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Exposition and Authority.

IT is somewhat strange that during General Smuts's recent visit to Great Britain so little attention has been directed to his constructive Sidgwick Lecture on "Democracy" at Newnham College, Cambridge, two years ago, almost every word of which has been underlined by current events. "Statesmen are not enough. . . . We want to-day the scientific spirit in human affairs." "It ought to be recognised that the scientific political expert is a necessary institution in national government. Great party disputes which threaten the tranquillity of the progress of the State should be remitted to a body of experts, where personal character and reputation confer exceptional authority on them, and whose recommendations should be available as a guide for public opinion and the Government."

The constructive truth of these words is attested by most of the inquiries which have been made in Great Britain in recent years, such as that conducted by the Coal Commission in 1926, the Macmillan report, with its warning on the necessity for deliberate planning in the sphere of finance and industry, in place of undirected natural evolution, and the Report of the Committee on Industry and Trade. High authorities like Sir William Beveridge maintain that the solution of our unemployment problem is much more a matter of thought and organisation than of money. Even political leaders agree on the necessity for closing the dangerous gap between knowledge and power which seriously threatens the continuance of our civilisation, although political events provide an almost unbroken sequence of disregard for facts and scientific method.

For this position, as pointed out in recent articles in NATURE, politicians are not alone to blame. Alike in domestic and in imperial affairs the scientific community has missed repeated opportunities of active participation in the framing of national and imperial policy, and even now the efforts of the British Science Guild to assess the value of the contribution of science to our national welfare and the potentialities of science in the evolution of a better order of society are largely unsupported.

The indifference of politics to facts and its dependence on narrow prejudices are paralleled by the apathy of scientific workers themselves towards public affairs. The situation here is the very reverse of that obtaining in Soviet Russia, where, as in Italy, there is danger that political

considerations may have undue influence on the selection of candidates for a scientific post. In Great Britain a scientific worker who is concerned about the social consequences of the application of scientific discoveries, or takes any active part in public affairs, either in a civic or municipal or national sphere, is apt to find himself regarded askance by his fellow-workers, and his candidature for important professorial posts probably would not be encouraged.

This attitude alone would largely account for the political impotence of scientific workers, which is well illustrated by their inability to return to Parliament, even in a university constituency, a candidate such as Major A. G. Church, who has rendered eminent services to the cause of science in Parliament and won general respect from all parties. Scientific workers at present form merely a disunited section, even in university constituencies, and until their interest in public and professional affairs is sufficiently strong to support united and representative professional associations their political impotence is likely to continue.

Indifference to public affairs finds further expression in certain criticisms levelled against the centenary meetings of the British Association. It has been objected that attempts to provide a general interpretation of science or of scientific topics in the presidential address are misleading to the public and not representative of the views of many scientific workers. Such criticism overlooks the fundamental need for an adequate interpretation of the mission of, and place of, science in human life and affairs and the limited opportunity which at present exists for such an exposition. So few, indeed, have attempted the interpretation in terms which the general public can understand, that it seems ungenerous to criticise those who have made the attempt. The general appreciation which was given to such addresses as Sir William Bragg's on " Craftsmanship and Science " and that of General Smuts are indication enough of their value.

A further objection that the publicity achieved by the British Association would be better attained by organising a more effective service of scientific news for the Press contains a valuable suggestion, but ignores the value and appeal of such a representative gathering of scientific workers in focusing public attention. No scientific meetings throughout the year, whatever their intrinsic merit, can hope to be given anything like the share of public attention that the British Association meetings receive. A visit of an eminent foreign man of science to Great Britain commonly remains unnoticed by the Press, and few indeed are the scientific lectures which receive more than the briefest paragraph in the daily Press.

This cannot be attributed to the lack of able expositors when all allowance is made for variations in such powers. The clearest lecturer on science receives no greater share of attention than the most famous professor, who finds it difficult to lecture in terms other than those which are intelligible to advanced students alone. Nor can we blame a lack of able writers, for their opportunities are restricted by the modern insistence upon a name or sensationalism. If the ability to express the results of their researches in language which can be generally understood is not widespread among scientific workers, there are, at all events, more competent writers on science than opportunities for their expression.

The difficulty is aggravated because, even in the scientific community, comparatively few have realised the profound difference between genius for research and ease of exposition, and the need for authoritative exposition. It is rare indeed for the two powers to be combined in the one individual. The most casual reading of scientific papers or attendance at scientific lectures reveals that a man may be an outstanding authority and investigator in a particular branch of science and yet unable to give a lecture that can be understood by ordinary people, or write an article or paper which is fully intelligible even to research workers in his own field. The extent to which ' scientific ' jargon has invaded all scientific journals is itself a consequence of the general lack of expository powers among scientific workers.

The existence of jargon, which is usually an indication too of loose thinking, is a further barrier to the task of disseminating the knowledge of science in the general community, and the latter task is one which urgently demands fulfilment, if, when scientific workers are able to make representations on national or imperial policy, their representations are to receive a fair hearing. Scientific workers must realise that trained minds devoted to the exposition of the results of scientific discoveries and their application are as essential as minds devoted to the acquisition of fresh facts and discoveries themselves, and scientific workers must be prepared to recognise and honour those who devote their time to the task of exposition and interpretation.

Mischief enough has been worked in the past by relying upon lay interpreters of science. The expositor required to-day must himself have had a

scientific training, be steeped in scientific principles and methods, and able to assess facts and values, and to interpret them in language understood by the common people. His authority is derived not so much from original scientific investigations of his own as from his power of comprehending his subject, assessing values, and understanding his public. In such exposition he will require the same qualities of mind and the unswerving loyalty to truth which his brother worker requires in his laboratory researches. Exposition is an art, and the imagination of mankind will only be fully touched by the achievements of science, and man roused to a wider application of scientific method, when innumerable artists of science, great and small, in utter fidelity to truth—to science as to life—have made plain its mysteries in words understood of all.

The formidable prejudices which exist against the expositor, who is commonly confounded with the demagogue or propagandist, are found even more among scientific workers than among the general public and the Press. Carlyle's assertion is uncomfortably true of the general scientific community: "Man is and was, always . . . much readier to feel and digest, than to think and consider. Prejudice, which he pretends to hate, is his absolute lawgiver; mere use and wont everywhere leads him by the nose." The prejudice of the scientific worker against participation in public affairs, and the prejudice of public and Press against the contribution of scientific workers who are disposed to public service, are mainly responsible for the gap between knowledge and leadership and the serious lag which has already developed between our rapid scientific advance and our stationary ethical development. These are among the prejudices which endanger the continuance of civilisation and which, as Sir Arthur Keith has warned us, must be mastered as a condition of its survival. The prejudice against exposition may be only a contributory cause, which hinders the task of educating the community as to the value of the contribution of science to the progress and well-being of society and its vast latent possibilities for the evolution and planning of a more balanced order. Interpreters of the right type will never be forthcoming in sufficient numbers until scientific workers are willing to accord to them honour where honour is due and to assist them by sympathetic and not unfriendly criticism. Fundamentally, the education of public opinion in this matter is a responsibility which scientific workers cannot evade.

While the ultimate solution may be found in education, we cannot wait on that slow process alone. Already industry is showing the way, even in Great Britain, to relate leadership and knowledge; and scientific workers must address themselves not only to the task of educating public opinion on the importance of this issue, but also must increasingly show by the force of example the value of the contribution which science makes to human welfare. Through their position in industry, and through their professional organisations, scientific workers have already opportunities of bringing far greater influence to bear on public affairs if they would but forget their prejudices and unite for common action. Nor should the existing organisations be inadequate to secure that the profession of science be represented in Parliament by those competent to exercise the authority which is combined with knowledge, provided there be the will to this end. A wider use of existing opportunities by scientific workers should do much to close this gap and disarm the prejudices of the public and Press against the authority of science; and it is unlikely that any more important opportunity for publicity and service could be found than those afforded by just those representative gatherings of scientific workers among which the British Association meetings are pre-eminent.

Science and Human Experience.

Science and Human Experience. By Prof. Herbert Dingle. Pp. 141. (London: Williams and Norgate, Ltd., 1931.) 6*s*. net.

IN addition to the renowned protagonists of mathematical physics and cosmical astronomy, of whom Eddington and Jeans are the best known in Great Britain, but of whom also many others are recognised, for example, De Sitter of The Hague, Max Planck of Berlin, H. N. Russell of Princeton, E. A. Milne of Oxford, Bohr and Heisenberg of Copenhagen, not to mention other well-known names, such as R. H. Fowler, C. G. Darwin, the Thomsons, and many more, there has now arisen one who apparently is well acquainted with the work of all these geniuses, but finds it possible to differ from them in several important particulars, and with a cultivated historic sense to review the progress of physics from the days of Copernicus and Galileo to the present time. This writer is Dr. Herbert Dingle, honorary secretary of the Royal Astronomical Society, and assistant professor of astrophysics at the Imperial College, South Kensington. He has written a compact book, mainly on the philosophy of physics, but incidentally on the philosophy of science in general.

He claims to have written it, not for philosophers, who have technicalities of their own which he does not pretend to criticise, but for scientific men themselves. Naturally he deals primarily with mathematics and physics, but hopes that his treatment will be applicable and useful in all departments of science, the unity of which he thinks is far more important than their differences. For he has a

"strong conviction that the boundaries which separate the physical, biological, and psychological sciences are only temporary conveniences which will one day disappear, perhaps as completely as the boundary between chemistry and physics has already done".

He says:

"Historically, Science is a special kind of philosophy, and indeed the inquiry into the nature of Science . . . must be a metaphysical inquiry."

"The unspecialised thinker [he says] is most conscious of the activities of Science through the inroads which it makes into his æsthetic, moral, and religious ideas."

This last fact it is perhaps which has led to the almost universal interest in the great questions of cosmogony. The ordinary man

"wants to know, perhaps with mingled hope and fear, how much farther Science can go in prescribing the character of the world in which his lot is cast. He is interested to know that the universe is a bigger thing than his forefathers imagined, but he is still more interested in the question whether it is a better thing. . . . He wants to know what this Science is in itself, what power for both construction and destruction is given to it, so that he may employ it in building his own intellectual habitation on a foundation which it is powerless to undermine. It is towards the solution of this problem that in this book I shall attempt to make a preliminary contribution."

Prof. Dingle evidently thinks that science can be of use or of harm in non-scientific domains, such as those of art, criticism, and religion; and he deals with these in an illustrative kind of way in the last three chapters of the book. Apart from this, and speaking as a physicist, he says:

"The book has two purposes. . . . In the first place it proposes an interpretation of the present position of physics, which seems to me to make rational what at first sight appears fantastic. . . . The second purpose of the book is to provide, for the ordinary intelligent reader, an account of the remarkable changes in recent physical thought which have excited so much general interest. . . . The new ideas [did not arrive] as a bolt from the blue, destroying at a blow the familiar beliefs of the past. They emerged gradually from the thoughts and labours of former generations, and now that they have come to light we can recognise in them the natural blossoming of seeds of thought planted long ago."

This gradual evolution is one of the things Prof. Dingle tries to demonstrate.

Evidently the book is one that must be taken seriously. In so far as the author opposes the presentation of some of the ideas of men whom nevertheless he greatly admires, then, so long as he fully understands the meaning of their statements, he will be performing a useful and much-needed purpose; for it is quite unlikely that the new physics as generally promulgated is right in every particular; and yet there are very few who have a knowledge which renders them competent to criticise.

It is not for a reviewer to attempt to decide which side is right and which is wrong in this battle of giants: he can but direct attention to the philosophic controversy which is here raised in a well-informed and polite and far-reaching manner, with at least one example to illustrate any general statement.

The author starts off with the definition of the field or scope of science. He does not mean to exclude other branches of human knowledge from full attention; but he would exclude them from what he means and understands by 'science' in the strict sense. The definition runs thus:

"What, then, do we mean by Science? I take it to be *the recording, augmentation, and rational correlation of those elements of our experience which are actually or potentially common to all normal people*,"

and every word is evidently carefully weighed. In connexion with this definition, he emphatically contends that the experiences susceptible to scientific treatment must be 'common' experiences, not individual. He goes on to explain what he means by 'potential experiences', and also what he means by 'normal people'; this last part of the definition giving him some trouble. Some readers will protest that this definition of the term 'science' is needlessly narrow, but when interpreting the author's contentions and occasional limitations, his definition should be borne in mind.

All this is introductory to the main theme of the book, which begins with interesting quotations from Copernicus and Galileo, and then goes on to criticise the attitude of Newton. In Galileo's view, says the author, the whole of objective Nature was susceptible of mathematical interpretation; and this he likens to Sir Arthur Eddington's limitation of physical science to pointer readings and metrical qualities. It is pointed out, however, that things

which Galileo would have treated as non-metrical, and therefore of the nature of secondary qualities, were after all susceptible of measurement, as illustrated for example by Newton's treatment of colour; so that the metrical world is more comprehensive than Galileo conceived it to be. Moreover, there are many undoubted parts of science which are non-metrical.

After a criticism of Newton's philosophy, Prof. Dingle proceeds to consider the two great methods of scientific advance; one being *abstraction*, the other *hypothesis*. Physics has proceeded mainly by abstraction; biology and chemistry perhaps mainly by hypothesis. He has interesting things to say about these two methods. Abstraction proceeds mainly by subtracting from observed phenomena everything that can be regarded as non-essential; whereas hypothesis adds to observed phenomena something—it may be a guess—which is not displayed by the phenomena themselves. The atomic view of chemistry, for example, and the biological origin of species, are hypotheses. When a hypothesis is verified it becomes a *fact*, and science is enriched. There is another kind of hypothesis which can never be verified. These are serviceable for correlation, and can be justified because they do correlate a mass of phenomena. Such hypotheses may be regarded as tools, whereby facts and relations can be established. If an event is outside experience it can enter science only as a tool.

"As biologists it does not matter to us whether the higher forms of life actually emerged from the lower ones or not. The hypothesis that they did so emerge correlates our observations, as well as a conception as it would do as a reality, and we can therefore employ it so long as it continues to be of value."

Hypotheses are unverifiable when they refer to events which took place in the past, such as the origin of the solar system, for example. But they also may be unverifiable if they cannot be observed, like the formation of atoms from protons and electrons, or the whole of ultra-microscopic physics. Such hypotheses may nevertheless have a correlating value, and may thus ultimately be justified.

Prof. Dingle illustrates the introduction of hypotheses into physics by three stages—one of 1687, by Newton himself, where he opposes all hypotheses as not deducible from the phenomena; the second stage, 1796, from Laplace, where he presents the nebular hypothesis with diffidence, as one which though highly probable is not the result of observation and computation; the third is from Eddington, 1926, where he regards the macroscopic equations as 'useful tools', and the microscopic view as containing "the real truth as to what is actually occurring". Prof. Dingle, after summarising the three stages—impermissible, highly probable, the real truth,—goes on to say that the whole microscopic scheme of physics belongs to the class of events the unobservability of which is part of their essential nature, and which therefore we presume can only be regarded as a hypothesis that is used for purposes of correlation.

The second law of thermodynamics he takes as an interesting example of the parallelism between abstractions from observation and the elaborations of the atomic hypothesis. It was originally formulated as representing deductions from large-scale phenomena, from which it is an abstraction: but it has now been formulated as having complete universality of application to the hypothetical atoms.

In Chap. iv. the author takes as an "extremity of abstraction" the theory of relativity. The following quotation may serve to illustrate:

"The net result of Einstein's great theory, then, is that we can now regard the whole mechanical and electro-magnetic phenomena of Nature as a manifestation of the characteristics of one abstract medium—space-time, or ether, or whatever else we care to call it. The Newtonian conceptions of space, time, mass, gravitation, momentum, as well as energy and electric and magnetic forces, all take their places as specified peculiarities of this medium. To Newton, space and time were the stage on which the drama of forces and motions was played. To Einstein, the drama is merged into the stage; the play is the scenery. Abstraction can hardly go further. It has made the diverse phenomena of Nature into a universe, but at the expense of all individuality. The world is united, but featureless."

In Chap. v. Prof. Dingle deals with the "extremity of hypothesis", which he illustrates by the quantum theory. The emission and absorption of light are thereby 'explained' on a basis of a solar-system structure for the atom, subject to essentially arbitrary conventions.

"The electron is not something imaginable, but a pure thought-structure. It is therefore useless, and even positively harmful, to try to picture it. . . . Relativity . . . is abstracted from our experience of phenomena; it surprises us because it reveals possibilities of experience which we never contemplated. The quantum theory surprises us because it reveals *impossibilities* of experience which we never contemplated; we thought we were justified in extending to atoms the abstractions discussed in relativity, and we find that we were not."

In Chap. vi. the author deals with "Experience

and Physical Theory", or what he calls "The common-sense of it all".

We have thus summarised the first half of the book, which now begins to get very interesting for the ordinary reader. In Chap. vii. the author controverts Eddington's limitation of science to the metrical elements of phenomena; claiming that those concepts are not entitled to a monopoly of the realm of science. In the next chapter he attacks the great writers on the question of determinism, or rather indeterminism, as applied to atomic phenomena, and has some illuminating remarks on uncertainty and probability. The remaining chapters deal with "Science and Art", "Science and Criticism", "Science and Religion"; subjects of which a treatment is evidently of intense importance to all except the unduly specialised, if they are dealt with (as they are) in the light of great and competent physical knowledge. These chapters contain a wealth of illustration from literature, and are very interesting and suggestive. Whether one wholly agrees with the author or not, the book is an achievement of first-rate value. OLIVER LODGE.

Progressive Entomology.

Recent Advances in Entomology. By Dr. A. D. Imms. (The Recent Advances Series.) Pp. viii + 374. (London: J. and A. Churchill, 1931.) 12*s*. 6*d*.

IF the quantity and quality of published work is a safe criterion of the vitality of a science, entomology is showing no apparent signs of decay. On the contrary, it is displaying all the symptoms of a normal and vigorous growth. So intensively is research being prosecuted on both the pure and applied sides, that it is becoming increasingly difficult for the individual to keep himself conversant with the various advances that are being continually made. More and more the field of experimental activity is being enlarged in the search of new facts that may be utilised in man's struggle for ascendancy over the insect hordes that frequently threaten his very existence. At the same time investigation of purely morphological problems proceeds apace, unravelling the complexities of insect structure and function and shedding new light on the problems of relationship and ancestry. In the interests of further progress it is essential that the results of this vast volume of work should be submitted periodically to critical review and analysis.

For the successful accomplishment of such a task Dr. Imms would appear to be the logical choice, in that he brings to bear upon the work a mind that has been abundantly enriched, both by the diversity of his own researches and by an intimate acquaintance with the general mass of entomological literature that is wellnigh unsurpassed. No matter what the individual's attitude to the subject, entomology, may be—general student, investigator, or teacher—all will profit from the careful perusal of this book, in which the difficulties, so far from being shunned, have been courageously tackled and rendered attractive by reason of a consistently lucid exposition.

In virtue of the subject matter of the book, the account of it must necessarily be in the form of a review of reviews. The 'advances' are classified under morphology, metamorphosis, palæontology, sense organs, coloration, ecology, parasitism, and biological control. In the province of morphology the author discusses the various theories of the segmentation of the insect head, the homologies of wing-venation, and the probable derivation of metameric appendages from the biramous limbs of the higher Crustacea.

So far as metamorphosis is concerned, no satisfactory explanation of diverse larval types had materialised until Berlese emphasised the existence of three distinct embryonic phases—protopod, polypod, and oligopod—with which the principal larval types appear to conform. Larvæ emerge from the egg in different stages of morphological development. Those of holometabolous insects are hatched in a more primitive condition than the hemi-metabolous. Consequently, there supervenes a highly specialised cœnogenetic development, which demands a pupal period of quiescence, during which transformation to the adult occurs. In insects, as in other animals, ontogeny is a recapitulation of phylogeny. But it must be remembered that ontogeny is subject to abbreviation and to masking by secondary non-ancestral features.

In the field of palæontology the researches of Handlirsch and Tillyard have considerably extended our knowledge of the probable trend of evolution in the principal insect orders. It is now generally accepted that the Exopterygota arose from the Palæodictyoptera of the Upper Carboniferous. The Endopterygota, on the other hand, would appear to have a tri-radiate ancestry, the lines of which diverged into the Mecoptera, Hymenoptera, and Coleoptera. Whilst these advances are eminently satisfactory, they contribute nothing to the solution of the two main problems of insect phylogeny—(1) the origin of insects as a class, (2) the origin of insect wings. It is to be hoped that

future discoveries will provide the clue to these fundamental questions.

Chapters v. and vi. deal with the various sensory organs of insects, optic, olfactory, gustatory, tactile, and auditory, and end with an interesting discussion of the relationship of insect behaviour—chiefly reactions to chemical and photic stimuli—to applied entomology. Reflex behaviour is intimately associated with the functioning of sense receptors, which are either aggregated to form complex sense organs or diffusely distributed over the body as isolated sensillæ. Whilst the exact rôle of the latter is difficult to diagnose experimentally because of their minute size and heterogeneity, histological structure may occasionally suggest their correlation with determinate responses of the individual under specific stimulation. Both from the point of view of structure and experiment, it is not difficult to ascribe to the tympanal organs of insects an auditory function. In these, groups of sensillæ or scolopalæ are identified with a tympanum, all of which is strongly suggestive of an ear. In the scattered simple ligamentous chordotonal organs a definite tympanum is absent, but the scolopalæ are identical with those of tympanal organs. Eggers, who has studied the question meticulously, believes that the latter are 'rhythmometers', which co-ordinate and regulate intrinsic muscular movements. There is, however, no good reason why they should not also be considered as receptors of extrinsic vibrations in the surrounding medium, and they would thus be fundamentally similar to those chordotonal sensillæ that are combined to form definite organs.

