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CONTENTS

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Power Alcohol

THE motor-car, of which there are so many millions, has provided a market as never before for a variety of manufactured products, and above all for the fuel used to drive its engine. It is responsible for the development of the great oil industry, including such highly technical sections of it as refining and cracking. The fact that only some favoured territories contain oil has introduced a new factor into the balance of international trade, resulting, for example, in large purchases of oil by British and European countries from the United States. Had world conditions remained what is termed normal, there would have been no desire to do other than buy oil of satisfactory quality at the cheapest delivered price, irrespective of its origin, but as a consequence of the dislocation of exchanges and the parlous condition of agriculture, the provision of substitutes for imported oil is being considered in a number of countries. Most of these alternatives would scarcely stand the test of scientific economics in normal times, a fact which necessitates their adoption under some form of government protection or compulsion, but it is none the less probable that, once established, a series of conditions might be set up which would favour and justify their continuation. At all events, the stimulus to invention and experiment, with the object of replacing imported oil by some other fuel, is present in all non-oil producing countries.

Petrol may be produced by the hydrogenation of coal or of low-temperature tar derived from coal and, as is well known, considerable quantities have been manufactured in this way in Germany, though it is not yet claimed that the process is a complete success, either economically or technically. A similar hydrogenation project, involving a capital expenditure of £7,000,000, has recently been the subject of controversial discussion in Great Britain : in particular, it is impossible to embark on it without a guarantee of the continuation of the present tax on petrol for a number of years, as the cost at the factory of synthetic petrol from coal is very materially greater than the price at a port of the imported article.

A car may be propelled by means of ordinary towns' gas, compressed for the purpose in cylinders, and the trials already made in this direction have shown that so far as the power obtained and the cost of the gas per mile run, the possibilities are great. The major problem is in connexion with

the recharging of the cylinders and the guarantee against accident in usage. Parallel studies are being made with hydrogen gas in cylinders, the gas being generated cheaply at electric power stations during the off-peak load period.

It is, however, primarily to another liquid fuel, the production of which has a great bearing on agriculture, that we wish now particularly to refer, namely, alcohol. This is already in use in a number of countries, and it may well be that the necessity not to buy from America, which is being forced on Europe by its inability to obtain dollars, will lead to a very large development of the use of power alcohol in the near future.

It may surprise those who judge the cost of alcohol by the retail price of potable spirits that it should ever be competitive with petrol: spirits, however, are made from expensive raw materials, are maturated for seven years or longer, are sold in bottles, and carry heavy transport, selling and advertising charges, to say nothing of the excise taxation, which in itself makes up the greater bulk of their cost. Industrial alcohol to-day is made in large, highly organised factories by fermentation of the cheapest possible carbohydrate material, in particular black strap molasses, which is transported from its place of origin in tank steamers and stored in large tanks. It is pumped and handled just like oil, at a minimum cost to the user. The alcohol produced is separated from the fermentation mash in a continuous still with a minimum expenditure of steam, and can be concentrated in one continuous operation to an anhydrous product containing 99·99 per cent of alcohol, which is quite a different material from the 96 per cent spirit of a year or so ago.

It is the new method for the production of absolute alcohol which has made the advent of power alcohol certain. It is based on the well-known work of Prof. Sydney Young, namely, that a ternary mixture of three liquids will boil at a lower temperature than any one of them singly, or any mixture of two of them. Young's laboratory results have had to wait nearly thirty years for their full application to practice. Yet another example is afforded by them of the ultimate value to industry of results which were seemingly at first only of theoretical interest. It is possible and practicable to add to an aqueous alcohol a third liquid, such as benzene or, preferably, benzene with a little high-boiling petrol from a particular fraction, and drive off all the water as a ternary mixture, leaving dry or absolute alcohol behind at the lower plates of the still. The ternary mixture, when condensed, separates into two layers, the aqueous being rejected after recovery of such alcohol as it retains and the benzene being returned to the circuit. The distillation plant for this purpose appears somewhat elaborate at first sight, but when once it has been tuned up it operates with great certainty and economy. Prior to its perfection the strongest alcohol which could be obtained by distillation was of 96 per cent alcohol, and further dehydration could only be effected by means of anhydrous solids, an operation which was far too costly for the purpose in view.

The necessity for dry alcohol to mix with petrol is occasioned by the fact that in presence of more than a minimum quantity of water the mixture separates into two layers, particularly below certain temperatures. The highest proportion of absolute alcohol that can be added without requiring carburettor or engine adjustment is 15 per cent. This proportion actually gives a better fuel than with petrol alone, although the calorific value of alcohol is less than that of petrol. Ample practical tests in all countries have served to confirm the utility of alcohol as a motor fuel: it is common practice to use a proportion of it in racing cars in Great Britain. This is not the place to discuss the cost of absolute alcohol on the large scale, but there is no doubt that, suitably denatured and free from excise charges, it could be added to petrol bearing the present excise duty in Britain without materially increasing the cost, and the same applies elsewhere.

Alcohol will mix in all proportions with benzole —the home produced spirit from our gas works and coke ovens: exhaustive, and on the whole satisfactory, tests were made by the London General Omnibus Company some years ago with such fuels. The use of mixtures containing alcohol, benzole, and a third component has been tried with some success. In Germany the latest attempt at a 'home' motor spirit is to use a mixture having the percentage composition of absolute alcohol, 10; synthetic methanol, 10, made from water gas; benzole, 10, from the coke ovens; petrol, 35, made by hydrogenation of coal oil; and imported petrol, 35. Of this mixture only one-third would be imported from foreign sources, the rest being the domestic product of German agriculture, the chemical and the coke oven industries. The outcome of the experiment with so complex a fuel will be watched with considerable interest. Previously German law had required a

minimum proportion of alcohol in all petrol used, which quantity had more or less equalled the capacity of the dehydrating plants a year ago. In Germany about two-thirds of the alcohol is made from potatoes, the rest coming from molasses, grain and paper pulp liquors.

France was the first country to introduce legislation making the purchase of alcohol by the oil companies compulsory. The bulk of the alcohol is used by the Paris omnibuses in the form of a 50 : 50 mixture of alcohol and petrol, the engines being specially adjusted for the purpose : such a fuel does not lend itself for general use. In France at present the conditions are not too favourable for the extension of the absolute alcohol industry, owing to the high cost of the carbohydrate material and the location and size of the distilleries, but political influences might very readily change the whole position.

In Sweden some 6 or 7 million gallons of alcohol are produced each year from the residues of the paper factories, all of which is sold in a 75 petrol : 25 alcohol mixture.

There is no need to enumerate what is being done in many other countries : in the British Empire, a mixture 'Shellkol' is marketed in Queensland. Enough has been said to indicate that, in those countries which have no petroleum supply, the study of domestic substitutes for it has become a major problem, both of economics and defence, and that in many countries national programmes are in hand to manufacture and dehydrate it in quantity. In those lands where carbohydrates can be grown cheaply and abundantly, the advantages to be derived from the use of alcohol lie in a market for surplus agricultural products. In South Africa, for example, the potentialities of cheap alcohol production are very great.

It is less than ten years since absolute alcohol was a laboratory rather than a commercial product. Its manufacture by the benzene-azeotropic process, for which the credit must be given to French enterprise, though the theory of the reaction was of English origin, has brought the world-wide utilisation of power alcohol definitely nearer now that the danger of the presence of water can be eliminated from the alcohol-petrol mixture.

If we look at the subject of international trading from the broader point of view, we are faced with the fact that at the moment many of the latest developments of modern civilisation are in danger of becoming useless. Of what value is the highly organised system of transporting materials from one country to another by land or by sea if trading be rendered impossible by lack of a medium of exchange ? Even if one country, rich in a particular natural resource, is able and willing to supply the world, other countries are being forced to provide substitutes of their own, more or less adequate, never entirely justified from the point of view of world economy. In the individual countries the resources of science are being used as never before to develop these alternatives. More than ever do we need the help of science in planning the campaign of our activities, "the era of conscious and deliberate management". Are we, for example, to buy less imported petrol ? Do we wish to encourage agriculture ? Such are among the questions to be answered. If the reply is in the affirmative, then a plan must be prepared to be operative over a period of years, such as has been operative for beet sugar ; a plan which can only be drawn by scientific experts in collaboration with the politicians, and can never be drafted by lawyers in the form of an Act of Parliament.

These anxious times demand new remedies, amongst them perhaps a body scientific which is articulate, a council of science putting on record the ascertainable facts on the broad economic questions, acting as a planning department for the best utilisation of the materials and men of the nation.

Intensive Natural History

The Natural History of Wicken Fen. Edited by Prof. J. Stanley Gardiner. Part 6. Pp. 489–652 + xii. (Cambridge : Bowes and Bowes, 1932.) 7*s.* 6*d.* net.

THE name of Wicken Fen in Cambridgeshire has long been associated in the minds of field naturalists with the flora and fauna that was probably characteristic of the whole of the 'Great Level' prior to its drainage in the seventeenth century.

Interesting to the botanist as the home of *Liparis læselii*, *Viola stagnina*, *Cladium mariscus*, *Lathyrus palustris* and a number of other rare or local species, Wicken Fen has equal attractions for the zoologist as a locality for the very rare water beetle *Hydrochus carinatus*, the swallow-tail butterfly and many other interesting animals. Unfortunately the changes, initiated by the artificial drainage of the past, still continue and no less than six of the Lepidoptera formerly characteristic

of Wicken, including the large copper (*Ocneria dispar*) and a moth, *Lælia cœnosa*, are no longer to be found there. So too with the flora, *Senecio paludosus* and *Typha minima* would both appear to have become extinct. Such changes in the past suggest an especial suitability in this area as the subject of intensive study, particularly with regard to the fluctuations in frequency, which plants and animals alike exhibit, and respecting the underlying causal factors of which we are so ignorant. These fluctuations are well illustrated at Wicken by the moth *Hydriomena sagittata* which has twice, within recent years, been apparently so scarce that it was feared to be on the verge of extinction.

This volume illustrates the great value of intensive study of a limited area, a value which will be enhanced in the future as the study of the plant and animal ecology of the area progress side by side. It is an outcome of such intensive work in a single locality that Wicken Fen has yielded four spiders which, so far as is known, are endemic, and two or three more which are known only from this locality in Britain. Nineteen ichneumon flies are here recorded by G. L. R. Hancock from Wicken as the first British records and the earthworm, *Allobophora icenorum*, described by Miss Pickford is another species new to science. It is indeed not too much to say that if the same amount of money, time and energy had been devoted in the past to intensive studies at home that has been spent on foreign expeditions, the yield to science would probably have been far greater.

It is not merely in the addition of new species, however interesting, that the value of intensive studies lies but also in the many fundamental problems upon which light is shed. It is true that the preliminary results, presented here in the fifty-six articles by a number of different authors, show little evidence of co-ordinated effort between the various branches, but such correlation will doubtless develop as the work proceeds, when such relations as may exist between the distribution of the animal population and the phases of the plant succession with their respective partial habitats, may be brought to light. In the meantime, these pages contain a large amount of information on the most diverse topics from the soil Protozoa and Collembola to the fossil vertebrates, the history of the drainage of the 'Great Level' and a comparison of the Fen of to-day with that of fifty years ago. These cannot fail to interest the biologist whatever may be his special field of interest.

The late Prof. Yapp laid a valuable foundation for future work in his account of the structure of fen vegetation from the static point of view, whilst Godwin and Tansley here develop the dynamic aspect as presented in the fen successions of which, in addition to the familiar primary succession passing from reed-swamp through 'carr' to deciduous woodland, there are recognised several 'deflected' successions consequent upon the interference of man. Data respecting the changes in level of the soil water show that the water table is slightly convex in winter and in summer concave owing to the high rate of transpiration, whilst the normally alkaline soil water contains only a small amount of dissolved oxygen and a high content of carbon dioxide.

To the concept of fenland conditions thus established future work can be related. Most of the work so far accomplished has aimed at the by no means easy task of listing the species of the area and, where possible, obtaining some measure of their relative and absolute abundance. Of vascular plants, Wicken provides less than two hundred species; but the magnitude of the work involved in a mere qualitative list of the insect fauna can be realised from the fact that the Staphylinidæ alone comprise nearly two hundred and seventy species.

A perusal of these pages cannot fail to make the reader feel a debt of gratitude to those responsible for obtaining this area for the National Trust and to Prof. Stanley Gardiner for having initiated its intensive study on modern lines.

E. J. SALISBURY.

Oceanography

Bulletin of the National Research Council. No. 85: Physics of the Earth—5: Oceanography. Prepared under the auspices of the Subsidiary Committee on Oceanography. Pp. v + 581. (Washington, D.C.: National Academy of Sciences, 1932.) 5 dollars.

SUMMARIES in any branch of science are always of value to the specialist and general reader alike. In oceanography, where so much of the work is of a highly technical nature, the need is great for a practical textbook giving not only a general survey of this vast and varied field, but also assisting towards a better knowledge of the newer and more specialised sections of research.

We think the present volume adequately fulfils such a function.

The work is a composite effort by a number of separate authors, each chapter being contributed by a specialist. The result is, in most cases, a lucid and up-to-date account of each particular theme, such as would be difficult or impossible for anyone but a specialist to produce. In nearly every case, a satisfactory bibliography is included. The chapters are of varying merit, strikingly dissimilar in method of treatment and style; at least one section has been expanded unnecessarily and occasionally considerable repetition occurs. All these are the obvious and more or less inevitable results of the composite method of production.

In the first section of the book, Littlehales gives a concise and lucid summary of the present state of our knowledge of the configuration of the ocean bottom and includes definitions of the terms used in its description. Then Collet classifies bottom deposits from physical, chemical and biological points of view, but it is to be regretted that he does not add a bibliography.

"Properties of Sea Water" is the next section and in our opinion the best. Here Prof. Thomas G. Thompson deals with the physical properties in detail, and in association with Robinson provides an admirable treatise on "The Chemistry of the Sea". Some space is devoted to descriptions of the more usual types of water samplers, the rest to a discussion of the substances found in ocean water, even those present in minute traces. The accounts of carbon dioxide equilibrium and of the physical chemistry of oceanic salt deposition (Igelsrud) are of great interest.

In the "Movements of the Sea" are considered waves, tides and currents, dynamic oceanography, ocean circulation and ice in the sea. With perhaps the exception of "Dynamic Oceanography", the subjects are treated on orthodox lines. The next section, devoted to oceanographical instruments and methods, is largely confined to a consideration of the apparatus used on the last cruise of the *Carnegie*. The most interesting portion is the short chapter by Iselin on bottom samplers. Unfortunately, no consideration is given to biological equipment as such.

The book concludes with a consideration of the "Interrelations of Oceanography" under the separate heads of meteorology (C. F. Brooks), biology (A. G. Huntsman) and geology (C. Schuchert). While quite interesting, some portions at least could have been shortened with profit.

The volume covers a large field in an astonishingly efficient manner; and while full of technical and highly specialised information, should provide interesting reading even for those with but a casual interest in this branch of science.

E. F. T.

Tribes of the Southern Sudan

Pagan Tribes of the Nilotic Sudan. By Prof. C. G. Seligman and Brenda Z. Seligman. (The Ethnology of Africa, edited by J. H. Driberg and Dr. I. Schapera.) Pp. xxiv + 565 + 61 plates. (London: George Routledge and Sons, Ltd., 1932.) 42*s*. net.

THIS book is the second to be published in a series of works on the ethnology of Africa edited by Mr. J. H. Driberg and Dr. I. Schapera. In his introduction to the book, Sir Harold MacMichael, Civil Secretary to the Sudan Government, points out that though a good deal has been written at one time or another concerning various tribes inhabiting the southern Sudan, the information has been somewhat fragmentary and not always reliable; and accordingly Prof. and Mrs. Seligman's work being, as it is, a general conspectus of the people, their traditions, their culture and ways of thought, cannot fail to be of great practical value to their fellow workers and to the administration of the Sudan.

Much of the introduction might be quoted to show the value of anthropological research as applied to the business of administration, and an authoritative statement, coming as it does from so able and distinguished a public servant as Sir Harold MacMichael, is all the more welcome. The Sudan Government has always taken interest in and given help in a practical way to ethnological investigation, an example which our Colonial Office has been slow to imitate, and which might have saved some blundering.

When working with so many different tribes, the question of an orthography must always present difficulties, and the authors are much to be congratulated on having worked out a suitable compromise, though I should have preferred to have seen *Lugbware* modernised further to its recognised form *Lugbwara*.

I like the schema of Nilotic and Nilo-Hamitic migration on p. 19, and think it will be more generally accepted than some which have been published; though at the same time, I should prefer to reserve judgment on the placing of the Lendu in the same group with the Lugbwara

(p. 463); there may be affinities in language, but physically they seemed to me to be of a different race altogether.

I was interested to see the account given by Mr. R. Gunnis of Olia's rain-stones (p. 131), because I was present when this took place, but I do not remember the incident of the breaking of the mud floor; the impression I hold was that the stones were in a pot buried in the floor, the top of the pot being flush with the floor. The stones were similar to those I had seen at Shindiro. Olia was somewhat of a puzzle; he reckoned himself as being pure Acholi, but he had some bits of things which he said had been given to his ancestors when they had visited the Mukama of Bunyoro; he had these rain-stones, and he lived next the Madi. I have always understood that the Madi crossed the Nile below Nimule about sixty years ago, after a famine, and lived on land formerly in occupation of the Acholi. At Atiak some intermarriage had taken place, and Olia's followers were not all pure Acholi, and had indeed adopted some Madi customs.

Now one of the most interesting points brought out by Rogers in his account of the Madi rain-stones (*Man*, 27, 58; 1927) is the number of chiefs who had these stones, twenty-two in a population of about eight thousand adult males, which looks very much as if each territorial chief tried to obtain the ascendency over his fellows by becoming a rain chief, for that area is subject to periodical food shortages. Is it not possible that Olia's forbears took a similar course, for his country is also in a dry zone? This is only speculation, founded on impressions rather than facts, because one has to remember that the southern Acholi do not ordinarily have rain-makers. That the Acholi of the southern Sudan also have rain-makers seems to me only to show what we know to be true, that they are of mixed origin. The point now is to determine how long it is since the chief of Atiak set himself up to be a rain-chief, or, alternatively, is he of such pure Acholi stock as he is usually represented to be?

The authors have been set an almost impossible task, that of bringing within the covers of a single book an account of all the tribes of the southern Sudan, tribes of widely different cultures, and some about whom we know very little. It is apparent also that they have found considerable difficulty in reconciling observations made by different investigators. That they have succeeded as well as they have done is a matter of great credit to them, and one feels that though there must of necessity be gaps in the picture they have drawn of the life of any one particular tribe, such gaps may be filled in by the administrator or missionary who is working in that tribe from knowledge gained in his own experience.

The book is well illustrated, and though one may grumble at the price, one cannot get away from the fact that here there is, in convenient form, all that is now known on certain aspects of native life in the southern Sudan, and the very incompleteness of our knowledge may stimulate others to investigate and publish matter which will give us the full story.

E. B. HADDON.

Short Reviews

Festivals and Songs of Ancient China. By Prof. Marcel Granet. Translated from the French by Dr. E. D. Edwards. (The Broadway Oriental Library.) Pp. ix + 281. (London: George Routledge and Sons, Ltd., 1932.) 18*s*. net.

THE English version of Prof. Granet's study and interpretation of certain odes of the Chinese classic, the "Shih Ching", is addressed to a wider public than the sinologue and differs from the French edition in the omission of the original texts and the Chinese characters in the notes. Scholars may regret it; but if, as the translator hints, this has made possible the production of Prof. Granet's remarkably penetrating analysis of the poems in a form more accessible than that of the original edition, it is a gain rather than a loss.

For the benefit of those who have not had the advantage of knowing the work in its original form, it may be said that the author takes certain of the love poems of the "Book of Odes" and, setting aside the symbolic and archæological interpretations of the Chinese commentators, regards them as survivals of what were once genuine expressions of an emotion. Analysing them from this point of view, he infers that they are parts of a forgotten socio-religious seasonal ritual of a primitive rustic organism—a village festival which served to reaffirm the social bond by affording an opportunity for the meeting of family or local groups and of members of the two sexes, isolated at other times of the year. These songs were, he holds, the material of an antiphonal contest between the sexes which culminated in betrothal and marriage. Prof. Granet quotes extracts from the records of travellers in the Far East which lend support to this original view.

Needless to say, nothing of this appears in the Chinese commentaries. Their interpretations,

however, which are given, are not without significance, in spite of their divergence from Prof. Granet's purpose. As an example of Chinese literary canons and symbolism they illuminate the psychology of a remarkable literary tradition.

Bauxite and Aluminous Laterite: a Treatise discussing in Detail the Origin, Constitution, known Occurrences and Commercial Uses of Bauxite. By Dr. Cyril S. Fox. Second edition, partly rewritten and enlarged. Pp. xxxi+312. (London: Crosby Lockwood and Son, 1932.) 30*s.* net.

IN the interval since the publication of the first edition of Dr. Fox's book (noticed in NATURE, 120, 800; 1927), a feature of the bauxite industry has been the increased production from southern Europe, in particular from Hungary and Yugoslavia. Most of the new matter in the second edition results from a visit by the author, in company with local geologists and mining engineers, to the deposits of Austria, Hungary, Italy and Yugoslavia. The exact mode of origin of the important European deposits has always been a matter of some uncertainty, and linguistic difficulties have tended to hamper British geologists in the study of the literature of these deposits. New information on this subject is therefore welcome.

The author's observations, and those of local geologists, have led him to put forward the view that the so-called Mediterranean or *terra rossa* type of bauxite is not a residual deposit, but a true sediment, laid down in water. He still thinks it very probable, however, that both true *terra rossa* and the bauxite of the limestone regions of southern Europe are derived from a common origin—the impurities of the limestones.

The new matter is incorporated in an introduction and a supplementary chapter. An important omission from the bibliography, which has not been brought up to date, is de Lapparent's recent memoir, "Les Bauxites de la France méridionale." (*Mém. de la Carte géol. de la France*, 1930.) Statistical information, which can be obtained from current government publications, is omitted from this edition. Otherwise the book is little changed.

V. A. E.

Proverbes et maximes Peuls et Toucouleurs traduits, expliqués et annotés. Par Henri Gaden. (Université de Paris: Travaux et mémoires de l'Institut d'Ethnologie, Tome 16.) Pp. xxxiii+368. (Paris: Institut d'Ethnologie, 1931.) 56.25 francs.

