.M., by Sir John Parsons, who will take as his subject "Young's Theory of Colour Vision".

THE Huxley Memorial Lecture, 1932, of the Imperial College of Science and Technology will be delivered by Mr. Aldous Huxley, on "Huxley as a Literary Man", in the Royal College of Science, Exhibition Road, S.W.7, on Wednesday, May 4, 1932, at 5.30 P.M.

AT the anniversary meeting of the Linnean Society of London held on Thursday, May 28, the following officers were elected :—*President* : Prof. F. E. Weiss ; *Treasurer* : Mr. Francis Druce ; *Secretaries* : Mr. John Ramsbottom (Botany) and Lieut.-Col. John Stephenson (Zoology). The Linnean Gold Medal was awarded to Prof. Karl Ritter von Goebel.

AT the spring convocation on May 6, the doctorate of laws was conferred by Queen's University, Kingston, Ont., Canada, on Dr. H. T. Güssow, Dominion Botanist and Chief of the Phytopathological Service of the Dominion of Canada. Dr. Güssow has also been honoured by being elected a fellow of the Royal Society of Canada.

PROF. C. H. DESCH has been appointed superintendent of the Metallurgy Department of the National Physical Laboratory, in succession to Dr. W. Rosenhain. Prof. Desch is at present professor of metallurgy, and Dean of the Faculty, in the University of Sheffield, and was formerly professor of metallurgy in the Royal Technical College, Glasgow. He is a past president of the Faraday Society and of Section B (Chemistry) of the British Association. Prof. Desch will not take up his new appointment until February 1932, as he had previously accepted an invitation from Cornell University to give a course of lectures there during the winter session of 1931–32.

THE following appointments have recently been made by the Governing Body to the staff of the Lister Institute of Preventive Medicine : Dr. A. Felix (research fellow in bacteriology), to be assistant in the Department of Bacteriology ; Dr. J. M. Gulland (University demonstrator in chemistry at the University of Oxford), to be first assistant in the Department of Biochemistry in succession to Dr. R. Robison, who became head of the department on Jan. 1 last ; Marjorie G. Macfarlane (Carnegie research fellow), to be temporary assistant in the Department of Biochemistry, and Adèle H. Rosenheim (Grocers' Company research student), attached to the same department ; Douglas McClean (research fellow in bacteriology), to be assistant bacteriologist in the Department for the Preparation and Study of Antitoxic Sera, Elstree ; Hester M. Jackson, to be temporary assistant in the Division of Nutrition ; Dr. G. P. Wright, to be research fellow in experimental pathology.

WE have received from Messrs. James Swift and Son, Ltd., 81 Tottenham Court Road, W.1, their new catalogues of petrological microscopes and accessories for the petrological microscope. The former lists instruments of varying degrees of complexity, from the 'Primex' designed to meet the requirements of the student to the 'Dick' and 'Graham-Dick' instruments adapted to the needs of the advanced worker. In all the models, the fine adjustment with single milled head at the back has been retained, but one actuated by lateral milled heads will be supplied if desired. A stereoscopic binocular

on the Stephenson principle is also in the catalogue. Of accessories, we note a series of micrometers and Shand's recording micrometer, goniometers of various types and complexity, and drawing and illuminating apparatus.

A LIST (No. 16) of nearly 600 second-hand books of zoological, botanical, and horticultural interest has just been issued by Mr. J. H. Knowles, 92 Solon Road, S.W.2.

A SHORT list (" Periodica ", Supplement 1) of scientific periodicals offered for sale by W. Dawson and Sons, Ltd., Pilgrim Street, E.C.4, has just reached us. It should be of interest to anyone wishing to add to their scientific library or to complete imperfect sets of periodicals.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A technical administrative officer under the Leeds Education Committee, for secondary and higher education—The Director of Education, Calverley Street, Leeds (June 10). A lecturer in the department of building of the Birmingham Central Technical College—The Principal, Central Technical College, Birmingham (June 12). A full-time teacher of electrical engineering subjects and chemistry at the Kingston-upon-Thames Junior Technical School—The Principal, Technical College, Kingston-upon-Thames (June 13). A head of the boot and shoe department of the County Technical College, Stafford—The Clerk to the Governors, County Education Offices, Stafford (June 20). A head of the department of industrial administration of the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (June 22). A headmaster of the Exeter Junior Technical School—The Secretary for Education, 39 Southernhay West, Exeter (June 22). A temporary principal technical assistant in the Shellfish Services staff of the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (June 22). A lecturer in economics in the Durham Colleges—The Secretary to the Council of the Durham Colleges, 38 North Bailey, Durham (June 23). Assistant lecturers in geology and mathematics in the University of Sheffield—The Registrar, University, Sheffield (June 24). A gas research Radiation, Ltd. fellow, at the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington, S.W.7 (June 26). Junior lecturers in, respectively, vertebrate embryology and cytology in the University of Edinburgh—The Secretary to the University, Edinburgh (June 26). A laboratory steward in the physics department of the Imperial College of Science and Technology—The Secretary, Imperial College of Science and Technology, South Kensington, S.W.7 (June 30). A research student in biochemistry at the Lister Institute—The Secretary, Lister Institute, Chelsea Bridge Road, S.W.1 (July 1). A lecturer in chemistry and botany at the Studley Horticultural and Agricultural College for Women—The Principal, Studley College, Warwickshire. A young master for science and mathematics at the Beacon Hill School—Bertrand and Dora Russell, Harting, Petersfield. A senior science master at St. Lawrence College, Ramsgate—The Headmaster, St. Lawrence College, Ramsgate.

Our Astronomical Column.

Calendar Reform.—The *Scientific American* for June contains an article by G. Eastman strongly advocating the adoption of a year of thirteen months with 28 days in each, and an extra day at the end, not to reckon as a weekday ; in leap year there would be a second extra day, which would be placed at the end of the sixth month ; each month would always begin with a Sunday. There is no question that such a calendar would be convenient to such astronomers as have occasion frequently to reckon the interval in days between given dates ; the want of system in the lengths of our present months, and the position of the leap day at the end of the second month, instead of the end of the year, are serious drawbacks. But the interruption of the regular sequence of weeks, which have now been running without a break for some three thousand years, excites the antagonism of a number of people. Some of these (the Jews, and also many Christians) accept the week as of divine institution, with which it is unlawful to tamper ; others, without these scruples, still feel that it is useful to maintain a time-unit that, unlike all others, has proceeded in an absolutely invariable manner since what may be called the dawn of history. This view found strong support at the meeting of the International Astronomical Union at Rome in 1922 ; and it is unlikely that there will be, at least in the near future, sufficient consensus of opinion to enable the scheme described above to be carried through.

Mr. Eastman outlines a second scheme, which does not interfere with the week ; this makes an ordinary year exactly 52 weeks, and inserts an extra week every fifth year (with occasional variations, akin to the Gregorian centennial-year regulations). The fact of making some years a week longer than others would, however, involve difficulties in the regulation of salaries ; the variation of the equinoxes and solstices by a week would also give trouble in meteorology.

To sum up : every scheme involves so many controversial points that it is unlikely that any change will be made unless the calendar reformers confine their demands to more moderate limits.

Light Variation of ϵ Aurigæ.—This star is of special interest from the great length of its eclipses (assuming, as is usually done, that the light-variation arises in this manner). *Astr. Nach.* 5784 contains a series of observations made at Bologna Observatory by Dr. L. Jacchia. The following are his dates for the phases : beginning of eclipse, May 13, 1928 ; beginning of stationary minimum, Oct. 22, 1928 ; middle of eclipse, April 25, 1929 ; end of stationary minimum, Oct. 25, 1929 ; end of eclipse, April 15, 1930. The light-variation includes secondary waves, their presence being confirmed by M. Gussow, using a photo-electric cell ; as a result of them, the increase of light was slower than the decrease. The mean magnitude at maximum is given as 3·23 ; at minimum, 3·88. The extreme points on the light-curve are 3·13 and 3·94. Five stars in Auriga and Perseus, of magnitudes between 2·72 and 4·78 (Harvard) were used as comparison stars.

Research Items.

Roman Pottery Kilns in Yorkshire.—The investigation of a Roman pottery kiln site at Throlam Farm, near Holme-on-Spalding, is recorded in the *Transactions* of the East Yorkshire Antiquarian Society, vol. 27, pt. 1, by Mr. T. Sheppard and Mr. P. Corder. The site is a mound, about a hundred feet in circumference and about six feet above ground level, consisting almost entirely of wood-ash and sherds. Near the centre is a mass of puddled clay forming a mound 14 ft. by 7 ft., stratified into clearly marked layers by bands of black ash and sherds, representing successive occupations or reconstructions. On the west end of this are two roughly constructed kilns, 3 ft. 6 in. and 2 ft. 7 in. in diameter respectively, which were fed from the same stokehole. They were constructed on the oven floor of an earlier and larger kiln which was itself superimposed on another. This larger kiln has been almost completely preserved. It differs from the usual type of small Roman pottery kiln only in certain particulars. No pit was excavated, but a mass of puddled clay was dumped on the floor of the kiln, and from this the later kiln was fashioned. The floor was supported on pillars which divided the furnace into three. The pottery, with the single exception of a Samian sherd, is of the Yorkshire coast Signal Station type of the last part of the fourth century; but as the bulk of the pottery is earlier than that of Huntcliffe or Scarborough, the most probable date is the later half of the third century.