The essentials of the theories of structural, pigmentary, and combination colours are excellently presented. The significance of coloration in the physiological processes of the individual tends, as the author remarks, to be relegated to the background. The subject of protective coloration has been widely discussed in entomological literature, and whilst the adherents of the theory of natural selection have invariably stressed, with no satisfactory proofs, the effect of the environment on the colour schemes of insects, they have entirely failed to realise that such a simple explanation is not readily tenable, since colour is the result of an intricate chain of chemico-physical processes within the organism.

Insect ecology and its practical application to the control of injurious species is assuming greater importance as time passes. It is generally recognised that the metabolism, behaviour, and distribution of insects are in great measure controlled by the physical factors of the environment, and the principles that have been formulated as the result of experimental methods are of considerable significance in particular cases. A notable example is that of the Hessian fly, the attacks of which in North America have been in great measure circumvented by postponing the sowing of winter wheat in the autumn until the second generation of the fly has succumbed to the operation of natural lethal factors in the environment. In England, as a result of the information acquired through the experiments of Frew concerning the oviposition habits of the gout-fly, an important pest of barley, it was found that manurial treatment of the crop so alters the relative growth of stem and ear as to effect a reduction of the number of 'critical' leaves arising above the ear. The fly is thus forced to deposit the greater proportion of its eggs on the 'non-critical' leaves below the ear, with the result that the downwardly migrating maggots miss the vulnerable ear and finally succumb at the base of the ensheathing leaves of the stem.

The important phase theory of locusts advanced in 1921 by Uvarov, which appears to be amply supported by the evidence of recent field investigations, receives due notice. Whilst the theory does not pretend to explain the periodicity of locust outbreaks, it at least sheds light on the solitary and gregarious forms of these insects and their transition one to another. The value of the theory lies in the fact that the research worker is now provided with an instrument by means of which the whole problem of locust control may be thoroughly explored. All that is now required is the provision of financial aid sufficient to establish a competent international locust research organisation as Uvarov has advocated.

In order to deal adequately with the recent extensive research activities in parasitism and biological control, the author has found it necessary to devote the last hundred pages to their consideration. Ample attention is paid to the principles of host selection, the various expressions of parasitism, such as multi-, super-, hyper-, endo-, and ecto-parasitism, the host relations of parasites, and the phenomenon of polyembryony in the Chalcidoidea-Proctotrypoidea and Vespoidea. The several aspects of biological control are fully discussed. Beginning with the introduction of *Vedalia cardinalis* into California to combat the cottony-cushion scale, the author then proceeds to describe the strenuous efforts to control the gipsy and brown-tail moths in New England, the mulberry scale in Italy, the levuana caterpillar in Fiji, and the larch sawfly in Canada, to mention but a few. Finally, due

consideration is given to the factors governing parasitic introductions, the utilisation of indigenous parasites, and the biological control of noxious weeds.

It only remains to say that typographical errors are few, that the illustrations, of which there are eighty-four, have been well chosen, and that there is both a general and an authors' index. The ample bibliographies at the end of each chapter will serve as a useful guide to the sources of further information. A. E. CAMERON.

An Encyclopædia of Scientific Agriculture.

Baillière's Encyclopædia of Scientific Agriculture. Edited by Dr. Herbert Hunter. In 2 volumes. Vol. 1 : *A-L.* Pp. xvi + 675 + plates 1-17. Vol. 2 : *M-Z.* Pp. 677-1361 + plates 18-29. (London : Baillière, Tindall and Cox, 1931.) 63*s.* net.

ABSTRACTING journals and periodic reviews of progress, by which the pure sciences meet the difficulty of the rapid growth of their literature, leave certain needs in agricultural science unsatisfied. In their applications to farming practice the various sciences become closely interdependent and, also, the scientific worker in agriculture must watch closely the alterations and advances in practical husbandry. Further, the practitioner, with science bearing ever more forcibly upon his activities, stands in need of a specially prepared presentation of its applications to his industry. An encyclopædia of scientific agriculture is thus a logical and timely enterprise in which the investigator, the teacher, the student, and the farmer are certain to be interested.

In forming a first judgment of an encyclopædia, one must be guided largely by the ideas upon which the work is based. The principle adopted has been to present the various branches of agriculture in the forms they have assumed under the influence of science. An acquaintance with the chief customary operations and the equipment of husbandry on the part of the reader has been assumed. With these ideas in mind there has been enlisted the help of an unquestionably authoritative body of contributors, nearly ninety in number. Supplementing the original articles of the contributors is a considerable body of descriptive matter arranged, like the articles themselves, alphabetically. Choice and composition of this descriptive matter must have been very difficult. Whether in some cases the editor may not have been too indulgent may perhaps be questioned ; but it is certain that his selection will prove helpful to all the types of reader he has endeavoured to serve.

A very wide range is covered by the original articles, but certain important branches of agriculture have, by design, been excluded. Livestock is the most important of these, the reason being, here, that the breeds, management, etc., have a full, up-to-date literature of their own. Poultry, however, relatively new to commercial farming in Great Britain, is covered in all its aspects by excellent articles. To exclude animal diseases was inevitable, for a popular account would not have been in keeping with the purpose of the " Encyclopædia ", while descriptions of recent advances and current problems would have unduly strained its scope. It is, perhaps, to be regretted that the important applications of physical chemistry to fungicide and spray materials has found no place.

In their writings on the soil, crop varieties, animal nutrition, fruit and vegetable crops, storage, and marketing, the contributors have assembled new knowledge for which any but the specialist would formerly have had to search through a very scattered field of publications. In not a few cases, the original articles, in addition to their value in building up the " Encyclopædia ", are distinct and welcome contributions to the literature of their subject. Certain fields have been covered in which no precise applications to practice have yet emerged but in which knowledge has made important recent advances. Drought resistance and the influence of low temperatures upon plant growth are among these special cases, the inclusion of which is a great asset to the work.

Room is found for some subjects not directly suggested by the title of the " Encyclopædia ". Thus certain legal enactments are included for the sound reason that these are based upon chemical or other scientific evidence. There is, too, a series of articles describing the agriculture of the British Dominions and of some of the Colonies. The importance of these stands out clearly in the light of recent research and, even more, of the present economic situation.

The merits of an encyclopædia, whether as to choice of matter or arrangement, can be gauged only by using it for reference in normal fashion over a considerable time. But a first inspection leads to the belief that the many interests comprised by the broad field of agriculture and its sciences will find in the " Encyclopædia of Scientific Agriculture " a ready and dependable source of help. The publishers are to be commended for the nature and magnitude of their enterprise and congratulated upon the hands to which they entrusted it.

Short Reviews.

The Journal of the Institute of Metals. Vol. 46. Edited by G. Shaw Scott. Pp. xii + 571 + 47 plates. (London: Institute of Metals, 1931.) 31*s.* 6*d.* net.

THE high reputation of the *Journal of the Institute of Metals* is worthily maintained by the latest issue. Commencing with the Autumn Lecture on "Thin Films in Relation to Corrosion Problems", by U. R. Evans, several subsequent papers deal with allied questions. The increasing use of the spectroscope in industry is shown by two contributions on this subject, which, together with the discussion upon them, represent substantial addition to our knowledge in this direction. Two further papers, both by Prof. Hanson and Mr. Slater, deal with the causes and the elimination of unsoundness in sand castings of aluminium. The profound influence of water vapour in the furnace atmospheres is most clearly demonstrated, and the importance of the conditions under which the metal is stored between the time it is first produced and that at which it is cast is emphasised. Three papers deal with the subject of the drawing of wire: two with the nature of the flow and the factors which affect it, the third with the changes of tensile strength of high conductivity copper as it is drawn down.

One of the most outstanding features of this volume is the remarkably wide range of the researches published, and few who are interested either in general metallurgy, or in specific metallurgical processes, can fail to find much of direct interest. In addition to the topics already mentioned, others dealt with include the production of copper-nickel alloys of high elastic limit, the application of electric furnaces to the manufacture and working up of the non-ferrous metals, the effects of cold-rolling and heat-treatment on alloys of lead, the ageing of duralumin, etc. The proportion of papers of practical importance is unusually high, but the purely metallographic aspects of the Institute's interests are equally well represented. If one of such papers may be selected, attention may be directed to that of J. A. Murphy on the silver-mercury diagram, which is of more than usual difficulty and merit. F. C. T.

Social Behaviour in Insects. By Dr. A. D. Imms. (Methuen's Monographs on Biological Subjects.) Pp. ix + 117. (London: Methuen and Co., Ltd., 1931.) 3*s.* 6*d.* net.

A SOCIAL system, existing in small winged or wingless insects, long before man had evolved, having its *raison d'être* in instinct and physiology rather than intelligence, yet possessing remarkable similarities to the system which man built round himself! What more fascinating study could one find in the realm of Nature than that of these six-legged creatures. Like us, they care for their young, nursing them in cradles and feeding them on the most appropriate food. They may keep armies for defence or aggression, or may turn to the peaceful pursuits of the dairy-farmer and husbandman. They even have sufficient sense of property to leave real estate to their offspring.

In this little book, Dr. Imms sets out to explain the behaviour of social insects, the basis of this behaviour in morphology, and the paths which they may be supposed to have traversed in evolution. The big majority of insects are solitary creatures, independent of each other, except for reproductive purposes. They die soon after oviposition and therefore have little opportunity to become interested in their offspring.

A striking clue to the evolution of communal life in these animals is to be found in sub-social forms where the family system is in process of establishment. Here we learn of the great significance which attaches itself to reciprocal feeding between adult and young forms, to the exploitation of flowers, and the dependence, total or partial, of caste formation and its associated polymorphism, on nutrition. How far the condition presented to us—of a vast proletariat of sterile working classes, each individual merged into the community, to which it may at any time be mercilessly sacrificed—is one to be emulated or not, the reader may decide. Many will agree with the author and "take comfort that a system of this kind is unattainable by repressive manifestations on the part of the most ruthless human dictatorship".

Forest Life and Adventures in the Malay Archipelago. By Dr. Eric Mjöberg. Translated from the Swedish by A. Barwell. Pp. 201 + 84 plates. (London: George Allen and Unwin, Ltd., 1930.) 12*s.* 6*d.* net.

ANYONE desirous of prosecuting a biological research expedition to the tropics would be well advised to read this little book, which is charmingly written and illustrated, and equally well translated. In the thirty-one chapters, "each complete in itself and requiring no further index", we read of such giants of the forest as the elephant, the rhinoceros, and the buffalo, delighting as much in the habits of them as in the exciting incidents of the hunt. The goat-antelope, living in impenetrable tracts round volcano summits and only seen once before by a white man, is described and pictured to us. We are told that though it is two-horned, it is to this animal that we must refer the mythical unicorn. Another interesting mammal is the scaly, hairless ant-eater or pangolin, which simulates death amid myriads of ants. When in their hunger and curiosity enough ants have entered beneath the scales, the pangolin shuts these down and calmly enters the nearest pool. The ants, on release, rise to the surface of the water, from whence they are skimmed by means of his sticky tongue.

Space is not available to do more than mention here such marvels of Nature as the flying frog, poisonous fish, fish which walk on land, the trilobite larvæ, 2½ inches long—neotenic females whose mates are insignificant blue-black beetles no longer than one-fifth of an inch. To the author belongs the honour of having solved this century-old enigma.

Mjöberg is as interested in the Malayan native

as he is in the flora and fauna, and it is to the friendships which he struck with these people, who are still as likely to collect human heads as camphor, that he owes much of his information.

Die Tierwelt der Nord- und Ostsee. Begründet von G. Grimpe und E. Wagler. Herausgegeben von G. Grimpe. Lieferung 18. Teil 10a: *Phyllopoda*, von Walther Rammner; Teil $10e_2$: *Isopoda genuina*, von H. F. Nierstrasz und J. H. Schuurmans Stekhoven, Jr.; Teil $10e_3$: *Anisopoda*, von H. F. Nierstrasz und J. H. Schuurmans Stekhoven, Jr.; Teil $10e_4$: *Isopoda*, Nachträge und Berichtigungen; Inhaltsübersicht. Pp. 32+77+34+5. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 13·50 gold marks.

THE present section containing the Phyllopoda and the Isopoda is a most useful addition to this series of short monographs on the various groups in the fauna of the North Sea and Baltic. There are few Cladocera in the area covered. *Podon* and *Evadne* are the only truly marine genera, *Bosmina coregoni maritima* being a variety of a freshwater species which is capable of living in the low salinity of the Baltic. The general account of these is full and well illustrated. The remainder of the section, and by far the greater portion, is taken up with the Isopoda, divided into Isopoda *genuina* and Anisopoda. Here we have abundant material in both divisions. In the first part, after very brief notes on anatomy and biology, with a table of distribution of all the species to be found in the Baltic and North Sea (81 in all), the account is a systematic one. This is extremely useful, for, with the exception of Sars' "Isopoda" in "An Account of the Crustacea of Norway", there is no work which describes and figures all the species in detail. Nearly all the illustrations are actually taken from Sars' own figures and are excellent. Parasitic species, of which there are many, are also included. The section on Anisopoda is on the same lines and equally well illustrated.

Nature in the Garden: Wild Life at our Doors. By Edward Step. In 2 volumes. (The "Come-with-Me" Books.) *Early Days to Early Summer.* Pp. x+149+31 plates. *Midsummer to Winter.* Pp. x+149+31 plates. (London and New York: Frederick Warne and Co., Ltd., 1931.) 2*s.* 6*d.* net each vol.

IT is a pleasure to pick up a work such as the late Mr. Edward Step has given us in his "Nature in the Garden". The irresistibly charming intimacy with which the author treats his subject by taking his readers on a Nature ramble around any typical English garden, whether in the town or country, will induce many to indulge in a pleasurable study of these two volumes. It is surprising what a vast amount of fact and helpful knowledge has been packed into these two small books, and after reading them through it is difficult to conceive of anyone failing to feel a greater interest in the natural history of his garden.

The numerous plates and illustrations are a great asset and show care taken over detail, besides being helpful and instructive to the reader. Without hesitation we may say that this work entirely fulfils the intention of the author, namely, to explain in simple non-technical language a few of the more obvious natural forms that appear in almost every garden. An added interest lies in the assurance given by the author that all the creatures mentioned in the pages of his two volumes were actually found by him in one or other of the gardens which he had owned from time to time.

Jungle Ways. By William B. Seabrook. Pp. 316 (32 plates). (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1931). 10*s.* 6*d.* net.

MR. SEABROOK, as he has shown in his previous writings, is keenly interested in all manifestations of magic and the occult. His visit to Africa, in fact, was largely inspired by a desire to study African magic in its native home as a result of his experience of voodoo in Hayti. His journey in French West Africa fell into four stages. He began in the Ivory Coast area among the Yafouba, an excellent district for the study of magic. He then went on to the Gueré cannibals. An interlude at Timbuctoo was followed by a visit to the Habbé cliff-dwellers. When the author was with the Yafouba he was taken under the wing of a young witch and with her assistance had an excellent opportunity of observing the working of magic in everyday life. He also witnessed a remarkable exhibition of the impaling of young girls on swords. He is no more able to offer an explanation than others who have seen similar performances elsewhere. Among the Gueré he experimented in cannibalism, and describes in some detail the appearance and preparation of the dish and his sensations before, during, and after. In the last section of the book are some striking pictures of phallic rites. The merit of the book lies in its vivid descriptions rather than in its additions to scientific knowledge.

Field Book of Ponds and Streams: an Introduction to the Life of Fresh Water. By Prof. Ann Haven Morgan. (Putnam's Nature Field Books.) Pp. xvi+448+23 plates. (New York and London: G. P. Putnam's Sons, 1930.) 15*s.* net.

A USEFUL book, well qualified to meet the needs of the naturalist anxious to learn about the many members of the flora and fauna of fresh waters. It cannot be expected that such a work could always guide to specific determinations; but often it does so, and the illustrations and descriptions of habits are so definitely to the point that the honest student may attain generic accuracy. Two chapters on varieties of habitat and methods of preserving water animals make an excellent introduction. Unfortunately for us, the book is concerned with American forms of life, and although fresh-water faunas bear a great resemblance the world over, there are groups, especially the vertebrate groups, which scarcely apply to Great Britain. A similar compact ecological treatment of our own fresh-water faunas would be a boon to students on this side of the Atlantic.

Petroleum in Australia.

SO much has been heard in the past concerning the prospects of commercial oil supply from indigenous resources of the Commonwealth, that mere mention of the subject is inclined to call forth expressions of scepticism and recollections of past disappointments. But whatever opinion may prevail in technical or financial circles at the moment, perusal of Dr. W. G. Woolnough's report of his tour of inspection of the oilfields of America and Argentina, as bearing on prospects in Australia,* is certainly worth while; if it does not convince in its object, it at least provides a most readable account of the industry in the first two countries, and a very fearless statement of the facts as regards Australia.

The dictum that "nobody but an optimist ever discovered oil" may be taken as the key-word of this report. Dr. Woolnough is clearly an optimist, but his is an optimism based on sober statement of facts, not on extravagant claims. He has toured the Americas widely and has learnt much, as everyone does who makes a similar journey, from the generous insight into the industry which is accorded the visitor. There is scarcely a single phase of the industry which is not discussed or referred to in its bearing on modern practice and tendencies throughout the oil centres of the world, and the author of this report is equally loud in his condemnation of the unsound as he is in praise of the activities which have made the American petroleum industry what it is to-day.

What seems to be needed in Australia, *pace* past efforts and all that has been written on the subject, is first of all a totally different attitude on the part of the public as a whole towards the actual prospect of finding oil. As in recurrent instances in the history of the American industry, the word petroleum has too often been interpreted in terms of stock-market activities; exploration should be unaccompanied by gambling in shares of companies, the claim of which to assets may only lie in mineral rights or prospecting rights. Exploration for oil needs money (seldom contributed from share funds), patience, up-to-date technique, and first-class initial research. Dr. Woolnough shows that Australians have a great deal to learn in the way of setting about to establish the claim that oil does indeed exist in the continent, and he is clearly impressed with the lessons that can be learnt from American operators.

In some respects it is a pity that this report has come at a time when the financial resources of the country are strained, and when economic conditions generally are against further bold enterprise to probe the question of oil prospects. While the competent geologist, weighing up his claims, may not agree with many of Dr. Woolnough's opinions in a broad way, there is no doubting the sincerity of purpose underlying his estimate of possibilities, and it would be a thousand pities if, because the moment is inopportune, his work were to be shelved and possibly forgotten. His arguments are interesting. The widespread belief that Australia is geologically too old to contain petroleum, he regards as fallacious. Equally valueless—and here we are at one with him—are the ideas that oil cannot occur commercially south of the equator, other than in tropical regions, and that "there has been a special dispensation of Providence in favour of the United States" in the matter of petroleum supplies. Again, indifferently qualified (and often incompetent) oil men drift from America into Australia, set themselves up as 'experts', from whom come some of the inaccurately worded prospectuses which have in the past misled the public. This sort of thing is checked to some extent in America by protective legislation; it should be similarly checked in the Commonwealth.

Paying tribute to the good work done in Australia in connexion with oil exploration in the past, Dr. Woolnough states quite unequivocally that nowhere does that work approximate in detail or completeness with the ordinary routine in the American oilfields. This is probably correct, but it must be borne in mind that had a really substantial oilfield been discovered in Australia, even by the 'blind stabbing' methods of the old days in the United States, such routine efficiency would have come about automatically, and comparisons would not to-day have been so unfavourable between the methods of the two countries. For what has been wanted, quite apart from a change of attitude of Government and people, has been the actual finding of a good field: in other words, the encouragement which achievement gives. Had there been a really lucky find in the past—the discovery of an oilfield of commercial magnitude comparable with any one of the unit-producing oilfields of the States during the last twenty years—the whole trend of the search for oil in the island continent would have been altered.

Another sidelight on Australian conditions may be quoted verbatim: "It cannot be too strongly insisted that absolute freedom of entry to responsible geologists makes for the most rapid and most economical development of potential oil resources, and that such entry in no way prejudices the interests of the holders of the land. The Australian system of taking up blocks of land without previous survey, and often by the process of marking them off on a map without even visiting the area, would be ludicrous were the effects less tragic." We doubt whether the annals of metalliferous mining history in the continent, wild incidents though they show, can point to more painful examples of that 'get-rich-quick' psychology which has proved so detrimental to sound oil exploration in the past.

Then there is the question of adequacy of geological maps. It is not sufficiently widely understood that in order to get the maximum amount of information of geological circumstances, thus

* The Parliament of the Commonwealth of Australia. "Report on Tour of Inspection of the Oil-Fields of the United States of America and Argentina, and on Oil Prospects in Australia." By Dr. W. G. Woolnough. Pp. 118. (Canberra: H. J. Green, 1931.) 5*s*.

to lessen cost of drilling in places foredoomed to failure, months (not days) of careful mapping are necessary. The author rightly enjoins his countrymen that there can be no "really wholesome appreciation of the seriousness of oil search" until such ideas are abandoned.

Thus it all comes down to the fact that prospects are still good, given active, honest, and modern methods. The introduction of overseas capital and technique, under proper and stringent safeguards, is urged. Petroleum will not be won by the 'gold-rush' principle, even if it exists in sufficient quantity to justify the optimism of this report, but at the same time it seems probable that unless the Government takes another hand in securing unfettered and co-ordinated research for oil in those parts of the continent where the Survey officers consider the most favourable chances to lie, then private enterprise will have to receive a considerable 'boost', either in the form of new financial resources or tempting technical information, before it will move. But when it comes, whether from national or individual impetus, the problem of oil in Australia will at least have been clarified in its main ethical and technical aspects by the publication of this excellent essay.

Infantile Anæmia and Diet.

THE appearance of a new disease always excites comment, but the disappearance of a common malady may pass without notice. Up to about twenty years ago, a type of simple anæmia, styled 'chlorosis', was prevalent among young employed women in Great Britain: it was easily cured by the administration of iron. To-day, with the improvement in the standard of life of working women, the disease appears to have vanished. Recent investigations have shown, however, that a similar type of anæmia occurs amongst infants, which also can be cured by adding iron to the diet.* The anæmia is of the so-called 'simple' or 'chlorotic' type; it is characterised by a marked reduction in the hæmoglobin percentage of the blood, without other changes.