M. HENRI GADEN'S collection of proverbs comes mainly, but not exclusively, from peoples encountered at St. Louis in French West Africa. The author has classified them under various headings, such as personal relations and the family, authority, good and evil, courage and intelligence, goodwill and avarice, life in general, practical wisdom, respect for tradition and the like. He has wisely added explanations and annotations freely; for many of the proverbs belong to the category specifically recognised by the people themselves, in which by allusion the meaning is shown to be quite other than that conveyed ostensibly by the words employed. Another and frequently recurring type belongs to the class which conveys a moral. Allusions to magical belief are common and can usually be shown to lie behind the proverbs which express distrust or dislike of neighbours. The occurrence of a succession of premature deaths among children or live stock in a house, for example, will be attributed to the proximity of a sorcerer as a neighbour, who, by the force of his nature, is compelled to seize upon the *bâlu*, the 'shadow' or 'image' of his victim, especially when it leaves the body during sleep.

M. Gaden prefaces his collection by an introduction dealing with language and vocabulary, and has added a very full and useful index of all the vernacular key words which occur in the proverbs.

Electricity and Magnetism for Beginners. By W. C. Badcock and Dr. E. J. Holmyard. (Dent's Modern Science Series.) Pp. viii+199+8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1931.) 2*s.* 6*d.*

THIS is a very welcome addition to the growing number of books written in what we may venture to call the good modern style; that is, not just a descriptive catalogue of marvels, or a collection of things to do made to appear of educative value by the free use of all the latest terms, though the background essential to their understanding is entirely lacking; but a really clear survey of the subject bringing out the fundamental principles, without a comprehension of which no real progress can be made, and written in an easy conversational mode, interesting historical references and practical applications falling naturally into place in the coherent story.

There is, however, we suggest, one very real danger in this sort of thing, particularly when done as well as it is in the present case: the book is not, indeed as the authors say, could not be, mathematical; but so comprehensive is its range and so lucid the qualitative explanation of the varied phenomena dealt with, that when the time comes for the more complete quantitative treatment the pupil may find the 'gilt all off the gingerbread', and his interest suffer accordingly.

Elastic Energy Theory. By Prof. J. A. van den Broek. Pp. x+260. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 22*s.* 6*d.* net.

VARIOUS methods are at hand for the analysis of statically indeterminate structures. The author, feeling that the elastic energy theory is inadequately treated in British or American textbooks dealing with strength of materials, has developed the theory systematically and has applied it to a wide range of redundant frames and beams.

A. F.

The Scientific Work of Joseph Priestley

By PROF. J. R. PARTINGTON, M.B.E.

PRIESTLEY'S most important scientific work was the result of a further development of the experimental technique available in his day for the manipulation of gases. This led him to the discovery of a number of new gases, and the creation of a special branch of chemistry called in the older books "Pneumatic Chemistry". The ascertained facts enabled Lavoisier to make such changes in the theory of chemistry that he may fairly be called the founder of the science as we know it to-day.

The existence of gases with characteristic properties was known before Priestley's time. Van Helmont, about 1620, had recognised the existence of at least two gases different from air, gas sylvestre (carbon dioxide) and gas pingue (hydrogen or hydrocarbons), and had invented the name gas, derived from chaos, which Priestley did not use. Van Helmont did not succeed in collecting gases; when the materials generating a gas, a process previously called "intestine fermentation", were sealed up in a glass vessel, the latter was "filled with plentiful exhalation (yet an invisible one) and however it may be feigned to be stronger than iron, yet it straightway dangerously leapeth asunder into broken pieces".

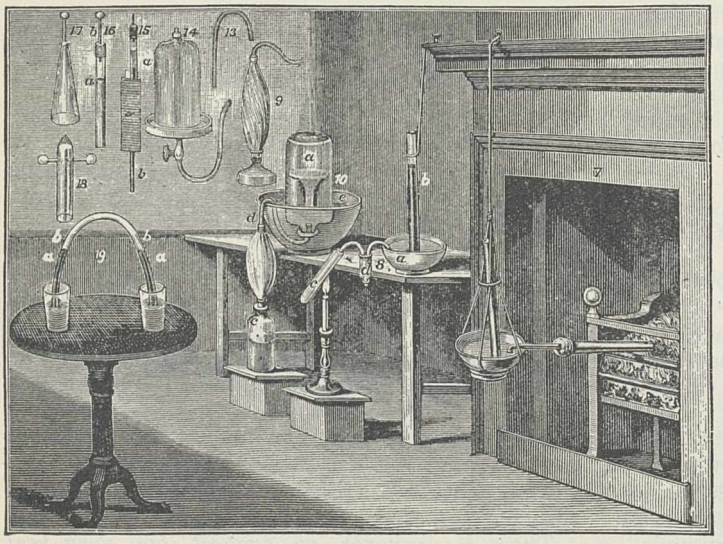

FIG. 1. Part of Priestley's Laboratory. From "Experiments and Observations on Different Kinds of Air".

Hydrogen was first collected from iron nails and dilute acid in an inverted bottle by Boyle: "the cavity of the glass was possessed by the air, since by its spring it was able to hinder the liquor from regaining its former place". Boyle also showed that hydrogen was combustible and would not burn without air. A little further progress in the manipulation of gases was made by Mayow (1674), and Stephen Hales ("Vegetable Staticks", 1727) collected over water in an inverted globe the "air" given off when all kinds of substances, such as saltpetre and coal, were heated in a gun barrel, or when sulphuric and nitric acids acted on metals. Hales measured these airs and then apparently threw them away without examining their chemical properties, regarding them all as modified air. His severely quantitative technique seems to have been influenced by the writings of Newton who, as Priestley says, "as he had very little knowledge of air, so he had few doubts concerning it". Cavendish in 1766 collected fixed air (carbon dioxide), discovered by Black in 1754, over water and mercury, and carefully investigated its properties, as well as those of inflammable air (hydrogen), discovered by Boyle. He used drying tubes and determined the densities and the solubilities of the gases in water and alcohol. The first use of mercury for collecting soluble gases is incorrectly attributed by Kopp to Priestley.

Cavendish's pneumatic trough had no shelf, a fitting introduced in a crude form by William Brownrigg, of Whitehaven, whose paper appeared in 1765, although it had been communicated to the Royal Society twenty-four years previously and was known to Hales and probably to Cavendish. Scheele, who used very simple apparatus and collected the gases in bladders (as did Cavendish) as well as jars, carried out his investigations from 1770 to 1772 (or 1773), but the work was not published until 1777, so that Priestley's discovery of oxygen in 1774 was made independently of Scheele's work.

Priestley's researches on gases were initiated by a chance event. In 1768 he lived at Leeds near what he calls a public brewery, and began to make experiments on the fixed air, "of which there is always a large body ready formed, upon the surface of the fermenting liquor". He showed that it could be absorbed by water to make an artificial Pyrmont water, and devised an apparatus for producing it from chalk and oil of vitriol, his supply at the brewery having been cut short by an unfortunate experiment in which a vat of beer was spoiled. He thought the reason for the turbidity produced in lime water by air in which a candle had burnt out was that "flame disposes the common air to deposit the fixed air it contains", an inability to furnish a correct explanation for a good experiment which is typical of his work from first to last.

Priestley took as his guide in chemical experiments a theory which he found exclusively professed by the chemists of his day, that reversion to the conceptions of Plato and Aristotle called the theory of phlogiston. He has been reproached for his use of this theory, but clearly unjustly,

since the theory was as inextricably entangled in the scientific thought of the eighteenth century as that of the ether a century later or the electron to-day. Macquer, writing in 1778, refers to it as "the surest guide we can take in chemical experiments"; Fourcroy continued to teach it until 1786–87 and Berthollet until 1785. Cavendish, a man of the highest intellectual capacity, believed in it, so far as we know, until his death in 1810, and Priestley still defended it in his last work, "The Doctrine of Phlogiston Established", in 1800 and 1803. It persisted in Germany after this. It is too much to expect a Laocoon to throw off such coils; a Hercules such as Lavoisier was necessary.

The researches on gases carried out by Priestley are collected in six volumes of "Experiments and Observations on Different Kinds of Air" (1774–86; abridged in three volumes, 1790; a modern abridgement in one volume for the use of students is much to be desired). Its title is correct, and the work itself reveals clearly the progress made by the mind and hands of the great experimenter. The results are given in the order in which they were found, as in Faraday's publications, and the apparent lack of order, systematisation and condensation, which intrudes on the attention of a hurried reader, is responsible for the incorrect judgment of the historians of chemistry, that Priestley was a hasty and careless worker. He certainly left too many experiments unfinished and failed to follow up many interesting results. His range of tests was too restricted, a lighted candle and a living mouse being his favourite 'reagents'.

Priestley's apparatus was simple, being, as he says, "nothing more than the apparatus of Dr. Hales, Dr. Brownrigg and Mr. Cavendish, diversified and made a little more simple". He worked in the midst of his family and Fig. 1 shows his laboratory. A substance is being heated in a gun barrel in the fire, the evolved gas being collected in a suspended pneumatic trough over mercury. A substance in the tube 8 *c* is heated by a candle and the gas, after passing through a trap *d* to separate any liquid carried over, is collected over mercury in 8 *b*. In 10, a gas evolved in the bottle *c* is collected over water, passing through a bladder on the way so as to allow of the bottle being agitated, rubber tubing being then unknown. Some apparatus is shown on the chart at the back, and 19 is a piece of apparatus for passing electric sparks through a gas, as used by Cavendish.

The pneumatic trough, which is in its modern form, and auxiliary apparatus, are shown in Fig. 2. The trough, which is provided with a fixed shelf, contains water. The jars *c*, *f* and *d* stand on the shelf *bb*, the jar *c* receiving gas from the bottle *e* fitted with a bent glass delivery tube. In the inverted glass *d* is a mouse, these animals being kept in the arrangement 3. The jar *f* contains a cup supported on a wire stand, also shown in 5; in the cup a substance may be exposed to the gas and if necessary heated by a burning glass. A plant is shown growing in the gas jar 2, and other small pieces of apparatus may be seen. The mice used were kept on "a shelf over the kitchen fireplace where, as is usual in Yorkshire, the fire never goes out". They live, he found, entirely without water and when passed through water "they require and will bear a very considerable degree of heat to warm and dry them".

With such apparatus Priestley investigated the properties of fixed air and inflammable air, discovered three gaseous oxides of nitrogen, ammonia gas (alkaline air), hydrogen chloride (acid air), sulphur dioxide (vitriolic acid air) and silicon fluoride (fluor acid air). The experiments on the oxides of nitrogen are particularly detailed and interesting.

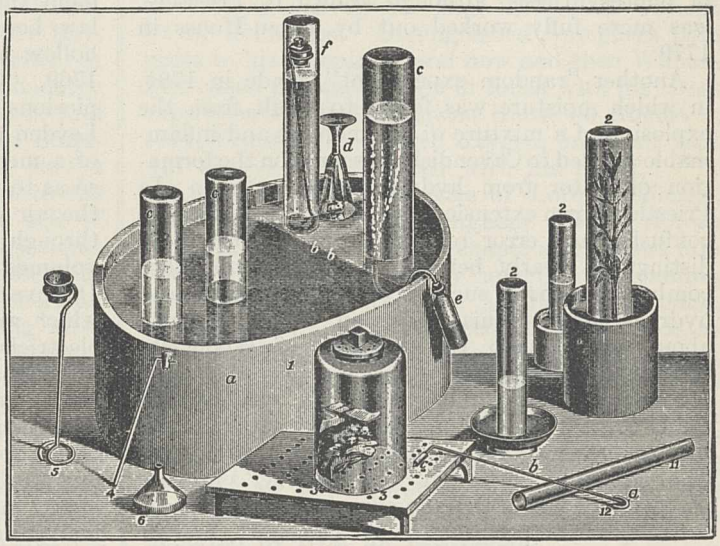

FIG. 2. Pneumatic trough and other apparatus. From "Experiments and Observations on Different Kinds of Air".

The discovery of oxygen on August 1, 1774, in the house of his patron, Lord Shelburne, falls somewhat apart from the rest of Priestley's investigations on gases. It was rather a chance discovery, the result of an experiment performed without definite purpose, as though "more is owing to what we call chance, that is, philosophically speaking, to the observation of events arising from unknown causes, than to any proper design or preconceived theory in this business". Among other materials heated in small tubes over mercury by means of a large burning glass was red precipitate of mercury, from which a gas was evolved in which a candle "burned with a remarkably vigorous flame . . . I was utterly at a loss how to account for it". After the candle came the mouse, and after the mouse Priestley himself. He found that the new air was respirable: "who can tell but that, in time, this pure air may become a fashionable article of luxury. Hitherto only two

mice and myself have had the privilege of breathing it". He suggested the use of oxygen in cases of pneumonia, and in the production of high temperatures.

Priestley believed in rapid publication, as did Faraday: "a person who means to serve the cause of science effectually, must hazard his own reputation so far as to risk mistakes in things of less moment", and all his results were available without delay to others, who could make better use of them than he could himself.

In August 1771 Priestley had found that vegetation, such as growing mint, spinach and groundsel, restores air vitiated by burning candles or by the breathing of animals: "the injury which is continually done to the atmosphere by the respiration of such a large number of animals . . . is, in part at least, repaired by the vegetable creation". In 1778 he found that water plants growing in water containing fixed air evolve oxygen. The part played by light in the process of photosynthesis, although known to Priestley, was more fully worked out by Ingen-Houss in 1779.

Another "random experiment", made in 1781, in which moisture was found to result from the explosion of a mixture of common air and inflammable air, led to Cavendish's research on the formation of water from hydrogen and oxygen. In Priestley's own extension of this work, considerable confusion and error resulted from his neglect to distinguish clearly between hydrogen and other combustible gases, such as carbon monoxide and hydrocarbons. This confusion remained until about 1800, when Cruickshank, of Woolwich, cleared up the matter.

Neither Priestley nor Cavendish was able to draw correct conclusions from his experiments. This was reserved for Lavoisier, "a great architect, who laboured little in the quarry" in the obscurity of which the two experimenters worked. Priestley never professed to be a chemist, and in the full sense of the word never was. His range of knowledge was too restricted, and he was thus incapable of appreciating the correct interpretations of his experiments when they were clearly placed before him.

Priestley's mind was powerful and broad: he was a good classical, oriental and modern linguist, who was able to argue points of theology with more orthodox divines with the scriptures in the original languages. He also had read extensively in philosophy and theology, and became involved in politics. His days became more and more occupied with these pursuits and he was the object of a growing animosity which finally hounded him from England to America, where he died. Although his experimental work imposed itself with unescapeable mastery on contemporary science, his theoretical contributions were negligible. Careful scientific thought does not flourish in such an environment.

No adequate account of Priestley's work in physics seems to be available. He published in 1767 a "History of Electricity", a subject which he calls his "favourite amusement". The experiments in electricity were begun at Nantwich and the book written in Warrington, with the encouragement of Benjamin Franklin. It contains an excellent account of early work in electricity and some new experiments, as well as the argument that electric forces obey an inverse square law because of the absence of charge inside a hollow conductor. In two papers published in 1769, "On the Lateral Force of Electric Explosions", he showed that a discharge from a Leyden jar when sent through a circuit composed of a metal chain with the ends brought together so as to form a small air gap, would in part jump the air gap of high resistance rather than pass through the metallic loop. In 1772 appeared two volumes on "The History and Present State of Discoveries Relating to Vision, Light and Colours", which were not so well received as the history of electricity.

"Human happiness", Priestley tells us in a characteristically discursive preface to the "History of Electricity", "depends chiefly upon having some object to pursue, and upon the vigour with which our faculties are exerted in the pursuit". He was happy in having several objects for the exercise of his vigorous and original mind. In science he was a great explorer, opening out in his rapid and fortunate survey a great number of sites, the rich treasures of which he left to others, equipped with greater patience and knowledge, to remove, arrange, classify and interpret. Such a pioneer fills a place in the annals of human achievement, and such a one was Joseph Priestley, the bicentenary of whose birth we now gratefully remember.

Priestley's Associations with London

By H. G. WAYLING

JOSEPH PRIESTLEY knew London well. Although he officiated for several years as a Dissenting minister at Nantwich and at Leeds, before coming to reside in London as Lord Shelburne's librarian, yet he generally managed to spend a month every year in the metropolis. His friendship with men like Benjamin Franklin, Dr. Richard Price, John Canton and Andrew Kippis encouraged him, while still a provincial pastor, to study natural philosophy earnestly. He speaks of the happy hours spent in their company at the London Coffee House on Ludgate Hill, the back premises of which abutted on to the Old Sessions House in Newgate. Over their cups, these philosophical enthusiasts discussed topical questions and laid plans for prospective publications.

A few yards higher up Ludgate Hill in St. Paul's churchyard, lived Joseph Johnson, the bookseller

who acted as Priestley's literary and commercial agent. Priestley's correspondence was often directed to Johnson, at whose house the itinerant cleric also occasionally lodged. Another business acquaintance on whom he called was Edward Nairne, a mathematical instrument maker to the Royal Exchange, who lived at 20 Cornhill. Nairne supplied electrical machines and air-pumps to Priestley, who, in one of his letters, directs attention to the fact that the recently imported commodity, caoutchouc, could be purchased at this establishment.

Priestley must have been very familiar with the road from the Royal Exchange to Westminster. At 36 Craven Street, Strand, where Benjamin Franklin lodged—a tablet on the house commemorates the fact—Priestley was a frequent caller, sometimes dining with the distinguished American, who, like himself, was a member of the congregation assembling at the Essex House Chapel, Essex Street, just opposite the Courts of Justice. Sometimes he preached at this church, giving a rest to his great personal friend, the Rev. Theophilus Lindsey, the officiating minister. A little to the east of the Law Courts is Chancery Lane, connecting the Strand with Holborn, and in this latter thoroughfare, at Featherstone Buildings, Priestley, as Lindsey's guest, was always *persona grata*. These buildings, which are to the west of Chancery Lane and on the north side of Holborn, are famous also as the temporary home of Sir Walter Besant, when he was a student at King's College, and at the corner house Sheridan and Miss Linley first set up housekeeping after their elopement from Bath. Another of Priestley's clerical friends was Dr. Andrew Kippis, the biographer of John Canton, the Spitalfields schoolmaster, and likewise of Sir John Pringle, P.R.S.

As a preacher with a slight stammer, Priestley would not be at his best as a rhetorician, but in the library or round the festive board, what eruditional entertainments he must have given. Can there be any doubt of the many cordial invitations he received when he came to London on his annual trip? Sometimes he stayed with Kippis in Whitcomb Street, parallel to the Haymarket, at other times with Dr. Price, who resided at Newington Green. It was this latter Nonconformist, who delivered a discourse on civil liberty at his chapel in the Old Jewry, Cheapside, which roused the ire of Edmund Burke to white heat. In the same place of worship, Priestley performed the mournful duty of preaching his friend's funeral sermon.

Having given some space to Priestley's devotional labours, it remains to mention those dealing with his scientific occupations. In 1773, he came to London as librarian and companion to Lord Shelburne, whose town residence, Lansdowne House, Berkeley Square, has recently been demolished. This post was ideally congenial to a man of Priestley's temperament and ability. The duties of his office were slight. In apartments reserved exclusively for him, he worked without let or hindrance. Distinguished foreigners paid visits to his laboratory and now and then William Pitt called on him to keep in touch with his latest experiments. At Lansdowne House on August 1, 1774, Priestley discovered oxygen, an event that will always be associated with his name.

After he left the service of Lord Shelburne, Priestley settled in Birmingham until a riotous rabble fired his house and chapel and caused him once again to seek safety among metropolitan sympathisers. Shortly after his flight to London, he was appointed to succeed Richard Price at the Gravel-pit Meeting House near Mare Street, Hackney. At this place of worship, he delivered his farewell sermon before sailing for America. His very last Sunday, however, was spent at the chapel in Essex Street, his friends "Sorrowing most of all at the words which he spake, that they would see his face no more". Next day he departed by river for Gravesend.

The Recent Japanese Earthquake

By DR. C. DAVISON

ONE of the greatest earthquakes of the present century—a century that includes the Kansu earthquake of 1920 and the Kwanto earthquake of 1923—occurred off the east coast of Japan at about 5.31 p.m. on March 2, G.M.T. (or March 3, 2.31 a.m., Japanese time). The centre, as determined from the Kew record, lay in about lat. 40° N., long. 144½° E. This point is 140 miles from the north-east coast of Japan, near the foot of the western slope of the Tuscaroora Deep, the depth of water in this region being 4,000 fathoms or about 4½ miles. It is, as Prof. Milne pointed out many years ago, the seat of some of the most violent of all Japanese earthquakes. Among them may be included those of the years 1563, 1659 and 1896, and perhaps that of 1668.

This centre is so distant from land that the destructive effects of the actual shock are not as a rule important. The recent earthquake was, however, of such strength that pictures were dislodged and ornaments thrown down within a district 235 miles in length from Morioka to Maebashi. It was strongest along the 54 miles of coast between Fudai and Kamaishi. As usual in great earthquakes, the shock was of considerable duration. At the observatory of Aomori, it was sensible for eight minutes, the greatest horizontal movement registered there being 87 mm. or about 3½ in. At Tokyo, where it did not even shake down plaster or stop clocks, it was felt for four minutes.

Though much damage was caused by the

earthquake and subsequent fires, the sea-waves were responsible for the greater part. In the Iwaki prefecture, that immediately to the west of the epicentre, the sea-waves advanced in the form of a wall of water from four to seven feet in height, that swept away villages along the coast and wrecked several small towns. At Kamaishi, the sea-wall was broken down by the waves and 1,500 houses were destroyed.

The loss of life and the injury to property were considerable. According to official figures issued on March 5, 1,560 persons were killed, 956 are missing and 354 wounded; while 2,878 houses were washed away, 1,458 were thrown down, and 211 burned.

One of the most notable predecessors of the recent earthquake was that which occurred on June 15, 1896, and is known as the Sanriku earthquake. According to Omori and Hirata (*J. Coll. Sci., Tokyo Imp. Univ.*, vol. 11, pp. 161–195; 1899), its epicentre lay in lat. 39° N., long. 144½° E., or some miles to the south of that of the recent earthquake.

In Japan, as elsewhere, great earthquakes seldom visit the same region, except at long intervals of time. The centres of successive earthquakes belonging to the same seismic zone are rather displaced some or many miles—in this case perhaps sixty miles—along that zone. On land, the Sanriku earthquake was much less violent than the recent shock, though it was felt to a distance of 320 miles from its centre, but it was followed by far greater sea-waves. All eye-estimates of the height of sea-waves are subject to large errors, and we cannot have much confidence in such figures as 94 ft. at Yoshihama and 60 ft. or 100 ft. along the eastern coast of Hokkaido. At Ayukawa, however, which is 170 miles from the epicentre, the tide-gauge showed for the chief movement a rise of 8 ft. above the usual level, followed by a fall of the same amount below it. The waves were certainly large enough to be recorded at Honolulu and Sausalito, at the entrance to San Francisco Bay, the latter station being 4,787 miles from the epicentre.