Blood Standards for Indians.—In the course of study of anæmia in the Bombay Presidency, it was realised that no normal standards for Indians are available with which pathological findings can be compared. Even accepted European standards are found to present considerable variations in different text-books. Major Sokhey and his assistants have therefore examined 121 healthy young Indian men and 101 women living in Bombay by approved methods and with specially standardised apparatus (Report of the Haffkine Institute for the year 1929, p. 26; Bombay, 1931). The following averages have been obtained:

	Men.	Women.
Red cell counts, millions per cubic mm.	5·11	4·47
Hæmoglobin—grams per 100 c.c. of blood	15·36	12·99
Volume of cells, c.c. per 100 c.c. of blood	41·72	36·27

Isolation of Sexes in Bird Movements.—In a short paper in the *Naturalist* (May 1931, p. 145), Noble Rollin is able to confirm the statement that as a rule female birds form the vanguard in migration, and that the males show a tendency to lag behind. The result is the more interesting because it has been found amongst birds in which the sexes cannot be determined by examination in the field. Birds were collected at random in the neighbourhood of South Shields, and grouped themselves in a series of six common land birds and seven waders and sea birds, a mixed bag of migrants and partial migrants. The sex was determined by dissection. On the whole, the results revealed by the two sets of records are very consistent. It would appear that during late autumn (October and November) the stock of birds is predominantly female, whereas in the winter (December and January) it is predominantly male. The curve in which the results are expressed illustrates the instability of the bird population of an area during autumn and winter, and this is apparently due to sexual dimorphism in the migratory movement.

Golgi Bodies and Yolk.—Allahabad University Studies, vol. 6, pt. 2 (Science Section), 1930, contains contributions from the Departments of Zoology, Chemistry, Botany, and Mathematics. Five of the seven zoological papers are on the cytology of oogenesis respectively of tortoises, the gecko, *Pila* (apple snail), frogs and toads, and fishes. In the tortoise, "fatty yolk is formed directly and indirectly by Golgi bodies", while albuminous yolk is formed either "by direct metamorphosis of mitochondria into a yolk body" or by other activity of the mitochondria; nucleolar extrusions take no part in the formation of yolk. In the gecko, the Golgi bodies "appear to play no part whatever in vitellogenesis". In *Pila*, the Golgi bodies contribute directly or indirectly to the formation of fatty yolk spheres; later the mitochondria multiply rapidly, swell, and give rise to true yolk spheres by a process of direct metamorphosis. In the frogs and toads, the Golgi bodies appear to take part in the formation of fatty yolk, though whether by direct metamorphosis was not determined. The true yolk is formed by the metamorphosis of mitochondria. In the fifth paper is described the infiltration of Golgi bodies, either in "big lumps or, as is more frequent, in the form of granular bodies", from the follicular epithelium through the zona radiata into the oocyte of the fishes *Saccobranchus fossilis* and *Ophicephalus punctatus*.

Hard Fibre Production within the Empire.—An interesting lecture upon this subject by Mr. Alfred Wigglesworth is reproduced in the *Journal* of the Royal Society of Arts, vol. 79, No. 4087, Mar. 20, with an abstract of the interesting discussion that followed the lecture. The hard fibres referred to occur in the leaves of monocotyledons, and for many purposes they are now being exploited, at the expense of the fibre from the inner fibrous bark of dicotyledonous plants such as flax and hemp. They include New Zealand flax, *Phormium tenax*, *Furcræa gigantea* (mainly exported from Mauritius), and *Agave cantala*. In every case, the successful introduction of such a hard fibre depends upon the development of methods for the separation of the comparatively small amount of fibre from the tough leafy tissues; and the rapid development in recent years of the hard fibre trade is very largely due to the success with which the problem of the large scale extraction of sisal fibre has been attacked. Sisal has long been cultivated in Mexico, but in 1836 Mr. Perrine transported suckers to Florida. From the Florida plants, by vegetative propagation practically the whole area now under sisal outside Mexico, in East Africa, Dutch East Indies, etc., has been supplied. Mr. Wigglesworth points out that there is ample room for scientific study of the breeding, cultivation, and methods of extraction, purification, and grading of all these fibres. One point of great interest is that the sisal fibre has a larger cell lumen than the Manila fibre (from *Musa textilis*) and Mr. Wigglesworth thinks that this explains why sisal absorbs more water—and more rapidly—than Manila fibre. The *Bulletin* of the Imperial Institute, vol. 29, No. 1, 1931, contains a report of the effect of sea-water on the strength and durability of sisal hemp in comparison with Manila. Three series of trials have been completed and the results afford clear evidence that East African sisal has satisfactory durability in sea-water.

The Wilberforce Radium Occurrence.—Under this title, H. S. Spence and R. K. Carnochan have recently described the richest deposit of radium ore yet found

in Canada (Dept. of Mines, Canada: *Investigations of Mineral Resources and the Mining Industry, 1929*, Ottawa, 1930, pp. 1-23). The ore consists of uraninite disseminated in large crystals and aggregates through strings and long miarolitic pockets of calcite and fluorite, with subsidiary apatite, occurring in a syenite-pegmatite, which itself contains large pockets lined with felspar crystals. The uraninite-bearing 'lead' is considered to be at least 500 ft. long by 5-12 ft. wide. Tests on a carload of ore showed that 1 gm. of radium would be recoverable from the concentrates separated from 3422 tons of ore. This result, and the development work carried out in the field, suggests that the occurrence has commercial possibilities. An analysis by Ellsworth of the uraninite shows U_3O_8, 61·64 per cent; ThO_2, 13·56 per cent; and PbO, 11·05 per cent, corresponding to an age of more than 1200 million years. It is of interest to record that, according to reports recently published in Montreal, pitchblende deposits have been found at Echo Bay on Great Bear Lake, 750 miles by river navigation from the railhead at Waterways, Alberta.

A Survey of Niagara Falls.—A phototopographical survey of Niagara Falls was carried out in 1927 by the Geological Survey of Canada, and is fully described by Mr. W. H. Boyd in *Memoir* 164 of the Geological Survey. Work on the American Fall was comparatively easy since, owing to the small volume of water, the rock crest is visible from end to end. In the Horseshoe Fall, however, the central part is completely covered and offers no points of identification. To overcome this difficulty, three cameras, one at each of three stations, were exposed simultaneously. Thus the appearance of the water along the width of the crest was revealed at the same instant from each of three stations. It was found to be easy to identify the same points of the water face in all the three photographs. Thus the crest could be mapped. Elevations along the crest line were also taken. Details of the methods employed are given in a pamphlet accompanying the surveys.

The Queen Maud Range, Antarctica.—This huge faulted range of mountains at the south-eastern end of the Ross Sea was discovered by R. Amundsen in his march to the South Pole in 1911. He charted roughly only a limited area on a small scale, for his field of vision was naturally limited. Amundsen's map appeared in his book "The South Pole" (1912). Admiral R. E. Byrd crossed the range to the west of Amundsen's route in his flight to the South Pole in 1929. From his height, the range of vision was considerable. The survey material from his aerial photographs was amplified by Prof. L. M. Gould's sledge journey along the base of the range. From all the available data, the American Geographical Society has produced a contoured map of the Queen Maud Mountains on a scale of 1 : 500,000, which is about ten times the scale of Amundsen's map (*Geographical Review*, April 1931). Positions are fixed from three astronomically determined points at which wireless time signals were observed. The map reveals three immense glaciers, named Amundsen, Thorne, and Leverett, comparable in nature with the Axel, Heiberg, and Liv glaciers of Amundsen and the Beardmore glacier of Shackleton. It gives the trend of the Queen Maud Range a more easterly direction than Amundsen had observed and disposes of his Carmen Land. The map is a valuable contribution to Antarctic cartography.

An Exceptional Night Sky.—Lord Rayleigh, in the May number of the *Proceedings* of the Royal Society, describes an unusual night sky which was watched by him at Terling (52° N.) on Nov. 8, 1929. The light was much the same in constitution as on ordinary nights, extending uniformly over the sky, but was very much brighter than usual, and of constant intensity over a period of hours. Its spectrum seemed continuous, and the green auroral line (λ5577) was not definitely seen. It was evidently of a totally different nature from the polar auroral light, and, confirming this distinction, the state of the earth's magnetism was steady. The negative bands of nitrogen could not be searched for on this occasion, as they were outside the range of the spectroscope used, but Lord Rayleigh says that in his experience the most striking distinction between the ordinary night sky and the polar aurora is the absence of the bands from the former; a contrary conclusion has, however, been arrived at by Sommer, who finds that these bands are present in the normal night light at Göttingen. Lord Rayleigh has remeasured the two unidentified lines (or band heads) in the night sky spectrum at λ4419 and λ4168.

Recombination of Cæsium Ions.—The information afforded by quantitative study of recombination of electrons and ions is of very great value in testing theories of many atomic processes, giving essentially the effective cross-section of an atom or ion under various conditions. An account of an investigation of the recombination of cæsium ions and electrons to form normal ($1\ ^2S$) atoms of cæsium, given by C. Boeckner in the February number of the Bureau of Standards *Journal of Research*, is of particular importance because it verifies the fact that the normal state of cæsium is anomalous in its behaviour; recombination into two of the excited states of cæsium ($2\ ^2P$ and $3\ ^2D$) takes place in the simple way which would be expected from the quantum theory of the hydrogen atom, whereas recombination into the more tightly bound $1\ ^2S$ state follows an entirely different law. The results were obtained by Mohler's method of measuring the intensity of the continuous recombination spectra which appear at the series limits, simultaneously with a probe wire analysis of electron velocities by Langmuir's method, and furnish incidentally a proof of the correctness of the current theory of exploring electrodes.

Electrical Resistance of Moisture Films on Glazed Surfaces.—In measuring the electrical resistance between two conductors separated by a mass of insulating material, it has long been known that the apparent value of the resistance depends on the humidity of the air and the previous history of the insulator. It is usual to divide the current which flows between the two conductors into two components, one flowing through the insulator and the other through a film of moisture or other conducting material on the surface of the insulator. In actual tests, the relative values of these two currents vary largely, since water, even when very pure, conducts much better than ordinary insulators; the surface leakage current may be many times greater than the component which flows through the solid insulator. In a paper published in the March number of the *Journal of the Institution of Electrical Engineers*, G. G. Smail, R. J. Brooksbank, and Prof. W. M. Thornton discuss how the electrical resistance of moisture films on glazed surfaces varies with the resistance, temperature, and vapour pressure of the surrounding medium. Their experiments show that there is a very sharply defined critical pressure above which the resistivity falls as the pressure rises, and below which they both fall together. The drop of voltage down a string of insulators depends on the

surface resistance as well as the capacitance of the units. When a steam jet is played on the string until there is a complete deposit of visible moisture, the voltage gradient becomes a straight line. The potential to earth of the lower units is sometimes more than doubled. Stabilising devices, therefore, at the earthed end of the string of insulators may be more effective in preventing flashover on the string. The experiments show that water films are deposited or adsorbed on glazed surfaces long before they are visible as dew.