The newborn infant is provided with a store of iron in its liver; about two-thirds of that present in the body at birth is laid down during the last three months of intra-uterine life. Thus the premature infant is born with only a small store, although the amount of iron per kilogram body weight is not much less than that found in the full-term baby. After birth the iron store is drawn upon so that by about six months of age it is no greater than in the adult liver. Milk contains little iron, cow's milk less than human: the chief sources in a diet are meat, eggs, and some green vegetables. Examination of the iron stores of newborn animals of different species has led to the conclusion that when an animal is dependent in its early life upon its mother's milk, the iron required for the formation of the hæmoglobin of its blood is supplied from a store in the liver which is laid down during the later stages of intra-uterine life, while when it is capable of fending for itself soon after birth such a store is unnecessary and is not found. The mammalian organism finds it easier to transfer iron from the mother to the child via the placenta than via the mammary glands and the milk.

A nutritional anæmia can be produced in young animals by an exclusive diet of milk, especially if the parents have been maintained on a diet deficient in iron. In the rat, this anæmia can be cured by the administration daily of small doses of iron together with copper. This observation, which appears well substantiated, may explain the contradictory results which have been reported in the treatment of experimental and infantile anæmias by administration of iron salts. This type of anæmia is not due to a vitamin deficiency, nor is it influenced by light treatment.

Dr. Mackay has examined during the past five years 1090 infants and 168 expectant and nursing mothers: the number of hæmoglobin estimations was 4811 on the infants and 315 on the mothers. Part of this work has already been published: the present report refers especially to 174 artificially fed and 230 breastfed infants and 83 mothers. The economic status of the parents of the breastfed babies was slightly better than that of the artificially fed: the fathers were usually small traders or manual workers. The infants were attending the Infant Welfare Department of the Mothers' Hospital of the Salvation Army or the Outpatient Department of the Queen's Hospital for Children. Their ages ranged from $2\frac{1}{2}$ weeks to 13 months. The artificially fed children were given dried milk with a cane sugar addition, and cod-liver oil and orange juice, up to 8 months of age: the breastfed were also given cod-liver oil and orange juice. Weaning began at about 8 months: thereafter a mixed diet was given to both groups. When iron was given to the artificially fed infants it was supplied as iron and ammonium citrate in the dried milk used ("Hemolac"), $31\frac{1}{2}$ grains being added to each pound of milk, so that an infant consuming 1 lb. of milk in the week received $4\frac{1}{2}$ grains of the salt daily. The iron salt used contained a trace of copper, and the dried milk also contained traces of copper and manganese: when mixed feeding was instituted the amount of iron and copper in the diet was considerably increased, since most foodstuffs are richer in these elements than milk. The hæmoglobin estimations were made by Haldane's method, the blood being obtained from a prick on the heel.

The hæmoglobin percentage of the untreated, artificially fed infants showed a sharp drop in the first month of life from the high birth value to about sixty-five per cent at 2-3 months old, a subsequent steady rise to 70 per cent at 5-6 months, and then a continuous drop to 65 per cent at 12

* Medical Research Council. Special Report Series, No. 157: Nutritional Anæmia in Infancy: with Special Reference to Iron Deficiency. By Helen M. M. Mackay, assisted by Lorel Goodfellow; with a Statistical Appendix by A. Bradford Hill. (London: H.M. Stationery Office, 1931.) 2s. net.

months old. The hæmoglobin curve for the breast-fed babies was similar, though running at a slightly higher level. Iron treatment of the artificially fed infants raised the hæmoglobin level from 3 months of age to about 80 per cent. Other very important observations were that iron treatment approximately halved the morbidity rate, both for diseases of the respiratory and of the gastrointestinal tract, as well as improving the rate of growth. The relatively low hæmoglobin level of the breastfed infants was not due to bacterial infections or nutritional upsets.

The hæmoglobin percentage of the mothers was 75-80, that is, somewhat below the standard for women. The administration of 10-30 grains of iron and ammonium citrate daily before confinement for one to two months had no significant effect upon the hæmoglobin level; when treatment was continued for 6 months after the birth of the infant the hæmoglobin rose about 10 per cent, as compared with a rise of 5 per cent in untreated mothers. The tendency to recovery from anæmia is thus aided by giving iron. No evidence was obtained that this treatment influenced the anæmia of the infants, but it is possible that a longer ante-natal administration might have a favourable effect. Some evidence was obtained that physical immaturity and anæmia in the mother predisposed to anæmia in the child.

Further analysis of the data showed that the greater the rate of growth after birth the more likely was anæmia to develop: babies of small birth weight grow more rapidly than those which are larger at birth, and anæmia becomes very evident about 6 months of age. The lower the birth weight also the greater is the average drop in the hæmoglobin level within the first 3 months of life. Slight infections do not appear to influence the hæmoglobin, but any severe illness which causes anæmia will hasten the onset of iron deficiency, so that iron treatment is required in the convalescence from such infections.

From the results of this research it is possible to deduce the normal hæmoglobin level in infancy as contrasted with the average level. For the first 3 months the average of the breastfed infants is considered to be the normal, thereafter that of the artificially fed babies supplied with iron. From the curve thus constructed it appears that the hæmoglobin percentage sinks from about 100 at birth to 70 at 2-3 months of age and thereafter rises to 80, this level being reached a couple of months later and being maintained until the end of the first year of life. On this standard about forty-five per cent of breastfed and fifty to seventy per cent of artificially fed infants have a hæmoglobin level ten per cent or more below the normal. The important conclusion reached is therefore that all artificially fed and many breastfed babies should be treated prophylactically with iron: for the former a medicated milk is convenient, for the latter a solution of the iron salt in water suitably flavoured can be used. By this means anæmia will be prevented and the incidence of infections will be greatly reduced.

John Mayow's Place in Chemistry.

AN interesting paper by Prof. T. S. Patterson, entitled "John Mayow in Contemporary Setting: a Contribution to the History of Respiration and Combustion", appears in vol. 15 of *Isis* (Feb.–Sept. 1931). In the course of a comprehensive and fully documented article of 93 pp., Prof. Patterson describes the results of a detailed examination of Mayow's "Tractatus duo" (1668) and "Tractatus quinque" (1674), and of contemporary works by Boyle, Hooke, Willis, Lower, Swammerdam, and other authoritative writers of the period upon the subjects of respiration and combustion.

It is evident from the character of this scholarly publication that the author has spared no effort to acclimatise himself in the scientific atmosphere of the Restoration period; so much so, that anyone who reads his critical appraisement of Mayow's work must receive his considered judgment with respect. This is to the effect that modern writers, mainly owing to their failure to go back to original sources, have (1) greatly exaggerated the resemblance of Mayow's views to our own; (2) read into his statements ideas that were not in his mind; (3) credited him with the discoveries and views of others; (4) confused his two works; (5) depended upon what has been written about him, rather than upon what he wrote. "An astonishing piece of special pleading" put forward by Yeats in 1798 is held responsible for most of the later exaggerations, and among the more recent writers who are quoted as having espoused the cause of Mayow with an unjustifiable enthusiasm are Rodwell (1874), Ramsay (1896), Gotch (1908), Gunther (1921), Singer (1928), Haldane (1929), and Dampier-Whetham (1929).

Thus, in Prof. Patterson's judgment, Mayow's "De Respiratione" is a succinct and fairly clear summary of views that had already been published by others, and in other parts of his treatises it is scarcely too much to say that the things that were true were not new, and vice versa. The following reference by Prof. Patterson to a passage from a modern historical work may be quoted as a typical criticism based upon his preceding analytical exposition of Mayow's writings:

"In practically every detail this description is entirely erroneous: at least, if we are to understand that everything here attributed to Mayow is to be regarded as having been actually discovered by him—otherwise it has little or no meaning. Mayow was not the *first* to show that a candle enclosed in a flask goes out while there is still, apparently, abundance of air; he was not the *first* to infer that air is heterogeneous; he was not the *first* to suggest the existence in air of a vital substance also to be found in nitre and nitric acid; he was not the *first* to call this substance nitro-

aerial spirit; he was by no means the *first* to show that gunpowder can burn without the assistance of air; he was not the *first* to prove—if he made the experiment at all—that the calx of a metal was heavier than the metal; he was not the *first* to show that an animal placed in a closed vessel died more quickly if a lighted candle was also placed in the vessel. It was not Mayow who *first* suggested that animals exhaust the air of some constituent necessary to life which enters the blood in breathing; and he was not the *first* to infer that this part of the air was the nitro-aerial spirit. And if he was not the first to show or suggest these things, why should he be credited with them? Moreover, he said nothing about combustion in 1669. The only statement which is *partially* correct is that Mayow attributed the increase of weight on calcination of antimony—he did not extend the suggestion to other metals—to combination with igneo-aerial particles, but, as has been shown above, this was merely the adoption of a notion already published by Boyle; and, in addition, since Mayow's idea of nitro-aerial spirit was very different indeed from our notion of oxygen, it could lead neither Mayow nor his contemporaries any way towards a comprehension of combustion and respiration. Therefore it was ignored, and quite rightly so. Mayow's so-called 'discovery of oxygen' was not forgotten; it was never made."

Prof. Patterson has done yeoman service to a cause he has at heart, by undertaking this laborious investigation with such painstaking care. His judgments are severe; but his argued conclusions are bound to impress his readers and help to reshape their conceptions of an important scientific epoch. The appearance of this critical study, long overdue, of Mayow's position among his contemporaries will therefore be welcomed by all students of historical chemistry. A serious study of original sources in this field is not free from drudgery; but we may hope that Prof. Patterson's provocative foray into the pre-phlogiston era will induce other chemical historians to burnish their weapons and take the field with (or possibly against) him. JOHN READ.

Obituary.

SIR ALFRED YARROW, BT., F.R.S.

WE much regret to announce the death, which occurred on Jan. 24, of Sir Alfred Fernandez Yarrow, the veteran marine engineer and shipbuilder. The son of a clerk in the employ of a West India merchant in the City of London, Sir Alfred Yarrow was born on Jan. 13, 1842. Evincing from his earliest years great natural ability, Yarrow attended first a small private school, and then at the age of thirteen years entered University College School, where he had Joseph Chamberlain as a schoolfellow. At the age of fifteen and a half years he was apprenticed to Miller, Ravenhill, and Salkeld, an eminent firm of marine engineers on the Thames, which had been founded by Joseph Miller in 1822 and had gained a high reputation as makers of machinery for mercantile vessels and for warships. One of the contracts completed by the firm during Yarrow's apprenticeship was the machinery for the cross-Channel steamer s.s. *Leinster*, one of four very notable craft running between Holyhead and Dublin, having a speed of eighteen knots.

On the completion of his apprenticeship, Yarrow, having with his friend Hilditch invented a steam plough, became connected with a firm of engineers of Chelmsford, and while acting as their London agent he was able in the course of two or three years to save £1000. Then in 1866, with a partner named Hedley, he set up as a builder of steam boats in a small yard on the eastern side of the Isle of Dogs, close to the Folly Inn, where it is said Charles II. used to pay clandestine visits to Nell Gwynne.

The Thames at this time was the centre of a flourishing shipbuilding industry. Below Yarrow's premises were the yards of Wigram and Green, with a history dating back to the time of Elizabeth, and the famous Thames Iron Works, while above were the establishments of Samuda, Dudgeon and Westwood, and Baillie, the last of which was taken over by Yarrow in the 'nineties and thus became the birthplace of some of our early torpedo boat destroyers. Though their first balance-sheets were not satisfactory, the tide of fortune soon turned in favour of Yarrow and his partner, and in the period 1868–75 they turned out no fewer than thirty-five steam boats. In 1875, Yarrow became the sole owner of the concern.

Just as the demand for fast sea-going vessels during the American Civil War had been a boon to the shipbuilders of the 'sixties, so the coming of the torpedo gave Yarrow and his rival, Sir John Thornycroft, whose works were higher up the river at Chiswick, their great opportunity. Beginning in 1873, Yarrow devoted himself to the design of fast steam boats for carrying torpedoes, and at a review at Spithead in 1878 two of his boats, uninvited, accompanied the Queen's yacht from Portsmouth. Though nominally a breach of etiquette, the performance of the boats led the Queen to say they had interested her more than anything else at the review. Six days later the Prince of Wales, afterwards King Edward VII., took a trip in one of them, and it was also one of Yarrow's boats that the present King commanded in 1889.

Though Yarrow's work was not confined to torpedo boats and torpedo boat destroyers, it was with these he achieved his greatest successes. The results of his work, like that of his eminent contemporaries, Thornycroft and Augustin Normand, of Havre, are written in the history of our modern navies. Fast-running reciprocating steam engines, forced draught for boilers, the well-known Yarrow water-tube boiler, superheating, balancing, the use of high tensile steel, and other matters all engaged his attention, and many of his vessels, such as H.M.S. *Hornet* and the Russian destroyer *Sokol*, created remarkable records. The *Sokol* was the first vessel in the world to steam at a speed of thirty knots. In the fifty years, 1868–1918, Yarrow turned out an aggregate of 127,000 tons and a total of 1,700,000 horse power, while his vessels placed end-

to-end would stretch a distance of thirteen and a half miles.

Economic factors having made shipbuilding on the Thames unremunerative, Yarrow in 1906 transferred his works to Scotstoun on the Clyde, and it was there that the famous river gunboats for the Tigris campaign were launched.

Of Yarrow's public work and his benefactions to the nation it is difficult to speak too highly. A member of the council of the Institution of Naval Architects from 1887, he contributed several papers to its *Transactions* and was always ready to place his valuable experience at the service of others. In 1894 he founded the Yarrow Convalescent Home for Children at Broadstairs. Some years later, at a cost of £20,000, he presented the country with the experimental tank at the National Physical Laboratory at Teddington. He was elected a fellow of the Royal Society in 1922, and in 1923, to mark his sense of the value of research, he made a gift to the Society of a sum of £100,000. In a letter accompanying the donation, Sir Alfred stressed "that the money be used to aid scientific workers by adequate payment and by the supply of apparatus or other facilities, rather than to erect costly buildings". Sir Charles Sherrington's presidential address to the Royal Society that year was devoted mainly to an account of the steps which had been taken to make the fullest use of this and other sums in hand for the benefit of research. It was decided to institute research professorships, to be awarded to workers of proved ability for independent research, and mobile both as regards the university at which they can be held and also as to subject of research. Prof. A. Fowler, professor of astrophysics in the Imperial College of Science, and Mr. G. I. Taylor, fellow and lecturer in mathematics in Trinity College, Cambridge, were appointed to Yarrow research professorships forthwith, and Prof. O. W. Richardson, professor of physics at King's College, London, in the following year. In 1926, Sir Alfred again placed scientific workers deeply in his debt by a gift of £10,000 to the British Association, to be used for general purposes, with the stipulation that it was to be expended, as to both capital and interest, within a period of twenty years. He believed that the present needs of the Association, in its work for science, should receive precedence over provision for the distant future.

With the passing of Sir Alfred Yarrow, the world has lost a great leader of industry, a pioneer of marine engineering science, and a generous benefactor of the cause of scientific study and research.

DAME BERTHA NEWALL (*née* PHILLPOTTS), D.B.E.

WE regret to record the death of Bertha Surtees Newall, more widely known under her maiden name of Phillpotts, which took place at Cambridge on Jan. 21, at the age of fifty-four years. Miss Phillpotts was the daughter of James Surtees Phillpotts, for many years headmaster of Bedford Grammar School. She entered Girton as a student, and took first-class honours in the Medieval and Modern Languages Tripos in 1901. In addition to the course laid down for her schools, she took up with enthusiasm the study of the Scandinavian languages under Mr. Eirikr Magnússon. Her College appointed her Pfeiffer student and College librarian, but she resigned in 1910 to study archæology, acting as secretary to the late Baron A. von Hügel. In 1913 she published her first book, "Kindred and Clan", and was appointed the first holder of the Lady Carlisle fellowship at Somerville College, Oxford. During the War she served as private secretary to the British Minister at Stockholm, perfecting her knowledge of Scandinavian languages and visiting Iceland six times. In 1919 she returned to take up an appointment at Westfield College in the University of London. Here she published her second and best-known book, "The Elder Edda and the Ancient Scandinavian Drama", of which the merit was immediately recognised.

In 1922, Miss Phillpotts became Mistress of Girton College, doing much valuable administrative and organising work for the College, and sitting as the only woman member on the Statutory Commission for the University of Cambridge. The strain of the work and private anxieties led to her resignation, and once more she became a student resident in Cambridge. In 1926 a generous donation of £10,000 from Sweden led to the institution of a School of Scandinavian Studies in the University, for the organisation of which Miss Phillpotts was largely responsible, and of which she was appointed director.

Miss Phillpotts had been made an O.B.E. in 1919, and was promoted to D.B.E. in 1929. She was Litt.D. of the University of Dublin. In 1931 she married Prof. H. F. Newall, professor of astrophysics in the University of Cambridge, 1909–1928.

Miss Phillpotts' published work, scholarly and erudite as it is, scarcely affords a true index of her commanding position in the field of studies she had made her own. Her profound knowledge of the languages, ancient literature, and antiquities of Scandinavia was fully recognised in the north of Europe, where she was regarded as one of the very few outstanding authorities on these subjects.

REFERRING to the death of Prof. E. S. King, on Sept. 10, which was announced in NATURE of Nov. 21, Dr. Harlow Shapley, director of the Harvard College Observatory, writes: "Prof. King was astronomer for more than forty years at the Harvard College Observatory. For many years he had been in charge of the photographic work, and had been important therefore in building up the great collection of astrophotographic plates. His own researches were largely in various fields of photometry, and his standards of stellar colour index have been internationally used for many years. In his researches on the colours of the brighter stars he directed attention to the probability that the solar system lies within a thin, nebulous envelope, perhaps only a few hundred light years in diameter, and thus he was the pioneer among the investigators who find the absorption of light in space localised in the local system."

News and Views.

Bicentenary of Gabriel Jars.

On Jan. 26 occurred the bicentenary of the birth of the eminent French mineralogist and civil engineer, Gabriel Jars, the author of "Voyages métallurgiques", which at the time of its publication was a cyclopædia of information on mining in Europe in the middle of the eighteenth century. The son of a miner, Jars was born at Lyons and became one of the earliest students of the École des Ponts et Chaussées, which had been founded in 1747 for the training of engineers for the Government service. Having gained both practical and theoretical knowledge of the art of mining, he was sent in 1757 with Duhamel du Monceau to visit the mines of Europe, with the view of the introduction of improvements into the mines of France. His first tour took him through the central countries of Europe, but afterwards he visited England and Scotland, and the Netherlands and Scandinavia. In 1768 he was admitted a member of the Paris Academy of Sciences, and he was arranging the accounts of his journeys when he suddenly died of sunstroke. His death took place at Clermont on Aug. 20, 1769, when he was only thirty-seven years of age. His brother had accompanied him on his later journeys, and to him fell the task of publishing the "Voyages métallurgiques", which appeared in three volumes during the years 1774–81.

Working-Class Conditions in Bombay.

A SOMEWHAT lurid light is thrown upon the effect of industrialism and its attendant conditions on the 'working classes' of Bombay by an analysis of certain statistics published by Dr. G. S. Ghurye and S. R. Despande in the *Indian Journal of Economics* for October. The statistics were collected by the Bombay Labour Office in co-operation with the Young Women's Christian Association with reference to infant mortality. The number of individuals from whom the particulars were compiled was 2053. The subjects of the inquiry were mainly of agricultural class origin, and mostly from the Konkan. After migration to the city they had usually kept in touch with their place of origin and visited it at least once a year. Their wages are low; they are permanently in debt; and ninety-seven per cent of them live in one-room tenements which are dark and ill-ventilated. The factory hours for mothers range from eight to ten a day. The age-range of the women workers under consideration is 15-45 years and above, the highest percentage, 23·8, lying in the age-group 21-25 years, the next, 22·8 per cent, being in the group 26-30 years. The drop in numbers above twenty-five years of age, which becomes very marked above the age of thirty years, falling to 11·3 per cent, is generally due to the return of the women workers to their place of origin, permanently incapacitated by illness.

THE average age of Bombay working women at the birth of the first child is eighteen years, the consummation of infant marriage, usually delayed until some time after puberty, taking place perhaps a little later on the whole among the workers. It is believed that in Indian women child-bearing ceases early, some considerable time before the menopause, say at about thirty-five years; but inquiry into cases where the family is evidently complete shows that in these workers it takes place at about twenty-eight years. This is supported by further data which show that the average interval between births is 2·8 years, and that the average fertility, taking women more than thirty-five years of age, is 4·4. An examination of the data in the light of these two sets of facts suggests that the figure of twenty-eight years as the close of child-bearing represents a fact and is not due to an accidental selection. The authors consider two features in these statistics disquieting, namely, the early age at which child-bearing ceases and the fertility rate, which is too low in relation to the mortality rate of Bombay city. They point out that there is a danger that the 'working class' of Bombay will fail to keep up its numbers. To others, however, it may seem that industrial and housing conditions which appear to result in the permanent disablement of a large proportion of the female population at the age of thirty or thereabouts, even taking into account the early maturity of the Indian woman, and reduces the child-bearing age by seven years, are badly in need of investigation.

Proposed International Congress of Anthropology.