In 1896, the sea-waves were far more destructive to life and property than those of the present year. In Kamaishi, 4,700 of the 6,557 inhabitants were drowned and 88 per cent of the houses were swept away. Along the whole coast affected, the number of lives lost amounted to 28,321, and of houses ruined to 6,222.

Obituary

LORD LOVAT, K.T., G.C.V.O., K.C.M.G.

THE death of Lord Lovat on February 18 will prove a great loss to forestry both in Great Britain and throughout the Empire. To his strong personality, tireless energy and great grasp of detail, Great Britain owes it to-day that she has a Forestry Commission in being, a considerable addition to the afforested area, and, it may be justifiably hoped, a settled forest policy. In future years it may come to be recognised that Lord Lovat's greatest claim to remembrance by his fellow countrymen will be the great part he played in a resuscitation of the national forestry question, which had practically lain dormant for more than a century.

Lord Lovat's interest in forestry, from a wider point of view than his own estates, was aroused before the War. In the latter part of the great struggle he acted as Director of Forestry in France, to co-ordinate the forestry operations being carried out with the object of supplying the troops in the field with the essential timber and other products of the forests. During this period, he was one of the originators of the Acland Report drawn up as a result of the Departmental inquiry, 1916–17, with the object of pressing upon the Government the paramount necessity of taking up the question of afforestation in Britain at the close of hostilities.

A Forestry Bill to this end was presented to Parliament and passed in 1919 and Lord Lovat was appointed in 1920 chairman of the Forestry Commission, which was empowered to carry out the provisions of the Bill. With the object of leaving the new Commission free from politics, a Treasury allotment was made and the Commission was not placed under a minister of the Crown.

With that energy and vitality for which he was renowned, Lord Lovat at once devoted himself to this new business, which involved commencing a planting campaign on land to be obtained from private individuals, since no State-owned land existed. That the organisation he and his Commissioners introduced was effective is proved by the fact that when he resigned the chairmanship in 1927 some 94,289 acres had been afforested and 391,511 acres of land had been acquired by the State. Before he resigned his post, with the spirit of generosity which animated him, he stated publicly: "If any good work has been done by the Forestry Commission, it does not lie with me but with the excellent body of Commissioners and staff which we have in the Forestry Commission." Yet it was an open secret that, but for Lord Lovat, the 'Geddes axe' might have brought the work of the Forestry Commissioners to an abrupt end and that on several occasions serious changes in policy were only prevented by his influence and tact.

Lord Lovat was chairman of the first Empire Forestry Conference, held in London in 1920 after the formation of the Commission, and of the second held in Canada in 1923, during which he visited most of the forests in the Dominion.

In connexion with forestry education and research, Lord Lovat held strong views which

were not always in accordance with those of the universities as a whole. As a result of the Conference in Canada, he was able to give effect to his scheme of establishing an Imperial Forestry Institute at Oxford with the support of grants from the Colonial Office in London and grants from certain Dominions and Colonies. The position which the Institute has taken in the eyes of the Empire justifies Lord Lovat's prescience in this matter. He was also responsible in no small degree for the revival of scientific research in forestry problems.

In 1927 Lord Lovat became Parliamentary Under Secretary of State for Dominion Affairs and chairman of the Overseas Settlement Committee. He was also chairman of the Committees on Agriculture in the Colonies and on Colonial Veterinary Sciences. These positions he resigned in 1929.

From 1927 until his death, Lord Lovat maintained his keen interest in the forestry question in Great Britain and linked to it the broader one of Empire forestry and Empire timber marketing and development as a whole. It is perhaps not too much to say that, outside India, the position of forestry throughout the Empire and the appreciation, which is now making headway at headquarters in London and elsewhere, is due to the vital force which Lord Lovat's invigorating personality gave to it. E. P. STEBBING.

PROF. MAX WOLF

PROF. MAX WOLF died on October 3, at the age of sixty-eight years. He was the son of a physician at Heidelberg, and showed an aptitude for astronomy from his youth. While still at school he erected a small observatory, with an equatorial built by himself; in 1884 he discovered the interesting short-period comet that bears his name.

Wolf soon adopted photographic methods and made the first photographic discovery of a minor planet in 1891. He and his assistants afterwards added many hundreds more. The first discovery was afterwards named Brucia, in appreciation of the gift of a double camera by Miss Wolfe-Bruce. He was appointed a supernumerary professor at Heidelberg in 1893, and succeeded to the ordinary professorship in 1902. He devoted himself to photography of the nebulæ and their spectra, and was the first to detect the expanding nebula round Nova Persei in 1901; he found evidence of rotation in the nebula Messier 81, and discovered the extended nebulosity that surrounds the Pleiades.

Prof. Wolf was one of the first to use the stereoscopic method for detecting proper motions of stars, by comparison of plates taken some years apart. He published several lists of stars with large proper motions. An article by H. Vogt in *Astronomische Nachrichten*, No. 5921, pays tribute to the excellence of his teaching at Heidelberg, and his popularity.

He received the gold medal of the Royal Astronomical Society, and similar honours from many other countries. In spite of failing health, he continued at work until the last, and made several planetary discoveries in 1932.

A. C. D. C.

WE regret to announce the following deaths:

Prof. Carl E. Correns, director of the Kaiser-Wilhelm Institut für Biologie at Berlin-Dahlem, Darwin medallist in 1932 of the Royal Society, on February 15, aged sixty-nine years.

Prof. E. E. Haskell, emeritus professor of experimental hydraulics in Cornell University, and dean of the College of Civil Engineering at the University in 1906–21, on January 28, aged seventy-seven years.

Dr. H. L. Snape, lately chairman of the Association of Directors and Secretaries of Education of the Union of Lancashire and Cheshire Educational Institutes, formerly professor of chemistry at University College, Aberystwyth, on March 2, aged seventy-one years.

Dr. Victor Sterki, assistant curator of Mollusca in the Carnegie Museum, Pittsburgh, since 1909, who has done much work on the anatomy, systematics and distribution of Mollusca, etc., on January 25, aged eighty-six years.

News and Views

Recommendations for Election to the Royal Society

THE Council of the Royal Society has agreed to recommend for election into the Society the following seventeen candidates: Mr. P. M. S. Blackett, lecturer in physics in the University of Cambridge; Prof. J. B. Collip, professor of biochemistry in McGill University, Montreal; Col. R. E. B. Crompton, electrical engineer; Prof. H. M. Dawson, professor of physical chemistry in the University of Leeds; Dr. A. T. Doodson, associate director of Liverpool Observatory and Tidal Institute; Dr. H. J. Gough, superintendent of the Engineering Department of the National Physical Laboratory, Teddington; Mr. J. Hammond, senior assistant at the Animal Nutrition Research Institute, Cambridge; Dr. G. M. Holmes, physician to the National Hospital for Nervous Diseases, Queen Square, London; Dr. H. King, chemist at the National Institute for Medical Research, Hampstead; Prof. J. E. Lennard-Jones, Plummer professor of theoretical chemistry in the University of Cambridge; Prof. J. W. McLeod, professor of bacteriology in the University of Leeds; Dr. A. S. Parkes, physiologist, Foulerton student of the Royal Society; Prof. E. J. Salisbury, Quain professor of botany at University College, London; Dr. B. Smith, district geologist of H.M. Geological Survey; Dr. W. R. Thompson, superintendent of Farnham House Laboratory of the Imperial Institute

of Entomology (London and Farnham Royal); Prof. A. M. Tyndall, Henry Overton Wills professor of physics in the University of Bristol; Prof. J. H. M. Wedderburn, professor of mathematics in Princeton University.

Elections to the Royal Society of Edinburgh

THE following were elected fellows of the Royal Society of Edinburgh at a meeting held on March 6: Dr. F. L. Arnot, lecturer in natural philosophy in the University of St. Andrews; Major P. C. Banerjee, Indian Medical Service; Mr. J. L. Begg, treasurer and past vice-president of the Geological Society of Glasgow; Dr. T. R. Bolam, lecturer in chemistry, University of Edinburgh; Mr. Finlay J. Cameron, general manager, Caledonian Insurance Company, Edinburgh; Mr. J. I. Carswell, lecturer in engineering, University of Edinburgh; Dr. A. M. Clark, lecturer and director of studies, University of Edinburgh; Dr. A. L. Craig-Bennett, lecturer in zoology, University of Edinburgh; Mr. E. G. Dymond, Carnegie research fellow and lecturer in natural philosophy, University of Edinburgh; Mr. J. M. Erskine, general manager, Commercial Bank of Scotland, Ltd., Edinburgh; Dr. Thomas Ferguson, H.M. medical inspector of factories, Home Office; Prof. C. Forrester, Department of Chemistry and Assaying, and acting Principal, Indian School of Mines, Dhanbad; Dr. W. H. Fowler, medical radiologist, Edinburgh; Mr. A. W. de R. Galbraith, city engineer, architect and surveyor, Christchurch, New Zealand; Mr. A. C. Gardner, chief engineer, Clyde Navigation Trust, Glasgow; Dr. R. P. Gillespie, lecturer in mathematics, University of Glasgow; Mr. T. H. Gillespie, director-secretary, Zoological Society of Scotland, Edinburgh; Mr. W. G. Guthrie, assistant in applied mathematics, University of St. Andrews; Lieut.-Col. E. E. Hume, Medical Corps, United States Army, librarian of the Army Medical Library, Washington, D.C.; Dr. D. Lees, clinical medical officer, Corporation of Edinburgh and surgeon in charge of venereal diseases, Royal Infirmary, Edinburgh; Mr. J. Macleod, manager, Glasgow Corporation Chemical Department; Prof. J. Malcolm, Department of Physiology, University of Dunedin, New Zealand; Mr. W. J. M. Menzies, inspector of salmon fisheries of Scotland, Fishery Board for Scotland, Edinburgh; Prof. L. M. Milne-Thomson, assistant professor of mathematics, Royal Naval College, Greenwich; Dr. J. Murray, Rector, The Academy, Annan; Mr. T. Nicol, lecturer in anatomy, University of Glasgow; Mr. C. W. Parsons, lecturer in zoology, University of Glasgow; Mr. A. W. N. Pillers, chief veterinary officer, Corporation of Liverpool and lecturer on veterinary parasitology, University of Liverpool Veterinary School; Mr. F. A. B. Preston, lecturer in municipal engineering, Town Planning, etc., Royal Technical College, Glasgow; Mr. J. L. Somerville, auditor to the University of Edinburgh; Dr. J. B. Tait, junior naturalist (hydrographer), Fishery Board for Scotland, Aberdeen; Mr. G. Taylor, assistant keeper, Department of Botany, British Museum; Dr. G. Timms, lecturer in mathematics, University of St. Andrews; Prof. J. M. Watt, Department of Pharmacology and lecturer in dental materia medica, University of the Witwatersrand, Johannesburg; Dr. W. F. J. Whitley, medical officer of health, Northumberland County Council; Mr. J. Wright, Kirkcaldy.

Centenaries of Priestley and Pepys

THE bicentenary of the birth of Joseph Priestley occurs on March 13, and elsewhere in this issue we print articles discussing his scientific work and describing his visits to London. A few weeks ago (NATURE, Feb. 18), reference was made to the association of Samuel Pepys with the Royal Society, the tercentenary of whose birth fell on February 23. Bicentenaries and tercentenaries of scientific interest are not of frequent occurrence and the Royal Society is marking the occasion by an "At Home" at 9 o'clock on Wednesday, March 15. With further reference to the article on Pepys Mr. Edwin Chappell, 41 Westcombe Park Road, London, S.E.3, has provided us with references showing that Pepys's birthplace was definitely in London. On this subject W. H. Whitear, in "More Pepysiana" (1927), says: "From information derived from the parish books of St. Bride's, Fleet Street, it seems to be beyond doubt that Samuel was born in his father's house in Salisbury Court". It is of interest in this connexion to give the record which appears in "Alumni Cantabrigienses" (Venn, 1924) against Pepys's name: Adm. pens. Trinity Hall, June 21, 1650. B. at Brampton, Feb. 23, 1632–3. Migrated as scholar to Magdalene, Mar. 4, 1650–1; Matric. 1651; B.A. 1653–4; M.A. 1660.

Carsten Niebuhr, 1733–1815

ON March 17 occurs the bicentenary of the birth of the famous German traveller, Carsten Niebuhr, who was the only survivor of the Danish expedition sent to examine the monuments and antiquities of the Orient in 1761. Born in the village of Lüdingworth in the Duchy of Lauenberg, Niebuhr appeared destined to follow in the footsteps of his forbears, who were small landowners. On coming of age, however, he spent his small patrimony in obtaining instruction in mathematics and by 1757 was a student at Göttingen, where he was afterwards taught the new methods of determining longitude by lunar observations by Tobias Mayer himself. Niebuhr made great use of this method in his travels in the East which occupied the years 1761–1767. After his return to Europe he commenced the publication of the account of his travels, married and, being given an official post in the town of Meldorf in Holstein, settled there. He was made a Danish councillor of State, a knight of the Daneborg and in 1802 was elected an associate of l'Institut de France. Towards the end of his life he became blind and lame. He died at Meldorf on April 26, 1815. His son, Barthold Georg Niebuhr (1776–1831), was a distinguished historian and archæologist and his grandson, Marcus von Niebuhr (1817–1860), an eminent Prussian official.

THE expedition which made Niebuhr famous was undertaken by the Danish Government at the instigation of the German orientalist, Johann David Michaelis (1717–1791), one of the first to study the biblical narratives as a part of Oriental history. The other members of the expedition were von Haven, a linguist, Peter Forskäl, a Swedish naturalist, Dr. Cramer, a physician, and Bauenfeind, a draughtsman. Leaving Denmark in a warship at the beginning of 1761, the party first visited Constantinople. From September 1761 until October 1762 the travellers were in Egypt, where Niebuhr determined the positions of Cairo, Rosetta and Damietta, made maps of the Nile and measured the Pyramids. Embarking at Suez, another year was spent in the Red Sea and Arabia. Most of the members, however, had been attacked with sickness; von Haven died in May 1763, Forskät in July, Bauenfeind in August and Cramer in February 1764. Niebuhr alone was left. By then he was at Bombay. About a year later Niebuhr set out on his return journey, visiting Persia, Mesopotamia and Syria, and after seeing Cyprus, Jerusalem and Damascus, he again reached Constantinople in February 1767. Three months were spent in studying the military and civil statistics of Turkey and Niebuhr then journeyed back to Denmark via Wallachia, Moldavia, Poland and Prussia. His "Descriptions of Arabia" was published in 1772 and this was followed a year or two later by his "Travels in Arabia and the Adjacent Countries". In June 1795 a fire at Copenhagen destroyed the copper-plates for the third volume and this was not published until twenty-two years after his death.

Centenary of Hilary Bauerman, 1833–1909

HILARY BAUERMAN, who was born in London on March 16 a century ago, had an international reputation as a geologist and metallurgist. He made geological surveys in many parts of the world, acted as juror at various international exhibitions, published widely read textbooks, and at his death left his fortune for the furtherance of the study of mineralogy. His parents, who were of German nationality, came to London in 1829. At the age of eighteen years, in 1851, Bauerman became one of the seven original students of the School of Mines in London, studying under Playfair, Ramsay, Forbes, Warington Smyth and others. He also spent three years at the Freiburg Mining Academy and then on returning to England joined the Geological Survey of Great Britain. His overseas work began with his appointment as geologist to the North American Boundary Commission. In 1868 he published his "Metallurgy of Iron", in 1883 became lecturer in metallurgy at Firth College, Sheffield, and in 1888 succeeded Prof. Percy as professor of metallurgy at the Ordnance College, Woolwich. He was elected an honorary member of both the Iron and Steel Institute and Institute of Mining and Metallurgy. He died unmarried at his house in Balham on December 5, 1909, and was buried in Brookwood Cemetery.

Harrison's First Marine Timekeeper

IN connexion with his efforts to make a timekeeper which would keep time accurately at sea, John Harrison made four instruments, one in 1735, a second in 1739, a third a few years later, for which he was awarded the Copley medal of the Royal Society, and a fourth which, after being tested on a voyage to Jamaica and back lasting from November 18, 1761, until March 26, 1762, caused him to be adjudged as having won the £20,000 reward offered through the Act of Parliament of 1714. There was much delay in paying Harrison and it was laid down that all four of his time-keepers were to be handed over to the Royal Observatory. These time-keepers naturally were soon superseded by better instruments, and they ceased to be used and fell into disrepair. Some twelve years ago, however, Lieut.-Comdr. Rupert T. Gould obtained permission to recondition them and he has now completed his labours by the restarting of Harrison's first marine timekeeper, made in 1735, but not used since 1767. All four of Harrison's instruments are thus again in working order, and according to an article in the *Times* of February 28, No. 1 will be kept going in an air-tight show-case. Needless to say, this instrument bears little resemblance to a modern chronometer. It weighs no less than 70 lb. Tested aboard H.M.S. *Centurion* and H.M.S. *Orford* in 1736, however, it gave satisfactory results, and on the voyage home, when the *Orford* sighted land the reckoning by the clock showed the position of the ship to be off the Lizard, while the ordinary methods of navigation gave the ship's position as off the Start. The former proved to be the correct position.

Prof. B. Němec

PROF. B. NĚMEC, director of the Plant Physiological Institute of the Charles University, Prague, celebrates his sixtieth birthday on March 12. Prof. Němec is a well-known plant physiologist, working especially in experimental cytology and caryology, anatomy and experimental morphology, physiology of fertilisation and genetics, on symbiosis and parasitism, plant pathology, regeneration and other aspects of plant physiology. His statolith theory in plants is widely known, and also his more recent discoveries, by the use of chloral hydrate and other agents, concerning artificially induced mixoploidy and polyploidy in plants. Prof. Němec is well known to English scientific workers. In 1927 he lectured at University College, London, and he has attended many scientific meetings in England, the last occasion being the Fifth International Botanical Congress at Cambridge in 1930. Prof. Němec is a foreign member of the Linnean Society of London and also of many other learned societies of his own and other countries.

Sir Robert Hadfield and the Academy of Sciences of the U.S.S.R.

AT the luncheon given to Sir Robert Hadfield on February 28 by M. I. Maisky, the Soviet Ambassador in London, in honour of the election of Sir Robert

as an honorary member of the Academy of Sciences of the U.S.S.R., it was recalled by M. Maisky that in 1831, Michael Faraday was also elected an honorary member of the Academy. Such events emphasise the internationalism of science. In Russia, since the revolution, new scientific institutes, laboratories and universities have been built, and science has made great progress; metallurgy in particular has been encouraged. In this work, Russia readily accepts foreign assistance. In his reply, Sir Robert Hadfield said that, to him, Russia is the land of Mendeléeff, whose work has been of fundamental importance in chemistry. He also spoke of the work of the well-known Russian metallurgist, the late Demetri Tschernoff, who did pioneer work on the metallography and scientific heat treatment of steel at a time when only empirical methods were used. His work, introduced to Great Britain by the late Sir William Anderson, led to the formation in 1881 by the Institution of Mechanical Engineers, of a special committee, of which Tschernoff was himself a member, to report on the heat treatment of steel; this committee is still in existence as the Alloys Research Committee. Referring to the Iron and Steel Institute, Sir Robert pointed out that there are, at present, fourteen Russian members, and he expressed the hope that this number will be increased, with the future developments of science in that country. Sir Robert Hadfield's name is, of course, associated with manganese and silicon steels, and when speaking of Russia's vast mineral resources, he naturally singled out manganese, which is much used in the production of high quality steel as well in the special alloy steels. Enormous deposits of this manganese ore occur in the valley of the Kvirila River, and Sir Robert anticipates heavy production during the next twenty years. Sir Robert concluded with a tribute to the interest in scientific development which is being shown in Russia.

Locomotion in Sponges

A NEW and valuable light was thrown on the vexed question of locomotion in sponges by Mr. M. Burton at a meeting of the Zoological Society on February 21. Mr. Burton had been asked to investigate some sponges growing on the filter-beds of the Society's Aquarium, as it was feared these might interfere with the circulation of the water. He found that even the adults were capable of moving appreciable distances to secure a more favourable area for feeding. Movement in post-larval, and young sponges, he pointed out, had been recorded on several occasions; but it was now apparent, for the first time, that even fully-grown individuals could change their position. This discovery has an important bearing on our conceptions of the biology of sponges. So far from being 'typically sedentary animals', as they are described in textbooks—the victims of chance and circumstance—it is now established that they can, or at least in some species, exercise some selection as to habitat, the movement being a directive locomotion, carried out by amœboid extensions of the ectosome.

THIS new discovery by Mr. Burton follows hard upon his observations on unattached sponges, published in the "Discovery" reports 1932, wherein it is shown that some species, and individuals of many other species, habitually lead a free existence, and are capable of being transported by currents. In this respect his observations on the sponges in the filter-beds in the Aquarium of the Zoological Gardens are particularly interesting. The individuals of this species, as yet unnamed, are very easily detached by small Crustacea, and are sufficiently buoyant to move several inches, in still water, as the result merely of a shrimp swimming by. Thus, at all ages, either by their own movement, or by being transported by currents, sponges are far from being the irrevocably fixed animals they have hitherto been supposed to be.

Australian Dairy Cattle Research Council

THE dairying industry in Australia is becoming alarmed at the prevalence of contagious abortion and contagious mastitis (mammitis) in milking herds. At the instance of the pure-bred cattle breeders of New South Wales, an Australian Dairy Cattle Research Council has been set up with headquarters in Sydney and a liaison committee in each State. It will work in close association with the Commonwealth Council for Scientific and Industrial Research and the State Departments of Agriculture, but will seek its funds from other than government sources and will be free from political control. The Australian Dairy Council, a body concerned mainly with marketing problems, has promised £2,000 a year for five years towards the cost of investigations, and other contributions are confidently expected. The work on abortion will be centred at the Glenfield Veterinary Research Station in New South Wales, while the mastitis work will be carried on in Victoria, probably with the University of Melbourne as headquarters.