Ohm's Law for Electrolytes.—Experiments made in 1927 by Wien on electrolytic conduction in fields of 30,000–300,000 volts per cm. indicated an increase of conductivity with field strength, amounting to as much as 50 per cent. These results have been interpreted in the light of the modern theory of strong electrolytes, by assuming that in the case of high ionic velocities there is no opportunity, or only a restricted opportunity, for the ion atmosphere of opposite sign to build up around the moving ion, so that the retarding effect of this atmosphere, giving rise to a change of equivalent conductivity with dilution, is not fully exerted. More recently, Wien has found the effect for field strengths so low as 3000 volts per cm. These experiments show that Ohm's law is not valid for electrolytes over the entire range of voltages. Although it would not be expected in the case of the low field strengths used in the Kohlrausch method of determining conductivities, a change of resistance with applied voltage has been reported by Parker. In the April number of the *Journal of the American Chemical Society*, Jones and Bollinger show that with low field strengths the voltage used is without effect on the measured resistance over a wide range of frequencies and of resistances, and with cells of widely varying design. Ohm's law may, therefore, be regarded as valid for electrolytes under these conditions.

The Nature of the Chemical Bond.—Recent applications of quantum mechanics have led to an approximate calculation of the energy of formation and other properties of very simple molecules, such as H_2, and have provided a formal justification for the rules stated by G. N. Lewis in 1916 for the electron-pair bond. Linus Pauling, in the April number of the *Journal of the American Chemical Society*, extends these applications and supplements Lewis's rules for the electron-pair bond by new rules which provide information regarding the relative strengths of bonds formed by different atoms, angles between bonds, free rotation or lack of rotation about bond axes, etc. A detailed theory of the magnetic moments of molecules and complex ions is also developed, the value of μ being given by $2\sqrt{S(S+1)}$, where S is the total spin angular momentum, the moment being determined entirely by the number of unpaired electrons. This relation, which does not apply to rare-earth ions, makes it possible to decide from magnetic observations between electron-pair bonds and ionic and ion-dipole bonds for various complexes. The tetrahedral carbon, nitrogen, and phosphorus atoms in appropriate compounds are reproduced, and the known results for rotation about single bonds (except when restricted by steric effects) and lack of rotation about double bonds follow. Several examples of the determination of structure from a knowledge of the calculated angles between bonds are given. On the theoretical side, special attention is directed to the effect of concentration of the bond eigenfunctions. The type of bond formed by an atom is dependent on the ratio of bond energy to energy of penetration of the core. When this ratio is small, the bond eigenfunctions are p eigenfunctions giving bonds at right angles to one another, but when it is large, new eigenfunctions especially adapted to bond formation can be constructed.

Metallic Corrosion.—Two papers communicated by Sir Harold Carpenter to the Royal Society, and published in the May number of the *Proceedings*, furnish a great deal of information about the mechanism of corrosion of metals. The first, by U. R. Evans, L. C. Bannister, and S. C. Britton, is on the velocity of corrosion from the electrochemical point of view. Currents flow between anodic and cathodic parts of corroding metals, and it has been shown that the currents measured are equivalent to the corrosion produced, the problem of corrosion speed being thus largely reduced to a study of the electrochemical factors which determine this current. One of the important factors which enters is polarisation set up by the current; it occurs in most cases at the cathodic area, and is due to limitations in the rate of supply of oxygen. When corrosion starts at a weak point in an invisible film covering the surface of a metal, the area being attacked changes until the current density over it is equal to a certain 'protective value', which is the current density which will cause any incipient attack on a weak point within the area in question to lead to a precipitation of rust so close to the surface as to seal the defect, a principle made use of in the 'cathodic' method of preventing corrosion. The second paper, by G. D. Bengough, A. R. Lee, and F. Wormell—the fourth of a series on the theory of metallic corrosion—is chiefly upon the effect of oxygen upon zinc immersed in potassium chloride solutions, and shows that the action cannot be completely explained by the difference in oxygen concentration which had been postulated in the 'differential aeration' theory. Zinc hydroxide plays an important part in the reactions, both in a thin film which adheres closely to the metal and is impervious to oxygen and zinc ions, but not to electrons, and in the loose masses which appear, and do not completely stop the passage of oxygen.

The Protection of the Underwater Hulls of Ships.—The possibility of producing a hard smooth surface on the underwater hulls of ships which would remain smooth has long been regarded as desirable, for such a surface would lead to a great economy in fuel. This is one of many subjects touched upon in a paper on "Modern Developments in Ship Design", by Dr. J. Tutin and A. C. Hardy, contained in the January number of the *Transactions* of the Institute of Marine Engineers. The authors state that marine growths cannot in general attach themselves to hard surfaces such as glass, porcelain, and clean steel. Is it too much, therefore, they asked, to expect modern chemical research to provide an anti-corrosive composition with an ultra-hard surface? In a written communication, contained in the *Transactions*, P. Jenkins, chief chemist to Messrs. J. Dampney and Co., Ltd., stated that he thought the theory that marine growths do not adhere to hard surfaces is doubtful; in the Hancock Museum, Newcastle, is a bottle encrusted with beautiful specimens of barnacles. All paints and compositions have of necessity to contain oily matter to repel water, and such materials cannot be made very hard. It is, therefore, too much to expect chemical research to find an ultra-hard preservative for ships' hulls. The only coating of this nature which can be applied to iron is vitreous enamel, and this is impracticable for the protection of ships. Vitreous enamels are fused at high temperatures and are applicable to only relatively small objects. They are also prone to chip off.

Statistics of the Universities of Great Britain.

TO the Returns * from Universities and University Colleges for the academic year 1929–30 the University Grants Committee prefixes an introductory note which serves to bring up to date the quinquennial review issued by the Committee last year and commented on at some length in NATURE of Aug. 2, 1930.

The total number of full-time students, of both sexes, which increased by 7 per cent in the preceding five years, shows a further increase (to 45,603) of nearly 3 per cent; whilst the proportion of women students, which declined during those years from 31·4 to 29·1 per cent, shows a further drop to 28·3 per cent. The regional distribution of the increment registered in 1929–30 was: England 914 (879 men), Wales 96 (108 men), Scotland 245 (251 men). It is pointed out in the Committee's note that the figures for 1929–30 are swollen by the admission of 232 students to two-year courses of training as teachers at university colleges, at the special request of the Board of Education, in view of the projected raising of the school age.

London has increased its lead as the university having the greatest number of full-time students (9141). The next twelve in order, Cambridge, Glasgow, Oxford, Edinburgh, Wales, Manchester, Liverpool, Durham, Leeds, Birmingham, Aberdeen, Bristol, show no change in their relative positions in this respect. All universities except Aberdeen and Reading show some increase.

The number of full-time students from homes outside the British Isles was 4573, being 10 per cent of the total and 4 per cent more than in the preceding year. More than one-third of these are from foreign countries, and the number of such foreign students tends to increase somewhat rapidly. It increased by 26 per cent in the five years 1923–29, and by 9 per cent from 1928–29 to 1929–30. The corresponding increases in the numbers of students from countries in the British Empire beyond the British Isles were 14 per cent in the five years 1923–29 and only 1·3 per cent in the following year. Why the pull of the home universities is waning in these countries while waxing in foreign countries is a question on which light could perhaps be thrown by the delegates who are to meet at Edinburgh in July in the fourth Congress of the Universities of the Empire. The universities which have the largest numbers of students from countries within the Empire outside the British Isles are London (1060), Edinburgh (456), Cambridge (352), Oxford (296), Glasgow (177), and Manchester (79). In addition to full-time students, there were 653 part-time students whose homes were outside the British Isles but within the Empire, and 852 foreign part-time students.

The distribution of the full-time students among the various subject groups in 1929–30 was: arts, 53·4 per cent; medicine, 19·1; pure science, 16·5; technology, 9·1; agriculture, 1·9. This shows but little variation from the preceding year's distribution. The decline in the number of men medical students, which had been continuous since 1923–24, was arrested in 1928–29, when there was an increase of 205, which was followed by a further increase in 1929–30 of 310. The similar decline in the number of women medical students continued down to 1929–30, when there was a small increase, from 1108 to 1136.

Full-time advanced students numbered 2128, of whom 1763 were men, an increase of 46 (men 55). The greater number of these students were at work at Cambridge (355), University College, London (228), Imperial College of Science, London (227), King's College, London (123), London School of Economics (121), Oxford (172), and Edinburgh (133). Their distribution among the various subject groups was as follows: mathematics and pure science, 42·4 per cent; arts, 39·2 per cent (35 per cent of the men and 58 per cent of the women); technology, 11·5 per cent; medicine, 4·7 per cent; agriculture, 2·2 per cent. Chemistry, including applied chemistry and biochemistry, claimed 487 students, engineering 216, physics 140, botany 87. In addition to these full-time students, 1683 part-time students (1351 men and 332 women) were engaged in advanced work.

A table showing the numbers of full-time staffs employed in the teaching departments gives the following totals: professors, 798; readers, assistant professors, and independent lecturers, 334; lecturers, 1147; assistant lecturers and demonstrators, 827; and others, 243. The number of lecturers is somewhat understated owing to the Oxford and Cambridge returns excluding lecturers holding no full-time university appointment, many of whom actually devote their whole time to teaching. Omitting Oxford and Cambridge, the table shows that for the instruction of every hundred full-time students there were available, on an average, the following full-time teachers: professors, 2; readers, etc., 0·9; lecturers, 3·3; assistant lecturers and demonstrators, 2·1; and other teachers, 0·7—total, 9. Taking England alone, exclusive of Oxford and Cambridge, the ratio of full-time teaching staff to full-time students was 10·8 per cent; in London alone it was 9, in Wales 11, and in Scotland 5·7.