CORDIAL support has been given to the suggestion that a new international congress should be organised to cover anthropology and ethnology. Such a congress would meet the need created by the strict limitation of the field covered by the new International Congress of Prehistory and Protohistoric Sciences, which is to meet for the first time in London this summer. According to a communication from Prof. J. L. Myres which appears in *Man* for January, inquiries made on behalf of the Council of the Royal Anthropological Institute have not only elicited cordial expressions of approval, but also the matter has been taken up actively in Germany by Dr. Eugen Fisher. As the result of a consultation with his colleagues, he has written recently to the Council of the Royal Anthropological Institute to express the fullest approval on behalf of all the full professors of anthropology in Germany. They express willingness to concur in any arrangements the Institute may make for the formation of an international congress on the lines laid down last May for the Congress of Prehistory. It is suggested that similar statutes and constitution should be formulated; that the congress should be organised in two sections, one for anthropology and one for ethnology; that four languages should be officially recognised for the proceedings, and that meetings should take place at intervals of four years, preferably in the year in which the International Congress of Americanists meets in Europe. Such a date would provide for an alternation with the Prehistoric Congress, which will meet in London in 1932 and, probably, in Oslo in 1936. The first meet-

ing of the Anthropological Congress would take place when the next meeting of the Americanists is held in Europe, that is, in 1934. The Council of the Royal Anthropological Institute accordingly invites the anthropologists of all countries to co-operate in forming such a congress.

Isolation of Vitamin B_1.

IN the second issue of the *Zeitschrift für Physiologische Chemie* for 1932, Prof. Windaus and his co-workers announce the isolation of the anti-neuritic vitamin B_1 in what appears to be the pure state. In 1926, Jansen and Donath reported the preparation from rice bran of a crystalline substance having the formula $C_6H_{10}ON_2$, which was believed to be the vitamin, but subsequent work, notably that of Jansen, Kinnersley, Peters, and Reader, in 1930, showed that the substance was not pure. In 1929, Windaus took up the preparation of vitamin B_1 from yeast, and in the initial stages of purification he followed well-known lines. From the neutralised raw extract he has recently prepared the gold salt, decomposed this with hydrogen sulphide, and from the filtrate isolated the picrolonate, which is dimorphous. Analysis of the picrolonate gave the surprising result that the vitamin contains sulphur as well as nitrogen: its formula is probably $C_{12}H_{17}N_3OS$. The hydrochloride was prepared; its absorption spectrum gave a maximum at 250-260 $\mu\mu$, and its potency, determined on pigeons, was 1·4-3·3 γ, as against 9 γ found by Jansen and others for the substance isolated by the original method of Jansen and Donath. Prof. Windaus states his belief that he has now isolated the pure vitamin.

Structure of the Cell Nucleus.

IN his presidential address to the Royal Microscopical Society delivered on Jan. 20, Prof. R. Ruggles Gates reviewed present knowledge regarding nuclear structure, especially in relation to genetics. On the basis partly of investigations in his own laboratory, Prof. Gates believes that the nucleolus contains two substances, one of which enters the chromosomes in prophase and leaves them in the telophase of mitosis, and that the chromosome is a double structure throughout the mitotic cycle, a split of the chromonema occurring in metaphase for separation in the following metaphase. The chromonema is derived by the union of chromosomes in prophase, and during interkinesis the chromosome is represented by a double chain of chromomeres. From the evidence of karyomeres in animal cells, the nucleus is regarded as a compound structure, and it was further suggested that the spindle is also compound, the real unit in mitosis being a chromosome with its surrounding karyolymph, which becomes transformed into spindle fibres.

PROF. GATES discussed the relation of chromomeres to genes, pointing out that we have no real knowledge of why the chromosome behaves as a unit. He suggested that the chromosomes of Protista are undifferentiated along their length, and that genic mutations have led to their gradual differentiation, with the probable result that genes are of different sizes. The gene is, however, not a representative particle but a physiological unit, the conception being necessitated both by the phenomena of crossing-over and of mutation. Each genic difference affects many or all parts of the body. Estimates indicate that the gene is of the same order of size as virus particles, and some at least cannot be composed of more than a few hundred molecules. The specific attractions which arise between chromomeres in meiosis belong to the level of organic rather than physical phenomena, and are at present wholly unexplained. Such conditions as high and low temperatures may inhibit this attraction, and genic mutations have arisen in which asynapsis occurs in one or in both sexes, leading to pollen or seed sterility. Prof. Gates stated that it is not at present clear exactly where the limitations of the gene theory lie.

The Expanding Universe.

IN his Friday evening discourse at the Royal Institution on Jan. 22, Sir Arthur Eddington discussed the expansion of the universe. Outside our own galaxy of stars there exists a vast number of external galaxies, each containing many millions of stars, which appear as nebulæ. These are to be found running away from us almost unanimously; and the farther away they are, the faster they recede. This effect has been observed up to a distance of more than a hundred million light-years; the speed there reaches 20,000 km. a sec.—as fast as an alpha particle. It looks at first as though the nebulæ must have a particular aversion to us, but it is not difficult to see that the recession is the effect of a general expansion of the universe, and is not especially aimed at us. An effect of this kind has been anticipated theoretically. Einstein's law of gravitation contains a term representing repulsive force, which is ordinarily minute and negligible; but at very great distances the repulsion becomes large and overmasters the ordinary gravitational attraction, so that very remote objects tend to scatter apart. The theory, however, does not predict the magnitude of this 'cosmical repulsion', and hitherto it has only been possible to evaluate it from direct astronomical observations of the nebulæ. Sir Arthur is convinced, however, that precisely the same cosmical term is concerned in the theory of the atom and supplies the standard which determines, for example, the radius of an atom. So that out of the theory of the atom (without any astronomical observations) we can predict the rate of recession of the nebulæ; or alternatively, astronomical observation of the distances and velocities of the nebulæ is a method of determining the masses of the electron and proton. Sir Arthur stated that, in his opinion, this astronomical phenomenon of the expanding universe is the main clue by which we can ultimately unravel the mechanism of the atom.

The Teleprinter.

SPEAKING at the annual dinner of the Insurance Institute at Birmingham on Jan 22, Sir Kingsley Wood, Postmaster-General, said that the Post Office hopes to introduce in a few months' time a tele-

printer exchange service. This system will probably be much used in the future by business firms. The new method enables letters, reports, and all kinds of messages to be type-written automatically between the offices of any two telephone subscribers, at any distance from one another. The typist in either office types the message, and it is printed simultaneously on the machine in the other's office. Both subscribers thus get a complete typed record of all the communications exchanged. The message can be sent at the speed at which the average typist works. To safeguard against wrong connexions, the sending subscriber presses the 'Who are you?' key. The distant machine at once transmits back its own exchange and number. The service will be available in London in the spring and in the provinces in the summer. Speaking of the British Industries Fair, Sir Kingsley Wood said that at the Castle Bromwich Section the Post Office would have an exhibit which would be connected with Olympia in London, so that the public could see how the system operates. The Post Office is apparently following out its new policy of advertising. We think this highly advisable, as much ill-informed criticism has recently been directed at it.

Pontifical Academy of Sciences.

AT the inaugural meeting of the eighty-fifth academic year of the Pontifical Academy of Sciences, on Dec. 20, it was reported that His Holiness Pope Pius XI., who was present at the meeting, had decided on the erection of a new hall in which the meetings could be held. After the delivery of the president's introductory address, in which the scientific activities of the past session were briefly reviewed, the awards of the assessors on the twelve papers on "Mendel's Law and Chromosomes", submitted in competition for a prize of 10,000 lire, were announced. First place has been accorded to Prof. Paolo Enriquez, of the University of Padua, while the paper of Dr. Fraser Darling, of Edinburgh, and that of Prof. Carlo Jucci are considered worthy of special mention, and are to be published at the expense of the Academy.

A NUMBER of communications were then presented to the meeting of the Pontifical Academy. In a paper on so-called embryos of a foraminifer, E. Dervieux stated that organic remains similar to those described by Prof. De Lapparent in 1925 as embryos of *Logena* have now been found in a deposit dredged from a depth of more than 2000 metres near the Balearic Islands. Inertia of space was discussed by G. Gianfranceschi, and a new Sicilian species of the genus *Amphimallus* Latr. was described by P. Luigioni. Dealing with the subject of physical space, matter, and electrons, P. Giorgi expressed the view that the equations of the new physics have reconciled the photonic and undulatory conceptions, but are not yet definitive, as they take account neither of the equality of all electrons or of all protons, nor of the difference in mass between electrons and protons, and, moreover, do not seem adequately to interpret nuclear physics. An account is given by Neviani of the skeleton of *Globicephalus melas* found some years ago near Ladispeli. In a note by G. Stein on the total lunar eclipse of Sept. 26—observed under ideal conditions at the Vatican Observatory—it is stated that the most striking feature was the appearance of the blueish luminous crescent, which showed no appreciable asymmetry with regard to the straight line joining the centre of the moon with that of the shadow. This phenomenon was also examined by M. Ananoff and referred to in NATURE of Jan. 23, p. 136. A paper entitled "Independence of Histogenesis and Organogenesis", by S. Ranzi, records interesting results connected with the development of pieces of the embryo of *Sepia*. The rock samples and fossils collected by General Nobile in Franz Joseph Land were discussed by G. De Angelis d'Ossat, and the various radiations influencing vegetable tumours were classified by Vincenzo Rivera into those which enhance and those which depress the growth of such tumours. Other communications dealt with the occurrence of *Orbitolina* in North America (A. Silvestri), Insecta orientalia (L. Navàs), the proteases of the acido-proteolytes (C. Gorini), the study of equations by an extension of Abel's problem (Scatizzi), etc.

British Museum Acquisitions.

AMONG recent acquisitions by the Zoological Department of the British Museum (Natural History) are three Norwegian beavers and a specimen of the rare squid *Stenoteuthis caroli*, about 6·5 ft. long, stranded at Scarborough. It is interesting to find that the Norwegian beaver is still holding its own. A high percentage of the squids stranded in Great Britain are found on the Yorkshire coast. The Department of Geology has recently been enriched by the presentation, through the trustees of the Vernay-Archbold Expedition, of a large series of fossils collected by Dr. Errol I. White in Madagascar during 1929. The specimens are chiefly those of the sub-fossil fauna which became extinct probably within historic times, for mention of many of the creatures, some of which are remarkable for their great size, occurs in Malagasy folk-tales. Among the interesting specimens are the remains of the extinct Giant Lemur, *Megaladapis*, which has the largest skull of any known primate, and is peculiar in lacking the front cutting-teeth (incisors) in the upper jaw. A fragment weighing 1084 gm. of the rare pallasite type of meteorite of a new find near Alice Springs, MacDonnell Ranges, Central Australia, and various minerals and rocks collected by the donor have been presented by Dr. Herbert Basedow to the Department of Minerals. A large collection of co-types of Chinese species of *Rhododendron* have been presented by the Edinburgh Botanic Garden. These were from collections made by the late Mr. George Forrest, news of whose death in Yunnan reached England only a few days ago. Miss M. Brown has presented the British herbarium of her father, Henry Brown (1824–92). The herbarium was got together mainly while Henry Brown was a pupil of Isaac Brown, of Hitchin, who was a well-known naturalist and Lord Lister's first schoolmaster.

Breeding of Touracos in England.

TOURACOS, of the species first to be made known to science (*Turacus persa*), were bred in England last year by Capt. H. S. Stokes, who gives an account of his success in the *Avicultural Magazine* for January (p. 3). The birds, which had made more than one unsuccessful attempt to breed before, hatched a young one in mid-July, which they brooded in turns, the cock taking the day shift, as with pigeons. As with these birds, too, the young was fed by regurgitation, and remained on the nest for some time; but here the resemblance ceased, for it was downy and left the nest and fed itself before it was fledged, with wing-feathers, however, developed, but showing white instead of the characteristic red on the primaries of this bird and its near allies in the touraco family. It was not until the bird was nearly full-grown that this red appeared by a gradual change in the colour of the feathers; this would seem to indicate that the characteristic copper-containing pigment, turacin, cannot be secreted by the young touraco until the demands of bodily growth have been practically met; and apropos of this red colour, it may be mentioned that in old stuffed specimens of touracos long exposed to light it becomes purple. The only species of the family bred here previously is *T. macrorhynchus*, a much less familiar bird; but it often happens in aviculture that the rarer species breed best.

Luminosity of Fire-Flies.

WE have received a communication from Mr. Edward T. Dixon, of Billy Dun, Half Way Tree, Jamaica, regarding the luminosity of fire-flies in Jamaica. He mentions having observed large numbers of a species of fire-fly emitting flashes of light in rhythmic unison, a feature, it may be added, that has been noted in other lands. In the Jamaican species the flashes were emitted at intervals of just under three seconds duration. Mr. Dixon mentions having seen half an acre or more of a grass field lit up brilliantly by the flashes of fire-flies so that the shrubs and hedges were revealed. During the intervals between the flashes nothing was visible in the prevailing darkness. Little is known regarding the phenomenon, and experimental observations with reference to the co-ordination of light emission by these insects might prove of great interest.

Centenary of the *Nautical Magazine*.

THE *Nautical Magazine* this year commemorates its centenary, and the January issue is therefore devoted mainly to a review of the progress of nautical matters during the last hundred years. The journal was founded in 1832, and edited for thirty-eight years, by Commander (afterwards Rear-Admiral) A. B. Becher, an officer who served for many years under Beaufort, the hydrographer to the Navy. The original prospectus of the magazine stated that its contents would be arranged under the four heads, hydrography, voyages, navigation, and nautical miscellany, while on his retirement Becher said that the aim of the magazine had been "to aid anything which might contribute to the seamen's benefit". Many eminent men of science have contributed to its pages. The names of Sir John Franklin, Lieut. Henry Raper, Sir W. Snow Harris, Lieut. M. F. Maury, James Glaisher, Sir William Thomson (afterwards Lord Kelvin), and Lord Brassey are all to be found among the contributors of the first half of the magazine's career, while in more recent times articles have appeared signed by distinguished officers of both the Royal Navy and the Mercantile Marine. Recognised all over the world as the magazine of the merchant service, the *Nautical Magazine* has faithfully reflected all the aspects of maritime affairs, the scope and interest of which are well illustrated by the series of articles on navigation, ships, education, meteorology, and other subjects in the centenary number.

Road Traffic Signalling.

WE learn from *Roads and Road Construction* for January that upwards of five hundred million pounds has been spent in roads and road construction during the past ten years. It is also stated that the work has neither been scientifically considered nor directed in relation to those chiefly concerned. The special aspect of road traffic signalling was considered at the Institution of Civil Engineers on Dec. 9. In opening the meeting, Major Aldington laid stress on the importance of extending the automatic signalling system to highways. This would expedite the movement of traffic and so would lead to economies. In the London area alone, £450,000 is spent annually in the provision of police to regulate the traffic at the points of intersection of roads. The provision of facilities for roundabout working and electric signalling would be a boon to drivers and would materially reduce the number of accidents. The discussion largely centred round the visual signal system adopted in Oxford Street. Some of the speakers suggested that the amber light should be regarded as the signal for pedestrians. Much was said in favour of a gyratory system being adopted in Oxford Circus. It was stated that the abolition of right-angled turns would be certain to make the traffic more fluid. It is also common knowledge that the traffic up Harewood Place, across Oxford Street, is often prevented from moving at certain times of the day, although the green lights are showing, by the crowds of pedestrians in Oxford Street. A model for the automatic control of signals at crossings was shown to the meeting, the signals being operated by the traffic.

Steam Research in Europe and America.

UNDER this title, Dr. Ing. Max Jakob last May delivered a course of four lectures under the auspices of the University of London. Constituting as they did a valuable up-to-date review of the experimental work of recent years, the lectures have been prepared for publication since being delivered, and have been printed *in extenso* in *Engineering* in eight sections during July-Dec. 1931. The first lecture dealt with the fundamental thermodynamical properties of water and steam, including the mechanical and thermometric direct measurements of pressure, temperature, and volume; the second with the calorimetric, direct measurements of sensible and latent heat contents; the third with the optical measurements by which attempts have been made to determine the specific

heat at high temperature, and the development of the steam tables in different countries, while the fourth lecture was a survey of some special problems of steam research such as evaporation, condensation, heat transfer, and heat radiation. Reference was made to the international co-operation on steam research suggested by the British Electrical and Allied Industries Research Association, while at the beginning of his lectures Dr. Jakob paid a tribute to the late Prof. H. L. Callendar, who had, he said, comprehended and mastered the whole science of thermodynamics of water and steam more fully than anyone else in the world.

Pendleton Earth-shake of Jan. 16.

AT about 12.30 A.M. on Jan. 16, slight earth-shakes were felt in the mining district around Pendleton, near Manchester. The intensity was less than usual (degree 4, Rossi-Forel scale). The disturbed area was roughly circular, about four miles in diameter, with its centre close to the line of the Irwell Valley fault, and about two miles north-west of Pendleton. There can be little, if any, doubt that the earth-shakes of this district are caused by slips along the fault due to the withdrawal of the coal or to other mining operations. The chief interest of the recent shocks is that they disturbed almost exactly the same area as one did on Feb. 27, 1899. On April 7, 1900, a similar shock occurred with its centre a short distance to the south-east, and on Nov. 25, 1905, and May 3, 1931, much stronger shocks, with their centres close to Pendleton, or nearly two miles south-east of the centre of the latest shock.

Announcements.

AT the annual general meeting of the Royal Meteorological Society on Jan. 20, the following officers were elected for 1932: *President*, Prof. S. Chapman; *Vice-Presidents*, Dr. C. E. P. Brooks, Mr. C. K. M. Douglas, Mr. J. Fairgrieve, Mr. R. G. K. Lempfert; *Secretaries*, Dr. J. Glasspoole, Mr. W. M. Witchell, Dr. A. Crichton Mitchell; *New Members of Council*, Lieut.-Com. T. R. Beatty and Mrs. C. J. P. Cave.

THE following have been elected officers of the Royal Microscopical Society for 1932: *President*, Mr. Conrad Beck; *Vice-Presidents*, Mr. A. Earland, Prof. R. Ruggles Gates, Mr. J. Rheinberg, Dr. G. S. Sansom; *Treasurer*, Mr. C. F. Hill; *Secretaries*, Mr. J. E. Barnard, Prof. R. T. Hewlett; *Hon. Librarian*, Dr. Clarence Tierney; *New Members of Council*, Prof. D. M. Blair, Mr. S. H. Browning, Mr. B. K. Johnson, Mr. A. More, Mr. J. Smiles, Mr. H. Wrighton.

THE present programmes of standard frequency transmissions on the first and third Tuesday afternoons of each month from the transmitting station 5 H.W., at the National Physical Laboratory, have now been discontinued. They will be replaced by specially modulated transmissions in accordance with a programme which will be announced at a later date. The three-monthly evening transmission on 1785 Kc/s. will be continued as at present. Particulars of this transmission can be obtained from the Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1.

AT the recent annual meeting of the Botanical Society of America, the following officers were elected for 1932: *President*, Prof. G. J. Peirce, Leland Stanford University; *Vice-President*, Prof. A. J. Eames, Cornell University; *Secretary*, Prof. S. F. Trelease, Columbia University. The following botanists were elected as corresponding members: Prof. P. A. Dangeard, The Sorbonne, Paris; Prof. Ludwig Diels, University of Berlin; Prof. H. H. Dixon, Trinity College, Dublin; Prof. K. Miyabe, Hokkaido Imperial University; and Prof. F. Oltmanns, University of Freiburg im Breisgau.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued a catalogue (No. 194) of nearly five hundred second-hand works of botanical interest, obtained chiefly from the library of the Royal Botanic Society of London. The prices asked appear very reasonable.

THE two large catalogues of chemical and physical apparatus issued by Messrs. F. E. Becker and Co. (W. and J. George, Ltd.) are well known in laboratories. This firm has now drawn up a 72-page supplementary catalogue on the same lines as the general catalogues, including only laboratory equipment made in Great Britain, and much of it in Messrs. Becker's own works. The reputation of British scientific instruments has grown rapidly in recent years and with it the range and scale of production. As a consequence Messrs. Becker are now able to state that, with the exception of furnace-made glassware, porcelain, and similar articles, they are practically independent of outside sources. The present catalogue certainly seems to include all the ordinary equipment of a laboratory.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in radiology in the University of Liverpool—The Registrar, the University, Liverpool (Jan. 31). An assistant medical officer at the Radium Institute, Manchester, for dealing largely with radium and deep X-ray cancer therapy in the Institute and Associated Hospitals—The Hon. Secretary, Radium Institute, Manchester (Feb. 2). Two mechanical engineers in the Ordnance Factories, Royal Arsenal—The Chief Superintendent of Ordnance Factories, Royal Arsenal, Woolwich, S.E.18 (Feb. 5). A biochemist at the Selly Oak Hospital, Birmingham—Dr. R. P. S. Kelman, Selly Oak Hospital, Birmingham (Feb. 10). A sub-editor of the *British Journal of Radiology*—The General Secretary, British Institute of Radiology, 32 Welbeck Street, W.1 (Feb. 20). A professor of zoology in McGill University, Montreal, Canada—The Secretary, McGill University, Montreal, Canada (April 1). A lecturer in philosophy at Exeter College, Oxford—The Rector, Exeter College, Oxford (May 14). A Dr. Robert Pollok lecturer in materia medica and therapeutics in the University of Glasgow—The Secretary, University Court, the University, Glasgow.

Letters to the Editor.

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Theories of Muscular Contraction.

SINCE Lundsgaard showed that the contractile mechanism can work without production of lactic acid and that this acid, when formed, appears mainly, perhaps entirely, after contraction is over, the one remaining important chemical change, the breakdown of phosphagen (phosphocreatine) is generally supposed to precede and cause contraction. This view, however, scarcely accounts properly for the observed behaviour of muscles poisoned with iodoacetate. In such muscles, when stimulated in nitrogen, exhaustion of the phosphagen supply brings to an end the only available exothermic reaction and the muscle fails to respond; but it does not fail to contract, *it fails to relax*, for it remains in a state of contracture ('rigor') developing a tension not far short of a maximal twitch. It seems more natural to conclude that the chemical reactions accompanying activity are primarily concerned with relaxation and occur after contraction; this is to say, they represent stages in a 'recovery process' as that term has been applied to processes in nerve.