Ritual at Ur

MR. C. L. WOOLLEY'S first report on the excavations of the current season at Ur (*Times*, March 3), dealing mainly with a building of the little-known First Dynasty, about 3000 B.C., below the platform of Ur-Engur's ziggurat, records several features which are new, some of them by no means readily susceptible of explanation. It would appear that a ziggurat, now sheathed in the later tower, occupied the middle of a platform, in the north and east corners of which were temples of the moon god. In describing the eastern temple, Mr. Woolley directs attention to the extraordinary thickness—some fifteen feet—of the brick floor of the approach chambers which led to the open ziggurat terrace. For this, the only explanation he has to offer is that it had some religious purpose. Again, in the courtyard are two circular structures of brick, which would be regarded as bases for columns, if it were not for their great diameter of thirteen feet. The suggestion that they were intended as the bases for altars is supported by the existence nearby of a brick-built basin sunk in the floor. In an adjacent room is a circular hearth for the great cauldron in which the food of the god was prepared.

Another curious piece of ritual, if Mr. Woolley's interpretation be accepted, is brought to light in a later building, which lay over the First Dynasty temple. Here were found four pits of some size—one rectangular pit is 15 ft. by 12 ft.—sunk in the floor. Three pits, one circular and two square, had been filled with clean red earth, the fourth rectangular pit had a layer of red earth superimposed on three layers of carefully laid gypsum blocks. Mr. Woolley offers the suggestion that these pits were intended for the foundations of altars, and aptly cites the "clean earth" which the old Sumerians brought for the foundations of their temples.

Corpus of Egyptian Pottery

TENTATIVE proposals for the compilation of a complete corpus of Egyptian pottery, which were discussed at Cairo in 1931, have now taken practical shape. A scheme has been drawn up by a committee consisting of Mr. Guy Brunton, Dr. Junker of Vienna and Mr. O. H. Myers. Excavators are to be supplied with cards on one side of which a print or drawing of the pot is to be affixed, and on the other information relating to it is to be given under a number of heads. These slips, when completed, will be returned to the editor of the corpus, Mr. G. L. Harding, or, during his absence while excavating at Lachish, to Mr. O. H. Myers of the Egypt Exploration Society. The scheme of the corpus is based upon the "Predynastic Egyptian Corpus" issued by Sir Flinders Petrie in 1921, as supplemented by the additional material obtained by Mr. Brunton in his Badarian excavations. It is, however, to be continued beyond these limits to the Arab period. The co-operation has been secured of the Egyptian Antiquities Service, the French, German and Italian institutes, the Egypt Exploration Society, the Oriental Institute of the University of Chicago and nearly all the other bodies represented in the archæological exploration of Egypt.

An Experimental Air-Map

WITH the view of devising a suitable system of cartography for aviators the American Geographical Society has constructed an experimental sheet of the Pittsburgh-Cleveland area on a scale of 1 : 500,000, which is published in the *Geographical Review* for January 1933 with accompanying text by Mr. O. M. Miller. Since the drainage system is the most conspicuous guide to an airman, all water is shown in white against a background of grey, varying tints of which are used to show the surface relief. The darkest tint, contrary to custom, shows the lowest ground. White spot heights are at water-level and black spot heights at the highest points in any area. Conspicuous relief features, such as bold escarpments, are marked by black hachuring but this seems to be sparingly used. A general description of surface conditions has been attempted such as "farming country", "forested uplands", etc. Railways in black and roads in green stand out well. Red is used exclusively for objects dangerous to flying, including built-over areas, power transmission lines and oil tanks. Air ports, beacons and lighthouses are shown in yellow. Air ports are named in black, other place-names being in red. The projection used is the modified polyconical. Meridians and parallels and lines of magnetic declination are omitted from the main map and shown on a key map in the margin. The American Geographical Society invites criticisms of this sheet from aviators.

Institute of Chemistry of Great Britain and Ireland

AT the fifty-fifth annual general meeting of the Institute of Chemistry held on March 1, the Meldola medal was presented to Dr. L. E. Sutton, of Oxford, and the Sir Edward Frankland medal and prize to Mr. L. Young, of the Royal College of Science. In moving the adoption of the report of Council, the president, Dr. G. C. Clayton, remarked on the increasing activity of the Institute. Dr. Clayton pointed out that for positions of control, science alone does not suffice : the chemist must acquire much knowledge and experience and become endowed with those not less-important qualities of character, judgment and tact, which responsibility entails. Not only competition, but also discovery and invention, together with modern methods in administration and management, have contributed to the existence of conditions which are bewildering to economists and financiers. These difficulties are not new : they were present when the mechanisation of industry started but have not become more acute. It is for chemists to put our old industries in the most favourable position to meet competition, and even more to branch out into new lines, especially new industries, which, by giving employment, will absorb some of those displaced by world competition in many of the heavy industries. Prof. J. F. Thorpe was elected president of the Institute in succession to Dr. Clayton.

Recent Investigations in Nutrition

THE Minister of Health has directed the attention of county and county borough councils and other maternity and child welfare authorities to certain recent investigations and the recommendations of the Advisory Committee on Nutrition based on them (Circular 1290 : 1932 : H.M. Stationery Office. Price 2*d*. net). They deal with Dr. Helen Mackay's work on the nutritional anæmia of infancy, Prof. and Mrs. Mellanby's researches on the etiology of rickets and dental decay and Dr. Corry Mann's experiment on the effects of additional milk in the diet of schoolboys. For preventing nutritional anæmia, it is recommended that iron ammonium citrate should be added to the milk given to infants or that a dried milk containing added iron should be used. It is pointed out that severe rickets is rapidly disappearing in Great Britain, but that in some areas the milder form of the disease is still prevalent. Faulty dentition is widespread. The importance of the diet of pregnant and nursing mothers and of infants and young children containing a sufficient amount of calcium, phosphorus and vitamin D is therefore emphasised. Of these, vitamin D is the most likely to be deficient. The diet should contain fat fish such as herrings,

sprats or mackerel, fish livers, egg yolk, milk and butter: if margarine is used, a brand containing added vitamins A and D should be employed. Cod liver oil and bone ash will also make good a deficiency in vitamin D, calcium and phosphorus. As regards milk, the circular urges local authorities to take every opportunity of directing attention to the merits of milk as a food and of stimulating its increased use as an article of diet for children.

Costs of Electricity Supply and Distribution

In an endeavour to foretell the future of electricity supply and distribution in Great Britain, Mr. J. M. Kennedy and Miss D. M. Noakes have made an elaborate analysis of the statistical returns issued by the Electricity Commissioners during the last ten years. They explained the conclusions arrived at in a paper read to the Institution of Electrical Engineers on January 26. They divide the capital invested into two parts, the first giving the costs of generation and the second the costs of distribution. The results show that the distribution side of electric supply is becoming the more important. They have also reviewed the revenue derived from the sales of electricity and allocated it between generation and distribution expenses. The figures show that although the efficiency of generation has increased materially, there has been little, if any, improvement in distribution efficiency. The cost per kilowatt installed during the last ten years has diminished from £25 to £20. This is probably due to the increase in the size of the turbine and boiler units installed. If it is assumed that the percentage of spare plant required would be 83 without the grid and 20 with the grid, the amount of spare plant released in five years time would be sixty million pounds in capital. As the sales of units per pound of distribution capital increase, the ratio of the distribution costs to the total costs decreases substantially. Whilst the distribution capital is increasing at the rate of 18 millions a year, the generation capital is only increasing at the rate of 7 millions. The authors state that if the companies offered sufficiently attractive tariffs, there seems no reason why the total domestic consumption should not be twice the present total sales for all purposes. If company control is decided on, a satisfactory scheme for the regulation of prices and dividends will have to be established. Any undue increase in the average remuneration of capital will inevitably keep up the price of electricity and retard development.

Image of the Physical World in Cinematography

The two dimensional world of light and shadow projected upon the screen of a cinema theatre is something quite unique and is essentially different from our own material world of reality. In *Scientia* for January, Mr. Torahiko Terada states that future cinema techniques could be anticipated by a careful study of these two kinds of worlds. He considers that the marvels of the cinema film depend mainly on the element of time. When the relative scale of time in the physical world and the screen world is changed we receive a shock. For example, we can see the seed of a flower growing up into full blossom in a few minutes or a bullet emerging from the muzzle of a gun accompanied by a retinue of vortices and waves. This change in the scale of time brings with it the corresponding change in every physical quantity depending on the time. When a scene of a collapsing brick chimney is projected with half the natural speed, its acceleration will only appear to be a quarter its natural value and the value of gravity will apparently be only a quarter its true value. C. F. Flammarion once dreamed of the possibility of reviewing the world's history in its reverse order by flying out of our earth with a velocity greater than that of light. The principle of relativity prohibits this, but, in the screen world, history may run easily in its reverse order. In our visual effect it is practically the perfect reversal of time. It may be considered a materialised extension of our memory. It is impossible to tell in what direction a pencil balanced on its point will fall but in the reversed film it will stand upright as nearly perpendicular as possible. On the other hand, in a reversed film we cannot tell the direction in which a billiard ball at rest on the table is going to move. The reversal of time as realised in the cinema is a straightforward denial of the second law of thermodynamics—the only law prescribing the sequence of the physical world.

New Britain

To those who believe that the present situation is a challenge to thought and that reconstruction demands fundamentally both clarity of thought and the readiness to discard preconceived ideas or established customs or institutions, when these stand in the way, the new quarterly journal, *New Britain*, should make a strong appeal. Its pages are characterised by a freedom from prejudice and a capacity for courageous and independent thought worthy of an organ aiming at national renaissance and in harmony with the spirit of the Oxford reformers to whom we owe the English Renaissance of the sixteenth century. Scientific workers will be particularly interested in the articles which attempt to assess the place of science in the new order. Mr. Gerald Heard, in his article on "Eugenics and the New Order", directs attention to the part which eugenics must play, pointing out that lack of will-power prevents use being made alike of the plans of leaders or the 'stones' provided by science. Prof. F. Soddy discusses the physical foundations of civilisation and the dangers attending a policy of drift and failure to abandon the old herd instincts of poverty and scarcity and methods of dominance based upon them. Dr. G. Scott Williamson in his article on "The Scientists' Outlook" deals particularly with the place of biological science in the new order of society and the dangers of palliatives as against a positive and thoroughgoing policy. The cultural aspects of science and its place among human values are discussed in thought-provoking essays by S. G. Hobson and Philip Mairet. The whole of the January-March issue places a welcome emphasis on the social and human values of science and the positive benefits which it might yet confer on mankind.

Voyage Around Franz Josef Land

THE remarkable feat of circumnavigating the ice-girt Franz Josef Land in a small motor vessel is reported by Science Service of Washington, D.C. Prof. N. N. Subov, arguing from temperatures in the Barents Sea in recent years that the arctic branch of the North Atlantic drift was unusually warm and would reduce the amount of ice around Franz Josef Land, set out last August from Murmansk in a hundred ton motor boat with 30 days' fuel and 40 days' stores. The tour, which was made from east to west, actually took thirty-four days. A large number of soundings and salinity observations were taken. A few small corrections in the map were also made.

Announcements

SIR RICHARD GLAZEBROOK, formerly chairman of the Aeronautical Research Committee, has been awarded the gold medal of the Royal Aeronautical Society.

AT a meeting of the Council of the Royal Society of Edinburgh held on March 6, the following prizes were awarded: The Makdougall-Brisbane prize for 1930–32, to Dr. A. C. Aitken, of the University of Edinburgh, for various contributions to mathematics published in the *Proceedings* of the Society; Gunning Victoria Jubilee prize, for 1928–32, to Sir James Walker, for his numerous contributions to physical and general chemistry. The Bruce-Preller lecture for 1933 will be delivered by Prof. C. H. Lander, on October 23, on the subject of the utilisation of coal.

MR. P. M. S. BLACKETT will deliver the G. J. Symons memorial lecture of the Royal Meteorological Society on March 15 at 7.30. The subject of the lecture will be "Cosmic Radiation".

THE annual general meeting of the British Medical Association will be held in Dublin on July 25–29, under the presidency of Prof. T. G. Moorhead, regius professor of physic at Trinity College, Dublin.

A SYMPOSIUM on the utilisation of coal has been arranged by the British Science Guild, to be held on March 27 at the Royal Institution under the chairmanship of Mr. H. T. Tizard. The speakers include Capt. B. Acworth, Mr. S. Lacey, Eng.-Rear-Admiral W. Scott Hill and Mr. A. C. Hardy. The discussion will be opened by Dr. O. M. W. Sprague.

THE Committee on Thermochemistry of the Union Internationale de Chimie proposes to publish an international table of thermo-chemical data. The Secretary of the Committee would be glad if authors who have published papers on thermochemistry within the last five years would send him two copies of their papers. Such copies should be sent to Dr. L. J. P. Keffler, The University, Liverpool.

AT the annual general meeting of the Society of Public Analysts held on March 1 the following officers were elected for 1933:—*President:* Mr. F. W. F. Arnaud; *Past Presidents on the Council:* Mr. E. Richards Bolton, Dr. J. T. Dunn, Dr. Bernard Dyer, Mr. Edward Hinks, Mr. P. A. Ellis Richards, Mr. G. Rudd Thompson, Dr. J. Augustus Voelcker; *Vice-Presidents:* Mr. John Evans, Mr. H. M. Mason, Dr. G. W. Monier-Williams, Mr. George Stubbs. *Hon. Treasurer:* Mr. E. B. Hughes; *Hon. Secretary:* Mr. G. Roche Lynch.

IN the paragraph in NATURE of March 4 (p. 300) entitled "Photographic Analysis of Explosion Flames", the velocity of detonation is incorrectly given, through an error in typing, as "one or two metres per second"; it should read "one or two miles per second".

UNDER the terms of the Thomas Gray Memorial Trust, the Council of the Royal Society of Arts has awarded the £100 prize, offered in 1932 for an essay on the rescue, by another vessel, of passengers and crew of a sinking vessel, to be equally divided between Commander R. D. Binney, Chief Officer J. W. Murphy, Lieut.-Commander D. A. Stride and Lieut.-Commander J. H. Walker. For the £100 prize offered for any valuable improvement in the science or practice of navigation, nothing of sufficient merit was submitted, but an award of £50 was made to Able-bodied Seaman J. Patteson for a device designed by him and entitled "The Harmonic Constant Tide Calculator".

SEISMOMETRICAL reports on the earthquakes felt and recorded in Tokyo are now issued by the Earthquake Research Institute. We have received the first two numbers dealing with the earthquakes of January–June, 1932. Each of them includes a map of the origins of the earthquakes (thirty in number) felt in Tokyo, showing that they lie in, and to the north of, the Bay of Tokyo, except four in the well-known zone that lies under the Pacific to the east of the Boso peninsula. Copies of the more important seismograms are also reproduced.

APPLICATIONS are invited for the following appointments on, or before, the dates mentioned:—An assistant engineer for the River Avon (Bristol) Catchment Board—The Clerk and Solicitor to the Board, The Council House, Bristol (March 13). A principal of the Gloucester Technical College—The Clerk to the Governors, 24, Barton Street, Gloucester (March 16). An assistant borough electrical engineer and a temporary constructional engineer in the Electricity Department of the Fulham Borough Council—The Town Clerk, Town Hall, Fulham, S.W.6 (March 16). A divisional engineer (electrical) in the Department of the Chief Engineer of the London County Council—The Clerk of the Council, The County Hall, Westminster Bridge, S.E. (March 17). A lecturer in medicine at the University of Aberdeen—The Secretary (March 21). A professor of civil engineering at Trinity College, Dublin—The Secretary of the University Council (March 31). A ballistic assistant for mathematical work in relation to trajectories of projectiles—The Secretary (C.E. Branch), Admiralty, S.W.1.

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.*]

The Presence of a Bacteriophage for *B. salmonicida* in River Waters

EPIDEMICS of "Furunculosis of the Salmonicidæ" generally attributed to a well-defined bacterium—*B. salmonicida* (Emmerich and Weibel, 1894)—have been the cause of a high mortality among salmon and trout in England during recent years and have been difficult to deal with owing to a lack of knowledge of the epidemiology of the disease and particularly of the reservoirs of the infection during inter-epidemic seasons. The problem of following out the infection is not easy as *B. salmonicida* has no saprophytic existence in river water, in which it does not live for more than a few days, so that it is useless to attempt the isolation of the bacillus from the suspected water—even if this were a practical possibility. Moreover, the absence of sick or dead fish does not exclude the possibility of infection, as apparently healthy fish are known to act as carriers of the disease and to be capable of spreading the infection.

It seemed possible that, if the infection of fish is associated with the appearance in the water of a specific bacteriophage, this might prove a useful index for tracing the infection. This aspect of the problem does not appear to have been considered, and as no reference to a phage for *B. salmonicida* could be found in the literature, the matter seemed worth looking into, and a search was made in a number of natural waters.

Examination of the water of the Thames at Kingston during the summer of last year showed the presence of a bacteriophage highly active for *B. salmonicida*, and the phage could be demonstrated in volumes as small as 0·3 c.c. of the water. The waters of several other rivers were then tested and active phages for *B. salmonicida* were isolated from the upper reaches of the Mole in Surrey, from the Arun and the Ouse in Sussex, and from the Avon at Bath.

The water of the Arun was interesting as it yielded two apparently distinct phages. One of these, which is highly active, forms small plaques (about one millimetre in diameter) on 1 per cent agar, and continues unchanged after repeated passages with *B. salmonicida*. The other, which is less active, at first forms larger plaques (about two to three millimetres in diameter), but on repeated passages with *B. salmonicida* gives both large and small plaques.

In a sample of water from the Burn of Houlland, North Roe, Shetland, kindly sent me by Capt. S. R. Douglas, no active phage could be demonstrated in 10 c.c. of the water. Control examinations of the tap water of the National Institute for Medical Research and of the Whitestone Pond, Hampstead, showed no active phage in 250 c.c.

The recognition of an active phage as a rule gives no difficulty, the plaques formed on agar being quite definite and unmistakable. Occasionally very feeble phages are encountered which, even after repeated passage with *B. salmonicida*, show only very faint and scarcely discernible plaques on agar. Whether these feebly active strains are true salmonicida phages appears doubtful, and for the purposes in question they may probably safely be ignored.

The presence of an active phage for *B. salmonicida* in the waters of a number of English rivers is highly interesting and its connexion or otherwise with the presence of infected fish would appear worthy of investigation as, if such a connexion were established, some measure of control might at once be possible particularly in the case of hatcheries, since apparently healthy fish from these have been incriminated as responsible for the spread of the disease. In this connexion the periodical examination (for the presence of the phage) of the effluent of a hatchery supplied with phage-free water might give valuable results.

CHARLES TODD.

National Institute for Medical Research,
Hampstead.
Feb. 27.

Origin of Angiosperms

IN various notes in *Science* and in my longer studies of cycadeoids, the view is maintained that the angiosperms must be very old, and in so far as not actually discrete, related to the older flowering gymnosperms. Such views of descent relegate gnetaleans to the position of a side or blind line as suggested by Seward. The group was even held to be angiospermous by Lignier and Tison. In any event, it pictures in a lively manner some of the types of change both vegetative and reproductive which must mark the evolution of the angiosperms from homoxylous freely flowering forerunners.

Primarily, the view of a cycadeoid rather than a cordaite or conifer explanation of angiosperm derivation rested on floral evidence taken with the sharp resemblance between the cycadeoid wood and that of the Oriental dicotyledonous family Trochodendraceæ, which could be shown to have a defined relationship to the magnolia group proper. Branching and habit presented no difficulty, as the small flowered *Williamsoniella* and *Wielandiella* bridged that gap. Nor was there any marked doubt as to either the time or general mode of origin of netvenation; while *Caytonia* afforded the needed example of a very primitive, even if much isolated, angiospermous carpel with cycadeoid-like seeds.

New evidence, slow to come, had to be awaited. Here the hope of floral discovery was a slender one; while the small and primitive types of cones are as little seen as the flowers, and without more intensive methods of search or some utterly unawaited 'finds', any crucially important types of either might not appear in another fifty years. Moreover, it was obvious that the petrified record of the angiosperms is very greatly limited by an easy liability to bacterial decay. In short, the nearest points of awaited discovery became: (1) determination of wood structure in the small-stemmed cycadeoids (*Williamsoniella*, *Wielandiella*) as probably dependent on the materials in mid- to lower Mesozoic lignites; (2) extension of knowledge of wood structure in the Trochodendraceæ and their allies back in geological time.

Now at this point, in the latter part of 1932, a turn in the long road has been made. Fr. J. Mathiesen, in an account of fossil plants from East Greenland[1], describes from Cape Dalton, lat. 69° 30′ N., certain calcified stems of good definition which are compared with the existent *Tetracentron*, hence *Tetracentronites*.

Accompanying them there is a *Corylopsis*-like type, *Corylopsites*. The age of these most significant new woods is Palæocene-Eocene. Also, B. Sahni[2] gives a description of a so-called new genus *Homoxylon* based on a portion of a larger stem from the mid- or lower Jurassic of the Rajmahal Hills. Unfortunately the exact locality of this likewise important wood, the original of which I have seen in thin section, is not yet determined, although there is no reason to doubt its Jurassic age. Sahni compares his new genus with *Trochodendron*.

So close is the structural resemblance between these new fossils that it appears to I. W. Bailey, who in a recent letter first directed my attention to the paper of Mathiesen, as if the generic analogy were reversed. That is, Bailey would compare the Greenland fossil with *Trochodendron*, the Indian with *Tetracentron*. However this may be, both these types, though so far separated in latitude and time, are in remarkable agreement with the magnolian woods, and both present a further and most striking resemblance to the wood of such species of the cycadeoids as *Cycadeoidea Dartoni*, *C. Wielandi*, *C. Painei* (or *Paynei*), *Raumeria Reichenbachiana*, and *Bennettites* (or *Cycadeoidea*) *Gibsonianus*. In fact, were these latter woods alone known without reference to foliage or fructification, they could at most be set aside as of a family directly related to the Trochodendraceæ. Also it must be remembered that many of the cycadeoids were microphyllous, and that *Drimys* is exstipulate. The only possible doubt as to the main position of the new Greenland and Indian types thus arises from the close agreement of the wood structures with those of such old and obviously specialised types as the cycadeoids just cited.

Comparison of the homoxylic (vessel-less) angiosperms with cycadeoids depends much on the region next the pith. *Drimys*, with thick-walled ray cells, and clear transition from well-defined scalariform to pit wood, is here the fundamentally important type; while consideration of the heteroxylic *Liriodendron* further shows how the simpler scalariform elements are transformed into vessels. The cycadeoids of reference here are those amongst the many species studied which in occasional specimens or parts of such in exceptional preservation show both ray and tracheidal features in full detail. Thus in *Cycadeoidea Dartoni* there is seen the most remarkable transition from scalariform to pit wood, exactly comparable to that figured by Mathiesen in the Greenland *Tetracentronites*. Again, in the radial sections from the mid-region of the United States National Museum type, *Cycadeoidea Paynei*, preservation of both ray and tracheidal elements is perfect, the structure-parallel of both with *Tetracentronites* complete. Likewise these features are seen in an equal beauty of preservation and identity amongst the very different, small-flowered, free-fruiting and geologically much younger cycadeoids of the Mesaverde of the San Juan Basin of New Mexico. In all the foregoing, the scalariform-pit wood transitions, and the thickened ray cells are present. That is, this structural agreement of the cycadeoids with the Trochodendraceæ, and in part with the magnolias, is in evidence far and wide from Jurassic, down into later Cretaceous times. It is too impressive to be without bearing on the origin of the angiosperms.