Statements of income and expenditure show totals of £5,338,064 and £5,280,530 respectively. Commenting on these accounts, the Committee observes that of the fifty-two institutions included in the returns, only two or three show deficits representing any serious financial weakness.

* University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1929–1930. Pp. 22. (London: H.M. Stationery Office, 1931.) 1*s.* 3*d.* net.

Second International Congress of the History of Science and Technology.

MEN of science from all parts of the world who are interested in the history and evolution of their subjects will be meeting at the Second International Congress of the History of Science and Technology to be held in London on June 29–July 4 under the presidency of Dr. Charles Singer. The Congress is held under the auspices of the Comité International d'Histoire des Sciences, with the collaboration of the Comité International des Sciences Historiques, the Newcomen Society for the Study of the History of Engineering and Technology and the History of Science Society. Inquiries concerning membership and meetings of the Congress should be addressed to one of the honorary secretaries, Mr. H. W. Dickinson, or Mr. Walter Adams, The Science Museum, South Kensington.

The Government is showing great interest in the Congress. The President of the Board of Education,

the Right Hon. H. B. Lees-Smith, will open the proceedings at the inaugural meeting on Monday, June 29; the Director of the Science Museum, Sir Henry Lyons, has generously invited the Congress to make the Science Museum its headquarters throughout the week; and other Government departments, such as the Royal Botanic Gardens, Kew, the Royal Observatory, Greenwich, and the Natural History Museum, have offered hospitality to members of the Congress.

Three vexed problems in scientific method will occupy the attention of members at the morning sessions on Tuesday, June 30, Thursday, July 2, and Friday, July 3. The first discussion will have as its general theme, "The Sciences as an Integral Part of General Historical Study". Prof. Gino Loria, of Genoa, will take the chair at this meeting. Mr. G. N. Clark, of Oxford, late editor of the *English Historical Review*, will open the discussion. Among those who will take part are Profs. A. V. Hill and A. E. Heath and Dr. Dampier-Whetham. On the same morning a discussion will be held on the teaching of the history of science. Prof. Welch, of Johns Hopkins University, will take the chair, and contributions have been promised from Profs. Loria, Wolf, and Aldo Mieli, of Paris.

The discussion on July 2 will be on the "Historical and Contemporary Inter-relationship of the Physical and Biological Sciences". Prof. William Ritter, of California, will take the chair, and opening papers have been promised by Prof. J. S. Haldane, of Oxford, and Prof. W. H. Welch, of Johns Hopkins. Prof. Baas-Becking, of Leyden, Dr. Joseph Needham, and Prof. Lancelot Hogben will be among the speakers. The final discussion (July 3) will be upon the "Interdependence of Pure and Applied Science". Sir Henry Lyons will occupy the chair, and contributions are promised from Sir Napier Shaw, Profs. F. G. Donnan and C. H. Desch, Mr. R. V. Vernon, of the Colonial Office, and others.

The United States will be well represented by delegates from the following institutions, among others: Columbia University; Brown University, Providence; Yale University; Rochester University; Bryn Mawr College; Colorado University; Clark University, Worcester; Smith College, Northampton; Georgetown University; Boston University; Dartmouth College, Hanover; Michigan University; University of California; Bates College, Lewiston; Pomona College, Claremont; Duke University, Durham; University of Cincinnati; State University of New Jersey; New York University; Massachusetts Institute of Technology; Goucher College, Baltimore; Utah State Agricultural College; University of Minnesota; Haverford College; Ohio State University; Mount Holyoke College; The Harvard Railway and Locomotive Historical Society.

Of other universities outside the British Isles, representatives have been appointed from Alberta, the Muslim University of Aligarh, Allahabad, Basel, Berlin, Bombay, the Université libre of Brussels, Calcutta, Cape Town, Dacca, Guatemala, Hamburg, Hong Kong, Leyden, Lucknow, Universitá Cattolica of Milan, Montevideo, Madras, New Zealand, Nova Scotia, Oslo, Punjab, Rangoon, Stellenbosch, Toronto, Tasmania, and a number of others. Among other institutions that will be represented are the Gesellschaft für die Geschichte der Naturwissenschaften of Berlin, the Institut für Geschichte der Medizin und Naturwissenschaften of Leipzig, and the Kulturwissenschaftliche Bibliothek Warburg of Hamburg. The Academy of Material Culture of Leningrad expects to send three representatives.

A full programme has been arranged for the social entertainment of members and guests. Receptions are to be given by the Royal Society, the Royal Society of Medicine, the Royal Institution, and the Institute of Historical Research. Special excursions are to be made to the Universities of Oxford and Cambridge, which have offered hospitality to members of the Congress. The Provost of University College, London, will entertain members at an Independence Day luncheon on July 4. Special visits will be made to the Royal Botanic Gardens, Kew; the Royal Observatory, Greenwich; Barbers' Hall; and the Royal College of Physicians.

A Ladies Committee, under the chairmanship of Mrs. T. F. Tout, is arranging a programme of visits for ladies at the Congress who will not be attending the morning sessions.

Water Power Developments in the United States.

RETURNS which have recently been issued by the Geological Survey of the United States Department of the Interior (*Report* No. 50,669) afford some interesting particulars of recent developments in the utilisation of the water power resources of the country. Up to Jan. 1, 1931, the total capacity of water-wheels installed in water power plants of 100 horse power or more was nearly fifteen million (14,884,667) horse power, representing an increase of more than a million (1,076,889) horse power, or 7·2 per cent, during the year 1930. In an article in NATURE for April 18, the corresponding figures for Canada were shown to be 6,125,000 horse power and 397,850 horse power. An estimate based on present practice in the installation of plant for the utilisation of water power indicates that about nineteen per cent of the available resources in the United States have been exploited, as compared with about fourteen per cent in Canada.

This estimate, however, as also that in the case of Canada, though taking into account the results of the latest surveys and investigations, cannot be regarded as final. In a number of the States, more particularly those in the south and centre, additional information is required before a definitely reliable figure can be arrived at. A moiety of the available power of the Niagara River and of the international section of the St. Lawrence River is included, though it is pointed out that an international agreement will be necessary in order to permit of the full development of these supplies.

Washington comes first among the individual States in extent of potential supplies, and is followed fairly closely by California, Oregon, and New York. A large proportion of the potential resources of the last-named State is available continuously, as distinguished from the bulk of the supplies elsewhere, which are of an intermittent character. This is due to the equalisation of the flow of the Niagara and St. Lawrence Rivers. The same remark applies to the States of Arizona and Nevada, where the resources are mainly on the Colorado River, the flow of which can be controlled.

The 14,884,667 horse power realised to date in the whole of the Union is the product of 3344 individual installations, of which nearly one half (1588), with a capacity of 13,108,830 horse power, are public utility and municipal undertakings, the remainder being devoted to manufacturing and miscellaneous purposes.

Association of Teachers in Technical Institutions.

THE twenty-second annual conference of the Association of Teachers in Technical Institutions was held at Manchester during the Whitsuntide holiday. On Whit Monday the Association was accorded an official welcome by Alderman F. J. West (ex-Lord Mayor of Manchester and a member of the Government Committee on Education for the Engineering Industry), Dr. Stanley Hodgson (Chairman of Governors, Royal Technical College, Salford), and Alderman J. Smith (Chairman of the Bury Education Committee). On the same day the retiring president, Mr. H. A. Norman (of Bury), inducted the president for the coming year, Mr. H. Ade Clark, who delivered his presidential address.

Those who expected Mr. Clark to deal with the matter of salaries (notice has been given that the present scales of salary for technical teachers will be terminated on Mar. 31, 1932) were disappointed. He insisted that the question was one for the Association's representatives on the Burnham (Technical) Committee, and said that whatever the outcome of negotiations might be, the Association could not lose sight of the problems which it had to face in company with the Board of Education, the local education authorities, and those engaged in the country's industry and trade. Those problems, he said, had been well summed up by one of his predecessors in office, Mr. A. E. Evans, in a paper to the last North of England Education Conference: "Soon after the War it became apparent that, hitherto unchallenged, or feebly challenged, commercial and industrial supremacy of Britain was likely to experience a fierce onslaught from other nations. It was recognised by those engaged in our technical institutions that one of the weapons of defence would be a system of education which would provide men and women —whether as leaders or as led—who realised the potentialities of this country and its associated Commonwealth as one of the great manufacturing, carrying, and exporting civilisations of to-day. To determine these potentialities and how best to educate men and women for their development was of vital importance."

With these points in mind, Mr. Clark surveyed the rapid developments of technical education, and, in indicating the Association's work in connexion therewith, he showed that it was not in Britain alone that the work of technical education was becoming recognised. The Association was in touch with the Technical Instructors' Society of Australia; it was linked to the great American continent through the English-Speaking Union; its views had been sought and given to the World Conference of Education Associations at the Geneva meeting, and its representatives had formed part of the English delegation which attended, last summer, the International Congress on Technical Education held at Liège under the auspices of the Belgian Government, when twenty-two nations were represented.

In spite of this development of national and international opinion, however, Mr. Clark indicated the difficulties which technical education had still to face.

If a scientific approach were to be made towards the solution of our problems of education and industry, it was clear that a small national co-ordinating committee would be necessary to bring together the information secured by local bodies which were forming machinery to draw together educationists and industrialists. The Board of Education was not yet prepared to admit the necessity of such a committee.

Frequently, too, those responsible for local educational administration seemed, "like the tradition-loving schoolmaster, unable to view problems except through academic spectacles. They . . . fear to face the implications of the changing needs of the kaleidoscopic industrial and commercial civilisation in which we live. . . . If rationalisation means the application of organised knowledge, the importance of technical education has to be realised by educationists as well as industrialists. The latter are by no means the only people clinging to ancient methods and conceptions."