When Fletcher and Hopkins had exploded the 'inogen' theory of contraction, it was assumed that the sequence of events must be (1) excitation, (2) an exothermic chemical reaction, (3) contraction. It was therefore supposed that in resting muscle the contractile mechanism (whatever its nature) was at zero energy potential and that the exothermic reaction 'charged up' the system to high potential, thereby producing a structure tending to be of shorter length. Relaxation was the result of dissipating the energy and returning to zero potential. The theory here suggested is the opposite and is a partial return to the 'inogen' theory. In resting muscles the contractile mechanism is supposed to be at a steady high potential, maintained by the resting metabolism. On excitation, the potential falls to zero and the muscle tends to a shorter length. It then relaxes because the contractile mechanism is recharged to its original potential by what is essentially a speeding up of chemical changes occurring the whole time. In quick moving muscles the recharging is begun by the rapid process of phosphagen breakdown; in slower muscles other slower reactions may perhaps replace the phosphagen mechanism.

The terms 'charge' and 'discharge' are intended to suggest the analogy of an electrical condenser. The contractile mechanism may well consist of longitudinally arranged and electrically polarised surfaces. If these are extensible, the repulsive forces of the electric charges will make them longer when charged than discharged. A mechanism of this sort is similar to that generally supposed to be concerned with the excitation process in nerve. However, the main point is quite independent of any particular type of physical mechanism imagined to exist in the muscle and is a matter of the time relations of the chemical reactions.

The theory here suggested, 'Charged at Rest', seems to fit the facts at least as well as the alternative 'Discharged at Rest', and in some cases better. As already mentioned, it gives a more accurate account of the phenomena of the iodoacetate muscle. It provides a function for the resting metabolism and explains why the metabolism of activity and of rest differ quantitatively rather than qualitatively. Again, it fits in better with the phenomena of the refractory period after excitation. If each excitation discharges the contractile mechanism to zero potential, a second discharge is impossible until recharging has begun, and the second discharge will be smaller than the first until the full potential is reached. On the 'Discharged at Rest' theory there is no reason to expect a refractory phase. Lastly, if, as seems likely, the initial resting state is more unstable the higher the potential, it is easy to see how some muscles can be self-exciting and others not. That is to say, the difference between heart and skeletal muscle is that in the heart the recharging process is slow (long refractory period) but tends to charge the mechanism up beyond the level at which it is stable. In skeletal muscle the recharging is rapid but never exceeds the level at which extra energy has to be provided by an external stimulus to discharge the mechanism.

A. D. RITCHIE.

Victoria University of Manchester,
Jan 8.

Inheritance of Milking Capacity.

A STUDY of the milk yields of the progeny of 728 bulls of the Red Danish breed has been made with a view to determine—first, the ability of each bull to transmit the different degrees of milking capacity; and secondly, having thus obtained an index of this ability, to determine the extent to which it was influenced by the various animals in his pedigree. The average number of daughters to each bull was 18. The figures were taken from the annual reports of the Milk Recording Societies throughout Denmark for 1918–1931. The daughters' yields were mainly calculated on the average of the first two lactations and corrected to the third lactation. The records of the dams and grandams were based on as many lactations as possible, from three to ten, and averaging 5·5. The average of these uncorrected lactations was taken as an indication of the milking capacity of the dam or grandams.

To measure the genetic aspect of the ability of bulls to transmit milking capacity, correlations were made of the average yields of the daughters of these

		Total Yield of Milk.			Total Yield of Butter-fat.		
x y	N	r	R_y^x	$\sigma y/\sigma x$	r	R_y^x	$\sigma y/\sigma x$
Bulls to Sires .	555	0·255	0·291	0·877	0·324	0·388	0·834
„ to Dams .	725	0·173	0·117	1·47	0·183	0·141	1·30
„ to Paternal G'sires .	473	0·202	0·263	0·767	0·193	0·267	0·723
„ to Maternal G'sires .	505	0·194	0·208	0·932	0·258	0·291	0·885
„ to Paternal G'dams .	721	0·026	0·018	1·45	0·061	0·055	1·10
„ to Maternal G'dams .	715	0·112	0·077	1·46	0·170	0·134	1·27

The standard error of 'r' ranges from $\pm 0{\cdot}03$ to $\pm 0{\cdot}04$.
R = Regression.
Bulls (x) mean total yield of milk = 4403 kgm., $\sigma = 440$.
„ „ „ of butter-fat = 179·64 kgm., $\sigma = 20{\cdot}48$.

bulls to the average yields of the daughters of their sires, and to the actual yields of their dams and grandams. Thus the milking capacity of the bulls (as measured by the yields of their daughters) has been correlated to the milking capacity of the sires and grandsires (similarly measured) and to the dams and grandams (as measured by actual production). These correlations are as shown in the accompanying table.

It is to be noted that the genotypes of the bulls have been compared to the *genotypes* of their male ancestors but to the *phenotypes* of their female ancestors. Hence the correlation figures to the male ancestry cannot be directly compared with those to the female ancestry.

It will be seen that as regards milk yield the paternal grandsire has an effect equal with the maternal grandsire, though as regards butter-fat yields the maternal grandsire is of slightly greater importance. This can be accounted for by the methods employed by the breeders, who for the past fifteen years have, through an intelligent appreciation of the value of the progeny test, paid almost exclusive attention to the male line. From a study of the records of the progeny of the two grandsires and the deviation of the yields of their daughters, it was found that the more highly selected bulls which appeared as paternal grandsires were distinctly more homozygous for the factors affecting the transmission of milking capacity than were the less highly selected maternal grandsires.

There is, however, a highly significant difference between the correlation figures to the two grandams. The correlation to the paternal grandam is practically nil, while that to the maternal grandam is significant.

Smith, Scott, and Fowler,[1] working with correlations of Ayrshire *cows* to their ancestors, found a significantly lower correlation to the paternal than to the maternal grandsire, and from this deduced the possibility that sex-linked factors might be involved. In the present study, the correlation to the two grandsires is approximately the same, but a difference is found between the correlations to the two grandams. The present study is of *bulls* and their ancestry. A character inherited in a sex-linked manner cannot be transmitted to a bull from his paternal grandam. (But a paternal grandam can transmit sex-linked factors to her granddaughters.) Accordingly, in the present work the test as to whether sex-linked factors are involved in the transmission of milking capacity depends on whether or not there is in this respect a difference between the correlations of the bull to his two grandams. This has been found to be the case. Thus, while from these figures it can be demonstrated that autosomal factors are concerned in the transmission of milking capacity, it is also clearly shown that this capacity is to no small extent conditioned by factors inherited in a sex-linked manner.

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[1] Smith, A. D. Buchanan, Scott, F. J., and Fowler, A. B. "The Inheritance of Milk Yield in Ayrshire Cows", *J. Dairy Research*, **1**, 174-179; 1930.

Field Studies and Physiology: a Correlation in the Field of Avian Reproduction.

ELIOT HOWARD,[1] in his classical field studies on the behaviour of the warblers, buntings, and other passerine birds, has pointed out that whereas the male has what we may call two *phases* of sexual behaviour—neuter and full male—the female has three; for she passes from the neuter phase of winter to full femaleness by way of a partly-sexed phase. During this intermediate phase she seeks out the company of a male, appears interested in various of his advances, and may construct the outer shell of one or several nests. But it is not until the fully-sexed phase that she will solicit or permit coition, or will construct a lining for a nest. The fully-sexed phase begins about 3-6 days before the first egg is laid.

Meanwhile, Riddle[2] and his associates, working with ring-doves (Peristeridæ), has found a remarkable set of physiological changes associated with ovulation in the female, and all taking their origin about four and a half days before the first egg is *ovulated* (that is, rather more before it is *laid*). The blood-sugar rises 20-25 per cent; the weight of the adrenals hypertrophies by about 40 per cent; the blood calcium rises about 100 per cent; the oviducts enlarge by about 800 per cent; the histological picture of the thyroid changes from rest to marked activity; the blood-fat goes up by about 35 per cent and its contained phosphorus by about 50 per cent; and the egg (oöcyte) itself suddenly begins to grow about twenty-five times as fast as before, and to put on yellow yolk in place of white. Doubtless general ovarian function also alters. All these changes reach their maximum at about the time of ovulation, except those involving fat and phosphorus, the maximum of which is about 2-2½ days before first ovulation.

Very similar changes occur in pigeons (Columbidæ); the change in growth-rate of the yolk of the egg occurs also in fowls and in ducks (Chomovič[3]), but here 5-8 days before ovulation.

From the facts concerning the onset of changed growth-rate of the yolk in fowls and pigeons, it is clear that the physiological change begins earlier and lasts longer in birds of a large size. In small passerines it would be presumed to begin not more than 3-4 days before ovulation or 4-5 days before laying.

It will, then, be seen that there is evidence of a striking physiological change occurring in certain female birds just about the moment in the reproductive cycle when a striking change in sexual behaviour occurs in other species: and it is, I think, legitimate to connect the two. The physiological change is, apparently, chiefly endocrine in nature, involving thyroid, adrenals, parathyroid, ovaries, and presumably pituitary. The correlated alteration in behaviour is of great interest in regard to sexual selection, for if in its absence the female will not permit coition, although the ovary is sufficiently active to induce some interest in birds of the opposite sex, we have an explanation of most of the many records where observers are puzzled by the apparent failure of male courtship-display to attain its end of stimulating the female to coition.

In any event, it seems worth while pointing out this interesting convergence of two quite independent lines of study.

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[1] Eliot Howard, "The British Warblers" (London: Poole, 1914); "Territory in Bird Life" (London: Murray, 1920); "Introduction to Bird Behaviour" (Cambridge Univ. Press, 1930).
[2] Riddle, O., references in *Amer. Philos. Soc. Proc.*, **66**, 497, 1927; *Endocrinology*, **13**, 311; 1929.
[3] Chomovic, G., *Ann. Czechoslovak Acad. Agric.*, **3** (A), 1; 1928.

Photoelectrons and Negative Ions.

PROF. WELLISH'S recent communication[1] calls for some comment, as he states that the experiments with photoelectric currents in dry air which he describes show that over the range of pressures 7 mm. to 760 mm. "the great majority of negative ions are formed in the vicinity of the electrode at which the electrons originate", a conclusion which is not in agreement with many other experiments made in Sydney and elsewhere.

Some of these experiments are described in the issue of the *Philosophical Magazine* for October 1925, p. 825, where the method used was specially designed to measure the coefficient of attachment a (Prof. Wellish denotes this quantity by λ) of electrons which move in a gas at a pressure p under a uniform electric force of intensity X.

The values of the ratio a/p with dry air then obtained have been confirmed more recently in some experiments by a method, yet unpublished, in which the nature of the photoelectric stream is examined at various distances from its source while the pressure and electric force are kept constant. With dry air and several other gases this method showed that for appropriate values of pressure and electric force the nature of the stream changes progressively with the distance from its source.

These experiments were not designed to give information about the formation of negative ions near the emitting surface, but by means of the theory and observations given in 1925 it is easy to calculate an upper limit for the ratio of the number of ions formed initially to the number formed in the gas. Such a calculation shows, for example, that this ratio is less than one in dry air at a pressure of 22·6 mm. with an electric force of 10 volts/cm. Moreover, if Prof. Wellish's conclusions be true, it would be practically impossible in any of these experiments to observe the attachment of electrons in the gas.

With regard to the evidence adduced by Prof. Wellish, it is remarkable that the curves A and B in his diagram are less consistent with his own views than with the theory that negative ions may be formed quite as notably in the gas as near the cathode. This is shown clearly in Table 1, where the observed values of the ordinates y_A, y_B (for the curves A and B respectively) for different values of the abscissa x are compared with values calculated on the two theories.

TABLE 1.

Constants adopted: mobility $k=1{\cdot}8$, $f_A=0{\cdot}5$, $f_B=0{\cdot}52$.

x.		y_A.	y_B.	a.	θ.
0·01	Observed	0·49	0·35		
	Theory of attachment	0·486	0·35	0·15	0·84
	Theory of non-attachment	0·483	0·35	0	0·67
0·02	Observed	0·45	0·22		
	Theory of attachment	0·448	0·22	0·20	0·60
	Theory of non-attachment	0·440	0·22	0	0·42
0·04	Observed	0·375	0·13		
	Theory of attachment	0·376	0·13	0·50	0·64
	Theory of non-attachment	0·344	0·13	0	0·25

TABLE 2.

X/p		0·85	0·424	0·212
$(a/p)\times10^3$	Wellish	2·5	3·4	8·5
	Bailey	2·1	3·1	—

In Table 2 a comparison is made between the values of a/p thus deduced from Prof. Wellish's experimental results and two values obtained by me in 1925, and this shows good agreement between them.

If the value adopted for the ionic mobility be 2·1, similar calculations show that the theory of attachment in the gas is still in better agreement with the above observed values of y_A and y_B than is the other, but less markedly so than is shown by Table 1.

It may then be concluded that for air pressures up to 59 mm. the formation of negative ions by attachment of electrons to molecules in the gas is no less notable a process than the formation of negative ions near the cathode.

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[1] NATURE, **128**, 547, Sept. 26, 1931.

Spectroscopic Evidence of Arsenic Hydride.

MESSRS. Kimball and Bates [1] have recently described some bands, emitted by a carbon arc, running in an atmosphere of hydrogen. The negative electrode was drilled and filled with arsenic. Because of this, the authors consider the bands to be due to AsH and As_2. I find, however, strong arguments for the bands being identical with the CH bands λ3143 A., already investigated by Fortrat [2] and Hori.[3] Even the conditions of activation, mentioned by Kimball and Bates, agree with my conclusions; namely, that the bands were missing when the arsenic was placed in the positive carbon. This can be explained by the fact that the presence of a metal in the positive carbon strongly reduces the temperature of the arc, and the activation of the CH bands is very sensitive for the temperature.

The unresolved band at 31802·6 cm.$^{-1}$ is surely identical with the Q branch in the CH band. The measurements of Fortrat are in good agreement with this, as well as with the values calculated from the formula of Kimball and Bates. In Hori's measurements a constant error appears, owing to the low dispersion used by him. Mr. T. Heimer, photographing the CH band in the second order of the 6·5 m. concave grating in this laboratory, also finds this error in Hori's measurements.

Directly repeating the experiments of Kimball and Bates, I find no signs of a band spectrum due to AsH.

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[1] NATURE, **128**, 969, Dec. 5, 1931.
[2] *C.R. Acad. Sc.*, **178**, 1272; 1924.
[3] *Z. Phys.*, **59**, 91; 1930.

The Spinning Photon and its Scattering by Molecules.

THE observed fact that a molecule in scattering light may change its state of rotation, itself conveys the suggestion that the photon has an intrinsic spin, the alternative explanation of a conversion of the linear momentum of light into the angular momentum of the molecule during the collision being *prima facie* highly improbable. The suggestion gains strength when we notice how simply the conception of the spinning photon explains both the selection rules in Raman scattering and the accompanying phenomenon of the reversal of circular polarisation. Nevertheless, to the critically minded, such considerations may fail to carry complete conviction. The reality of photon spin is, however, established [1] by quantitative studies of (1) the intensity of the lines in the rotational Raman spectra of gases, (2) the depolarisation of the Rayleigh scattering when separated from the rotational scattering. The Kramers-Heisenberg theory of dispersion as developed by Manneback [2] fails to give correct results on both of these points, while a modified theory based on the concept of the spinning photon meets with complete success.

A further test of the theory of the spinning photon is furnished by quantitative studies of the state of polarisation of the vibration lines in Raman spectra. In certain simple cases, it is possible to associate these lines with linear modes of the vibration of the molecule. Each such vibration line should be accompanied by faint rotational companions on either side of it, the ratio of the intensity of which to that of the parent line is determined by the state of polarisation of the latter. The change in the depolarisation of the Raman line, when measured with a nicol and a spectrograph, using alternately a very wide and a very narrow slit, enables this ratio to be determined. As

an example, we may mention the case of the strongest vibration line in the spectrum of liquid carbon disulphide. Careful measurements, using a pointolite mercury lamp and photographic photometry, indicate the depolarisation of this line with a fine slit to be 18 per cent. Manneback's theory indicates that the depolarisation should increase, when a very wide slit is used, to 44 per cent, while the theory of spinning photons gives it as 26 per cent. The latter is in close agreement with the observed value, which is 25 per cent.

It is well known that some vibrational Raman lines show very large depolarisation. Bär [3] and Hänle [4] have observed that such lines exhibit the phenomenon of reversal of circular polarisation. In terms of the theory of photon spin, we must assume that in such cases the molecule takes up angular momentum from the incident light in some manner otherwise than by its rotation as a complete entity. Internal spins or rotations within the molecule associated with such modes of vibration have to be postulated. The familiar example of a vibrating string or rod which describes circles or ellipses may help in picturing this state of affairs.

S. BHAGAVANTAM.

210 Bowbazar Street, Calcutta,
Dec. 13.

[1] *Ind. J. Phys.*, vol. 6, p. 353; 1931.
[2] *Z. Phys.*, vol. 62, p. 224; 1930.
[3] *Helv. Phys. Acta*, vol. 4, p. 130; 1931.
[4] *Naturwiss.*, vol. 19, p. 375; 1931.

Behaviour of Pyroelectric Crystals.

IN some simple demonstration experiments using liquid air we repeated many of the interesting observations reported by L. Bleekrode [1] and by Miss M. E. Maurice [2] on the demonstration of electric lines of force around pyroelectric crystals. As these papers may have escaped the notice of some mineralogists and crystallographers, we feel it may be helpful to direct attention to what, in our estimate, is the simplest and most striking way of demonstrating the phenomenon of pyroelectricity.

As it came to our notice that at least some mineralogists have considerable difficulty in showing this phenomenon by the well-known method due to Kundt, which consists in dusting finely pulverised red lead and sulphur over the crystal as it cools, we employed this process, taking all the precautions mentioned by Dana [3] to ensure success. Although Dana refers to this method as "very convenient and simple", we consider that Bleekrode's method, in which the low temperature of liquid air is utilised, has advantages over it in this respect. Further, our experiments, using Kundt's method, did not show the effects predicted at all clearly; in fact, we obtained convincing results only in certain simple cases, for example, with a long tourmaline crystal possessing one polar axis.

In contrast to this, the behaviour of a crystal after immersing it in liquid air leaves no doubt as to its pyroelectric nature. The directed growth of the whisker-like ice filaments which form on the polar surfaces of pyroelectric crystals as they warm in air is striking, especially when viewed through a low-power microscope. The shooting off of portions of the ice filaments along the lines of electric force is most marked about a minute after these crystals begin to form. Although we observed the phenomenon clearly with tourmaline and quartz, it was best shown by a small boracite crystal with cubic, rhombic, dodecahedral, and positive and negative tetrahedral faces. Clouds of small ice projectiles passed during a limited period between one set of tetrahedral faces possessing a positive charge and the other negatively charged set. Even with a tourmaline crystal about 4 cm. long, small particles were shot from one pole to the other. By means of an electrified rod, it was easy to show the nature of the poles with this crystal.

In her paper (loc. cit.) Miss Maurice described a new method for measuring the electric moment of a tourmaline crystal, in which the crystal was deflected by an electric doublet. We made an approximate determination of this quantity simply, by suspending the crystal from a single silk thread and then determining its period of vibration in the uniform electric field existing between two large parallel plates in air. In two successive trials the electric moment obtained was 31·3, 31·6 e.s.u. and the charge on each end 11·2, 11·3 e.s.u., the crystal having cooled after being discharged in each case through about 150° C. The minimum period occurred after twenty minutes' cooling, and it was used in the calculation. As no special precautions were taken to prevent leakage from the crystal, the absolute values have little significance.

My thanks are due to Mr. C. A. Jarman for assistance with these experiments, and to Prof. W. N. Benson, who lent the crystals.

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[1] L. Bleekrode, *Ann. Phys.*, **12**, p. 218; 1902.
[2] Miss M. E. Maurice, *Proc. Camb. Phil. Soc.*, **26**, part iv., p. 491; 1930.
[3] E. S. Dana, "A Text-Book of Mineralogy", 3rd edition, p. 307.

Microscopic Cracks produced by Electric Spark.

IF a thick electric spark is made to glide along the surface of a piece of an ordinary window glass, a faint trace of the spark track is left on the glass surface. On examining this track under microscope, we find a large number of hair-like cracks running

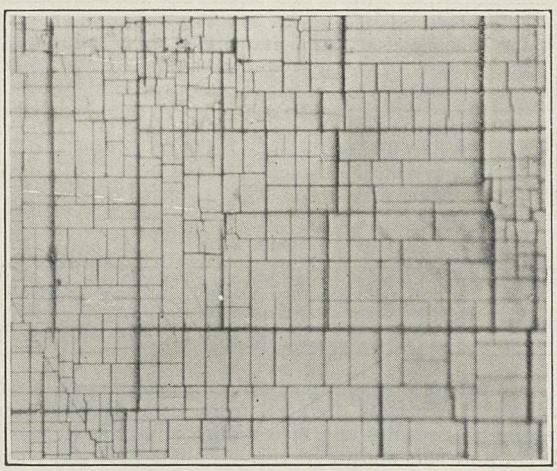

FIG. 1.—Cracks on a cleavage surface of rock salt crystal produced by repeated sparking. Spark length, 3 cm.; capacity, 15 m. ×150.

roughly parallel to each other and transverse to the axis of the track. It is interesting to observe that the cracks undergo further development even if left undisturbed. Minor secondary cracks gradually appear, filling up the space between the primary cracks with complicated networks. A thin surface layer bounded by these cracks begins to be peeled off, showing thus a mozaic of Newton rings. This latter pattern becomes visible an hour after the sparking and is most marked along the middle zone of the track.