Much of this bettering of illustration and comparison has depended on more persistent and improved sectioning methods. Thus Mathiesen mentions that he found etching the Cape Dalton calcified materials with hydrochloric acid an advantage. This I also found an aid in clearing polished surfaces of calcified stems from the Isle of Wight. Also, silicified stems containing distinct amounts of residual carbon as in *Raumeria* and other cycads such as the *C. nigra* from Colorado, may be effectively etched with hydrofluoric acid where the requisite thinness and clearness is difficult to reach by the simple thin-section method. Followed by careful washing and covering, such sections supplement the gelatine pulls.

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[1] *Meddelelser om Grønland*, Bd. 85, No. 4.
[2] *Pal. Ind.*, 20.

Upper Pressure Limit in the Explosive Chain Reaction between Hydrogen and Oxygen

WHEN the two pressure limits, between which the normally slow combination of hydrogen and oxygen, at, say, 540° C., becomes explosive, were first discovered, the existence of the lower limit was attributed to the deactivation of chain carriers at the wall of the vessel, and that of the upper limit to deactivation in the gas phase. Unless one or other of the deactivation processes is vigorous enough to balance a branching of the chains, explosion occurs. The theory of the lower limit has since been confirmed by detailed investigation, and shown to account for the facts more or less quantitatively. Theories which make the upper limit depend upon the vessel wall have also been suggested, but further experiments have shown that the assumption of some form of gas phase deactivation cannot be dispensed with.

Hitherto, no really quantitative theory about the detailed nature of this deactivation has been worked out. The first tentative idea was that it depended upon the mutual destruction of hydrogen peroxide molecules concerned in the propagation of the chain. The well-known theory of Haber that hydrogen atoms and hydroxyl radicles play the most important part in the chain naturally suggests that the deactivation might consist in the recombination of such atoms or radicles: for this a three-body collision would be advantageous.

The purpose of this note is to state that further experiments, shortly to be published, lend what seems to be practically conclusive support to the view that the upper limit is governed by ternary collisions in the gas phase. The particles which are deactivated or recombine in this process must be much more massive than pairs of hydrogen atoms.

The following simple theory accounts quantitatively for many of the facts about the upper limit. Let X and Y be two kinds of atom or molecule which collide in the course of a chain and let there be a certain probability that at such a collision the chain branches. If, however, any third molecule arrives while X and Y are associated together, then deactivation occurs. Equating rate of branching to rate of deactivation we have:

$$k[\mathrm{X}]\,[\mathrm{Y}] = Z_1\,[\mathrm{X}]\,[\mathrm{Y}]\,[\mathrm{H_2}] + Z_2\,[\mathrm{X}]\,[\mathrm{Y}]\,[\mathrm{O_2}] + Z_3\,[\mathrm{X}]\,[\mathrm{Y}]\,[\mathrm{M}]$$

M representing an inert gas present. The Z factors are proportional to the collision frequencies of the complex X Y with hydrogen, oxygen or the inert gas

respectively. From this it follows that at the limit $Z_1[H_2] + Z_2[O_2] + Z_3[M]$ is a constant. Experiment shows, in agreement with this, that at the limit in the absence of an inert gas, $[H_2] = C - b[O_2]$, and also that on addition of inert gas there is a linear decrease in the partial pressures of hydrogen and oxygen. The influence of helium is considerably greater than that of argon on account of its much greater speed, and consequently greater Z_3 value. Similarly, the constant b, which equals Z_2/Z_1, is much less than unity.

The value of Z can be shown to be proportional to $\sigma^2_{XYM} \Big/ \mu^{1/2}_{XYM}$ where $\mu = \dfrac{m_{XY} \cdot m_M}{m_{XY} + m_M}$, m_M, etc. being the molecular weights and σ_{XYM} the sum of the molecular diameters of the complex X Y and the colliding molecule M; similarly for Z_{H_2} and Z_{O_2}.

To allow the high speeds of hydrogen and of helium compared with oxygen and argon to have the influence in the calculation which experiment shows them to have in practice, the value of m_{XY} must not be too small. Thus X Y must be much heavier than a pair of hydrogen atoms. For the purposes of a preliminary calculation, we have assumed X Y to be an activated complex of H_2 and O_2, which has a finite probability of branching unless hit by a third molecule. Using the molecular diameters given in the table in Tolman's "Statistical Mechanics", we find that helium should have 1·77 times the effect of argon, while the experimental value is about 1·6. Moreover, the ratio of the Z values for hydrogen and oxygen gives the calculated value of the constant b as 0·39, compared with an experimental value of 0·325. Having regard to uncertainties in the molecular diameters, these agreements are very close, and show that the relative speeds of the different molecules principally determine the variation of the upper limit. Thus the theory of gas phase deactivation of fairly massive complexes in ternary collisions is strongly supported.

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Feb. 11.

Structure and Division of Somatic Chromosomes in *Allium*

THREE divergent views have been expressed regarding the structure of chromosomes. Pfitzner in 1882 suggested that a chromosome is made up of a row of granules embedded in an achromatic or less chromatic matrix. About the same time, Baranetzky found a spiral structure in certain stages in the meiotic cycle of the chromosomes of *Tradescantia virginica*. Vejdovsky (1912) has termed this spiral the chromonema. The chromonema theory conceives of a continuous, filiform, spirally coiled chromatic element in an achromatic matrix. The alveolar theory foreshadowed by van Beneden and worked out by Grégoire and his pupils contemplates the homogeneous chromosomes of the metaphase becoming during the following stages a honey-combed structure by the appearance in it of numerous alveoles. The supporters of this view assume that a longitudinally aligned central series of alveoles would account for the origin of the split in each chromosome.

The exact nature of the behaviour of chromosomes both in mitosis and in meiosis, as well as their rôle in heredity, can be understood only if their real structure is known. A study of the structure of the chromosomes of *Allium* has been undertaken under the kind guidance of Prof. R. Ruggles Gates, with the view of solving some of these problems. A preliminary account of the results so far obtained by cytological observations and the use of wire models is given below.

(1) At the early metaphase each chromosome is seen to be composed of two spirally coiled chromonemata and the duality of this spiral has been observed in all stages of the mitotic cycle.

(2) The spiral is coiled in opposite directions in the two arms of the chromosome, the null point of the spiral being the attachment constriction of the chromosome.

(3) This form of double spiral permits of the separation of the chromosome into two by a simple uncoiling. This commences at the ends, as observed in *Allium*, but conceivably in some forms it may be initiated by the pull of the spindle fibres at the point of constriction.

(4) This unwinding causes rotation in the two arms of the chromosome; it may be possible that, as a result of this rotary motion in each arm of the chromosome, longitudinal cleavage is initiated in each chromonema at the metaphase stage.

(5) The separated chromonemata (daughter chromosomes), which now present a double spiral structure in each, remain parallel until they are finally pulled apart to the opposite poles of the spindle.

The doubleness of the anaphase chromosomes is clearly seen and the twisted appearance of these is due to slight loosening of the double spiral, which has been observed by Hedayetullah[1] in *Narcissus* and by Miss Perry[2] in *Galanthus*. The threads of this spiral retain their spiral structure in the subsequent stages of the mitotic cycle. The different appearances presented by the chromosomes in these stages are mainly due to the compact or loose nature of the double spiral. The dual threads remain closely associated together until their final separation at the next metaphase.

Further work on this subject is in progress and it is hoped that a detailed account may be published at a later date.

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Feb. 7.

[1] Hedayetullah, *J. Roy. Mic. Soc.*, **51**, 347–386.
[2] Perry, *J. Roy. Mic. Soc.*, **52**, 344–356.

Synthesis of Protein by Green Plants

IN green plant tissues, the relation of protein synthesis to light has long presented puzzling features. It is known that many such tissues can synthesise protein in the dark if carbohydrate supply is abundant. Normally, however, protein accumulation in leaves appears to take place chiefly or solely in the light. In the case of an alga, *Chlorella*, Muenscher showed that approximately equal amounts of protein were accumulated if the algal cells were grown in either dark or light on a glucose medium containing nitrate. Muenscher's cultures were continued over a long time, and they simply show, therefore, that protein synthesis approaches the same *equilibrium* point in the dark as it does in the light.

Using the same strain of *Chlorella* as Muenscher (that of Hopkins and Wann), we have found that the

alga grows and synthesises protein much more rapidly in the light than in the dark. Thus of a number of pure cultures (inoculated with the same number of cells and grown on a glucose medium containing ammonium nitrate), some were taken for analysis to represent the original condition, others were kept for three days (*a*) in the dark or (*b*) in continuous light. These yielded on analysis, as mgm. per culture, the following:

	Dry Weight	Total Nitrogen	Protein Nitrogen	Gain in Protein Nitrogen
Original	84·4	2·83	2·56	
Dark	112·1	3·42	3·05	0·49
Light	193·4	5·60	4·97	2·41

It thus appears that the *velocity* of protein synthesis is much greater (five times) in the light, though the final equilibrium is similar in either light or dark, if sufficient carbohydrate is available. This conclusion would also satisfactorily interpret the available data for the higher plants.

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Insects and Micro-Climates

IT is well known that when water is exposed to dry air, evaporation takes place and the liquid becomes cooler than its surroundings; when a dish of water is placed in still air at 30° C., the temperature of the water is sometimes considerably lower than that of the air. The amount by which the water is cooler depends on the humidity of the air, for the lowering of the temperature is directly proportional to the rate of evaporation, which is governed by the saturation deficiency. In our experiments, when the air in the room has a humidity of 78 per cent, then the temperature of the water is 27·9° C., and when the humidity is 40 per cent, then the temperature is 22° C.

The temperature of the air immediately above the water in the dish has approximately the same temperature as the water. Experiments have shown that *Culex fatigans* is killed by an exposure to 41° C. for an hour, and it is suggested that its habit of resting in damp situations has enabled this insect to survive in countries where the shade temperature is frequently considerably above 41° C. Many insects which are found in these situations are probably attracted there by the lower temperature and not by the high humidity.

The large fall in temperature due to evaporation means that the conditions to which many insects are subjected are even more different from those measured by standard meteorological methods than is usually realised. In experiments with a number of different insects, we have shown that exposure to dry air is usually more rapidly fatal than exposure to moist at the same temperature. At first sight this would imply that, for any given temperature, the higher the humidity the more favourable the conditions for these insects; but it is possible that the effect may be the reverse, for the high atmospheric humidity will prevent evaporation and raise the temperature to which the insect is actually subjected. For example, in air at 35° C. with a relative humidity of 90 per cent, the temperature of the water would be 33° C. (assuming that 2·5 mm. saturation deficit gave a reduction of 1° C. which was the amount found in our experiments). If, however, the air was at 40° C. and had a relative humidity of 10 per cent —conditions which would prove rapidly fatal to many insects—then the water would only be at 20° C.

We should like to direct the attention of entomologists to these observations, in the hope that they will study the climatic conditions of the air in wells, over collections of water in rot-holes and in other places where insects are found resting.

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Feb. 20.

Triphenylmethyl Derivative of Vitamin C

1 GM. of ascorbic acid (vitamin C) was dissolved in 5 c.c. of pyridine and 1·4 gm. triphenylchloromethane were added. After standing for two days at 30° C. the solution was diluted with chloroform, shaken out twice with water and dried with anhydrous sodium sulphate. The solution was evaporated *in vacuo*, the syrupy residue dissolved in a little benzene and precipitated with petrol. The precipitate was ground up in a mortar under 2 per cent acetic acid, dried, and reprecipitated from benzene as above.

Trityl-ascorbic acid is a white amorphous powder, easily soluble in chloroform, benzene, alcohol and alkali, insoluble in ether, practically insoluble in water and petrol. It begins to colour at 80° C. At 130° it melts with blackening and decomposition. Its specific rotation is + 30° (*c.* 3·0). Its percentage composition was carbon, 71·1 and hydrogen, 5·41; calculation for the formula $C_{25}H_{22}O_6$ gives carbon, 71·73 and hydrogen, 5·3.

The mono-acetone-ascorbic acid did not give a trityl derivative. The acetone-ascorbic acid and the triphenylchloromethane were recovered unchanged.

It follows that vitamin C contains a primary OH group, which is involved in mono-acetone-ascorbic acid in the formation of the isopropylidene group. Owing to the presence of a carboxy group, we may also conclude that vitamin C is not an aldehyde and the CO group is present as ketone.

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Feb. 6.

Indophenol Reducing Capacity of Lemon Juice and its Fractions in Relation to Vitamin C Activity

MR. DANN[1] is labouring under a misapprehension in interpreting the results of my paper[2]. My figures show that if the reducing capacity of the various lemon juice fractions be interpreted in terms of fresh decitrated lemon juice, eighteen guinea-pigs receiving daily doses equivalent to 2 c.c. (reduction value 8–10 c.c.), eighteen receiving doses equivalent to 1·5 c.c. (reduction value 6–8 c.c.), thirty-six receiving doses equivalent to 1 c.c. (reduction value 4–6 c.c.), seventy-two animals in all (tested usually three in a group), died of apparently uncomplicated scurvy within 30–40 days. It need scarcely be stressed that young guinea-pigs do not vary in biological response to anything like this extent but *always* survive much longer than 30–40 days, even if they are not fully protected, on daily doses of 1–2 c.c. or even less of lemon juice. This fact invalidates Mr. Dann's inferences.

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[1] Dann, NATURE, **131**, 274, Feb. 25, 1933.
[2] Zilva, *Biochem. J.*, **26**, 1624; 1932.

Vitamin C and Ascorbic Acid

MESSRS. Birch, Harris, Ray and Dann have summed up in NATURE of February 25 (p. 273) the arguments for believing that vitamin C and hexuronic (ascorbic) acid are identical. In the course of their observations they refer to "Ostermalt" as having been shown by their chemical method to contain an amount of ascorbic acid that should cause it to protect guinea-pigs from scurvy in a daily dose of 3·3 gm.; no figure was apparently available to the authors enabling them to compare this conclusion with an actual biological assay.

In further substantiation of the authors' views that ascorbic acid and vitamin C are identical, I may be permitted to state that Ostomalt, to which they presumably refer, as manufactured in these Laboratories for the last six years, contains a proportion of concentrated Californian orange juice? The amount of this juice present in Ostomalt is such as to give the equivalent of half its own volume of fresh orange juice to the product. 3·3 gm. of Ostomalt occupy a volume of about 2·5 ml., and the figures given by Birch, Harris and Ray for the protective dose of orange juice are 1·2, 1·5, 1·9 ml. It will therefore be seen that the results obtained by their titration method are in good agreement with the equivalent of fresh orange juice present in the product.

A short while ago an independent laboratory, carrying out tests for an official body, found by biological assay that Ostomalt contained an amount of vitamin C that was "in very fair agreement with their [the manufacturers'] claim that the product contained antiscorbutic vitamin equivalent to half its volume of fresh orange juice".

It would therefore seem that the chemical estimation of the vitamin C present in this product, which is primarily a mixture of malt solids, concentrated orange juice, and cane sugar, with certain other vitamin supplements, is in substantial agreement with direct and indirect biological assays, affording further confirmation for the views of Birch, Harris, and Ray as to the identity of vitamin C and ascorbic acid.

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An Inhibitor of the Antimony Trichloride Test for Vitamin A in Cod Liver Oil.

IT has been shown[1] that traces of substances like furan, indol and skatol inhibit strongly the intensity of the absorption band of vitamin A with antimony trichloride at 620 mμ. In cod liver oil, there must be such an inhibitor, because after saponification a much stronger Carr and Price reaction is obtained with the unsaponifiable fraction.

Attempts to isolate this inhibitor by means of different soaps in various solvents; vacuum distillation; bromination and debromination; and cooling down to low temperature in different solvents, proved to be unsuccessful. However, I have succeeded in isolating it in the following way: Cod liver oil for medical purposes (pale yellow coloured) is saponified, acidified and the mixture of acids dissolved in five volumes of petroleum ether (b.p. 60°–80°). After drying with anhydrous sodium sulphate the solution is vigorously shaken up with 1/10 volume of diluted sulphuric acid (5 volumes of 96 per cent sulphuric acid + 2 volumes of water). The sulphuric acid layer contains the inhibitor and is poured out into a large volume of cold, saturated sodium sulphate solution. This mixture is extracted several times with petroleum ether. After evaporation of the solvent, the resulting oil is distilled and boils at 180°–210°/1–2 mm. This oil is dissolved in petroleum ether and again shaken out with sulphuric acid. The resulting oil, a pale yellow viscous substance, boiled at 203°/1 mm. From 1 litre of cod liver oil about 2½ c.c. was obtained.

The inhibiting power (measured by means of a Zeiss stuphometer with the *S* 61 filter) is four to five times as large as that of indol. The substance readily absorbs bromine and gives a strong orange yellow colour with tetranitromethane. The iodine value (Wijs) and bromine value (Kaufmann) depend on the time of reaction and excess of the reagent. Iodine values varied from 205 to 392, and bromine values from 166 to 364.

Molecular weight determination gave 332 (titrated as a mono-basic acid). Analysis gave as a formula $C_{21}H_{36}O_3$. Qualitative tests for sulphur and nitrogen (Lassaigne) were negative. Catalytic hydrogenation (platinum catalyst) showed absorption of about 4 atoms of hydrogen per molecule. The hydrogenated product has lost the inhibiting power, and gives no colour with tetranitromethane (bromine value after 5 minutes reaction = 0).

However, it may also be pointed out that the inhibiting power of a substance is not due to its unsaturation alone, because specially prepared, very pure, unsaturated fatty acids (oleic, linoleic acid) do not show any inhibiting power. Impure fatty acids (oxidised) give a red Carr and Price reaction; thus in presence of vitamin A there results a mixed colour, but no inhibition will be seen by spectroscopical research.

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Jan. 30.

[1] NATURE, 128, 495, Sept. 19, 1931.

Dissociation of Nitrous Oxide in the Glow Discharge

IN a recent paper, Kueck and Brewer[1] describe experiments made on the dissociation of nitrous oxide in the 'glow' discharge. Using a special disposition of electrodes which eliminates anode glow and positive column, they find, with fields of the order of 2,000 volts/cm., over a pressure range 2–5 mm., that the initial decomposition rate is practically independent of the initial pressure. Similar results for both nitrous oxide and ammonia have been described by Hinshelwood and Hutchinson[2], who, using a method which gives essentially the integrated dissociation throughout all parts of a normal glow discharge, state that for weak discharges the absolute amount of decomposition tends to be independent of the initial pressure. They observe, however, that for more intense discharges "the amount of decomposition becomes proportional to the pressure, i.e., the percentage decomposition is now independent of the initial pressure". This they term the "unimolecular state". Unfortunately, they give little data as to the potentials employed.

I have, for some time, carried out experiments on nitrous oxide under slightly different conditions, namely, in the high-frequency discharge (frequency approximately 100 kc.) in long tubes (*c.* 70 cm.) of 4 cm. diameter with external electrodes very close to the ends. Under these conditions, the glow is distributed almost uniformly throughout the gas. In the earlier experiments, damped high-frequency current from a spark oscillator was employed. Fields of average peak intensity ranging from 100 to 400 volts/cm. were applied, with initial pressures ranging from 0·1 to 3·0 mm., and a specially devised membrane gauge[3] enabled any one dissociation to be followed almost to completion.

The results were in substantial agreement with those of Hinshelwood and Hutchinson. At the lowest intensity of discharge, there was a definite tendency for the initial rate to vary little with the initial pressure, but at the highest potential difference employed there was a small pressure range in which the dissociation was sensibly unimolecular. The transition from one state to the other is shown strikingly by plotting the half-value period T, against the initial pressure p_0, for a given potential difference. For low potential difference, T increases rapidly with p_0, but the curve shows a slight inflection, which becomes more pronounced at higher potential differences and finally develops into a flat portion of curve parallel to the p_0 axis over an appreciable range of p_0. But even at points well removed from this unimolecular region, a given dissociation as a whole is found to be better described by a unimolecular law than by any other law of integral order, although the velocity constant is now pressure dependent.

In a further series of experiments (in collaboration with Mr. C. H. Noton) a valve oscillator was used, current measurements were made, and an improved discharge tube and gauge allowed the dissociation to be followed in greater detail. Measurements were made well away from the unimolecular region. It was found that for a brief period (3–4 sec.) after initiation, the dissociation rate increased, rapidly attained a maximum, and then proceeded 'normally'. The current varied in a similar manner, reaching maximum shortly after $(dp/dt)_{max.}$. A number of considerations militate against its being ascribed to possible selective adsorption on the walls in the initial stages, and the effect appears to be real. A similar and much larger effect has also been observed with nitrogen pentoxide. Further experiments are in progress and are being extended to ammonia. It is hoped to publish shortly details of the experiments already made.

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Jan. 31.

[1] *J. Phys. Chem.*, **36**, 2395; 1932.
[2] *Proc. Roy. Soc.*, A, **117**, 131; 1928.
[3] *J. Sci. Instr.*, **7**, 217; 1930.

Relative Intensity of Spectral Lines in Indium and Gallium

DURING 1932, work has been carried on in this laboratory on the measurement of the relative intensity of spectral lines in the above elements. The amount of material available was very limited, consisting of a small quantity of metallic indium and a little gallium chloride, both kindly supplied by Prof. Fawsitt, of the Inorganic Chemistry Department of this University. All this material has now been used up, and thus the results are published at this stage.

Results are given for the doublet $2p_{3/2}$–$2s_{1/2}$ and $2p_{1/2}$–$2s_{1/2}$ for each element. The wave-lengths of these lines are 4511 A. and 4102 A. respectively for indium and 4172 A. and 4033 A. respectively for gallium. Measurements of other doublets of the same series had not been successful by the time the material had all been used up.

The photographic methods introduced by Prof. Ornstein were followed fairly closely. The spectra were produced in an arc with silver-tipped copper poles, which gave a clear spectrum in the required regions. In the case of indium, a button of the metal alloyed with lead was placed on the lower pole, while for gallium the chloride was packed into a hole drilled in the lower pole. The potential applied to the arc was in one plate 100 volts and in the others 250 volts, while the arc current was 3–4 amp. A set of density marks, taken with a small incandescent lamp calibrated photographically by means of a standard lamp, was put on each plate. A reducer was used to divide each spectrum into two parts so that two sets of readings might be obtained from each spectrum. These two sets agreed within experimental error. The exposure time for the arcs varied, and was not always the same as that for the density marks, but there is no corresponding variation in the results.