To show that those who may be powers in public life also needed convincing, Mr. Clark referred to a recent speech of the Right Hon. Sir Herbert Samuel, M.P., who said (as though to show the superiority of university to technical education) that although technical colleges may be useful and necessary, non-technical institutions gave something better. Men, he said, are not content with obtaining the means of getting a living; they want to live; and the most powerful events of our time do not turn upon economic issues. In such thinking, Mr. Clark suggested, there is a lack of clarity. "Does not a university provide technical education? What sort of doctors, lawyers, architects, would we have if it did not? And do technical colleges not teach the art of living? Is there any better way that such an art can be taught than by the relationships of men (social, industrial, and commercial) made through the work they have to perform in the world? Where would our art of living be without our engineering, our chemistry, our building, and our domestic science? And is there any art or ideal or joy that is not ultimately dependent on economic issues?"

Among the resolutions dealt with by the Conference was one asking for a review of the conditions of entry into various branches of industry. It stressed the desirability of remission of some period of apprenticeship for ex-full-time pupils of senior and junior technical schools, the need for an extended provision of opportunity for all entrants into industry to pass into the ranks of skilled workers, and the need for further provision of part-time day courses for apprentices and learners. Considerable discussion was also centred upon a resolution which included a declaration that a knowledge of biology is part of a sound general education, and that more experts are needed in biological subjects for the proper development of agriculture and industry.

In connexion with the Conference, an excellent exhibition of books and apparatus was provided by a number of publishers and apparatus manufacturers.

Organisation of a Locust Campaign.

THE locusts constitute one of the oldest known plagues of agriculture, but the efforts to study them have always been sporadic and local, while the problem is a very wide one. It is very gratifying to learn, therefore, that the Empire Marketing Board, acting on the recommendations of the Committee on Locust Control of the Economic Advisory Council, has made a grant of £2720 towards the organisation of exhaustive investigations on locusts. The grant represents one half of the estimated cost of investigations during the first year, the other half being covered by contributions from the various British territories participating in the scheme.

The investigations are being conducted by the

Imperial Institute of Entomology, where a special section has been formed for the collection and summarising of all the available information on locusts. Regular reports on the appearance and movements of locusts are being received in the Institute, where they are analysed and correlated, so that a clear picture of the situation is obtained and deductions can be drawn as to the possible source of each invasion. Data of this kind make it possible to draw conclusions as to which areas can be suspected as the probable permanent breeding grounds of locusts.

At present the Red Sea littoral of Africa, the northern provinces of Kenya, and certain areas in Arabia are marked down as deserving a close investigation, and two field entomologists will be sent shortly to the Sudan, and one to Kenya, to study the conditions on the spot. It is hoped that the field entomologists will be able not only to locate the breeding areas, but also to study the natural conditions which make them favourable for locust breeding. Thus, the first year's programme of work consists mainly of a preliminary ecological survey of the breeding areas. The whole scheme is planned to cover a period of five years, and it is proposed to establish a field laboratory for studying locust bionomics on the spot and for experimenting on natural factors which may be responsible for controlling locusts or encouraging their multiplication and the transformation into the swarming phase. Knowledge of this kind would make it possible to suggest methods for preventing outbreaks, or at least to forecast outbreaks, which alone would mean an enormous saving.

The investigations were proposed originally to include only British territories, but lately certain foreign governments have expressed their readiness to co-operate in the scheme. Such a concerted attack on the locust problem has never been attempted before, and valuable results can confidently be expected.

University and Educational Intelligence.

CAMBRIDGE.—The report of the General Board in connexion with the scheme for the employment of the Rockefeller Endowment for Scientific Departments recommends that the following posts be established as from Oct. 1: a University lectureship in cytology in the Department of Agriculture; a University lectureship in plant physiology and a University lectureship in mycology in the Department of Botany; an additional University lectureship and an additional University demonstratorship in the Department of Biochemistry.

In a series of reports, the General Board recommends that readerships in the University should be created for the following: Mr. F. T. Brooks, of Emmanuel College, in mycology; Dr. A. D. Imms, of Christ's College, in entomology, and Mr. James Gray, of King's College, in experimental zoology. The following posts will also be created: a curatorship of the Sedgwick Museum in the Department of Geology; a senior curatorship and a junior curatorship of the Museum of Zoology.

At Clare College, Dr. H. Godwin, research fellow of the College and University demonstrator in botany, has been appointed to an official fellowship. At Trinity College the following have been elected to research scholarships: J. C. Jaeger in mathematics, W. G. Thompson in physics, E. F. Warburg in botany, and P. Ullyott in zoology.

EDINBURGH.—Dr. Walter Smith Kay, who died on April 22, has bequeathed to the University the sum of £5000, subject to Government duty, the annual income to be applied towards aiding research in mental diseases or psychiatry in such manner as the University Court and the professor of psychiatry shall think fit. The Senatus has intimated that Prof. Sydney Smith is appointed dean of the Faculty of Medicine, in succession to Prof. Lorrain Smith, who died on April 18.

LONDON.—Dr. C. R. Harington (pathological chemistry) has had the title of professor conferred on him in respect of his post at University College Hospital Medical School; Mr. James Fairgrieve (education, with special reference to methods of teaching geography) has been appointed reader in respect of the post held by him at the London Day Training College; and Dr. R. C. J. Howland (mathematics) has been appointed reader in respect of the post held by him at University College.

The title of emeritus professor of experimental pathology in the University has been conferred on Sir Charles Martin, and that of emeritus professor of biochemistry in the University on Dr. Arthur Harden, on their retirement from the Lister Institute of Preventive Medicine.

OXFORD.—In view of certain statements in the Report of the Library Commission, by which it appears to be contemplated that the part of the Old Ashmolean Museum at present occupied by those engaged on the Oxford English Dictionary shall be "retained as a first provision for large co-operative enterprises" such as the Dictionary of National Biography, the Association of Friends of the Old Ashmolean, at its annual meeting held on May 29, adopted a resolution strongly advocating the restoration of this historic building to scientific purposes akin to those for which it was originally founded. At the same meeting it was pointed out that there is still a confusion in the minds of many persons as to the relations existing between the two museums known as the "Ashmolean" and "Old Ashmolean" respectively. The Ashmolean Museum exists for the purpose of illustrating art and archæology; whereas the Old Ashmolean was intended for scientific studies, and has been intimately associated with the natural sciences ever since 1683.

THE Scientific Club of Winnipeg has awarded its Research Prize of 250 dollars, for the most meritorious investigations conducted by a post-graduate student in the University of Manitoba during the last three years, to Dr. P. A. Macdonald. The researches of Dr. Macdonald, which were carried out in the Department of Physics, consisted of studies of the senses of temperature, pain, vision, touch, and hearing, with particular reference, in the last three, to the validity of the Weber-Fechner law.

A NUMBER of studentships in relation to cotton growing, not exceeding eight in all, will be awarded in June next by the Empire Cotton Growing Corporation. They will be of two kinds, namely, specialist studentships and agricultural studentships. The first-named are intended to enable graduates, who believe that they have a leaning towards research, to equip themselves for posts in which work of that type is required. Successful candidates will, in general, be required to take a course in agriculture during the tenure of their studentship if they do not possess an adequate knowledge of the subject. The Agricultural Studentships are intended to enable men to receive such specialised instruction as their previous qualifications and experience show to be most desirable in order to equip them for agricultural posts in cotton-growing countries wherever opportunities for employment may present themselves, whether in government agricultural departments, with commercial cotton-growing companies, or under the Cotton Growing Corporation. Forms of application, returnable by, at latest, June 10, can be obtained from the Secretary, Empire Cotton Growing Corporation, Millbank House, 2 Wood Street, S.W.1.

Birthdays and Research Centres.

June 7, 1877.—Prof. C. G. BARKLA, F.R.S., professor of natural philosophy in the University of Edinburgh.

The *J*-phenomenon still engages our attention on account of its seemingly fundamental nature. Experimental results 'cut right across' current theory and indicate that some properties of radiation (at least) are controlled not by independent constituent wave-trains or quanta but by a quality of the whole stream of radiation more closely allied to temperature. Some elusive condition is, however, essential to the occurrence of the *J*-discontinuities—a condition found to be independent of the nature and disposition of apparatus so far as these are externally observable. Recent experiments with Mr. Honeyman show the rapid development of the characteristic discontinuities with the time of exposure of the radiating substance to X-rays; while experiments with Mr. Kay confirm and extend this conclusion by showing that two different specimens of one kind of radiating substance behave differently at the same time, one providing discontinuities, the other not. Our immediate problem is to discover the nature of this critical state of the radiating substance.

June 11, 1867.—Prof. CH. FABRY, professor of physics in the University of Paris.

Nous connaissons assez bien la partie basse de notre atmosphère, celle qui nous est directement accessible. Mais au-dessus, entre la basse atmosphère et les espaces cosmiques, s'étend une région étendue, qui fait encore partie de la terre puisqu'elle gravite avec elle, et dont l'étude est très difficile. Cette étude est cependant fort importante; ce sont ces hautes couches de notre atmosphère qui reçoivent tous les chocs venant de l'extérieur: Étoiles filantes et bolides, corpuscules électriques (rayons cathodiques et rayons positifs), radiations de toutes longueurs d'onde. Ce que l'on sait sur ces hautes couches a été trouvé un peu par hasard; c'est ainsi que l'étude pratiqué des communications par radio a fait connaître l'existence de hautes couches renfermant un nombre important de charges électriques.