Using a cleavage surface of rock salt crystal instead of the glass surface, a fine pattern of rectangular cracks is obtained (Fig. 1). Other crystals give different but characteristic patterns, though not always coinciding with the usual cleavage cracks. The breadth of the zone of cracks increases with the capacity of the spark circuit. The relationship between the density of cracks and the capacity and the potential difference is not simple. The appearance of the cracks is probably due to the electrostatic stress acting as a superficial tension along the spark track. It seems that the present phenomena may be utilised for measuring the steepness of the potential gradient along the spark track.

Details of the results of experiments will be published later in the *Scientific Papers* of our Institute.

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Character of Atmospheric Ionisation.

IN recent months an apparatus has been set up at Kew Observatory for investigating atmospheric ionisation. A continuous record is taken of the ionisation currents to the central electrodes of three cylindrical condensers, through which air is aspirated. The outer cylinders of the condensers are maintained at three different voltages, which are automatically reversed in sign every five minutes, so that positive and negative ions are alternately collected by the central electrodes. The ionisation currents are recorded photographically on bromide paper by light reflected from the mirrors of three Dolezalek electrometers. The mouths of the condensers project through the wall of a hut and are 10 cm. apart from each other. The mean height above the ground, a grass lawn, is 1·5 metres.

A quite unexpected phenomenon has been observed on the photographic traces. So far as can be seen, the ionisation current consists of a succession of pulses which occur simultaneously on all three current records. The magnitude of the effect varies with atmospheric conditions and from one pulse to the next. About twenty such pulses are recorded by the electrometers in each four minutes of charging up; that is, the frequency is five per minute on the average. In fine weather conditions, each electrode collects about 10^8 ions in four minutes, so that each pulse contains on the average about 5×10^6 ions. Further, a proportionality exists between the pulses on the three instruments; a large 'kick' on one electrometer is accompanied simultaneously by large 'kicks' on the other two.

The Dolezalek electrometers are not critically damped, so it is impossible at the present stage to make accurate measurements of the succession of electrometer 'kicks' which constitute for the most part the current traces. It is intended to utilise a Lindemann electrometer, which is practically dead beat, for obtaining more exact information on the nature and magnitude of the pulses.

The results can only be interpreted as evidence that the ionisation in the bottom layer of the atmosphere is by no means uniformly diffused. Parcels of relatively highly ionised air are present which are of such a size that when one condenser receives a charge-pulse so do the other two. It is not possible to give the number of ions comprising a parcel; one can only point out that the fraction which each condenser collects may be from 10^6 to 10^7 ions. For comparison, we note that an α-particle produces about 2×10^5 pairs of ions in its path through air at atmospheric pressure; each parcel of ions in the atmosphere probably contains about a thousand times this number.

The phenomenon is yet to be explained, but one feels that the picture it has suggested of ions in parcels distributed more or less regularly through the atmosphere must modify considerably our ideas in atmospheric electricity.

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Polish on Metals.

SIR GEORGE BEILBY [1] attributed the polish on metals to the covering over of the surface by a layer of amorphous metal resulting from rubbing, which causes the metal to flow and then harden as a supercooled liquid. Prof. G. P. Thomson's high-speed electron beam camera [2] was used to investigate this.

Small blocks of copper and silver were etched and pictures taken which showed diffraction rings corresponding to the spacings in the cubic lattice of each metal. The copper block was rubbed successively on emery papers No. 00, No. 000, and No. 0000, with benzene as a lubricant to prevent the abrasive from being forced into the metal. At this degree of polish the diffraction rings were diffuse but of the same atomic spacings. As crystals normally give sharp diffraction patterns, the rubbing must have decreased the original size of the crystals, which reduced their resolving power and so caused the rings to broaden.

After polishing with light magnesium oxide and water, the mirror-like surface gave only two broad diffraction rings in place of the previous diffraction rings. The spacings of the copper atoms were now different from those in the crystal structure. The copper atoms must have been flowed into a random arrangement different from their orderly positions in the cubic lattice. But the atoms can approach each other only to a finite distance which will predominate, so that this new semi-orderly arrangement will be favourable for electron diffraction interference.

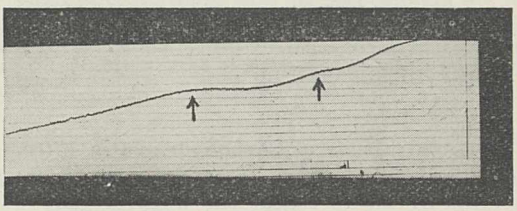

FIG. 1.

The intensity of the diffracted electrons I depends on the factor ψ, the amount that a single copper atom diffracts as the angle of incidence varies, and on the factor x, a function of the distance between the copper atoms, the angle of incidence, and the wave-length of the electrons. $I = 2\psi^2(1 + \sin x/x)$. A microphotometer record of the two broad rings from polished copper is shown in Fig. 1.

NEAREST DISTANCE OF APPROACH OF ATOMS.

	Calculated from diffraction expts.	In normal crystal (X-rays).
Copper . .	$2{\cdot}585 \times 10^{-8}$ cm.	$2{\cdot}54 \times 10^{-8}$ cm.
Silver . .	$2{\cdot}718 \times 10^{-8}$	$2{\cdot}876 \times 10^{-8}$
Iron . .	$2{\cdot}667 \times 10^{-8}$	$2{\cdot}78 \times 10^{-8}$

These broad rings also appeared from a stainless steel mirror classed above as iron, and from silver and

copper polished with rouge and water. Some specimens were washed in absolute alcohol, others in benzene, and others in water before being photographed. When rouge was used without a quantity of water it became embedded in the metal surface, as shown by Mr. B. K. Johnson using an immersion microscope, and also by the diffraction photographs showing the normal crystal pattern sharply plus additional rings given by the rouge. R. C. FRENCH.

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[1] Sir G. T. Beilby, "Aggregation and Flow of Solids".
[2] G. P. Thomson, *Proc. Roy. Soc.*, A, **128**; 1930.

Magnetism of Precipitates of Colloidal Silver.

IN a series of contributions [1] it has been shown by us that the magnetic properties of graphite, antimony, bismuth, and gold are modified by colloidalisation.

We have recently investigated two forms of colloidally precipitated silver. In one method, a dilute solution of silver nitrate was reduced by tannin after adding sodium carbonate. In the second, a dilute solution of the same salt was reduced by hydrazine hydrate. The colloids were coagulated, washed, and dried in vacuum desiccators, precautions being taken to avoid oxidation and impurities. In the former method the specific susceptibility of two specimens was $0{\cdot}166 \times 10^{-6}$ and $0{\cdot}133 \times 10^{-6}$; in the latter method, one specimen had a specific susceptibility of $0{\cdot}166 \times 10^{-6}$. (The specific susceptibility of silver in the massive state is $0{\cdot}2 \times 10^{-6}$ at atmospheric temperature (I.C.T.)). The maximum size of the particles was about 10μ. Further attempts are being made to grade the particles and obtain more accurate information.

The hypotheses suggested in the note [2] on a similar phenomenon observed in the case of gold are also applicable to silver. Gold and silver are known to possess paramagnetic atoms, but build up diamagnetism only in the massive state. Changes depending on their crystal and block structure can therefore be expected in them.

V. I. VAIDHIANATHAN.
B. S. PURI.

Forman Christian College,
Lahore, Dec. 5.

[1] See V. I. Vaidhianathan and Balwant Singh, NATURE, **128**, 302; 1931, and earlier references there.
[2] See also a later communication to NATURE, **128**, 153; 1931, by S. Ramachandra Rao, where the work on graphite, bismuth, and antimony has been repeated by him, confirming the previous results.

Photosynthesis of Carbohydrates *in Vitro*.

IN a recent paper on this subject,[1] unsuccessful attempts by me to repeat the work of Baly [2] were described. It was not mentioned, however, that consideration had been given to the possibility of the failure to detect any photosynthetical sugars being due to the adsorption of these sugars on the large surfaces exposed by the catalyst powders. The catalysts were, in fact, repeatedly examined for the presence of any organic matter. The kieselguhr supported catalysts and the nickel carbonate were, after use in the photosynthetic tests, heated for some hours with water, and also with absolute alcohol, under reflux. On subsequent evaporation of the water or alcohol, no organic residue was obtained. Tests for charring with concentrated sulphuric acid on the catalysts gave negative results.

In addition, estimations of organic carbon were made, by the method described, on the nickel carbonate after use as a catalyst, but no trace of organic matter was found. Control experiments in which sucrose was estimated in presence of nickel carbonate showed that the latter did not interfere with the carbon estimation even if present to the extent of 40-50 times the weight of carbohydrate. JAMES BELL.

The Sir William Ramsay Laboratories
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University College, London, W.C.1.

[1] *Trans. Far. Soc.*, **27**, 771; 1931.
[2] *Proc. Roy. Soc.*, A **116**, 197; 1927. *Trans. Far. Soc.*, **27**, 545; 1931.

Growth Curves of the Gramineæ.

IN my paper read at the Belgian Congrès National des Sciences at Brussels in 1930, I gave a short account of my measurements of the growth-energy of *Triticum vulgare*, *Hordeum vulgare*, *Secale cereale*, and *Avena sativa*, in accordance with growth (velocity) curves in general. I followed accurately each day, at the same time, all shoots which issued from one single seed. The curves plotted on rectangular co-ordinates always gave a straight line between the points of inflexion (arithmetical series), and the Archimedes spirals constructed revealed for each kind of plant, during the whole of its life, two distinct growth-waves.

New experiments with the same and other Gramineæ have given the following results: the straight line between the points of inflexion is confirmed; the shoots are interdependent on one another and, in determined order, variable for each individual. For example, numbering the successive shoots of a given *Avena* type, shoot 2 issued from shoot 1, shoot 3 from shoot 2, 4 from 3, 5 from 4, 6 from 5, 7 from 3, 8 from 7, 9 from 6, 10 from 8, and so on, all 195 shoots finally being noted in a table of reference, with their order-numbers, in two separate groups. The roots are in accordance with the corresponding grouping of the leaves, this being directly visible by careful carding of them. Plotting all curves of one sample of a complete individual on rectangular co-ordinates in chronological order, one sees, following the tops, two or more distinct, regularly ascending-descending lines, that is, the pointed growth-waves of the above. From the beginning to the end they mark characteristic sines and cosines (tangents), and their distances apart again show successive agglomerations or groups from birth to death. A detailed account will be published later in *Roux' Archiv*. M. C. SCHUYTEN.

Institut des Hautes Études de Belgique,
Antwerp, Dec. 23.

Esperanto in Scientific Literature.

FOLLOWING Mr. Morris-Owen's letter in NATURE of Dec. 5 regarding the use of Esperanto in scientific literature, readers who are interested, as I am, in meteorology, may like to know that, for several years, the Aerological Laboratory of Tateno (Japan) has issued its yearly reports in Esperanto. These volumes, containing on an average some 250 pages, 9 in. × 12 in., with many tables, diagrams, and maps, place at our disposal a wealth of information on local meteorological data, to which it was almost impossible for us to get access previously. This example was followed a couple of years ago by the Meteorological Office of the Trans-Siberian Railway, at Karbin: the translation into Esperanto is given by the side of the Russian text; which is a boon to the majority among us, who have found it much easier to master Esperanto than Russian. This year, the Institute of Meteorology and Geodynamics of Ljubljana (Jugoslavia) has followed suit, and I gather that similar institutions are considering taking the same step.

T. J. GUERITTE.

Members Mansions,
36 and 38 Victoria Street, S.W.1, Dec. 12.

Research Items.

Ancient Gold and Enamel Work from Cyprus.—Mr. L. H. Dudley Buxton describes in *Man* for January a remarkably fine piece of ancient gold and enamel work, found, it is said, with two bronze tripods and a fragment of a large bronze vessel by a peasant while digging at Episkopi, the ancient Curium. Unquestionably the bronzes were of Mykenæan age, but it is uncertain what reliance can be placed on the story that all the objects were found together. The object is 17cm. in height and consists of a hollow cylinder of gold surmounted by a cloisonné sphere, on top of which stand two birds, almost certainly hawks. The cloisons on the sphere are formed by semi-circular bands in rows one above another. The colours are alternating rows of white, lilac, and green. The body feathers of the birds are similar but smaller scales; the wings and other large feathers are indicated by long parallel stripes. Mr. Buxton's descriptive note is followed by a discussion of the dating by Mr. S. Casson. In default of positive evidence the period must be established by technique, colour, design, and style. The object has no parallel. The method of representing and distinguishing the feathers is derived from the East and first appears on Hittite sculpture in a modified form on the Sindjirli sphinxes. It is not found in Egyptian goldwork; but it continues into Hellenic art, mostly in metal-work, and lasts into Byzantine times. The clue to the dating lies in the enamelled scales, which resemble very closely the incised coloured scales common on proto-Corinthian pottery. The application of enamel to cloisons in gold jewellery was not uncommon in the sixth, fifth, and fourth centuries B.C., but this example seems the earliest known. It can scarcely be later than the sixth century B.C. and probably belongs to the early part of that century. Prof. J. L. Myres adds a note in which he suggests the possibility of an earlier dating, pointing out the affinities of the treatment of the plumage and the wings, which exhibit features found in Phœnician, Hittite, and early Greek work. He recognises, however, that the earlier dating isolates the object as a piece of enamel technique. The object is figured in a coloured plate.

Diorite Axes from Ireland.—Two remarkable diorite axes from Rathlin Island, Co. Antrim, have been described by Dr. Marcel Baudouin and Mr. C. Blake Whelan (*Bull. Soc. Préhist. française*, 1931, No. 10). Their peculiar character, which is of particular interest to French archæologists, lies in the fact that they differ from the 'diorite axes' found in Brittany and Vendée and resemble the Campignian 'flaked axes' of flint. One of them shows no signs of polishing, and may be compared with specimens of the middle Campignian, or Estrellian, while the other is polished only at the base of the cutting edge, this bringing it into relation with the Jablinian, the period of the introduction of polishing. The method of manufacture—by striking off large flakes—differs entirely from that of the polished flint axe, in the preparation of which a large number of very small flakes was struck off. It is evident that, like the Campignian axes of France, the Irish were made without any intention of subsequent polishing, and the size of the flakes is responsible for the irregular character of the work in the partly polished axe. It is to be noted that the fine grained diorite of Brittany and Vendée, unlike that of Ireland, is not suitable for flaking, but was worked by pecking, as is shown by incomplete specimens. It is evident that the two axes here under consideration come from the same workshop. The method of working is identical, except that the one which is partly polished has a number of fine retouches along the edges. The resemblance to the 'haches plates' in flint of the Paris basin is marked. It is concluded (1) that there are diorite axes which were worked by flaking, a fact not yet admitted in France; (2) that there are diorite axes of Campignian facies which are partly polished, and that in a manner differing from that found in France; and (3) that this technique required a special kind of diorite.

Migration of Birds at St. Kilda.—The first-fruits of an interesting natural history expedition to St. Kilda carried out in the late summer of 1931, by T. H. Harrisson and a party of enthusiastic undergraduates, appear in a short account of the early autumn migration of that year (*Scot. Nat.*, p. 3, 1931). The visit lasted for three weeks, up to Aug. 13, and the observers had the advantage of seeing the arrival of the forefront of the autumn migration, which had passed on before Dr. Eagle Clarke landed on either of his prolonged visits. As a result, the composition of the migrant groups was somewhat different from that seen by Dr. Clarke. The largest movements were those of waders, but, on the whole, there was a scarcity of those species which breed in high Arctic latitudes and apparently follow the natives of lower altitudes in migratory succession. Few of the migrants seen stayed more than a few days on the island. The list includes twenty-two species.

Herring Behaviour.—In the *Journal du Conseil Permanent International pour l'Exploration de la Mer*, vol. 6, No. 2; 1931, Mr. Michael Graham makes an original contribution to the study of the problems of herring behaviour. By collecting ideas from fishermen and observing at sea with the drifters, the author attempted to find out how and why the herring get into the nets. It is generally agreed that the entanglement of the fish in the net is due to some sudden concerted movement on the part of the shoals, known by the fishermen as a 'swim'. Mr. Graham collected observations on the time, area, and directions of these swims. So far as information can show, the swims appear to be limited in area and to have a definite direction; that there are certain hours when the swims predominate seems certain. It is suggested that normally the herring can see the net, but that a shoal is subject to crowd psychology and will act concertedly under the influence of such factors as panic, sexual excitement, and migratory impulse; under such conditions the fish would be unable to avoid the net. The author records a number of fishermen's beliefs and discusses them in the light of his hypothesis. It is to be hoped that this very interesting work on the habits of the herring will be followed up.

Storage and Transport of Fruit.—The Empire Marketing Board has recently published two reports on the deterioriation of fruit during transit by sea. "Australian and New Zealand Fruit Shipments" (E.M.B. No. 46, H.M. Stationery Office, 1*s.* net, pp. 64, Nov. 1931) is a report by the Economic Section of the Board of a five years' survey covering investigations in the Dominions and at the docks of Great Britain. Inquiry was directed along four main channels—over-ripeness, fungal rotting, internal breakdown, and bitter-pit. The first two causes of deterioration are aggravated by too high a temperature in the ship's hold. Two types of internal breakdown are described, one associated with low temperature and the other with late harvesting. Bitter-pit has been shown to be more extensive in early than in late picked apples, and more severe in fruit from trees bearing a light crop. The report emphasises the need for a uniform temperature during shipment, not too high to over-ripen or cause fungal

rotting, nor too low to cause deep scald or internal breakdown. The need for quicker handling of fruit consignments after arrival at British docks is also suggested. The other report is entitled "Transport and Storage of Bananas with special reference to Chilling", and is by Dr. C. W. Wardlaw and Dr. L. P. McGuire (E.M.B. No. 45, H.M. Stationery Office, 1*s*. net, pp. 37, Nov. 1931). It deals chiefly with main stalk rot of bananas (*Thielaviopsis paradoxa*), finger stalk rot (*Glœosporium musarum*), and fruit rot (*Botriodiplodia theobromæ*), and shows how these diseases can be overcome by rapid chilling of the cargo to 53° F. This temperature is low enough to curtail fungal activity and high enough to allow adequate ripening. Pre-storage and nutritional factors also influence the fungal rotting.

Ensilage.—Ensilage has now become an important part of agricultural practice in the British Isles, and an up-to-date account of the subject is to be found in Bulletin No. 37, issued by the Ministry of Agriculture as a revised edition of their Miscellaneous Publication, No. 53 (London: H.M. Stationery Office, price 1*s*.), by A. Amos and H. E. Woodman. Although the making of silage from succulent green fodders is recorded in 1843, the first attempts to introduce the art into Great Britain were but temporarily successful, and it was not until 1910 that any consistent advance in its production was made. The operation is not difficult, the crops are easy to grow, require less labour than roots, and can conveniently be cut between hay and corn harvests. In addition, silage has a high feeding value and will keep for a long period without deterioration. Several distinct forms of silage can be obtained according to the conditions under which it is produced; the quality can also largely be controlled. Although most herbaceous plants are satisfactory for conversion into silage, certain points should be observed in making a selection of the most suitable crop. The three chief methods of silage making are by means of tower silos, clamps, and stacks. Full details, including any necessary precautions, are supplied for each method. The chemistry of silage and the changes that occur in the plant while it is in the silo are also fully discussed, and a comparison of the results of feeding experiments with silage, the fresh green crop, and other commonly used food-stuffs shows that it can be used with advantage for many classes of stock.

Ganometric Method of Measuring Geological Time.—Prof. H. Fairfield Osborn, with the assistance of Mr. E. H. Colbert, has published in the *Proceedings of the American Philosophical Society*, vol. 70, No. 2, 1931, a preliminary notice of a method of measuring time in its geological aspect. This method, which is termed the 'ganometric', has been arrived at from a close examination and comparison of the enamel folds in the posterior molar teeth of the many genera and species of elephants. It has been found that the total length of enamel, when measured along the folds, shows a definite increase in course of time. The rate of increase seems to vary in different phylogenetic lines, being rapid in some and slow in others. More detailed investigation into this interesting suggestion is in progress, and, if the thesis can be proved true, it will form a very useful test of the age of deposits and in addition will be most useful in helping to date such human remains and artefacts that may be found, as they sometimes are, in the same levels as proboscidian remains.

A New Canadian Uraninite.—In 1930 uraninite was discovered in pegmatite on the Huron claim, Winnipeg River area, south-east Manitoba. Selected material has now been analysed by H. V. Ellsworth, and the results appear in the *American Mineralogist* for December 1931 with a general account in which J. S. DeLury collaborates. The figures for age calculation are as follows:

U	53·50	55·01
Th	12·46	12·25
Pb	15·44	15·50
$\frac{\text{Pb}}{\text{U}+0{\cdot}38\ \text{Th}}$	0·265	0·260

The very high lead-ratio makes this the oldest uraninite yet discovered, and in view of this surprising result, it is of importance to notice that the authors add, "There is not the least suspicion that galena or any other foreign minerals were present". The ratio is approached only by that of the Ingersoll, South Dakota, uraninite (0·225) analysed by C. W. Davis. The Manitoba uraninite occurs in pegmatites that cut the Rice Lake series, which is lithologically similar to the Keewatin-Coutchiching rocks of Ontario. If the age indication of the lead-ratio is accepted, the pegmatites must be very much older than those cutting the Grenville series in Ontario and Quebec, for which the corresponding ratios lie between 0·15 and 0·16.

Measurements on Isotopes.—A number of new measurements on isotopes with the mass-spectrograph have been described by Dr. F. W. Aston (*Proc. Roy. Soc.*, Jan.), which provide, as usual, a useful check upon the chemical values of the atomic weights. Caesium, for which the accepted chemical value is 132·81, has been found to have the distinctly higher atomic weight $132{\cdot}92 \pm 0{\cdot}02$. For strontium the positive ion value is $87{\cdot}64 \pm 0{\cdot}06$, in excellent agreement with the chemical value 87·63. For rubidium and thallium the chemical and electrical values are also in good agreement, although for the latter element Hönigschmid's number 204·39 is preferred to Briscoe's more recent 204·34. Barium ($137{\cdot}43 \pm 0{\cdot}08$) also agrees reasonably well with the chemical determination, but for scandium Dr. Aston's value is $44{\cdot}96 \pm 0{\cdot}05$, which is lower than the chemical value, 45·1, suggesting that the latter needs revision. For the remaining element studied, lithium, Dr. Aston gives a value $6{\cdot}928 \pm 0{\cdot}008$, in good agreement with some other recent physical determinations, but not in accord with the results of band spectrum analysis.