When an arc was taken using pure indium, a reversal effect was obtained. To investigate the effect of this, alloys of lead and indium were made up, containing different proportions of the two metals, varying from 1 In : 10 Pb to 1 In : 500 Pb, and used in different plates. These alloys were prepared by melting the lead and indium together in a crucible under tallow to prevent oxidation. The mean results obtained with different alloys showed no regular variation, so that apparently any reversal effect is negligible at these concentrations. With the same object, some of the gallium arcs were taken with pure gallium chloride and others with a mixture of approximately equal parts of the chlorides of zinc and gallium. Both gave the same results within experimental error.

The results for indium are given below. The first column gives the proportions by weight of indium to lead in the alloy used in the plate. The intensity ratio given in the third column is that of the line of longer wave-length. The ratio a_1^2/a_2^2 is obtained from I_1/I_2 by multiplying the factor $(\lambda_1/\lambda_2)^2$, a_1 and a_2 being the amplitudes of the virtual oscillators given by the equation $I = a^2v^4$. The last row in the table gives the mean of all the results for different plates and concentrations.

In./Pb.	No. of Readings.	Mean I_1/I_2	Mean a_1^2/a_2^2	Mean error in I_1/I_2
1/10	5	1·66	2·42	0·11
1/33	3	1·51	2·21	0·06
1/33	3	1·73	2·53	0·09
1/33	7	1·64	2·39	0·05
1/100	4	1·47	2·15	0·06
1/500	7	1·61	2·35	0·04
	29	1·62	2·35	0·09

The corresponding results for gallium are given below. The last row again gives the mean of all the results.

No. of Readings.	Mean I_1/I_2	Mean A_1^2/A_2^2	Mean error in I_1/I_2
8	1·36	1·55	0·07
8	1·36	1·55	0·07
16	1·36	1·55	0·07

The mean values of a_1^2/a_2^2 obtained for this pair of lines for indium and gallium, namely 2·35 and 1·55 respectively, may be compared with the value 2·58 obtained by Prof. Vonwiller[1] for the corresponding pair for thallium.

In conclusion, I wish to thank Prof. Vonwiller, who suggested the work, for his continued help and advice.

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Dec. 21.

[1] *Phys. Rev.*, **35**, 7, 802; 1930.

Absorption Bands of Iodine Vapour at High Temperatures

I HAVE investigated the absorption of iodine vapour in a tube of 26 cm. length at temperatures above 800° C. over the region 2900–5000 A. and have observed the appearance of a continuous absorption band with a sharp limit at 3425 A. on the long wave side. With increasing temperature the intensity of this band increases and at 900° C. a new absorption band appears with the long wave limit at 3252 A. At about 1050° C. both bands extending from 3425 A. to 3000 A. change in appearance, showing on the continuous background many close bands. These are extremely diffuse and it was impossible to decide whether they are genuine band heads or due to fluctuations of intensity in the continuous spectrum.

The table below gives the temperature t and the vapour pressure p at which each kind of spectrum appears.

Limit of band.	Broad continuous band appears at		Narrow bands appear at	
	t	p in mm.Hg.	t	p in mm.Hg.
3425 A.	775°	80	1050°	760
3252 A.	885°	760	1050°	760

If the vapour has the temperature 1050° C., the broad continuous band at 3252 A. appears first at a pressure of 150 mm. mercury. Similar experiments were also made with a shorter absorption tube of 13 cm. length and it was found that the length of the tube does not affect the appearance.

The following are peculiar features of these absorption bands: (*a*) an abrupt limit on the red side which in the region investigated is independent of the temperature between 800° and 1050° C; (*b*) the maximum of the absorption lies close to the red edge of the band, namely, at 3425 A.; another less prominent maximum lies at 3252 A.; (*c*) the bands extend down to about 3000 A.

Oldenberg[1], investigating the influence of foreign gases on ultra-violet fluorescence of the iodine vapour, observed these bands in emission. He found that with increasing pressure of foreign gas the continuous band at 3460 A. first increases and then spreads into many narrow diffuse bands. The same phenomenon was observed by Cario and Oldenberg[2] in electric discharges through narrow capillary tubes in iodine vapour and by E. Hirschlaff[3] in fluorescing vapour at high temperatures. The narrow absorption bands show an exact agreement with those measured by Oldenberg between 3252 A. and 3000 A.; in the region 3425–3252 A., however, the bands quoted by Oldenberg were not all found and those actually observed show an irregular increase of $\Delta\nu$ with the wave-length.

The appearance of these bands in the absorption spectrum seems to contradict Oldenberg's suggestion ascribing their origin to the recombination of iodine ions $I^+ + I^- = I_2 + h\nu$ (*Ionenvereinigungsleuchten*).

In connexion with the observed absorption band limit at 3425 A. (800°–1050° C.) it is of interest to note that according to Oldenberg's observation in fluorescence (20° C.), the band limit appears at 3460 A., whereas Hirschlaff finds it at 3439 A. also in fluorescence (640° C.).

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[1] O. Oldenberg, *Z. Phys.*, **25**, 136; 1924.
[2] G. Cario and O. Oldenberg, *Z. Phys.*, **31**, 914; 1925.
[3] E. Hirschlaff, *Z. Phys.*, 75–325; 1932.

Neutrons

I HAVE obtained the following result, from a unified field theory. Two particles, of charges e, E, and masses m, M exert on each other, apart from the usual electrostatic force, also a 'gravitational' repulsion with a potential

$$\frac{e^2E^2}{4mc^2}\,\frac{1}{r^2}$$

if $M >> m$.

If this result is correct, it could account for the existence of neutrons. An electron and a proton are held together in a neutron by combined attractive and repulsive forces which are in statical equilibrium. The size of a neutron is thus $r = 1{\cdot}4 \times 10^{-13}$ cm., and the binding energy is $mc^2 \sim 5 \times 10^5$ electron-volts.

Chadwick's values for the size and binding energy of a neutron are 10^{-12}–10^{-13} cm. and 10^6 to 2×10^6 electron-volts.

D. MEKSYN.

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Feb. 12.

Preservation of Fossil Bones

REFERRING to the note in NATURE of January 28, p. 129, I have found that the safest and simplest method of hardening permanently and without discoloration the tusk and osseous fragments of the great Mammalia (mammoth and rhinoceros) recently found in the west of Scotland is repeatedly to baste the pieces with a strong solution of gum Dammar. This should be done after the object has become rather dry but before any warping occurs.

The method of treatment will, however, depend upon the condition of the relics. The Scottish pieces which I have handled are now exhibited in Kelvingrove Museum, Glasgow, and were all found in a very wet and spongy condition, 15–25 ft. under grass-level and in the laminated gravels of the old raised terrace of the Kelvin River, some eight miles east of Glasgow, at about 170 ft. O.D.

Had the pieces been allowed to remain without treatment, disintegration would now have been complete; with an incalculable loss to science.

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Research Items

Ancient and Modern Man. In opening a discussion on man's kinship with the primates at the Royal Anthropological Institute in November last (*Man*, No. 9, 1933), Dr. S. Zuckerman offered the suggestion that the existing classification of man is irrational, preventing a convincing evolutionary interpretation of the remains of fossil man available for study. Dr. Zuckerman reviews the evidence on which he bases his suggestion in the *Eugenics Review*, vol. 24, No. 4, and arrives at the tentative conclusion that archaic types and modern man fall into two easily definable groups, the sub-family Palæanthropidæ comprising such forms as *Pithecanthropus*, Peking man, and Neanderthal man; and the sub-family Neanthropidæ consisting of types like modern man and the men of the upper palæolithic. Generic status has been assigned to *Sinanthropus*, yet taking the ten Neanderthal skulls selected for contrast by Prof. Davidson Black, they show intra-specific differences of linear dimensions often greater than those regarded as generic differences in the family Hominidæ. Again, in the main distinguishing feature of Neanderthal skulls, the small flattened sagittal area, *Sinanthropus* corresponds not only to Neanderthal man, but also to Rhodesian man and *Pithecanthropus*. Differences in the vertical planes in which certain breadth measurements of the brain-case fall have been taken as differentiating *Pithecanthropus* and *Sinanthropus*, yet as important a difference in one of the breadth measurements differentiates all Neanderthal men from modern man; but here it is regarded as specific only. The difficulties which arise from the unequal significance attached to the peculiarities of Neanderthal man, *Sinanthropus* and *Pithecanthropus*, point to one of two conclusions—either *Sinanthropus* should be included in the genus *Pithecanthropus* or the accepted classification of all extinct Hominidæ should be revised.

'Iberomarusian'. In *L'Anthropologie* (T. 42, Nos. 5–6) MM. E. G. Gobert and H. Vaufrey discuss the application of the term 'Iberomarusian' coined by A. Barbin (1869–1932) to distinguish an industry discovered by him in the cave of La Mouillah, near Marnia (Oran). This culture he regarded as closely related to the upper palæolithic of south-east Spain, described by Siret. The most characteristic feature of the culture is its microlithic industry, though it has been regarded as distinctively palæolithic. Other Iberomarusian sites have been identified in eastern Morocco, Oran, Algiers and Constantine. A distribution map published in 1914 shows that Capsian and Iberomarusian are mutually exclusive, the former being confined to the southern Tunisian area and adjacent province of Constantine, while the latter belongs to the littoral area of the tells. The authors now describe two sites which mark the extremes of the Iberomarusian culture in east and west. These are Ouchtata (Tunisia) and El-Hank and Aïn Rahmane (Casablanca). The description of the finds on these sites establishes the character of the culture with greater precision, while the El-Hank site indicates the close relation of the Iberomarusian with the underlying Aterian, which is a late survival (also found elsewhere in Africa) of a technique of Mousterian origin. Tentatively it is suggested that the Iberomarusian is the littoral facies of the continental Capsian and that in the steppe region the typical Capsian overwhelmed and took the place of the Aterian, which on the littoral lies at the base of the Iberomarusian. This last is mesolithic rather than palæolithic. But even if the Iberomarusians and Capsians possessed industries of widely different facies, they were nevertheless of one and the same race, that of Mechta el-Arbi. The evidence being against the African affinities of the upper palæolithic of south-east Spain, 'Iberomarusian' might possibly be replaced by 'Oranian'.

Spread of Eskimo in Greenland. It is rare in modern times to find an extension of the area occupied by primitive people. There are abundant signs that in the past all the ice-free border of East Greenland was occupied by wandering Eskimo but the last seen on the north-east coast were on Clavering Island in 1823. In 1894 the Danes founded the Eskimo settlement of Angmagssalik in the south-east and in recent years have been successfully promoting further settlement. In a lecture to the Royal Geographical Society on February 6, Capt. E. Mikkelsen described some of these efforts and discussed the habitability of the coast, especially the Boisseville Coast between Kangerdluksuak and Scoresby Sound. A new colony of 85 Greenlanders, transferred from Angmagssalik, was established at Scoresby Sound in 1924. This colony flourished and now numbers 150. Conditions in the vicinity point to the possibility of its extension. Seals, walrus, narwhals, foxes, bears and birds are abundant. The musk-ox also occurs in fair numbers but these are protected at present. It is essential, however, if the colonies are to thrive, that the seal and walrus shall be protected from European hunters not only along that coast but also farther to the north, whence the ice-floes come south with the seals. The Boisseville coast is less attractive but the number of bears show that seals are abundant. Eskimo have already used this coast in the past and it is the aim of the Danes to establish along it a line of contact between the Scoresby Sound colonies and Angmagssalik.

Abnormal Chitons. Iw. Taki (*Mem. Coll. Sci.*, Kyoto Imp. Univ., Ser. B, vol. 8, No. 1, 1932) records eight specimens of Japanese chitons with less than the usual number (eight) of shell-plates. Examples are described in which reduction to five, six or seven plates has occurred, with subsequent regulation of form among them, including cases in which a shell-plate partly atrophied has fused with other plates. Specimens with a reduced number of shell-plates tend to have a shorter body-length than normal. The author brings together previous records of hypomeric and coalesced shell-plates—35 with seven plates, 9 with six plates, 2 with five and 2 with three plates. There is no case recorded in which the number of plates exceeds eight.

Bast-Sap. Prof. H. H. Dixon (*Sci. Proc. Roy. Dub. Soc.*, 20 (N.S.), 487–494) has described experiments which, it is claimed, elucidate the path and mechanism of translocation in plants. It is now suggested that the sieve tubes can permit a mass flow of solution. Experiments are described which show that under external pressures of 3 atmospheres, a solution introduced into the phloem moved at a rate of 7–8 cm. per hour. An incision into the phloem, without

penetrating the xylem, frequently causes, especially in angiosperms, an exudation of a minute amount of liquid (0·1–0·2 c.c. from a 1 mm. slit in 30 min.) which contains organic matter (up to 12 per cent sugar). This mechanism of phloem exudation, which is now attracting considerable attention, is supposed to reveal the composition of the moving fluid and also to demonstrate the reality of mass flow. The osmotic pressure of the exudate varied from 13 to 35 atmospheres. Experiments on *Fraxinus excelsior* show that the sap from a higher level is always more concentrated than from a lower. This difference (maintained chiefly by the supply of carbohydrates at a high level and their removal at a lower) causes the flow along the sieve tubes. It is suggested that the theory offers adequate explanation for other recent results on ringing experiments.

Uses of Rice Grass. The history of the remarkable polyploid plant *Spartina Townsendii* has recently been described by J. Bryce ("The Economic Possibilities of Rice Grass", *J. Roy. Soc. Arts*, 81, No. 4176, Dec. 2, 1932) who shows how its habit of growth is specially suitable for use in land reclamation and the prevention of coast erosion. Many striking instances of its wonderful power of colonisation are given, and experiments on the best methods for the utilisation of this power are described. In Holland, where the Kreekrak Polder was rising at the rate of a foot in five years, *Spartina* caused the level to rise nearly five feet in a similar time. Rice grass is also a palatable food for farm animals, especially sheep, and large yields of produce can be obtained. It can be grown in districts where salt abounds, either on the seashore or in the neighbourhood of artesian wells the waters of which are heavily charged with saline matter.

Phylogeny of Ammonites. A monograph on the Lower Triassic ammonites of North America (U.S. Geol. Surv. Prof. Paper 167, 1932, pp. 199, pls. 81) by the late J. Perrin Smith is the last of a series of five works on Carboniferous, Permian and Triassic ammonoids published from 1903 onwards. The Lower Triassic ammonites of North America have been found in Idaho, California, Nevada and Utah, and comprise 117 species belonging to 32 genera. Only three of the genera are peculiar to North America and it is probable that these will eventually be found elsewhere. Three families, the Xenodiscidæ, Meekoceratidæ and Hungaritidæ, are almost certainly immigrants from the Indian region, while the Pronoritidæ and Thalassoceratidæ are probably native to the American region. *Tirolites* is an immigrant from the Mediterranean region. The Celtitidæ appear in America, on one side, and in Albania on the other, and probably originated in the Arctic province. Of the five zones which have been recognised in the Lower Trias, only three are found in North America, the zones of *Meekoceras*, *Tirolites* and *Columbites*. The systematic part of the work is fundamentally phylogenetic and is based on the stratigraphical succession of adult forms, and on the evidence of ontogeny. The author is convinced that the late Palæozoic and early Mesozoic ammonoids repeat in their ontogeny their ancestral history with a fair degree of exactness, for they had not been greatly affected by unequal acceleration of development and scarcely at all by retardation or arrest of development. In the Jurassic and Cretaceous Ammonites recapitulation is not so distinct, because the disturbing factors (acceleration, retardation, and the development of cænogenetic characters) have combined to obscure the record. By the application of these methods the author traces the various genera of Lower Triassic ammonites back to their Palæozoic ancestors, but for the details of this phylogenetic study the work itself must be consulted.

Lowering of the Japan Sea Floor. Prof. H. Tsuya has described some pebbles recently brought up from the bed of the Japan Sea (*Earthq. Res. Inst. Bull.*, vol. 10, pp. 864–875; 1932). They were collected at various points on a submarine ridge, the Yamato Bank, that runs northwards from the south-west coast of Japan, and at depths of 1,500–2,000 ft. The pebbles are rounded or subangular, and vary in size from mere sand-grains to more than 20 in. in length. All of them have the general petrographic characters common to their respective rock-types now exposed in the Japanese islands. It is improbable, from their wide distribution, that they are ballast dropped from passing ships, and, from the size of some of them, that they were transported by currents so far from the present shores. There remains the alternative that the sea-floor on which the pebbles lay was, in recent geological time, either a land-surface or a shallow sea near the shore, and the author directs attention to papers by Dr. H. Yabe (*Bull. Imp. Acad.*, vol. 5, pp. 167–169, 430–433; 1929), in which are described two submarine shelves round the coast of Japan, furrowed by valleys that are continuations of those on the present land. From the depth of the margin of the lower shelf, Dr. Yabe infers that the Japanese islands were at no very distant date joined to the continent and that they have since then subsided by not less than 2,360 ft.

Further Calculations of Electron Scattering by Atoms. In a recent paper (*Proc. Roy. Soc.*, Jan.) Massey and Mohr amplify their previous work on the scattering of electrons by atoms. The wave-mechanical problem involves in general the distortion of the incident electron wave by the atomic field, exchange of electrons between the atoms and the incident beam, the disturbance of the atomic field, and the distortion of the scattered wave by the new atomic field. The distortion of the scattered wave might be expected to be large in the case of inelastic collisions as the spread of the atomic field and the wave-length of the electron are both increased by the collision, and the present paper represents an improvement on previous work in that this distortion is included as well as the effect of exchange of electrons. The calculations have been carried out for the elastic scattering in hydrogen and helium and for electrons which have excited the 2^1P and 2^3P states of helium. The new curves for the atomic cross-sections do not differ very significantly from the old, and at low velocities the theory predicts too large a cross-section. This behaviour is probably due to the neglect of the disturbance of the atomic wave functions by the incident electrons. The theory applied to inelastic scattering by heavy atoms shows that the angular distribution of scattering is similar to that for elastic collisions, except at low velocities and large angles, and this is in accord with observation.

Radioactivity of some Rare Earth Elements. The radioactivity of samarium has been reported by Hevesy and Pahl (NATURE, 130, 846, Dec. 3, 1932) and this observation has been confirmed by Libby and

Latimer (*J. Amer. Chem. Soc.*, Jan.), who have also found the elements lanthanum and neodymium to be radioactive. The activities of lanthanum and neodymium are not appreciably screened by 0·07 mm. of aluminium, whereas that of samarium is largely, if not completely, screened, indicating that the activities of the former are mainly of the β-type whilst that of samarium is due to α-rays. Two different samples of neodymium, one sulphate and the other oxalate, showed a molar activity about 2·5 times that of potassium ; the lanthanum activity was eight times that of potassium and the samarium about three times. Very pure gadolinium sulphate gave a negative result. It is considered that the radioactivity of the three rare earth elements is due to the presence of unstable isotopes, but the possibility of the presence of actinium as an impurity in the lanthanum and neodymium samples has not been excluded.

Steam-Jet Operated Air Ejectors. Steam jets have long been used for increasing the draught through boiler furnaces and in connexion with vacuum brakes on trains, and in 1902 Sir Charles Parsons introduced his 'vacuum augmenter' for increasing the vacuum in a condenser of a turbine plant. Since then, single-stage and two-stage ejectors have come into common use in power stations. The theory of the appliance is not a simple one and the success attained with various types has been mainly due to prolonged experimental investigations. Some of these investigations have been carried out in engineering laboratories. One such inquiry was described by Dr. A. H. Church in a paper published in 1927 in the *Journal* of the Royal Technical College, Glasgow, while on February 17, Mr. F. R. B. Watson in a paper read to the Institution of Mechanical Engineers dealt with a recent investigation made in the engineering laboratory in the University of Bristol. His paper was entitled "The Production of a Vacuum in an Air Tank by Means of a Steam Jet". The objects of his investigation included the study of the effect of the distance from the steam nozzle to the diffuser, the explanation of the action of the parallel throat in an ejector and the determination of the ratio of steam to air at different vacua and under different initial steam pressures. A description of the plant used was given and the paper was illustrated with photographs, curves and tables. The paper is printed at length in *Engineering* for February 24 and March 3, the latter issue also containing a report of the valuable discussion which followed the reading of the paper.

Astronomical Topics

The Reinmuth Planet, 1932 *HA*. This is the planet that can approach the earth within 3 million miles, and that actually came within 6 million miles last May. Dr. G. Stracke has published a very careful discussion of its orbit (*Astr. Nach.*, No. 5919) including the effect of planetary perturbations. Unfortunately, the accurate observations cover a range of only 18 days, April 27–May 15. The discovery plates on April 24 had such long trails that they could not be measured with exactness. The planet was photographed at Johannesburg on May 7 ; combination of this position with northern ones indicated a parallactic shift of about 100″, giving a good determination of the distance from the earth. The following are Dr. Stracke's elements :

Epoch 1932 Apr. 25·0 U.T.			q 0·644597
M 319° 59′ 1·60″			e 0·5662417
ω 284° 51′ 48·73″	}	1932·0	a 1·4860743
Ω 35° 50′ 19·59″	}		Period 1·8116 years
i 6° 25′ 10·85″	}		n 1958·6005″
			T 1932 July 7·5

The period just exceeds that of Eros, 1·761 years ; Eros has still the shortest known period among the minor planets. But both Eros and *HA* have shorter periods than Mars (1·881 years). *HA* makes a still closer approach to the orbit of Venus than to that of the earth, so it is subject to considerable perturbations from these planets.

Dr. Stracke fears that there may be great difficulty in recovering *HA* ; but efforts will doubtless be made in the spring of 1934, though its distance from the earth will be considerably greater than in 1932. It will not receive a permanent number or a name until it is recovered, as the present range of observations is too short for this purpose.

Annuaire Astronomique Camille Flammarion, 1933. This attractive handbook, published annually by the Observatory of Juvisy, contains the usual calendar information with diagrams of the planetary paths among the stars, and descriptive articles about them. The article on Pluto states that "it is certainly not greater than the Earth, or even than Mars". The last four words cannot be taken as certain ; many of the estimates of its mass exceed that of Mars.

In the diagram of the tracks of future solar eclipses that of 1945, total in Norway, has been inserted ; it was accidentally omitted last year. The table of elements of periodic comets is carefully kept up to date by M. F. Baldet. It includes the observations of the first half of 1932. The stellar tables include explanations of the spectral types, and details of magnitude, distance and motion. There are light-curves of some variable stars and details of novæ. The list of the latter includes 20 somewhat doubtful ones before 1572 and 41 certain ones observed since that date ; 31 of the latter are between 1892 and 1925 showing that the rate is about one a year.