L'étude de l'absorption des radiations venant des astres, en particulier du soleil, dans leur passage à travers notre atmosphère, a révélé aussi des choses très inattendues. Il y a, dans la partie haute de notre atmosphère, une certaine quantité d'ozone, qui absorbe une grande partie des radiations ultra-violettes venant du soleil. Des résultats fort importants ont déjà été obtenus, en particulier par Dobson et ses collaborateurs; l'étude demande à être poursuivie. Des recherches récentes (Buisson, Ladenburg et Götz) ont confirmé que la basse atmosphère contient un peu d'ozone; il faut en tenir compte dans les études sur l'absorption. L'altitude de la principale couche d'ozone de la haute atmosphère a été, jusqu'ici, évaluée à 50 km. environ; si l'on tient compte de l'ozone de la basse atmosphère, on sera probablement amené à placer encore plus haut l'ozone de la haute atmosphère, peut-être à 80-100 km. (Chalonge). Cet ozone est peut-être en relation avec la couche ionisée que révèlent les observations sur la radio.

Les expériences récentes poursuivies dans divers pays sur les *fusées* donnent l'espoir que l'on pourra un jour envoyer des instruments dans ces très hautes régions.

Societies and Academies.

LONDON.

Royal Meteorological Society, May 20.—**Sir Gilbert Walker**: Recent work by S. Mal on the forms of stratified clouds. Two years ago it had been suggested that the breaking up of a stratum of cloud into polygons or long strips was often due to instability, accompanied in the latter case by shear parallel to the strips. Mal showed that a rectangular pattern was caused when the unstable stratum was subjected to a less rapid shear than is needed for strips; and verified from measurements made in the sky that cloud strata break up or persist according as their temperature gradient is unstable or stable; and that when they break up the pattern assumed is polygonal, rectangular, or in strips according as the shear is zero, moderate, or large.—**C. K. M. Douglas**: A problem of the general circulation. So far as can be judged from present data, there is no appreciable net flow of polar air in the lower troposphere towards the subtropical anticyclone. This supports the view of Dr. Jeffreys, namely, that the exchange of air between different latitudes, required to maintain the angular momentum of the zone of west winds against friction, is carried out entirely by currents lying side by side, and not one above the other. The fundamental problem is the relation of the individual cyclone to the general circulation, and this has not yet been solved.—**G. S. P. Heywood**: Wind structure near the ground, and its relation to temperature gradient. The wind velocities were obtained by two anemometers at heights of 12·7 m. and 94·5 m. above the ground. There are not many results from anemometers so high as 95 m.; for this reason, the ordinary diurnal variation at this height in summer and winter is shown, with that at 13 m. for comparison. The vertical gradient of temperature up to 87 m. is also recorded. Wind gradient must depend largely on temperature gradient, and the relation between the difference in wind velocity and the difference in temperature over approximately the same height interval, is worked out for various wind strengths.

PARIS.

Academy of Sciences, April 20.—The president announced the death of René Kœhler, *Correspondant* for the section of anatomy and zoology.—**M. Delépine**: Notice on Raffaello Nasini.—**L. Joubin**: Notice on René Kœhler.—**Lucien Daniel**: The persistence and accentuation of variations in the descendants of the Jerusalem artichoke grafted on the sunflower. In agreement with the hypotheses of Lamarck and Darwin, it has been proved by a series of experiments started in 1894 that grafting in the Jerusalem artichoke and its descendants is a powerful factor of variation, the action of which persists and is sometimes accentuated in the successive generations of this species.—**W. Tartakowsky**: The representation of a system of numbers by a system of positive additive quadratic forms.—**S. Carrus**: The integration, without the sign of quadrature, of certain systems of differential equations with any coefficients.—**Mlle. Marie Charpentier**: Semi-closed ensembles and their applications in the theory of Peano points.—**E. Kogbetliantz**: Jacobi developments.—**N. Abramesco**: The movement of a variable plane figure with conservation of similitude.—**Alfred Rosenblatt**: The plane movements of viscous liquids adjoining radial movements.—**Paul Woog, Mlle. Emilie Ganster, and Jean Givaudon**: The stabilisation of oils for chronometry. Fatty oils as lubricants for clocks and watches have advantages over mineral oils, but have the dis-

advantage that the viscosity changes owing to oxidation. Experiments on various anti-oxygens, based on the work of Moureu and Dufraisse, have led the authors to propose a mixture of β-naphthol and a red dyestuff to be added to the oil. The former prevents oxidation, and the dye by absorbing the actinic rays hinders oxidation due to exposure to daylight.—G. A. Mokrzycki: Determination of the combustible necessary to reach the practical plafond.—G. Reboul: Singularities presented by bodies submitted to the action of resistance cells.—Th. V. Ionescu: Ionised gases and Coulomb's law. The existence of a vibration period for ionised gases makes possible the calculation of the velocity of propagation of an electric wave in these media.—Mlle. Paule Collet and G. Foëx: The magnetic states of platinum.—V. Lalan: The hypothesis of the curve of pursuit and refraction in optical systems in motion.—H. Hulubei and Mlle. Y. Cauchois: A simple and luminous arrangement for the study of the Raman effect.—Jean Becquerel and Louis Matout: A new magneto-optical effect: rotatory power along the optical axis of certain uniaxial crystals in the neighbourhood of absorption bands under the action of a magnetic field normal to this axis.—S. Rosenblum and M. Valladares: Figures of distribution of the active deposit on electrodes.—Georges Fournier: The existence of different isotopes. A list is given of probable isotopes not, so far, found experimentally.—René Pallu: The decomposition of monobarium phosphate in solution.—Georges Arditti: The oxidation of paraffin oil by air. For the detection of the first traces of acid formed by the oxidation, use is made of Dubrisay's method of the change in the interfacial tension between the oil and a solution of caustic soda. At temperatures of 15° C. and 85° C. there is no oxidation, but traces of acid appear at 110° C.—P. Bary and E. Fleurent: The law of degradation of solutions of rubber as a function of the time at different temperatures.—P. Laffitte and M. Patry: The transmission of a detonation at a distance.—M. Paić: The double compounds between the mercuric sulphates and mercuric iodide.—J. Bougault and G. Schuster: A new triglyceride obtained from cocoa butter. A palmitostearoazelain.—M. Tiffeneau, Mlle. Jeanne Lévy, and E. Ditz: Two diastereoisomeric derivatives of campholenic acid: their formation in unequal but inverse proportions by inverting the order of introduction of the fixed radicals.—R. Cornubert: An attempt at the reproduction of a tetrahydropyrone compound.—Charles Dufraisse and Roger Netter. Researches on the ethylenic ketones: α-bromo-β-aminobenzalacetophenones.—Marcel Godchot and Mlle. Germaine Cauquil: Some new derivatives of the cyclo-octane series. A new cyclo-octene oxide is described, as well as the glycol obtained by its hydration.—R. Paul: The action of magnesium on some halogen substituted ether oxides. The reaction between magnesium and oxides of the type $RO(CH_2)_3X$ (X = I, Br, or Cl) has been studied. The reaction is influenced both by the catalyst added and by the nature of the solvent.—Paul Gaubert: The artificial coloration of crystals of oxalate and nitrate of urea. A study of the influence of various colouring matters on the crystalline forms of urea oxalate and urea nitrate.—F. Zambonini and V. Caglioti: New researches on the chemical composition of sarcolite from Mont Somma (Vesuvius). Five complete analyses are given: these are not in agreement with the formula proposed by Gossner and Mussgnug.—Yang Kieh: The dislocated zone situated to the north of the Chaîne de la Marche.—V. Frolow: The periodicities of the risings of the Niger at Koulikoro. The results of the study by the method of A. Wallen of 24 years' data.—R. Bureau: The variations of wireless atmospherics during the eclipse of the moon of April 2, 1931. The curves of the records of atmospherics recorded at Saint-Cyr and at Mont Valérien show a marked anomaly between 18 h. and 24 h. on April 2, 1931. Hence there is a connexion between the eclipse of the moon and atmospherics.—Jean Chevrier: Magnetic exploration in Syria.—P. L. Mercanton: The inversion of the magnetic inclination in geological time. New observations. In an earlier communication, a study of the natural magnetisation of volcanic lavas of various origins (Greenland, Spitsbergen, Australia) led to the conclusion that at the Tertiary epoch, at the time of the great volcanic outbursts, the terrestrial magnetic inclination was, in both hemispheres, the reverse of what it is to-day. Further experimental data in support of this view are now given.—F. Labrousse: The changes in reaction observed in the course of the development of some fungi. The influence of the nature of the nitrogenous food material.—E. Wollman and V. Uribe: Researches on humoral immunity in cold-blooded animals.—Maurice Nicloux: The micro-estimation of organic substances in dilute solutions by sulphochromic oxidation. Special application to the micro-estimation of ethyl alcohol.—Delherm and Laquerrière: A new apparatus for faradic currents.

ROME.