Ammonium Phosphomolybdate.—Although the yellow precipitate formed from molybdic and orthophosphoric acids in presence of nitric acid is known to have the composition $(NH_4)_3PO_4$, $12MoO_3$, $2HNO_3$, H_2O, it is usually supposed to be formed only when ammonium molybdate is present in large excess, and hence that the method cannot be used for the determination of molybdenum. Special conditions in great number have been published in connexion with the use of the method in the determination of phosphoric acid. Kitajima, in the *Scientific Papers of the Institute of Physical and Chemical Research, Tokyo*, No. 330 (October 1931), shows that molybdenum can, in fact, be determined by this method, and he has worked out the conditions for the determination of phosphoric acid.

Chlorination of Benzene and Toluene.—It is generally known that in the chlorination of toluene at higher temperatures substitution occurs mainly in the side chain, whilst in the presence of halogen carriers in the cold the nucleus is substituted. Mason, Smale, Thompson, and T. S. Wheeler have described (*J. Chem. Soc.*, Dec. 1931) experiments on the chlorination of toluene and benzene in the vapour phase, the main object being to determine to what extent chlorine enters the nucleus of toluene at high temperatures in the absence of specific chlorine carriers, and to determine whether, as regards the kinetics of side-chain chlorination, this hydrocarbon can be regarded as a substituted methane, the chlorination of the latter

hydrocarbon having been investigated by Mason and Wheeler, whose results were published in the September issue of the same journal. The results show that in the absence of specific carriers chlorine enters the side chain, and also, with the same conditions of short periods of heating, the kinetic formulæ developed by Martin and Fuchs in 1931 apply to toluene considered as a substituted methane. In the case of benzene, the main object was to investigate, with particular reference to the formation of monochlorobenzene, the extent to which substitution occurs at high temperatures, in the absence of specific chlorine carriers. It is shown that direct chlorination to chlorobenzenes takes place in the vapour phase above 400°, mono- and di-chlorobenzenes being the chief products. The rate of reaction is not so great as in the case of toluene. The results, in the case mentioned, are in good agreement with the kinetic formula for a two-stage reaction. The rate of reaction is increased by addition of iodine, a chlorine carrier, and other liquid-phase catalysts. With ferric chloride the proportion of dichlorobenzene formed is increased and a little trichlorobenzene is also formed.

Bushings for Outdoor Transformers.—The increasing use of outdoor substations for the transmission of electrical power has made it necessary to adapt transformers for use in unprotected positions out-of-doors. The transformers are usually connected to overhead transmission lines, the junction between transformer winding and overhead line being at the terminals, where the winding is brought out from the oil tank surrounding the transformer. These terminals are called outdoor bushings, and on their design a great amount of scientific and mathematical research has been expended. In a paper read to the Institution of Electrical Engineers on Dec. 3, Mr. W. J. John gave a careful résumé of the work that has been done previously and deduced some useful conclusions. The main requirements of a bushing are that it must withstand all the electric stresses due to its connexion with the overhead system, insulate the conductors when rain is falling on the transformer, and be absolutely water-tight so that moisture cannot get into the insulating oil. Before the engineer accepts bushings, they have to pass certain standard tests; but the severity of these tests should not be unduly high. They have to be tested under artificial rain conditions, the water used having a standard resistivity usually of 10,000 ohms per cm. cube. The shape of the bushings is of importance, so that the electric stresses which govern flash-over and puncture may be computed. It is of special importance to prevent the brush discharges, usually called the corona. Mr. John gave laws for corona and puncture-voltage, and also for the permissible voltage gradients. He showed that for any given flash-over distance under wet conditions, the corresponding dry flash-over distance can be fixed within narrow limits; experiment shows that the law connecting the two is linear.

Astronomical Topics.

Astronomical Phenomena for February.—Venus is becoming increasingly conspicuous as an evening star; the planet is drawing away from the sun, and going farther to the north of it; its stellar magnitude is −3·5, three-quarters of the disc being illuminated. Venus will be near the moon on the evening of Feb. 9, and about a degree north-west of Uranus on the evening of Feb. 26.

Jupiter is in opposition on Feb. 7; satellite II. will be in transit from 1.15 to 4.7 A.M. on this day, and will partially cover its own shadow; reference should be made to the British Astronomical Association Handbook for mutual eclipses and occultations of the satellites; the seasons for these only occur once in six years, so opportunities should not be missed.

Neptune is in opposition on Feb. 26; it is then 1¼° east of the fourth magnitude star ρ Leonis, which will make the planet easy to pick up in small telescopes.

Occultations of stars by the moon occur at 9.11 P.M. on Feb. 11, at 7.35 P.M. on Feb. 16, and at 6.19 P.M. on Feb. 18; the stars are rather faint. February is a good month to look for the zodiacal light, since the ecliptic then makes its greatest slope to the horizon in the evening sky. This applies only to those who are far from the glare of artificial lights. The most convenient minima of Algol occur at 11 P.M. on Feb. 16 and at 8 P.M. on Feb. 19.

The well-known variable star Mira Ceti is due to reach its maximum early in April; but it will then be too near the sun for observation. It should, however, be visible to the naked eye after the middle of February, and it is of interest to follow the increase of its light, which is fairly rapid. Its position relatively to α and γ Ceti and to α Piscium should be learnt from a map. A binocular is a help.

A New Faint Comet, 1931 *e*.—This comet was found by Herr K. Reinmuth on Dec. 31 in the course of the regular work on minor planets that is carried on at Königstuhl, Heidelberg. It was of magnitude 15; its motion did not differ greatly from that of a minor planet, but both he and Dr. M. Wolf decided that it was a comet after inspecting its images on four different plates; its aspect was decidedly nebulous, its diameter being estimated as 36″. The following positions are from *Rechen-Instituts* Circulars 530 and 533; they are referred to the equinox of 1925:

Dec. 31	19h 29·9m U.T.	R.A. 3h 49·6m	N. Decl. 37° 26′
Jan. 10	18 58·4	3 45·1	37 22
12	21 41·0	3 44·7	37 21

No orbit is yet to hand, but the above figures suggest that the comet was stationary in R.A. about Jan. 16, in which case it would be near the discovery position at the end of January.

The comet was within a few degrees of 1931 *d* (Neujmin 1), but identity is not possible, the orbit of Neujmin being well known; moreover, it had sunk to magnitude 17 in December, and showed no sign of nebulosity at this apparition.

Nova Pictoris.—A series of observations has been published (*Mon. Not. Roy. Ast. Soc.*, Nov.) of the components of this star made with the 26½-inch refractor at the Union Observatory, Johannesburg, by W. H. van den Bos and W. S. Finsen; they also include some made at Lembang, Java, by Dr. J. Voute. An interesting point is the outward movement of the components *B*, *C* from the principal star *A*. The measured distances early in 1928, 1929, 1930, and 1931 were for *B*: 0·35″, 0·55″, 0·84″ and 0·95″; for *C* they were 0·38″, 0·60″, 0·80″, and 0·98″. The faint component *D* remained nearly constant at 0·27″; it was not visible in 1931. The nebulous and unsymmetrical character of the central nucleus *A* added to the difficulty of the measures; *B* and *C* faded more rapidly than *A*; in 1929 they were fainter than *A* by 1·6 and 2·1 mag., in 1931 by 2·6 and 3·6 mag. The paper compares Nova Pictoris with Eta Argus; it is recalled that Dr. Innes detected two near companions of Eta Argus in 1914 and 1915; also the disc of the principal star appears nebulous in the 26½-inch. The light-curve of Eta Argus resembles that of a nova, differing only in the slowness of the changes; Nova Pictoris has also been slower than the average nova, but much more rapid than Eta Argus.

The Kinematograph in Education.*

AN account of what has been called "The Middlesex Experiment", carried out with sound films by a joint committee on which various educational authorities in the county were represented, has recently been published. The experiment was made possible by the generous offer of the Western Electric Company to provide, free of charge, sound film equipment and the services of competent operators. Sixteen films were used, divided into four groups; six had geographical value, four dealt with biology or nature study, and the other six were of general interest. These were lent by British Instructional Films and British Movietone News.

The value of the films to the children (3600, in fifteen schools) was tested in the first instance by questions set on each film, easier questions in some cases for the junior pupils and more difficult questions for the senior pupils, with an essay in special cases. A questionnaire on the value of each film was answered by a teacher in each school. Final conclusions were drawn from an examination of these sources of information, control classes taught in the usual way without films being considered too cumbersome.

It may be said at once that, if the opinions of teachers are worth anything, a case is made out for the use of films in educational work in schools. There is, indeed, plenty of criticism; one of the facts that emerged is that even the best film material available for use in schools is unsatisfactory in numerous respects. But it is also stated that "even the least satisfactory among the films used in the experiment had a certain value as instruments of education; the better films were frequently stated to be of very considerable value". The films created a liveliness of mind and desire for further learning that is not taken account of in any assessment of answers to questions on the scenes exhibited.

It is curious, however, that while the title of the volume is "Sound Films in Schools", and while, in fact, sound films were used, the emphasis seems to be laid not so much on the sound film as compared with the silent film or with the ordinary lesson, but on results of using the sound film with pupils of different grades of intelligence. We are not impressed by the evidence that the sound film is "superior" to the silent film. There is, indeed, the statement that "the general consensus of opinion on the part of teachers consulted is that they [the sound films] are preferable to silent films for educational purposes", but the statement comes as a shock to the reader. Practically no evidence, statistical or other, is adduced to support the statement in this extreme form. So far as can be gathered, there were no control experiments with adequately captioned films, and it is certainly interesting to note that one of the most common criticisms of the films was that there were too few captions.

On the other hand, there are many solid results of the investigation and suggestions for further inquiry. The children were divided into those of average ability and those described as backward, and probably the most striking result of the experiment was the value of the film to the backward pupils; it is, indeed, in the case of the backward pupils that the value of the sound film is most clearly demonstrated. Another very striking result, though it is rather belittled in the text, is that the lesson should follow the film—not precede it. The evidence for this (as given in Table XVIII.) is overwhelming. The result is as important as it is striking. It implies that, under the conditions of the experiment, the picture was *not* an illustration but the raw material.

The experiment, in fact, marks another advance in our knowledge of how to use films in school. The criticisms of teachers have led to the formulation of definite requirements that such films must fulfil. The committee of the Geographical Association, which has been investigating silent films, has come to almost identical conclusions. It may, therefore, be taken for granted that all school teaching films, sound or silent, must have the following qualifications:

(1) The film must be coherently planned.

(2) It should be short and aim at conveying one main idea.

(3) All essentials to the main theme must be included and irrelevances ruthlessly excluded.

(4) The commentary should be in simple language and should anticipate the picture.

(5) Talking down and cheaply humorous touches must be avoided.

(6) The repetition of essential action is recommended.

(7) Films should be correlated with recognised courses of study.

(8) Only such subjects should be shown in film form as cannot be more effectively dealt with through another medium.

* Sound Films in Schools: the Report of an Experiment undertaken jointly by certain Local Education Authorities and by the National Union of Teachers in the Schools of Middlesex. Pp. viii+120+8 plates. (London: *The Schoolmaster* Publishing Co., n.d.) Cloth, 2*s.* 6*d.*; paper, 1*s.* 6*d.*

Pit-Dwellings in Arizona.

FOR several seasons past Dr. Frank H. H. Roberts, Jr., has been engaged on behalf of the Bureau of American Ethnology, Smithsonian Institution, Washington, D.C., in the investigation of archæological sites in Arizona and Colorado, with the view of tracing the development of the culture of the 'Basketmakers', the prehistoric inhabitants of the arid areas of the south-western United States, and its relation to that of the early Pueblo Indians. The following is a report of the field-work in the summer of 1931, which has revealed what would appear to be a hitherto unsuspected phase in the development of the multi-cellular dwelling characteristic of later Pueblo culture.

During the summer field season of 1931 investigations were carried out at a site three and a half miles south of Allantown, Arizona. When the work was brought to a close at the end of September the subterranean portions of fourteen pit-houses had been cleared of the debris which accumulated in them during the centuries which have passed since their abandonment. Several of the dwellings had been destroyed by fire, and the charred remnants of timbers lying on the floors demonstrated clearly the methods of roof construction. This evidence, together with the nature of the pits which remain, makes possible the drawing of an accurate picture of the type of dwelling in vogue during the early stages in the occupation of the site.

The semi-subterranean houses were rather crude. They had consisted of a circular, oval, or rectangular excavation roofed over with a pole, brush, bark, and plaster superstructure. The earth walls of the pits were covered with plaster made from adobe mud in

which there was a small admixture of ashes. The pits ranged from 0·91440 m. to 1·524 m. in depth and from 3·048 m. to 6·096 m. in diameter. The superstructure erected over the pits was supported by four upright posts set in the floor a short distance from the walls. The upper ends of these main supports were forked, tree trunks with suitable crotches having been obtained for the purpose, and carried crossbeams. These stringers formed a rectangular framework against which were placed the upper ends of smaller timbers, the butts of which rested on the ground some distance back from the edges of the pit. The slanting poles formed the main part of the sloping upper walls of the house. At the top the rectangular space was covered with a flat roof, with an opening near the centre which functioned as a smoke-hole and entrance. The entire framework was covered with brush, leaves, and strips of cedar bark. On top of this a thick layer of mud plaster was spread, and over all there was a thin coating of earth. Indications were that the tops of the roofs were only elevated above the ground sufficiently to provide for drainage. A village composed of houses of this type would not be striking in appearance, since all that an onlooker would see would be a series of low, rounded mounds with the ends of ladders projecting through rectangular openings in their tops.

The interior features of such houses were simple. Near the centre of each, directly under the opening in the roof, was a fire pit. Close to it, on the south-east side, was a second depression in the floor, in which rested the lower end of the ladder used in gaining access to the chamber. An occasional dwelling had a storage recess in the wall. Where these were present they were on the floor level; none was placed above it. At the east or south-east side of each room there was an aperture in the wall, which opened into a short tunnel. The latter led to a vertical shaft the outlet of which was on the ground-level some distance from the edge of the roof mound. This constituted the ventilator. The nature of the houses was such that a constant supply of fresh, cold air was drawn down into them through this ventilator. Between the opening in the wall and the fire pit, at the base of the ladder, an upright slab of stone was set in the floor. This is called the deflector, and was so placed to prevent the inrushing air from blowing directly on the fire. The draft at times was so strong that it was necessary to stop completely the opening. A well-worked oval slab of stone was provided for this purpose. The cover stones were found in position over the opening in a number of the pits when they were excavated.

Houses of the type just described generally stood alone, but in two different groups at this site they were connected. There were no partitions at the sides where they joined, and long, narrow dwellings resulted. One of the examples was composed of two and the other had three connecting chambers. Each room was complete in itself, to the minutest detail, but because of the lack of a separating wall, became an integral part of the larger structure. It is possible that the two groups represent one of the prototypes for the communal dwellings which in later times were erected above ground. If such were the case, there is in this district evidence of an interesting variation in the evolution of the house. In the more northern parts of the south-west archæological area, the single family domiciles had practically emerged from the ground before the development of the multiple-roomed structures began. In general it may be said that the structures uncovered in 1931 conformed to the widespread semi-subterranean type of house built in many sections of the south-west. They are particularly comparable to the pit-dwellings which Dr. Roberts found during previous investigations in the Chaco Canyon, in north-western New Mexico, and at the old Long H Ranch, Arizona, about 48·280 km. south and west of the Allantown location. All showed individual differences and variations, but in their main essentials they exhibited a striking similarity.

The Allantown site is of considerable importance, because trenching has shown that it contains four distinct and sequent levels of occupation. Complete excavation will throw light on the closing days of the Basketmakers, show the beginnings of the Pueblo culture, and trace its growth through two subsequent periods. The houses excavated in 1931 belong to the Pueblo I. phase. Investigations will be resumed in the present year, when further portions of the site will be cleared.

Fuel Research in Great Britain.*

THE Report of the Director of Fuel Research for the year ending March 31, 1931, has only recently been issued. The delay in publication, usual with official documents, detracts somewhat from the freshness of its contents, for in recent months, at the centenary meeting of the British Association and other gatherings, the status of fuel processes has been the subject of repeated discussion.

There is a discussion by the Director of the economic status and prospects of the evergreen topic of low-temperature carbonisation of coal. He expresses the opinion that the receipt from the coke will have at least to cover the cost of the coal carbonised. The coke must fetch more per ton than the coal from which it is made. The crux of the question is the price which the nation is prepared to pay for the reduction of smoke nuisance, while at the same time retaining the open domestic fire. The damage and expense incurred by burning a ton of raw coal in the domestic hearth has been calculated to be 10*s.*, and if this sum could be included in the balance-sheet there is little doubt that the production of free-burning cokes would soon become a flourishing industry. It must be remembered that gas and ordinary gas-works coke are both smokeless fuels, the uses of which are extending, as is the use of electricity for many domestic purposes. Indeed, the rapidly growing use of gas coke as a fuel for open grates of suitable design is a factor which should not be overlooked.

The Report states that the benefit to the mining industry would be less than frequently claimed, because the use of carbonised fuel would merely displace house coal, the demand for which would be correspondingly reduced. The fall in the value of liquid fuels which has occurred in recent times places a great obstacle in the way of new carbonisation industries, and also of the production of oils by the direct hydrogenation of coal.

Low-temperature tars regarded as fuel oils or 'cracking stock' have defects. On the other hand, they appear to lend themselves to conversion into stable oils and motor spirits by hydrogenation. The Report gives the results of encouraging experiments in this direction, and it seems that the hydrogenation of tar may advance more rapidly than the direct hydrogenation of coal.

The Report reviews the circumstances in which the

* Department of Scientific and Industrial Research. Report of the Fuel Research Board for the year ended 31st March 1931: with Report of the Director of Fuel Research. Pp. viii+104+2 plates. (London: H.M. Stationery Office, 1931.) 2*s.* net.

Gas Light and Coke Company came to select the low-temperature carbonisation system developed at the Fuel Research Station for a full scale commercial trial at the Richmond Gas Works. Various causes led to the cessation of the experiments before, in the opinion of the Department and the Mines Department, a conclusive result was obtained. One of the principal difficulties encountered was the distortion of the metal retorts employed. This distortion resulted in an unduly heavy charge for replacements being added to the cost of the working of the plant. In view of the very promising results and increased throughput recently obtained at the Fuel Research Station with a brick retort, it is proposed to erect and work as steadily as possible two new retorts of that type at the station, so as to obtain further data regarding the life and working of such retorts. The disappointing results of this attempt to develop an apparently promising low-temperature process illustrate the need for caution in forecasting the commercial prospects of new schemes in this field.

Very interesting results have been obtained with horizontal gas retorts. By modifying the method of heating the retorts, the daily throughput has been increased by 70 per cent. The effect of this on the economics of carbonisation may be far-reaching, for more than seven million tons of coal are carbonised daily in such plant.

The organisation of the Physical and Chemical Survey of the National Coal Resources has now been almost completed, and covers practically all the coal areas in the country.

Many other aspects of the national fuel problems are touched in this interesting report.

Treatment of Fodder Crops.

VARIOUS are the proposals for restoring arable farming to its former prosperous state. Apart from the recent Government promise of establishing a quota for wheat, we have had such interesting suggestions as Prof. Orwin's mechanised farming, which is already being tried in various parts of the country, and the erection of canning factories in which fruit and vegetables take the place of wheat, and of which two are already being built in Norfolk alone. Yet a third proposal which seems worthy of trial is the so-called 'Mason System for Harvesting and Drying Green Fodder Crops'. The process invented by Mr. Arthur J. Mason is the result of twenty years' experimental work, and has been in commercial operation in the United States since 1926. It aims at producing home-grown feeding stuffs by artificially drying green fodder crops cut before the flowering stage and converting them directly into high-grade feeding-stuffs of comparable value with such imported products as cake, cereals, wheat offals, etc., at a distinctly lower price. The Rothamsted Experimental Station is already running some eighty experimental plots with the view of discovering the most suitable crops in Great Britain for the Mason process.

Investigations seem to show that crops thus grown in place of cereals will increase the yield of English arable lands about three and a half times (in food and monetary value) and assure the farmer a net profit of £2-£5 an acre, provided that the crop is cut three or four times in the season—a perfectly feasible matter if the crop is cut before flowering sets in. In such cases the normal yield per acre is, compared in feeding value with cereals, 3 to 4 tons per acre against 0·8 tons of wheat, the value of the product being 3½ times as high. The system has the further advantage of completely eliminating the more or less considerable loss in hay-making caused at present by the ordinary vagaries of the English climate. The crop, in fact, can be cut at any time, regardless of the weather, and the feeding value of the product is approximately double that of the ordinary sun-dried hay, there being no loss of proteins or vitamins by 'wilting' in the sun or by exposure to wet. Thus with lucerne, which yields in the case of ordinary hay-making about 12 per cent protein, the content of protein rises to 18 or 20 per cent when treated by the Mason process.