A cryptic sentence on page 185 seems to need revision : enumerating the various motions of the earth, it concludes : "Enfin, un quatorzième mouvement . . . a été découvert en 1916 : le déplacement . . . du système sidéral tout entier, . . . à la vitesse de 600 km./sec., vers . . . la constellation du Capricorne."

The Observer's Handbook for 1933. This volume, published by the Royal Astronomical Society of Canada, contains, besides the usual calendar matter, diagrams of the paths of the planets through the stars, with some details about Pluto (the earliest photograph of which was taken in 1914, and not 1919 as stated). There are useful notes on the phenomena of each month and a table giving particulars of the positions, spectral type, distance, absolute magnitude and motion of the 260 brightest stars : another table does the same for the 35 stars nearest to the sun. A few stars occur in both tables. There is also a list of occultations of stars by the moon visible at Ottawa in 1933.

Virus Diseases*

THE term 'virus', formerly used in a much wider sense, has recently been given a special and restricted application. Viruses are distinguished from such long-recognised agents of infection as bacteria by their small dimensions, putting many of them beyond the limit of clear visibility by the highest powers of the microscope, and allowing them to pass through filters fine enough to retain the smallest ordinary bacteria; and by the fact that they cannot be cultivated on ordinary, non-living media. The work of Pasteur and Koch initiated an epoch of investigation on the relation of visible bacteria to different infections, so that the first clear recognition of the existence of ultramicroscopic and filterable infective agents came only in the last decade of the nineteenth century, and the present century has seen the rapid progress of investigations on their nature. The viruses first recognised—those of mosaic tobacco disease and the foot-and-mouth disease—are still far beyond the range of the most advanced microscopical methods, and, if studied by themselves, might still be regarded as living contagious principles in solution. A large number of diseases of man, animals and plants are now known to be due to infection by viruses, and methods now available have shown that the infective units of the different recognised viruses cover a wide range of dimensions.

Ordinary bacterial filters only indicate that the sizes of the infective units of viruses are below a certain maximum. Ordinary microscopical methods may show that the particles of a particular virus are beyond the range of resolution, or that it contains particles which can be brought just into the range of visibility (about 0·2 μ) when loaded with a dye. Neither of these methods, however, enables the natural sizes of the units of different viruses to be determined for comparison.

Conventional microscopical methods revealed the association between infection with certain viruses and the appearance in the infected cells of the relatively large structures termed 'inclusion bodies'. These could not represent the virus in the form in which it passes a bacteriological filter. In 1904, however, Borrel described extremely minute bodies in suitably stained films from the juice of tissues infected with fowl-pox, and similar 'elementary corpuscles' were later found in material from vaccinia (by Paschen) and from *Molluscum contagiosum*. The important discovery was made in recent years (Goodpasture) that the large 'inclusion bodies' consist of 'elementary corpuscles' closely packed in a structureless matrix, and that a single washed inclusion body will transmit a virus infection. The evidence for identification of the elementary corpuscles as the organisms of these viruses has been strengthened by their agglutination with sera from animals immune to the corresponding virus (Ledingham).

In the absence of any possibility of testing their identity with the virus by artificial culture, there remained that of comparing the sizes of fresh, unstained elementary corpuscles from different viruses, as measured on photographs of critical microscopic images, obtained with ultra-violet rays of a suitable wave-length (Barnard), with the sizes of the infective units of the corresponding viruses, as measured by differential filtration through graded collodion membranes, of which the effective pore dimensions could be determined with sufficient accuracy (Elford). The comparison of the measurements of visible corpuscles, on one hand, and infective units on the other, has now been completed in the case of several viruses, and has shown a correspondence so satisfactory as to leave no room for doubt that the elementary corpuscles are the organisms of these viruses.

Filtration measurements of the infective units of other viruses, however, show that they are much too small to be brought within the range of any microscopical method which can be foreseen. In the case of the virus of foot-and-mouth disease, the units appear to have a diameter as small as about 10 mμ, only about twice that of the molecule of oxyhæmoglobin. The difficulty of regarding such minute particles as self-propagating organisms has given rise to the suggestion that they are toxic principles, reproduced by the perverted metabolism of cells which they infect. A similar suggestion has been made to account for the reproduction of the virus-like lysins or bacteriophages which infect bacteria. In both cases, however, such a theory seems to be incompatible with recent evidence dealing with specific immunity to such viruses.

Specific treatment of viruses is still limited to the production or re-inforcement of a naturally acquired immunity. Recent success in that direction with dog-distemper (Laidlaw and Dunkin) has aroused in some minds a hope of similar success with a human disease, such as influenza. The analogy fails, unfortunately, through lack of an animal species in which the influenza virus can be propagated and made the subject of deliberate experiment, and of evidence of a strong and lasting immunity to its attack. The facts, however, that methods for the exact study of viruses are only now becoming available, and that knowledge of their properties is of recent and rapid growth, justifies a general hope of much wider success in dealing with the diseases which they produce.

* Substance of a lecture entitled "Ultramicroscopic Organisms and the Troubles which they cause", delivered by Sir Henry Dale, Sec. R.S., at Bedford College, London, on March 1.

Geology in Great Britain

THE "Summary of Progress" of the Geological Survey of Great Britain for 1930 has been issued in the three parts that have now become customary, the first[1] being devoted to the annual reports of the Geological Survey Board and of the Director and to the routine work carried out during the year under review, while the others contain papers on subjects of special interest. Forty-four maps were published with seven English and three Scottish memoirs, some of which have already been noticed in our columns (NATURE, vol. 127, 574, April 11, 1931).

Of the Scottish memoirs, that dealing with Ardnamurchan deserves special mention. It is a work of unrivalled geological interest that will always rank as one of the greatest contributions to the

literature of Tertiary igneous activity in the British Isles. This memoir has already been individually reviewed (NATURE, 128, 619, Oct. 10, 1931). It is noteworthy that work has been resumed in the Ardnamurchan-Moidart area of the West Highland district. The survey of Unst has been completed and a summary report accompanied by a geological map is supplied by H. H. Read.

An important statement in the report of the Survey petrographer refers to the Cheviot granite: "It has been established beyond reasonable doubt that the normal Cheviot granite is a soda-rich granophyric granite almost devoid of ferromagnesian constituents, and that the so-called augite-granite owes its unusual characters to the incomplete assimilation of basic material derived from the andesitic lavas".

In Part 2[2] there are five papers on various aspects of Carboniferous geology and palæontology. Sir John Flett contributes a stimulating paper on a teschenite sill in Fife, and W. Q. Kennedy gives a critical discussion of the parent magma of the British Tertiary Province. The results of a gravitational survey over a region of magnetic anomaly in Leicestershire are recorded by W. F. P. McLintock and J. Phemister. In Part 3[3] these authors also describe a magnetic survey over the Lornty Dyke in Perthshire, while A. F. Hallimond deals with a similar survey over the Pentland Fault near Portobello. Stanley Smith continues his invaluable work on corals, describing here his investigation of certain Upper Carboniferous species from Glamorganshire. The zonal sequence of the non-marine lamellibranchs of the Upper Carboniferous of Yorkshire is dealt with by D. A. Wray and A. E. Trueman.

Discussing the correlation of the British and French Upper Coal Measures, R. Crookall concludes that our highest Coal Measures are the equivalent of the Upper Westphalian of the Continent. Bernard Smith gives records of a suite of borings through the glacial drifts of the northern part of the Isle of Man. Sir John Flett returns to the problems of differentiation presented by teschenite-picrite sills, dealing here with a sill encountered in a boring at Blackness on the south shore of the Firth of Forth. The petrography and stratigraphical position (Caradocian) of the keratophyric lavas of the Tweed valley in Peeblesshire are described by R. J. A. Eckford, M. Richie and D. Balsillie. In an important paper on a carbonate rock associated with cromaltite in the Loch Borrolan laccolith, J. Phemister reaches the conclusion that the so-called limestone is not of sedimentary origin, but represents a carbonated ultrabasic rock; the demonstration removes the only piece of direct evidence which has been advanced in favour of assimilation of limestone in this alkali intrusion.

The memoir on the Whitehaven and Workington district[4] covers part of the western fringe of the Lake District and the lowland mining and agricultural areas extending to the Solway Firth and the Irish Sea (Sheet 28). The region owes its economic importance to its wealth of coal and iron ore lying close to the seaboard. The memoir is the first complete description of the area to be published, and in view of the great variety of geological formations and tectonic episodes, it constitutes a noteworthy contribution to British geology. Many problems of general interest are discussed. The Skiddaw slates are found to have closer analogies with the Levis shales of Quebec than with their equivalents in Wales and Shropshire. The Ennerdale granophyre is shown to be a stock rather than a laccolith and to be of probably Caledonian age. Seven chapters are devoted to the Carboniferous formations. A very large number of shaft and boring sections have been examined and surface mapping has been supplemented on an unusual scale by observations underground. The red Permo-Triassic beds present many fascinating problems. There is a remarkably full sequence of glacial deposits, three episodes, each comprising an advance and retreat of the ice, having been established. The second glaciation, due to combined Lake District and Scottish ice, has left a widespread record of powerful erosion, ground moraine and drumlins, eskers, kames, deltas and overflow channels. Other chapters deal with recent deposits and economic products, and special mention must be made of a masterly chapter on the structure of the district.

The Brampton district[5], portrayed on Sheet 18, is an attractive area stretching east from Carlisle to near Haltwhistle, which includes parts of the Alston block, Tyne gap, Edenside and the Carlisle plain. The rugged crags of the Whin Sill, surmounted eastward from Greenhead by the Roman Wall, are of interest both to geologists and archæologists. The Carboniferous rocks naturally claim most attention and they are of special importance in forming a link between Northumberland and West Cumberland. Although the Midgeholm coalfield is now almost exhausted, appreciable reserves of the Little Limestone coal still exist. A noteworthy account of the rhythmic cycle of deposition characteristic of the Yoredale Series is given. In the New Red Sandstone Series of the western half of the district the only mineral of value is the gypsum used for plaster making. Glacial drifts mask the outcrops of the solid rocks over widespread stretches, and the chapters that deal with the waxing and waning of the glaciers and with the development of the river systems are of more than usual interest.

The Manchester memoir[6] is descriptive of Sheet 85, which covers an area extending west to Tyldesley, north to Bolton, Bury and Rochdale, and east to Oldham and Hyde at the foot of the Pennines. It thus embraces much of the highly industrialised area of South Lancashire. Although the region has been heavily exploited in the past, there are still considerable resources of coal within easy reach. Apart from chapters on the Permo-Triassic rocks, tectonics and glacial geology, the memoir is almost wholly devoted to the stratigraphy, palæontology, structure, and economics of the Coal Measures. Investigation of fossil bands which mark important horizons has been extended over the whole field, and wherever exposures are available has afforded a more exact correlation of coal seams than has hitherto been practicable. The important fossils from each horizon are figured so that their recognition in newly exploited areas should not be difficult.

The official descriptions of the geology of the Scottish Highlands north of Inverness are completed with the publication of the memoir on central Sutherland[7]. An area of nearly nine hundred square miles, mapped on Sheets 108 and 109 of the geological map of Scotland, is covered. The region includes the peaks of Ben More Assynt, Ben Loyal, the Griams, Morven and Scaraben and is very thinly populated, being mainly devoted to deer forest and shootings. Geologically, however, it is of great interest since all the great formations of the Northern Highlands fall within its limits. The opening chapters

describe the scenery and physical features and summarise the geology. Short chapters dealing with the Lewisian, Torridonian and Cambrian on the west and with the Old Red Sandstone and Jurassic on the east link up the memoir to those already issued. The main features, however, are the descriptions of the vast spread of Moine rocks, of the gneisses of Lewisian type that occur as apparently integral parts of the Moine Series, and of the great masses of granite that have veined and permeated the Moine, producing great injection-complexes that are of outstanding petrographic significance.

A series of memoirs is to be published under the general title: "Economic Geology of the Fife Coalfields". The first of these[8] to appear deals with the western part of the county, around Dunfermline, and includes the important coal-mining districts of Valleyfield, Blairhall, Tounhill, Saline and Blairenbathie. The introductory chapter provides a summary of the geology and a brief account of the physical features and of the Old Red Sandstone rocks of the district. This is followed by detailed descriptions of the Calciferous Sandstone and Carboniferous Limestone Series, and special attention is given to the important coalfields of Limestone Coal Group age. The structure is very complicated, as there are many faults, intrusions of igneous rocks, and locally, considerable thicknesses of volcanic ash. To aid in the elucidation of the relations, more than 1,600 boring records have been collected and annotated. Later chapters deal with the superficial deposits and with such economic materials as building stone, road metal and fireclay. The memoir includes a map and a glossary of mining terms.

The memoir devoted to chemical analyses[9] is the outcome of a generally expressed desire that the great number of chemical analyses of British rocks and minerals made by the Geological Survey should be collected and classified, and published in a separate volume. Analyses of igneous and metamorphic rocks and isolated minerals to the number of 611 have been dealt with. They have been brought together from Survey memoirs and other official publications, and additional analyses, hitherto unpublished, have been drawn from the records of the Laboratory. So far as practicable, they have been tabulated under rock-groups; each rock being named and its microscopical characters briefly described. Full details of localities are given, and reference is made in each case to the Survey map and the memoir dealing with the district concerned. The methods usually employed in the chemical analysis of rocks are indicated.

[1] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1930." Part 1. Pp. iv+92+2 plates.
[2] *Ibid.* Part 2. Pp. vi+90+9 plates. 2*s.* net.
[3] *Ibid.* Part 3. Pp. vi+92+9 plates. 2*s.* net.
[4] "Geology of the Whitehaven and Workington District (Explanation of Sheet 28)." By T. Eastwood, E. E. L. Dixon, S. E. Hollingworth, and B. Smith. Pp. xvii+304+8 plates. 6*s.* net.
[5] "Geology of the Brampton District (Explanation of Sheet 18)." By F. M. Trotter and S. E. Hollingworth. Pp. xi+223+9 plates. 5*s.* net.
[6] "Geology of Manchester and the South-east Lancashire Coalfield (Explanation of Sheet 85)." By L. H. Tonks, R. C. B. Jones, W. Lloyd, and R. L. Sherlock, with a Chapter on the Palæontology by W. B. Wright. Pp. xv+240+7 plates. 5*s.* net.
[7] "Geology of Central Sutherland (Explanation of Sheets 108 and 109)." By H. H. Read. Pp. viii+238+5 plates. 4*s.* 6*d.* net.
[8] "Economic Geology of the Fife Coalfields. Area I (Dunfermline and West Fife)." By D. Haldane and J. K. Allan, with Contributions by C. H. Dinham. Pp. viii+158+2 plates. 3*s.* 6*d.* net.
[9] "Chemical Analyses of Igneous Rocks, Metamorphic Rocks and Minerals compiled from the Records of the Geological Survey." By E. M. Guppy, with Petrological Descriptions by H. H. Thomas, and Notes on the Methods of Analysis by F. R. Ennos and R. Sutcliffe. Pp. x+166. 3*s.* 6*d.* net.
(London: H.M. Stationery Office.)

University and Educational Intelligence

EDINBURGH.—On March 2 Sir Ian Hamilton was installed as the Lord Rector, received the honorary degree of LL.D. and delivered his rectorial address, the last part of which was a plea for the control of civil air-craft. "Insist on the Disarmament Commission bringing some concrete act, in regard to the air service, home with them. If we refuse to grapple with this air problem, now in its infancy, within two or three years it will have got quite beyond human control, and then, where's all the use of your learning."

LEEDS.—Mr. A. V. Williamson, head of the Department of Geography in the University, has been elected to the newly-established readership in geography.

LONDON.—The title of reader in experimental physiology in the University of London has been conferred on Mr. H. P. Gilding, in respect of the post held by him at University College.

The following degrees have recently been conferred: D.Sc. degree in anatomy on Mr. Francis Davies, reader at King's College, for three publications on anatomy; D.Sc. degree in physiology on Mr. E. W. Fish, recognised teacher at St. Mary's Hospital Medical School, for a published work entitled "An Experimental Investigation of Enamel Dentine and the Dental Pulp" (Bale, Sons and Danielsson, Ltd., 1933); D.Sc. (Economics) degree on Hans Raj Soni (London School of Economics) for a thesis entitled "Indian Industry and its Problems" (vol. I—"Factors in Industrial Development") (Longmans, 1932).

ST. ANDREWS.—At a meeting of the University Court on March 3 it was intimated that Mr. Frank O. Salisbury has offered to paint and present to the University, a replica of his portrait of Dr. Edward Harkness, founder of the Commonwealth scholarships and the Pilgrim Trust and the benefactor of the University of St. Andrews and many other educational institutions. In addition to the original portrait (which remains in the possession of Dr. Harkness) a replica was painted by Mr. Salisbury for Harvard University. The portrait represents Dr. Harkness in the robe of the LL.D. of St. Andrews. The Court agreed to accept Mr. Salisbury's generous offer.

WALES.—The Council of University College, Cardiff, has received under the will of the late Prof. C. M. Thompson a capital sum of £5,000, the income from which is to be expended on books and periodicals relating to chemistry or certain allied branches of science.

WITH reference to the announcement made in NATURE of February 18, p. 248, of the Lady Tata Memorial scholarships for research in blood diseases, we are informed that the total number of scholarships has been increased to four, and that they are open to candidates from all nations, including India. Nominations in respect of Great Britain and the Dominions will be made by the advisory committee in London to the trustees in Bombay. Applications may be addressed to Dr. H. S. Patel, c/o Messrs. Tata Ltd., Capel House, 62 New Broad Street, London, E.C.2, to Prof. A. Vacha, Calvinstrasse 27, Berlin, N.W.40, or to the Lady Tata Memorial Trustees, c/o Messrs. Tata Sons Ltd., Bombay House, Bruce Street, Fort, Bombay.

Calendar of Nature Topics

The Débacle

March 15.—During the winter, the rivers of Canada, Russia and Siberia are firmly frozen, and the break-up of the ice in spring is an imposing phenomenon, which is termed the 'Débacle'. In southern Canada and southern Russia it begins about the middle of March, but is progressively later in higher latitudes, not coming until May or even, in the extreme north of Siberia, not until June. It lasts from a fortnight to six weeks, during which time the drifting ice masses often form jams, blocking the rivers and causing floods. In the northward flowing rivers of Siberia, in which the upper courses melt first and pour their waters over the still frozen lower reaches, this process is accentuated, and the whole country becomes impassable; Irkutsk, for example, is isolated for a month in May.

Manuring of Grass-Land

In the "Farmer's Kalendar" written by Arthur Young in 1771, we find the top-dressing of grass land set down as a suitable operation for February. The manures that he recommends for this purpose are distinctly nitrogenous and he says, "some of them, particularly soot and malt dust, will show themselves the first heavy showers, in a finer green than the rest of the field; but your proof of it does not arise from fine greens but weight of hay".

More than a century and a half afterwards, the use of quick-acting nitrogenous artificials is now gradually coming into grass-land management as a means of obtaining this vigour which the older writers had observed. Careful work on the effect of early nitrogen on pasture has shown that more rapid growth of grass takes place in spring and the herbage is of particularly high feeding value if grazed while it is still young. In regard to nitrogenous manures, we are more favourably placed than farmers in the last years of the eighteenth century.

We now have available unlimited supplies of active nitrogen compounds at unusually cheap prices, and modern practice exploits their crop-producing power to the full. Owing to the greater activity of present-day nitrates and ammonium salts, as compared with the organic sources of nitrogen on which Arthur Young and his contemporaries had to rely, the time of application to grass-land is now somewhat later than formerly and much of the nitrogen used for the 'early bite' goes on the land in March.

Return of the Gannets

Generally about the end of February or the beginning of March, the gannets (*Sula bassana*) make an appearance at the Bass Rock in the Firth of Forth, from which Linnæus named them, after their short winter absence on the high seas. Exceptionally early returns have taken place in the second week of January. Early in April the first eggs will be laid, and very soon thereafter the whole breeding colony of more than eight thousand individuals will be in full activity. A census made in 1929 revealed the presence of 4,047 nests, and adding to the nesting pairs the numbers of birds which were nestless on account of the destruction of their eggs by herring gulls, the adult breeding gannets of that year numbered 8,294 individuals. In addition, there was an unestimated group of immature and other non-breeding birds which spent most of their time at sea. The shore leave or breeding season of gannets is a generous allowance, for they remain at the Bass from March until the young are able to fly, the general departure taking place in October; but often a rearguard remains to convoy the last fledged of the young, so that in 1929, four hundred birds still hung about the Rock in early November and the last group of about fifty left only on November 13.

Migration of Caribou in Canada

In recent years the caribou or woodland reindeer of Canada have increased in numbers, at any rate in the western part of their range, and with increasing numbers they have reappeared on their old migration routes. Great herds had been observed by Mr. W. B. H. Hoare, during his survey of the Thelon Game Sanctuary in 1928–29, to congregate during the winter in the neighbourhood of Great Slave Lake and Artillery Lake. Early in March a distinct migration northwards began. The moving herds assumed a wedge-shaped formation, the thin edge leading, and during the six weeks which they occupied in passing a particular place, the wedge expanded from a few hundred yards in width to an army which extended from Artillery Lake to Thelon River.

The order of precedence was definite: the wedge tip consisted of a narrow column of old bulls, and during the first two weeks nothing but bulls appeared in the widening phalanx. Then followed two weeks when bulls and cows were about equal in numbers, and the final two weeks saw cows and yearlings make up practically all the remainder of the herd. The migration was a slow movement in extended order, for the animals fed as they marched. During these winter movements the cows travel farther than the bulls, penetrating, towards the south, the fringe of the timber lands, and towards the north passing on to the safe areas selected for fawning. So that the bulls may be said to confine their wanderings to the central part of the caribou range, whereas the cows, starting in the rear of the migration, soon overtake the bulls and pass on through their ranks to the farther north.

Low Temperatures cause Mortality amongst Marine Fishes

The exceptionally protracted spell of cold weather in the early part of March 1929, which was responsible for the mortality amongst shallow-water molluscs already referred to in this Calendar (Jan. 28), also affected the inhabitants of deeper water. The heat stored by the ocean during the summer months is dissipated slowly, so that the northern sea reaches its lowest temperature in March, and in its shallower reaches in the North Sea is, therefore, particularly susceptible to unusually low air temperatures. Such an area lies off the Dutch coast, where the influence of chilled water from Continental rivers is also felt. As a consequence, the catches of bottom fish made during March and April 1929 showed an exceptionally large proportion of dead individuals. Soles seemed to have suffered most, but brill, dabs, plaice, cod and even crabs were brought up dead, and the chafed condition of the surface of their bodies showed that the mortality was not due to the operation of the trawl. Although the earlier reports came from the area off the coast of Holland, similar conditions were found to exist in limited areas to the east and west of the main region, so that in all an area about 200 miles long and 50 miles broad was affected to some extent.