Royal National Academy of the Lincei, Nov. 2.—F. Vercelli: Complementary observations to the note on a general method for the analysis of the periodicity in statistical and experimental diagrams.—C. Carathéodory: Canonical transformations of slipping and their application to geometrical optics.—R. Nasini: Discovery of boric acid in the glaze of the vases of Arezzo. The glaze of these vessels, which constitute one of the finest examples of the Roman art of the first century B.C. and the first A.D., contains boric acid, not in accidental traces, but as a definite component (see NATURE, Dec. 6, p. 877).—S. Amante: Matrices which satisfy a given algebraic equation.—B. de Finetti: Determinate and indeterminate problems in the calculus of probabilities.—Maria Pastori: Isotropic tensors: relation between the components.—Margherita Piazzolla-Beloch: Connected oblique multilaterals.—E. Čech: A demonstration of Jordan's theorem.—A. Kolmogoroff: The conception of the mean.—Nikola Obrechkoff: A generalisation of Cesàro's summation.—G. Rabaté: Some points of direct infinitesimal geometry. Investigations on the notions of contingent and paratingent used by G. Bouligand as instruments of his direct infinitesimal geometry are summarised.—E. Gugino: The extension of Morera's theorem to the motion of systems with reversible linkings.—L. Poggi: Extension of D'Alembert's paradox and of the Kutta-Joukowski theorem to circular-arc profiles.—E. Pistolesi: The dynamic actions of a circulatory current on cusped profiles.—A. Signorini: The mechanics of continuous systems. In dealing with any problem of finite deformations, it is convenient, in the first place, to subject the general equations of the mechanics of continuous systems to a transformation analogous to that which, in the particular case of hydrodynamics, leads from Euler's equations to those of Lagrange. A new Lagrangian form of the indefinite equations now given may be of use in the indirect solution of certain particular problems.—Angelina Cabras: The mechanics of rigid bodies in generalised spaces. A scheme of procedure for applying the methods described in a preceding note to the static and dynamic treatments to all elliptical S_n is given.—Enrico Volterra: The general laws of the vibrations

of a network of stretched elastic wires with nodes in common and fixed or vibrating extremities are considered, the initial configuration of the system and the initial velocities of the elements of the elastic elements of the system being assumed known. The application of such laws to the study of water-hammer in a network of pipes under pressure is described.—R. Bilancini: The coefficient of correlation. An examination is made of the coefficient of correlation in the case when the relation between the two magnitudes considered is not linear, but when one of the magnitudes is expressible by means of a polynomial of the other of degree n, greater than one.—E. Fermi: Quantistic electrodynamics (2). The quantistic forms recently derived for the equations of a system composed of an electromagnetic field and of any number of point electric charges referred to the non-relativistic case, the velocity of the charges being not very high. These are now converted into the relativistic forms by a method other than that based on Dirac's theory of the rotating electron.—G. B. Pacella: Simple method for the calculation of an aspherical plano-convex lens. The form to be assigned to an aspherical lens with one plane face in order that it may be stigmatic for the point on the axis at infinity when a beam of monochromatic light falls on it, is determined.—A. Masotti: Calculation of the resultant and of the resultant moment of the electrostatic pressures in a plane field by formulæ analogous to the hydrodynamical formulæ of Blasius. The analogy between the electrostatic pressures exerted on the surface of an electrified conductor in equilibrium and the hydrodynamic pressures of a liquid in permanent, irrotational motion on the surface of an immersed solid, is developed. It is shown that, for an indefinite cylindrical conductor in an electric field with distribution uniform to infinity, the resultant of the electrostatic pressures on unit length of the conductor has the direction and sense of the electric force at infinity, while its magnitude is the product of such force by the charge of unit length of the conductor; the system of electrostatic pressures is equivalent to the resultant applied at the baricentre of the charges.—A. Corbellini and L. Barbaro: The anomalous decomposition of the tetrazo-derivative of 2 : 2′-diamino-1 : 1′-dinaphthyl. The acid melting at 250°-252°, previously observed as a product of this decomposition, is formed by partial decomposition of the tetrazo-compound when acid solutions of its sulphate or chloride are heated. This reaction proceeds also, although very slowly, at the ordinary temperature, and yields, in addition, neutral compounds difficult to purify.—Morello Morelli: Spectrochemistry of solutions of boric acid in glycerin. The molecular and specific refractivities of boric acid in glycerin solution are greater than in aqueous solution, and decrease as the concentration of the solution is increased. Dissolution of boric acid in glycerin is accompanied by expansion, the extent of which increases markedly with the concentration.—F. Rodolico: Polyhedric pisolites of magnesite and of dolomite.—G. Mezzadroli and E. Vareton: Action of ultra-short electromagnetic waves ($\lambda = 2$-3 m.) on silkworms (3): Irradiation of the eggs. The favourable effect of the waves is increased if the exposure is commenced prior to hatching of the eggs.—M. Fedele: Innervation and peripheral sensitive arrangements of the arterial trunk of reptiles.—S. Ranzi: Conditions determining the development of gills (investigations on the experimental embryology of cephalopods).—M. Mitolo: Oxygen and central nervous functions. One of the mechanisms which explain the action of oxygen in the functions of the central nervous system and the indispensability of this gas to the central nervous elements is the continuous oxidation of acids occurring among the metabolic products of this system.—Clara Forti: Excision of the vessels and nerves of the ovary; total or partial excision and metabolism (3). This excision produces slight retardation of the metabolism during the first few months after the operation.

Official Publications Received.

BRITISH.

Rhodesia Museum, Bulawayo. Twenty-ninth Annual Report, 1930. Pp. 12. (Bulawayo.)

Proceedings of the Royal Society. Series A, Vol. 131, No. A817, May 1. Pp. 275-517. (London: Harrison and Sons, Ltd.) 12s.

The Proceedings of the Physical Society. Vol. 43, Part 3, No. 238, May 1. Pp. viii+227-370. (London.) 7s. net.

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Welsh Timber Trees, Native and Introduced. By H. A. Hyde. Pp. viii+107+25 plates. (Cardiff.) 1s.

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1930. (No. 2269.) Pp. v+61. (Ottawa: F. A. Acland.) 25 cents.

Canada: Department of Mines: Geological Survey. Memoir 164: The Niagara Falls Survey of 1927. By W. H. Boyd. (No. 2246.) Pp. ii+15+5 plates. 10 cents. Summary Report, 1929, Part B. (No. 2255.) Pp. 202B. (Ottawa: F. A. Acland.)

Canada: Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1929. (No. 719.) Pp. 69+5 plates. (Ottawa: F. A. Acland.)

Publications of the Dominion Astrophysical Observatory. Vol. 4, No. 19: Four Spectroscopic Binary Orbits. By W. E. Harper. Pp. 309-323+1 plate. 25 cents. Vol. 4, No. 20: The Galactic Rotation Effect in some Late Type Stars. By R. O. Redman. Pp. 325-340. 25 cents. Vol. 4, No. 21: Y Cygni. By R. O. Redman. Pp. 341-350+1 plate. 25 cents. (Ottawa: F. A. Acland.)

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee. Part 20. Pp. 193-268. (Trinidad: Government Printing Office, Port-of-Spain.)

Journal of the Royal Statistical Society. New Series, Vol. 94, Part 2. Pp. 171-358+xvi. (London.) 7s. 6d.

The Transactions of the East Riding Antiquarian Society. Vol. 27, Part 1. Pp. iv+80+8 plates. (Hull: The Museum.) 10s. 6d.

Imperial Bureau of Fruit Production. Horticultural Abstracts. Vol. 1, No. 1, March. Pp. 24. (East Malling.) 1s. 6d.

Report of the National Park Committee. (Cmd. 3851.) Pp. 131. (London: H.M. Stationery Office.) 2s. net.

Department of the Interior, Canada: Topographical Survey. Bulletin No. 63: The Aneroid Barometer and Altimeter, their Characteristics and Use in Mapping. By R. H. Field. With an Appendix: The Field Use of the Aneroid Barometer, by G. C. Cowper. Pp. 36. (Ottawa: F. A. Acland.) 10 cents.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1363 (Ae. 491—T. 2977 and 'a'): Maximum Lift in Closed and Open Jet Tunnels. By F. B. Bradfield, K. W. Clark and R. A. Fairthorne. Pp. 19+5 plates. 1s. net. No. 1278 (Ae. 424—T. 2923 Spin 8): Spinning Experiments on a Single Seater Fighter. Part 1: Further Model Experiments, by A. S. Batson and H. B. Irving; Part 2: Full Scale Spinning Tests, by S. B. Gates. Pp. 10+12 plates. 9d. net. No. 1353 (Ae. 484—T. 2984): The Two-Dimensional Flow of Air around an Aerofoil of Symmetrical Section. By T. Tanner. Pp. 11+18 plates. 1s. net. No. 1356 (Ae. 487—T. 2969): Spinning of a Model of the Fairey IIIf Seaplane. By H. B. Irving and A. S. Batson. Pp. 15+27 plates. 1s. net. (London: H.M. Stationery Office.)

FOREIGN.

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 9, No. 12: The Fur Seal of the California Islands, with new Descriptive and Historical Matter. By Charles Haskins Townsend. Pp. 443-457. (New York City.)

Scientific Publications of the Cleveland Museum of Natural History. Vol. 1, No. 5: Bird Banding by Systematic Trapping. By S. Prentiss Baldwin. Pp. 125-168+plates 19-25. (Cleveland, Ohio.)

Collection des travaux chimiques de Tchécoslovaquie. Redigée et publiée par E. Votoček et J. Heyrovský. Année 3, No. 4, Avril. Pp. 187-240. (Prague: Regia Societas Scientiarum Bohemica.)

Publications of the United States Naval Observatory. Second Series, Vol. 13, Appendix 1: The Gravity Measuring Cruise of the U.S. Submarine S-21. By F. A. Vening Meinesz and F. E. Wright; with an Appendix on Computational Procedure, by Miss Eleanor A. Lamson. Pp. x+94+9 plates. (Washington, D.C.: Government Printing Office.)

Det Kgl. Danske Videnskabernes Selskabs Skrifter: Naturvidenskabelig og mathematisk Afdeling. 9 Række, IV, 1: Contributions to the Study of the Development and Larval Forms of Echinoderms, I-II. By Th. Mortensen. Pp. 39+7 plates. (København: Andr. Fred. Høst and Søn.)

Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1930. Erstattet von dem Direktor, Dr. R. Schorr. Pp. 28+4 Tafeln. (Bergedorf.)

Mitteilungen der Hamburger Sternwarte in Bergedorf. Band 6, Nr. 34: Sechster Nachtrag zum Eigenbewegungs-Lexikon. Zusammengestellt von W. Kruse und B. Imgart. Pp. 221-327. (Bergedorf.)

Det Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser, Bind 10, Nr. 1: Der grosse europäisch-sibirische Kreuzschnabelzug 1927. Von Ad. S. Jensen. Pp. 27. (København: Andr. Fred. Høst and Søn.) 1.00 kr.

Ministerio da Educacao e Sande Publica. Annuario publicado pelo Observatorio Nacional do Rio de Janeiro para o Anno de 1931. Anno 47. Pp. xv+426. (Rio de Janeiro.)

Japanese Journal of Geology and Geography. Transactions and Abstracts, Vol. 8, No. 3. Pp. iii+113-289+13-27. Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 7, No. 4, March. Pp. 267-346+22. Japanese Journal of Botany. Transactions and Abstracts, Vol. 5, No. 3, March. Pp. v+253-369+55-87. (Tokyo: National Research Council of Japan.)

Egyptian University: Faculty of Medicine. A Study of Hairs and Wools belonging to the Mammalian Group of Animals, including a Special Study of Human Hair, considered from the Medico-Legal Aspect. By Prof. John Glaister, Jun. (Publication No. 2.) Pp. ii+188+145 plates. (Cairo: Misr Press.)

Soil Bulletin. No. 1, December. Pp. iii+38. No. 2, March. Pp. ii+60+9 plates. (Peiping: Geological Survey of China.)

Annales de Zô-sè. Tome 17, Fasc. 4. Pp. C31. (Zi-ka-wei.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 6, No. 4, April, R.P. Nos. 292-302. Pp. 523-763. (Washington, D.C.: Government Printing Office).

Bulletin of the National Research Council. No. 82: List of Seismological Stations of the World. Second edition. Compiled by H. E. McComb and Clarence J. West. Pp. ii+119. (Washington, D.C.: National Academy of Sciences.) 1.50 dollars.

Diary of Societies.

FRIDAY, JUNE 5.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 9.30 A.M.—Dr. A. B. Kelly and Prof. L. Findlay: Congenital Shortening of the Œsophagus, and the Thoracic Stomach resulting therefrom.—Dr. H. G. Hodgson: The Radiography of Sinusitis.—Prof. G. Portmann: Treatment of Cicatricial Stenosis of the Œsophagus by Autodilatation.—Sir StClair Thomson: A Permanent Tracheostomy in Stenosis of the Larynx.—At 5.—O. O. Popper: Demonstration of Broncho-œsophagoscope.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Mrs. Patrick Villiers-Stuart: The Indian Paradise Garden (Sir George Birdwood Memorial Lecture).

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr. H. C. Hepburn: Electro-osmosis and Electrolytic Water-transport. Part 2.—J. S. Badami: Spectra of Trebly and Quadruply Ionised Antimony Sb LV and Sb V.—G. I. Finch, R. W. Sutton, and A. E. Tooke: A Time Base for the Cathode-ray Oscillography of Irregularly Recurring Phenomena.—Dr. R. L. Smith-Rose and J. S. McPetrie: The Attenuation of Ultra-short Radio Waves due to the Resistance of the Earth.—Prof. S. Chapman: The Absorption and Dissociative Ionising Effect of Monochromatic Radiation in an Atmosphere on a Rotating Earth. Part 2. Grazing Incidence.—A Ripple-tank Demonstration of Beats as Moving Interference Fringes, by M. O. Clarke.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—R. O. Jones: The Development of the Tawe Drainage.—Dr. S. W. Wooldridge and C. J. C. Ewing: Further Observations on the Geology of the Lane End Eocene Outlier.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY (at Kensington Town Hall), at 8.15.—Prof. J. S. Huxley: Development in Relation to Heredity and Evolution (Cavendish Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. E. W. MacBride: Habit—the Driving Force in Evolution.

TUESDAY, JUNE 9.

MINERALOGICAL SOCIETY, at 5.30.—G. E. L. Carter: On an Occurrence of Vanadiferous Nodules on the Coast of South Devon.—M. H. Hey: Studies on the Zeolites. Part II. Thomsonite (including Faroelite) and Gonnardite.—A. Russell: An Account of British Mineral Collectors and Dealers in the 17th, 18th, and 19th Centuries (continued).—Dr. L. J. Spencer: (*a*) Hoba (South-West Africa), the Largest Known Meteorite; (*b*) Twelfth List of New Mineral Names.—Dr. J. L. E. Drugman: On Different Habits of Fluorite Crystals.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. T. Thomson Flynn: Exhibition of Photographs of Living Tasmanian Marsupials.—Prof. J. Huxley: The Relative Size of Antlers in Deer.—T. L. Green: The Anatomy and Histology of the Alimentary Canal in the Common Wasp, *Vespa vulgaris*.—Dr. Marion A. Hamilton: The Morphology and Biology of *Nepa cinerea* Linn.—S. Maulik: On the Structure of the Larvæ of Hispine Beetles.—Prof. F. H. Edgeworth: (*a*) On the Muscles used in Shutting and Opening the Mouth; (*b*) On the Development of the External Ocular, Masticatory, and Hyoid Muscles of the Monotremata; (*c*) On the Development of the External Ocular, Masticatory, and Hyoid Muscles of *Sphenodon punctatus*.—Joyce Omer-Cooper: Report on the Dytiscidæ (Coleoptera), Mr. Omer-Cooper's Investigation of Abyssinian Fresh-waters (Dr. Hugh Scott's Expedition).

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—Prof. H. S. Holden: Wound-healing in Plants.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 8.30.—Prof. A. Calmette: B.C.G. Immunisation of Infants.

WEDNESDAY, JUNE 10.

RESEARCH DEFENCE SOCIETY (Annual General Meeting) (at 11 Chandos Street, W.1), at 3.30.—Dr. H. H. Dale: The Effect of Research on Curative Medicine (Stephen Paget Memorial Lecture).

FARADAY SOCIETY (at Chemical Society), at 8.—Annual General Meeting.—At 8.15.—Dr. W. H. J. Vernon: (*a*) A Laboratory Study of the Atmospheric Corrosion of Metals. Part I. The Corrosion of Copper in Certain Synthetic Atmospheres, with particular reference to the Influence of Sulphur Dioxide in Air of Various Relative Humidities; (*b*) An Air Thermostat for Quantitative Laboratory Work.—Dr. W. H. J. Vernon and L. Whitby: The Quantitative Humidification of Air in Laboratory Experiments.

INSTITUTION OF STRUCTURAL ENGINEERS (at 10 Upper Belgrave Street), at 8.—H. A. Holt: The Art of Making and Using Concrete (2): The Raw Materials of Concrete and their Field Testing.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—W. T. Griffiths: Continental and American Practice in Nickel Deposition.

ROYAL SOCIETY OF MEDICINE (Surgery Section) (Annual Meeting) (at Manchester Royal Infirmary).

THURSDAY, JUNE 11.

ROYAL SOCIETY, at 4.30.—M. L. E. Oliphant: Electron Emission from Langmuir Probes and from the Cathode of the Glow Discharge through Gases.—H. E. Watson, G. Gundu Rao, and K. L. Ramaswamy: The Dielectric Coefficients of Gases. Part I.—G. D. Bengough, A. R. Lee, and F. Wormell: The Theory of Metallic Corrosion. IV.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 8.—Sir John H. Parsons: Young's Theory of Colour Vision (Thomas Young Oration).

FRIDAY, JUNE 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Dr. L. J. Comrie: Note on Mr. Chappell's Method of Second Difference Integration.—Bertha Swirles: The Absorption Coefficient of a Degenerate Gas.—G. Castelnuovo: De Sitter's Universe and the Motion of Nebulæ.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 5.—Annual General Meeting.

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

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

PUBLIC LECTURES.

FRIDAY, JUNE 5.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—R. R. Hyde: Industrial Welfare.

TUESDAY, JUNE 9.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir George Buchanan: International Hygiene.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital, W.2), at 5.—Prof. J. S. Haldane: The Problems of Silicosis.

WEDNESDAY, JUNE 10.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—A. T. Pike: Town Planning.

FRIDAY, JUNE 12.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Sir Thomas Legge: Industrial Poisonings.

CONFERENCES.

JUNE 9 TO 12.

INSTITUTE OF BRITISH FOUNDRYMEN (at Birmingham).

Wednesday, June 10 (*morning*) (at Grand Hotel).—A. Harley: Presidential Address.
G. W. Spring: The Effect of Elevated Temperatures on Grey Iron Castings.
Prof. H. Thyssen: Factors in the Conductivity of Irons
M. Arzens: The Laboratory and the Foundry.
E. N. Simons: The Merchandising of Castings.
Dr. J. G. A. Skerl: Sands and Sand Testing.
J. Arnott: Silicon as an Alloying Element.
W. C. Devereux: High-Duty Light Alloys.

Thursday, June 11 (at Coventry).—L. H. Pomeroy: The Relationship between the Engineering and the Foundry Trades.
J. G. Pearce: Recent Developments in Cast Iron in Great Britain.

JUNE 10 TO 13.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Winchester).

Wednesday, June 10, at 8.—Sir J. Arthur Thomson: Some Natural History Problems of the Countryside (Presidential Address).

Thursday, June 11 (Botanical Section), at 11 A.M.—J. Groves: Stoneworts, Ancient and Modern.
At 11.45 A.M.—Prof. S. Mangham: Plants as Civil Engineers.
(Archæological Section), at 11 A.M.—Dr. W. E. St. L. Finny: The Kings of Wessex from Egbert to Athelstan.
At 12.45.—The late A. Hadrian Allcroft: The Pre-History of the Village Church. Part 2.

Friday, June 12 (Geological Section), at 10.30 A.M.—Prof. H. L. Hawkins: Some Generalisations on the Nature, Deposition, and Palæontological Implications of the Chalk.
At 11.45 A.M.—F. H. Edmunds: The Relation of Soil and Geology of the Weald.
(Zoological Section), at 10.30 A.M.—J. F. Marshall: The Stereoscopic Photomicrographs of Fossil Insects exhibited in the Congress Museum.
At 11 A.M.—H. Main: Insect Observations Underground.
At 12.—E. A. Martin: The Making of Pearls.
At 8 P.M.—W. P. D. Stebbing: A Motor Tour of 7500 miles from the Transvaal to Western Uganda (Public Lecture).

Saturday, June 13 (Regional Survey Section), at 11 A.M.—H. J. E. Peake: Archæological Surveys.

SUMMER MEETING.

JUNE 11 TO 13.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Sheffield).