J. R. Lumley and G. T. Atkinson showed that the hydrographical conditions were exceptional, for although the temperature of the North Sea along the shores of Scotland and northern England did not vary much from that normal for the season, the temperature of the Continental shores fell below 0° C. and considerable quantities of ice were present on the coasts of North Germany and Denmark (*Jour. du Conseil*, vol. 4, Dec. 1929). Other happenings, apparently due to the same cold spell, were the increase in the numbers of flounders caught and the presence of numbers of small sturgeon in the southern North Sea, as if they had been forced to migrate from the rivers to the sea by the intense cold.

Societies and Academies

LONDON

Royal Society, March 2. T. M. LOWRY and H. HUDSON: Optical rotatory power. (4) Rotatory dispersion of bornyl and menthyl xanthates, especially in the region of absorption. The fundamental problems of the form of the absorption bands in organic compounds, and of the relationship between absorption, circular dichroism and rotatory dispersion in optically-active compounds, are discussed on the basis of experiments made with the bornyl and menthyl xanthates and dithiourethanes prepared and studied by Tschugaeff. The experimental curves are symmetrical on a scale of wave-lengths. The ratio of the dichroism to the absorption of unpolarised light is approximately proportional to the frequency throughout the greater part of the first band, but on the side of shorter wave-lengths the circular dichroism decreases rapidly, becoming opposite in sign for three of the compounds. It is therefore suggested that the neighbouring absorption band at shorter wave-lengths is also optically active, but that its circular dichroism is opposite in sign to that of the first band. The rotatory dispersion of these compounds has also been measured in the visible and ultra-violet spectrum, including the region covered by the first absorption band. W. F. K. WYNNE-JONES: Acid strength and its dependence upon the nature of the solvent. The dissociation constants of acids in any particular solvent cannot be regarded as a measure of their real relative strengths, since it has been found by Goldschmidt and others that the order of the dissociation constants for a series of acids is dependent upon the solvent. The change in the dissociation constant of an acid on going from one solvent to another is determined partly by the relative basicities of the solvents and partly by the electrical forces between the ions. Since the effect of the former must be the same for all acids, it is proposed to eliminate it by considering not the actual dissociation constants but the constants relative to some standard size. The variations in these relative dissociation constants should then be determined by the electrical forces, and, on the basis of the Born equation, a relationship is deduced.

Physical Society, Jan. 20. SIR ARTHUR EDDINGTON: Notes on the method of least squares. In inferring the value of a physical quantity x from observations, some risk must be accepted. It is therefore presumed that the investigator has made up his mind how much risk he will take, and desires the closest possible limits—the narrowest range of values of x—that he can adopt without exceeding this risk. The aim is to furnish a concise treatment of combination of observations on this basis. Stress is laid on the fact that the method of least squares is justified without the assumption of a Gaussian error law of the observations. Most of the paper deals with quite elementary points, but it ends with a discussion of the more difficult questions which arise in inferring the mean square error of observation from the residuals. MARY BELL and S. E. GREEN: Radiometer action and the pressure of radiation. While the manner in which radiometer action diminishes as the vacuum improves was being investigated, the series of radiometer effects, recorded in the first part of this paper, was observed. Radiation was directed upon light vanes suspended by means of a fine quartz fibre in a flask for a series of vacuum conditions. In the case of a platinised glass vane, at a pressure of a few millimetres of mercury, the deflections on both the glass and the platinised sides were of the order of those registered at the highest vacua obtained. At pressures of about 10^{-2} mm. gas effects developed which were very large in the case of the glass and mica vanes but much less marked with the aluminium vane. With all the vanes, gas action had practically vanished at a pressure of 10^{-6} mm. of mercury. Measurements of radiation pressure were made by the direct method with metal vanes and a vacuum so high that radiometer action was eliminated. The maximum deflections of the suspensions were observed, and the corresponding energy-densities of the radiation were measured by a Callendar cup radio-balance. The results show that the difference between pressure and energy-density varies from + 4 to − 3 per cent. F. J. W. WHIPPLE: The wet-and-dry bulb hygrometer: the relation to theory of the experimental researches of Awbery and Griffiths. Simultaneous values have been published by Awbery and Griffiths of the dew point, of the vapour-content as determined by a gravimetric method, and of the reading of a wet-bulb thermometer, the observations covering a range of air-temperatures from 30° to 100° C. These observations have been rediscussed and it is demonstrated that August's formula by which vapour pressure is deduced from dry and wet bulb readings is valid over the experimental range of temperature. G. I. FINCH and R. W. SUTTON: The control of ignition-coil discharge characteristics. The theory of the ignition coil is developed and is verified by means of the cathode ray oscillograph. It is shown that the spark-gap voltage is constant throughout the life of the inductance component, and that the inductance-component current is oscillatory, but unidirectional. The theory leads to the conclusion, confirmed experimentally, that the closing of the primary circuit during the life of the inductance component rapidly extinguishes the secondary discharge. A contact-breaker, enabling the duration of opening of the primary circuit to be controlled with accuracy over a range between 0 and 2 m. sec., is described. P. VIGOUREUX and S. WATTS: The temperature coefficient of the Weston standard cell. The E.M.F. reached a maximum at about 3°, and at − 20° it was just over a millivolt less than the maximum. The cells behaved satisfactorily at − 16°, but at − 18° freezing took place gradually and was accompanied by a rapid decrease in E.M.F. Frozen cells resumed their normal behaviour when kept at room temperature for about a day. Cooling increased the internal resistance of the cells. An E.M.F. temperature formula valid between − 20° and + 40° is derived.

LEEDS

Philosophical and Literary Society, Dec. 6. E. C. POLLARD: The entry of the disintegrating alpha particle into the nitrogen nucleus and a general relation between heights of nuclear barriers and atomic number. Experiments on nitrogen are described which fix the height of the potential barrier at $4{\cdot}3 \times 10^6$ electron volts. There is an indication of a virtual alpha particle level at 2·2 cm. alpha particle range. The general evidence indicates that the heights of the potential barriers of the light nuclei are proportional to the atomic number. H. M. DAWSON: Ionisation of sulphuric acid. The second stage ionisation of the acid has been determined from reaction velocity data for the hydrolysis of ethyl acetate by the joint catalytic action of the hydrogen and bisulphate ions. The method is probably much more accurate than methods which are based on osmotic (freezing-point, partition) or electrical (conductivity, potential, transport) measurements. The results show that the first-stage ionisation is practically complete and that the second stage ionisation increases from 8·5 to 85 per cent when the concentration of the acid decreases from 0·1 to 0·001 mol. per litre. J. H. PRIESTLEY, LORNA I. SCOTT, and MARJORIE E. MALINS: A new method of studying cambial activity. Details are given of a new 'strip' method of studying the tissues derived from the cambium which seems to be applicable to a wide range of problems connected with radial growth. By the use of this method during 1932, the view that cambial activity recommences in the opening buds and thence spreads basipetally over the old wood of branches and trunk, has been confirmed in the case of some thirty species of hardwoods and six species of softwoods. (See NATURE, 130, 494, Oct. 1, 1932.) GEORGE COCKERHAM: Variations in the total nitrogen content of normal and leaf-roll potatoes. A preliminary study of diurnal variations in the total nitrogen content of the leaves (laminæ and petioles) of normal and leaf-roll potato plants with a note on the distribution of total nitrogen in normal and virus infected tubers.

PARIS

Academy of Sciences, Jan. 23 (*C.R.* 196, 225–304). CHARLES NICOLLE, J. LAIGRET and P. GIROUD: The passage of the virus of exanthematic fevers by the digestive canal in the rat. Experiments were made with three types of virus: the virus was found to be capable of traversing the wall of the alimentary canal of rats. FRANCESCO SEVERI: Some new theorems in algebraic geometry. V. LALAN: The affine signification of the pseudo-arc and of the pseudo-curvature of minimal curves. C. POPOVICI: The necessity of introducing a new idea concerning the discontinuity. GEORGES GIRAUD: Correction to a recent communication. ARNAUD DENJOY: The calculation of the coefficients of trigonometrical series. KING-LAI HIONG: Meromorph functions of infinite order. L. ESCANDE and P. DUPIN: The similitude of transitory regimes in movements of rotation. JACQUES VALENSI: Stream lines in the flow round a cylinder of revolution with a high Reynolds number. ROBERT GIBRAT: The existence of a dangerous rotation velocity, independent of the balancing, for certain turbo-alternator groups. JACQUES WINTER: The phenomena of resonance in undulatory mechanics. COMAS SOLA: The radial velocity of some nebulæ. F. LINK: The photometric theory of eclipses of the moon. D. BARBIER: Remarks on the dynamic parallaxes of double stars. A reply to some criticisms of Finsen. H. BORDIER: The production of Merget's phenomenon by d'arsonvalisation with short waves. Merget's phenomenon, the adsorption of gas when moisture is expelled by heat, has been studied for liquids other than water: data are given for methyl alcohol, acetone and ethyl ether. P. BIQUARD: An optical method for the measurement of the absorption of ultra-sound waves by liquids. If I, I_0, are the light intensities transmitted by the cell when the ultra-sound waves are present and absent respectively, the ratio of these intensities varies linearly with the energy of the ultra-sound waves. YEU-KI-HENG: The action of aluminium salts on alkaline tartrates. CH. BEDEL: The magnetic susceptibility of ferrosilicons rich in silicon. Figures are given for twelve alloys with silicon content varying from 34·64 to 99·86 per cent. All these alloys were paramagnetic. At the composition corresponding to the compound $FeSi_2$ there was a large increase in the magnetic susceptibility. SERVIGNE: The existence of a polonium acetylacetonate. This substance was found to be soluble in warm chloroform, benzene, alcohol and acetone. In chloroform solution the substance was not sensibly ionised. From the study of the isomorphism of known acetylacetonates, the radio-element would appear to be tetravalent. MLLE. SUZANNE VEIL: The periodic precipitation of mercuric iodide. A. PERRET and R. PERROT: Contribution to the study of the cyanide-cyanamide equilibrium. Sodium cyanide was heated with chlorides of lithium, calcium, barium, strontium, magnesium, beryllium, zinc and cadmium, in presence of iron powder as catalyst, and the proportion of cyanamide determined. FRANCIS MEUNIER: The corrosion of welds of mild steel. CHARLES BARON: Carburation in internal combustion motors. P. CARRÉ and D. LIBERMANN. The reaction of thionyl chloride upon phenol. M. BACKÈS: The action of phosphorus oxychloride upon some aldehydes. J. A. MULLER and MLLE. EGLANTINE PEYTRAL: The sudden pyrogenation of ketene. Analysis of the gases obtained by rapidly passing ketene through a platinum tube at 1150° C. The hypothesis that the primary decomposition is into CO and CH_2 is consistent with the results. S. GOLDSZTAUB: The crystalline structure of sodium ferrite. L. ROYER: The orientation of crystals of organic substances depositing in contact with a mineral with ionic structure. G. FRIEDEL: Remarks on the preceding paper. MLLE. HENRIETTE ALIMEN: Important erosion of the Stampian in the Paris basin. MARCEL BADOUIN: An intentional fabrication of an engraving of a horse's hoof on granite, by means of a stone tool. Prehistoric engravings of animal's hoofs on granite rocks have been found in France and elsewhere: the author proves experimentally that such engravings can be readily made on granite with flint tools. EMILE F. TERROINE and MLLE. SIMONE VALLA: The comparative value of various protein foods in growth. The use of a protein food for young animals should not be based on the total nitrogen present, but on the proportion of the protein which can be utilised by the organism for the production of new tissue. Barley is markedly superior to wheat in this respect. P. MEZINCESCO: The utilisation of amino nitrogen by the animal organism. L. BUGNARD, P. GLEY and A. LANGEVIN: The recording and measurement of the blood pressure. The method described, based on the effect of the pressure changes on a

piezoelectric quartz crystal, gives a record of the changes in arterial pressure and also the absolute pressure. ALBERT LAMBRECHTS: The spectrographic study of phlorhizine and its derivatives. The ultra-violet absorption spectrum of phlorhizine. MAURICE PIETTRE: The flocculation in the organism of colouring matters, chemically defined artificial colloids. MLLE. H. F. M. PETTER: The structure of *Sarcina gigantea*. E. MANOUSSAKIS: A method of immunising the rabbit against dysenteric infection.

Forthcoming Events

Monday, March 13

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Capt. C. R. P. Diver: "The Physiography of South Haven Peninsula, Studland Heath, Dorset".

INSTITUTE OF INDUSTRIAL ADMINISTRATION, at 6.30—(in the Lecture Hall, Institute of Hygiene, 28, Portland Place, W.1).—A. P. M. Fleming: "Research in Relation to Industry".

Tuesday, March 14

ROYAL INSTITUTION, at 5.15.—Sir James Jeans: "Modern Astronomy" (succeeding lectures on March 21, 28 and April 4).

Wednesday, March 15

ROYAL METEOROLOGICAL SOCIETY, at 7.30—(G. J. Symons Memorial Lecture).—P. M. S. Blackett: "Cosmic Radiation".

ROYAL SOCIETY OF ARTS, at 8.—Prof. W. A. Bone: "The Chemistry of Hydrocarbon Combustion".

Thursday, March 16

CHEMICAL SOCIETY, at 8.—Discussion on "The Chemical Constitution of Oestrin" to be opened by Dr. G. F. Marrian.

Friday, March 17

PHYSICAL SOCIETY, at 5—(at the Imperial College of Science and Technology).—Annual General Meeting.

ROYAL INSTITUTION, at 9.—Prof. W. L. Bragg: "The Structure of Alloys".

Saturday, March 18

ROYAL ANTHROPOLOGICAL INSTITUTE, at 2.15—(at St. John's College, Cambridge).—Dr. L. S. B. Leakey: "Discoveries of Human Remains at Kanam and Kanjera (Kenya)".

ROYAL INSTITUTION, at 3.—Developments in Cinematography: A Display of Films, (1) Instructional Films.

Official Publications Received

GREAT BRITAIN AND IRELAND

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 72, No. 434, February. Pp. 93–188+xiv. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

The British Wood Preserving Association. Circular No. 1: The Preservative Treatment of Estate and Farm Timber. By R. C. B. Gardner. Pp. 36+2 plates. (London.) 6*d*.

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended March 31, 1932; with Report of the Director of Fuel Research. Pp. viii+96. (London: H.M. Stationery Office.) 2*s*. net.

Royal Society of Arts. Tenth Annual Competition of Industrial Designs, 1933. Pp. 32. (London.) 4*d*.

Department of Scientific and Industrial Research. Building Science Abstracts, Vol. 5 (New Series), No. 12, December. Abstracts Nos. 2169–2427. Pp. 399–529. (London: H.M. Stationery Office.) 1*s*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1476 (T. 3268): Stressless Corrosion followed by Fatigue Test to Destruction on Aluminium Crystal. By Dr. H. J. Gough and G. Forrest. Pp. 11+8 plates. 1*s*. net. No. 1483 (T. 3223): Periodic Flow behind an Airscrew. By C. N. H. Lock and D. M. Yeatman. Pp. 15+6 plates. 1*s*. net. No. 1493 (T. 3262, 3294, S. 121): Stability on the Water of a Seaplane in the Planing Condition. By W. G. A. Perring and H. Glauert. Pp. 60+4 plates. 3*s*. net. No. 1494 (T. 3291): Airflow about Aeroplanes shown by Wool-tufts. By B. Melvill Jones and J. A. G. Haslam. Pp. 12+12 plates. 1*s*. 3*d*. net. (London: H.M. Stationery Office.)

Forestry Commission. Bulletin No. 14: Forestry Practice; a Summary of Methods of establishing Forest Nurseries and Plantations with Advice on other Forestry Questions for Owners and Agents. Pp. 108. (London: H.M. Stationery Office.) 2*s*. net.

OTHER COUNTRIES

Canada: Department of Mines: Geological Survey. Economic Geology Series, No. 11: Rare-element Minerals of Canada. By H. V. Ellsworth. (No. 2314.) Pp. v+272. 40 cents. Economic Geology Series, No. 12: Manganese Deposits of Canada. By G. Hanson. (No. 2317.) Pp. v+120. 20 cents. (Ottawa: F. A. Acland.)

Canada: Department of Mines; National Museum of Canada. Bulletin No. 69 (Biological Series No. 18): Methods of Collecting and Preserving Vertebrate Animals. By R. M. Anderson. Pp. v+141. 25 cents. Bulletin No. 70: Annual Report for 1931. Pp. 119. (Ottawa: F. A. Acland.)

University of California Publications in Zoology. Vol. 38, No. 13: Postjuvenal Molt and the Appearance of Sexual Characters of Plumage in *Phainopepla nitens*. By Alden H. Miller. Pp. 425–446+plates 8–9. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 25 cents.

R. Osservatorio Astrofisico di Catania. Annuario 1933. Pp. iv+39. L'Attività del Sole nell'anno 1932. Pp. 14. (Catania.)

Merentutkimuslaitoksen Julkaisu Havsforskningsinstitutets Skrifter. No. 80: Vedenorkeusarvoja 1929 ja 1930. By S. E. Stenij. Pp. 84. 35 Fmk. No. 81: Croisière thalassologique et observations en bateaux routiers en 1931. Rédigé par Gunnar Granquist. Pp. 38. 20 Fmk. No. 82: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres Juli 1930—Juni 1931. Herausgegeben von Gunnar Granquist. Pp. 44. 25 Fmk. No. 83: Strom- und Windbeobachtungen an den Feuerschiffen in dem Jahren 1930 und 1931. By E. Palmén. Pp. 85. 35 Fmk. No. 84: Havsforskningsinstitutets vårksamhet år 1931. By Rolf Witting. Pp. 15. 10 Fmk. No. 85: Översikt av isarna vintern 1931–32. By Gunnar Granquist. Pp. 50. 35 Fmk. No. 86: Untersuchungen über gelöste Phosphate und Stickstoffverbindungen in den nordbaltischen Meeresgebieten. By Kurt Buch. Pp. 30. 20 Fmk. (Helsinki.)

Societas Scientiarum Fennica: Commentationes Physico-Mathematicæ. VI, 14: Über die Einwirkung des Windes auf die Neigung der Meeresoberfläche. By E. Palmén. Pp. 50. 15 Fmk. VI, 16: Zur Theorie der Wasserschwingungen in einem begrenzten Meeresbecken, mit besonderer Berücksichtigung des Einflusses von Luftdruck. By S. E. Stenij. Pp. 80. 30 Fmk. VI, 26: Ein selbstschreibender Apparat für Ausmessung von Mareographenkurven. By S. E. Stenij. Pp. 8. 4 Fmk. (Helsingfors: Akademische Buchhandlung.)

Proceedings of the Imperial Academy. Vol. 8, No. 10, December. Pp. xxix–xxxi+475–529. (Tokyo.)

Memoirs of the Indian Meteorological Department. Vol. 25, Part 9: On Evaporation and its Measurement. By Dr. S. K. Banerji and H. M. Wadia. Pp. iii+291–325+3 plates. (Calcutta: Government of India Central Publication Branch.) 2 rupees; 3*s*. 6*d*.

India: Meteorological Department. Scientific Notes, Vol. 5, No. 51: A Preliminary Study of Rainfall at Quetta. By A. K. Roy and R. C. Bhattacharya. Pp. 49–61. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1*s*.

Holiday Courses in Europe, 1933. Compiled by the League of Nations' Institute of Intellectual Co-operation. Pp. 60. (Paris: Institute of Intellectual Co-operation; London: George Allen and Unwin, Ltd.) 2*s*.

Royal Observatory, Hong Kong. Weather Observations from Ships (Appendix to Hong Kong Observations, 1931). By C. W. Jeffries. Pp. 41. (Hong Kong.)

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 11: Reports of Agricultural Field Officers for the Year 1931. Pp. iv+143. (Kuala Lumpur.) 50 cents.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 5, No. 1, Janvier. Pp. 48. (Prague: Regia Societas Scientiarum Bohemica.)

Państwowa Rada Ochrony Przyrody. Nr. 34: Sprawozdanie z Dzialalności Państwowej Rady Ochrony Przyrody w Roku 1932. By Prof. Dr. Wladyslaw Szafer. Pp. 15. Ochrona Przyrody: Organ Państwowej Rady Ochrony Przyrody. Rocznik 12. Pp. iv+190+4 plates. (Krakow: Państwowa Rada Ochrony Przyrody.)

Mellon Institute of Industrial Research. Bibliographic Series, Bulletin No. 3: A Select, Annotated Bibliography on the Hygienic Aspects of Aluminium and Aluminium Utensils. With a Preface by Edward R. Weidlein and an Introduction to George D. Beal. Pp. xi+80. (Pittsburgh, Pa.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 21, No. 5, December. Pp. 727–935. (Tokyo and Sendai: Maruzen Co., Ltd.)

Nyasaland Protectorate: Geological Survey. Bulletin No. 4: The Portland Cement Clays of Lake Malombe; an Account of Investigations carried out jointly by the Geological Survey and the Imperial Institute during the period 1928 to 1931. By Dr. F. Dixey. Pp. 11. (Zomba: Government Printer.)

The Journal of the Botanical Society of South Africa. Edited by R. H. Compton. Part 18, 1932. Pp. 32+4 plates. (Kirstenbosch, Newlands.)

Argeologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 1, Stuk 5–7: Studies in Native Animal Husbandry, 3: Native Milking Pails, by H. H. Curzon, A. D. Thomas and W. O. Neitz; 'N Nuwe Suid-Afrikaanse Kultuur, by Dr. Ir. E. C. N. Van Hoepen; Die Oog van die Leeu, by Dr. Ir. E. C. N. Van Hoepen. Pp. 55–64+plates 20–24. (Bloemfontein.)

Ministry of Agriculture, Egypt: Technical and Scientific Section. Bulletin No. 119: Investigations on the Wilt Disease of Egyptian Cotton caused by various Species of Fusarium. By Dr. A. Fikry. Pp. iv+106+16 plates. (Cairo: Government Press.) 10 P.T.

Columbia University Bulletin of Information. Thirty-third Series, No. 16: Announcement of Professional Courses in Optometry for the Winter and Spring Sessions, 1933–1934. Pp. 31+3 plates. (New York City.)