The installation costs approximately £7600, allowing £3500 for the drying plant and the rest for harvesting and haulage. It is capable of dealing with the product of 800 to 1000 acres, and should produce about 2600 tons of concentrates, worth £15,600 to £20,000, per annum, which could be grown within a three-mile radius in any arable district. Each factory could be organised as a single operating company, which purchases the standing crops and carries out the harvesting and the drying, the farmer receiving £2 per ton (dry) for his crops. Obviously in view of the farmers' sad experience with the sugar beet factories, the farmers concerned should have a direct interest in the factory, and some say in the prices. The factories would first concentrate on the production of fine ground meal for poultry food, for which there is an immediate market, but the product has also been found invaluable for cattle and sheep feeding. Considering the costliness of erecting sugar-beet factories and the large amount of the sugar-beet subsidy, it would be quite worth while for the Ministry of Agriculture to consider if some of the subsidy might not be diverted to encouraging the erection of some of these factories, of which the cost appears extremely modest. The system was recently brought to the notice of Section M (Agriculture) of the British Association by Sir Richard Paget, Bt. (1 Devonshire Terrace, London, W.2), from whom further information can be obtained.

University and Educational Intelligence.

CAMBRIDGE.—A. S. Paterson has been appointed to the Pinsent-Darwin studentship for three years from Oct. 1.

The council of the Senate has issued a report on accommodation for the Department of Mineralogy and Petrology. It is recommended that a new building covering about 5600 sq. ft. and containing four floors should be constructed between the Sedgwick Museum and the Department of Physiology.

At Emmanuel College, Mr. F. T. Brooks, University reader in mycology, has been elected to a reserved official fellowship.

LONDON.—At a meeting of convocation on Jan. 18 the Earl of Athlone was elected chancellor of the University. The installation ceremony will be held at the University on Feb. 18.

The following degrees have recently been conferred: D.Sc. (Statistics and Eugenics) on Ethel Mary Elderton (University College) for "Report on the English Birthrate" (*Eug. Lab. Publications*, 1914) and "On the Factors which influence Infant Welfare" (*Annals of Eug.*, 1926–29); D.Sc. (Economics) on Hilda Rodwell Ormsby (London School of Economics) for "The Geography of France—Regional and Economic" (Methuen, 1931).

The following titles have been conferred in respect of posts held at the Colleges indicated: *Professor:* Dr. Robert Robinson (biochemistry, Lister Institute of Preventive Medicine). *Reader:* Dr. J. M.

Gulland (biochemistry, Lister Institute of Preventive Medicine); Dr. William Robson (biochemistry, King's College); Dr. Edward Mallett (electrical engineering, Imperial College—City and Guilds College); Mr. Albert Rushton (electrical engineering, Imperial College—City and Guilds College); Dr. G. I. Finch (general chemical technology, Imperial College—Royal College of Science); Mr. V. C. Illing (geology—petroleum technology, Imperial College—Royal School of Mines); Dr. A. Morley Davies (palæontology, Imperial College—Royal College of Science).

NOTTINGHAM.—The Massey scientific research fellowship, of the value of £400 per annum, which has recently been established at University College, Nottingham, for the purpose of promoting research on cancer by physical and chemical methods, has been awarded to Dr. L. A. Woodward. After two years' research under Dr. N. V. Sidgwick at Oxford, Dr. Woodward was awarded a senior grant by the Department of Scientific and Industrial Research to carry on, under Prof. P. Debye, spectrophotometric research on the Raman effect in electrolytes.

APPLICATIONS are invited for Tate, Morgan, and Holl scholarships at the Battersea Polytechnic. The scholarships range in value from £20 to £30 per annum with free tuition and are tenable for two or three years. Particulars are to be had from the Principal, Battersea Polytechnic, S.W.11. The last day of entry is April 16.

AT a dinner, on Jan. 18, given by the Argentine Chamber of Commerce in Great Britain, the Prince of Wales announced the provision of scholarships at the University of Oxford, on the lines of the Rhodes scholarships, to enable students from the University of Buenos Aires to study in Great Britain. So far, provision has been made for two students from the University of Buenos Aires to go to the University of Oxford for a period of two years.

THE subject for the essay for the Cecil Peace Prize of £100, which is offered annually for an essay on some topic connected with the maintenance of international peace, has been announced. For the year 1932, the subject is "The Danger from the Air. Discuss possible methods, by International Convention or otherwise, of dealing with it." Further particulars can be obtained on application to the Secretary, Universities Bureau of the British Empire, 88A Gower Street, London, W.C.1.

Calendar of Geographical Exploration.

Feb. 3, 1488.—The Cape of Good Hope.

Bartholomew Diaz de Novaes touched the south coast of Cape Colony at Mossel Bay (Bahia dos Vaqueiros), midway between the Cape of Good Hope and Port Elizabeth. Diaz sailed from Lisbon for the Congo river in 1487 and thence surveyed the coast of Africa southwards to Walfish Bay. The currents off the South African coast hampered him, and he sailed far to the south of the Cape of Good Hope into the region of the westerlies, but finally reached the coast on the above date. Thence he proceeded to the mouth of the Great Fish river, but the discontent of the officers and men compelled him to return. In December 1488 he was back in Lisbon. His voyage opened the way for the route round Africa to the east, and added 1260 miles of coast-line to the map of Africa. Fragments of the pillar which he erected on Diaz Point in 26° 38′ S. (South-West Africa) still remain. Diaz accompanied Cabral on his voyage in 1500, when Brazil was discovered, and should have helped to guide the fleet thence to India, but perished in a great storm off the Cape of Good Hope.

Feb. 3, 1643.—Japan and Sakhalin.

Martin Gerritszoon Vries sailed with two ships from Batavia in search of imaginary islands, one supposed to be rich in gold and one in silver. The ships were nearly wrecked off Nippon, but reached Yezo and discovered an island, probably Iturup, passing through the strait which still bears the name of Vries. Part of the coast of Sakhalin was then explored, and descriptions of the hairy Ainu were brought back. The companion ship, instead of sailing through Vries Strait, passed along the outer shores of the Kurile Islands, reaching 47° 8′ N., twelve degrees east from the most easterly point of Nippon.

Feb. 4, 1823.—Lake Chad.

Lake Chad was seen by Europeans for the first time. Denham, Clapperton, and Oudney had set out from Tripoli in the hope of gaining further knowledge of the Niger. The party crossed the Sahara, reached Bornu, explored Lake Chad, and proved that the Niger was in no way connected with it. They brought back accounts of the Arabs, the Berbers, the Fulah, and of many negro tribes. The information thus collected about the kingdoms of the Central Sudan threw much light on the writings of Arab travellers.

Feb. 5, 1725.—Bering's Voyages.

Vitus Jonassen Bering set out from St. Petersburg to conduct an expedition to north-east Siberia in order to find whether Asia and America were separate. Peter the Great had appointed Bering to be commander, but in 1724 Peter died before the preparations were completed. Bering and his companions crossed Siberia by land, going from stream to stream and carrying with them the materials for the boats, which were built in Kamchatka. Bering sailed north-eastwards along the coast of Kamchatka, surveying it as he went. On Aug. 15, 1728, he sailed past the north-eastern promontory of Asia in 67° 18′ and observed that the coast trends westwards, as the Chuckchee had already told him. He considered that he had thus fulfilled his mission and returned to Kamchatka, whence he tried to reach America, but was driven back by bad weather conditions.

In 1740, Bering fitted out two vessels at Okhotsk, the *St. Paul* and *St. Peter*, the latter being commanded by Chirikov, and they set out for America. During a storm the vessels separated. Bering reached America between lat. 58° and 59° N., where the naturalist, Steller, who was with him, noted the volcano, Mount St. Elias. With great difficulty owing to continuous fog, the *St. Paul* rounded the peninsula of Alaska. Scurvy broke out among the crew, and the ship drifted helplessly at the mercy of wind and wave among the Aleutian Islands. It finally ran aground on Bering Island, where Bering died on Dec. 8. Thirty-two out of a party of seventy-six had died, but the survivors built a new vessel, and ultimately reached Kamchatka. Steller wrote a full account of the six months' stay on an uninhabited island, giving a valuable description of the fauna. Chirikov also reached the coast of America, in lat. 56° N. Bering's voyages decided the question of the existence of a strait between North Asia and North America. The strait had been passed by Dezhnev eighty years before, but no record had been kept of this. Bering's and Chirikov's voyages brought to light the existence of the long chain of volcanic islands between Alaska and Kamchatka.

Societies and Academies.

LONDON.

Royal Society, Jan. 21.—C. Donhoffer and J. J. R. Macleod: Studies in the nervous control of carbohydrate metabolism. When decerebration is performed through the pons in rabbits under amytal anæsthesia, the percentage of blood sugar rises very high after the effects of the anæsthetic have passed off. After pontine decerebration the percentage of lactic acid increases in the blood and the percentage of glycogen decreases in the muscles, but may either increase or decrease in the liver. No relationship exists between the degree of decerebration, hyperglycæmia, and the percentage of glycogen initially present in liver and muscles, and when previously fasted animals are used it is impossible to account for the hyperglycæmia by the sugar arising from the glycogen which disappears. It is concluded that a process of gluconogenesis is responsible for most of the extra sugar, but it has so far proved impossible to determine the extent to which protein and fat contribute towards its production. In fasted animals, having small percentages of glycogen in the liver and muscles, pontine decerebration fails to induce hyperglycæmia after double adrenalectomy, or administration of atropine, ergotamine, or amytal. It is concluded that decerebration hyperglycæmia is in large part due to stimulation through the autonomic nerves of some process by which the liver discharges sugar in excess of that available from the glycogen initially present in it. Since amytal paralyses this pathway, it prevents the rise in blood sugar percentage following pontine decerebration, piqûre, and asphyxia, but not that due to the injection of large doses of adrenaline.—W. T. Astbury, T. C. Marwick, and J. D. Bernal: X-ray analysis of the structure of the wall of *Valonia ventricosa*. (1) The cell-wall is built up of two main sets of cellulose chains which form crystallites crossing at an angle maintained remarkably constant through the whole thickness and over considerable areas of the wall. The orientations of the cellulose chains are parallel to the directions of the fine crossed striations which may be detected on the surface of the wall. The extinction directions shown by the wall in polarised light lie between the directions of the cellulose chains and vary in a manner determined by the inter-chain angle and the relative proportions of the chains associated with each orientation.—F. A. Askew, R. B. Bourdillon, H. M. Bruce, R. K. Callow, J. St. L. Philpot, and T. A. Webster: Crystalline vitamin D. Further purification of the antirachitic principle has been achieved by esterification of the crystalline distillation products formerly described as calciferol. The purified calciferol now obtained has an antirachitic activity twice as great as any previously recorded, and appears to be identical with the vitamin D_2 of Linsert and Windaus. A simplified process is described for preparing the pure product from the irradiation products of ergosterol without distillation. An account is given of two inactive compounds termed pyrocalciferol and sterol X. Evidence is given of the relations between the crystalline antirachitic products hitherto described, showing that the activity of each of them is due to one common constituent. Thus the vitamin D_1 of Windaus is a compound of calciferol (=vitamin D_2) and sterol X, and the crystalline distillation products first described contained pyrocalciferol and sterol X, as well as calciferol. (See also NATURE of Oct. 31, 1931, p. 758, and Jan. 9, p. 50.)

PARIS.

Academy of Sciences, Dec. 21.—A. Lacroix: The members and correspondents of the Académie royale des Sciences (1666–1793).—Paul Pascal and Pierre Minne: The existence and preparation of lead suboxide. The only method of preparation giving a definite compound is the decomposition of lead oxalate at 275° C. in a vacuum (1 mm.). The magnetic susceptibility proves that it does not consist of the mixture Pb+PbO. The pure suboxide (Pb_2O) cannot be obtained by the reduction of lead monoxide.—Lucien Lichtenbaum: A topological invariant.—E. Pinte: Congruences of straight lines and parallel surfaces in Hilbertian space.—Jacques: Networks the tangents of which belong to linear complexes and non-Euclidian surfaces of constant total curvature.—Paul Mentré: The projective application of a quadratic complex on the non-special linear complex.—F. Marty: The iteration of certain algebraic functions.—M. Davin: The elastic state of an indefinite two-dimensional body pierced by a circular hole.—D. Belorizky: The application of Sundman's methods to the problems of celestial mechanics.—A. Lallemand: The preparation of two types of aqueous solutions of cobaltous salts. Study of their magnetic state as a function of the dilution. Two types of solutions of cobalt salts are known; in the first the magnetic susceptibility is constant and independent of the concentration, in the second the magnetic susceptibility increases with dilution to a sharp maximum. The author gives the conditions for preparing either of these types of solution at will. L. Néel: The magnetic properties of iron above the Curie point. From studies of the magnetic properties of iron-tin alloys and iron-silicon alloys at temperatures ranging from 800° C. to 1100° C., the ferromagnetic Curie point found (θ_f) is 772° C., and the paramagnetic Curie point (θ_p) is 815° C.—Mlle. A. Serres: The magnetic moment of tetravalent cobalt. From a study of magnesium cobaltite ($MgO \cdot CoO_2$), the magnetic moment of Co'''' is found to be 29·0 magnetons.—E. Rinck: An allotropic transformation of barium in the solid state. Barium, fractionally redistilled in a vacuum, is attacked by carbon dioxide and can only be handled in argon. Its melting point was redetermined and found to be 710° C. From a study of the electrical resistance, two allotropic forms of barium are shown to exist, α-barium stable below 375° C. and β-barium stable between 375° and 710° C.—Mion: Contribution to the study of the system water, ethyl alcohol, acetic acid, ethyl acetate. The miscibilities of the ternary system (water, alcohol, ethyl acetate) and quaternary system have been determined at 0°, 15°, and 30° C: the results are given in tabular form.—M. Bourguel and L. Piaux: The Raman effect and chemistry; the allene linkages. The Raman effect for allene and its derivatives shows that these hydrocarbons contain neither an ethylene nor acetylene linkage. Hence the usually accepted formulæ require revision.—Jean Cournot: The influence of the state of the surface on the corrosion of rustless steels. The effect of the condition of the surface on corrosion is specially marked in the case of rustless steels: to obtain a maximum resistance to corrosion it is necessary to polish the surface with the finest grade emery.—Mlle. Suzanne Veil: Precipitations stratified in spirals.—M. Patry and P. Laffitte: The beginning of the explosive wave in mercury fulminate.—Frank A. Perret: The new dome of Mt. Pelée.—Emile F. Terroine and H. Trimbach: The urinary excretion of ketonic substances during starvation in various species of animals. Experiments on the pig, rabbit, dog, cat, and rat showed no increase in ketonic sub-

stances excreted in the urine during starvation; on the contrary, there was a reduction. The increase observed in man and in the primates appears to be exceptional.—J. Errera: The electrometric titration of the proteins. The isoelectric points of the albumins and globulins are in the acid region (*p*H 4–5·5), whilst those of the prolamines and glutelines are in the alkaline region (*p*H 8–10).—Paul Fleury: The glycerophosphomolybdates. In the glycerophosphates the phosphoric acid still possesses, although in a weakened form, the property of forming complex compounds with molybdic acid. Two of these have been isolated in the crystalline condition, sodium β-glycerophosphomolybdate and potassium β-glycerophosphomolybdate.—A. Ch. Hollande and Mme. G. Hollande: The cytology of *B. coli*.

SYDNEY.

Royal Society of New South Wales, Nov. 4.—A. R. Penfold: The essential oil of *Leptospermum Liversidgei* var. B. and the occurrence of isopulegol. The presence of *d*-*a*-pinene, citronellal (33-42 per cent), and sesquiterpene alcohol was confirmed, and the occurrence of isopulegol both free and combined as caprinic acid ester revealed. The isolation and identification of this alcohol is the first authentic record of its occurrence in Nature.—E. Cheel: Notes on the *Pericalymmæ* section of the genus *Leptospermum*, with descriptions of three new species. An account was given of the first collection of plants commonly known as 'tea-tree' in Australia or 'manuka' in New Zealand, made by John Reinhold Forster and his son, George Forster, who accompanied Capt. Furneaux of the *Adventure*, which left England in 1772, on Capt. Cook's second voyage to the shores of Australia. Three new species were described: *L. trivalum* has small capsules, normally three-valved. The plant otherwise resembles *L. myrsinoides*, which is confined to Victoria, whereas the new species is widespread over the western and southern parts of New South Wales, extending to Victoria. *L. sphærocarpum* has spherical-shaped fruits, and has affinities with *L. nitidum*, a Tasmanian species. *L. semibaccatum* has fruits somewhat berry-like when fresh, an unusual character for this group of tea-trees.

VIENNA.

Academy of Sciences, Oct. 15.—A. Kailan and J. Kohberger: The velocity of catalysed hydration.—L. Moser and H. Hackhofer: The determination and separation of rare metals from other metals. (20) The determination of iridium and its separation from platinum and other metals. Hydrolysis was used and also bromide-bromate.—L. Moser and H. Graber: The determination and separation of rare metals from other metals. (21) The determination of rhodium and its separation from platinum and other metals. Oxidising hydrolysis was in many cases successful.—W. J. Müller, H. K. Cameron, and W. Machu: The theory of passivity phenomena. (14) The passivity of nickel. The substances forming surface layers are the natural nickel oxide which forms in air, basic nickel sulphate, double refracting nickel sulphate pentahydrate, nickel peroxide.—J. Kühtrieber: New Plecoptera larvæ.—F. J. Widder: *Draba norica*, a new plant of the Eastern Alps.—A. Rollett and F. Scholz: The course of esterification with mixed anhydrides and mixtures of anhydrides.—M. Mladenovic: The elemic acid from Manila elemi resin. (3) The elemonic acid, its hydration product, and bromo-hydro-elemonic acid.—A. Dadieu, K. W. F. Kohlrausch, and A. Pongratz: Studies on the Raman effect. (16) The Raman spectrum of organic substances (cis-trans-isomerism).—A. Dadieu and F. A. Schneider: Raman effect and constitution of nickel carbonyl.—S. Pelz: Electrolytic coloration of alkali halide crystals.

Forthcoming Events.

Societies.

FRIDAY, JANUARY 29.

SOCIETY OF MEDICAL OFFICERS OF HEALTH (Fever Hospital Medical Service Group) (at 1 Upper Montague Street, W.C.1), at 4.—Dr. E. W. Goodall: Pre-bacterial Views of Infectious Diseases (Presidential Address).

ROYAL ASTRONOMICAL SOCIETY (Geophysical Meeting), at 5.—Prof. E. V. Appleton: Upper Air Ionisation.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Malformations of the Human Body considered from a New Point of View (Hunterian Lecture).

MONDAY, FEBRUARY 1.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. J. P. Hosford: Some Factors in the Causation of Hydronephrosis (Hunterian Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society) (Inaugural Meeting for Year), at 6.—F. W. Mackenzie Skues: Presidential Address.

INSTITUTE OF FUEL (at Institution of Electrical Engineers), at 6.30.—Presentation of the Melchett Medal to Prof. Bone and delivery of the Melchett Lecture by Prof. Bone: A Century of Fuel Economy.

ROYAL SOCIETY OF ARTS, at 8.—Capt. O. A. Barrand and G. A. Green: Life-Saving Appliances on Merchant Ships (Thomas Gray Lectures) (3).

TUESDAY, FEBRUARY 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. C. A. Edwards: The Progress of Research relating to Physical Metallurgy (3).

WEDNESDAY, FEBRUARY 3.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. R. T. Payne: Excretion Urography (Intravenous Pyelography) (Hunterian Lecture).

ROYAL SOCIETY OF ARTS, at 8.—A. Broughton Edge: Geophysical Methods of Prospecting.

ROYAL SOCIETY OF MEDICINE (Medicine and Surgery Sections), at 8.30.—Special Discussion on Diagnosis and Treatment of Abscess of the Lung.

THURSDAY, FEBRUARY 4.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—M. H. A. Newman: Topological Methods in the Theory of Continuous Groups (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. G. Cannon: Feeding and Digestion of Invertebrates (3).

FRIDAY, FEBRUARY 5.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Discussion on Common Colds and their Sequelæ.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. R. Hobbs: Puerperal Sepsis, with an Account of the Treatment of Puerperal Infection by Glycerine Drainage (Hunterian Lecture).

GEOLOGISTS' ASSOCIATION (in Botany Theatre, University College) (Annual General Meeting), at 7.30.—Prof. W. W. Watts: Fossil Landscapes (Presidential Address); and presentation of Foulerton Awards to F. Gossling and Dr. S. W. Wooldridge.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. G. C. Simpson: Weather Forecasting.

Public Lectures.

FRIDAY, JANUARY 29.

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: The Desert (Swiney Lectures) (11).

SATURDAY, JANUARY 30.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. A. I. Richards: Women's Life and Work in a Central African Tribe.

MONDAY, FEBRUARY 1.

LONDON SCHOOL OF ECONOMICS, at 5.—H. D. Henderson: Trade Theories and the Great Depression (1). (Succeeding Lectures on Feb. 8, 15, and 22.)

GUY'S HOSPITAL MEDICAL SCHOOL (in Physiological Theatre), at 5.—Prof. H. A. Harris: The Use of X-Rays in Physiological Investigations.

IMPERIAL COLLEGE OF SCIENCE (Royal College of Science), at 5.30.—Dr. T. M. Finlay: The Evolution of Landscape: The Ocean and its Work (Swiney Lectures) (12).

KING'S COLLEGE, LONDON, at 5.30.—Dr. A. M. Blackman: Egyptian Myth and Ritual.

TUESDAY, FEBRUARY 2.

LONDON SCHOOL OF ECONOMICS, at 5.—Dr. A. F. Meyendorff: Modern Theories of Law: The Psychological Theory.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.15.—Dr. E. W. Fish: The Pathology of Dentine and the Dental Pulp.

WEDNESDAY, FEBRUARY 3.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. D. M. Connan: The Social Burden of the Rheumatic Diseases.

SCHOOL OF ORIENTAL STUDIES (jointly with Royal Anthropological Institute), at 5.—C. W. Hobley: The Development of Native Education in Kenya.

BEDFORD COLLEGE FOR WOMEN (in Physiological Department), at 5.15.—Prof. S. J. Cowell: Modern Aspects of Nutrition. (Succeeding Lectures on Feb. 10, 17, and 24).

BELFAST MUSEUM AND ART GALLERY, at 8.—J. J. Ward: Wonderland of the Spiders.

THURSDAY, FEBRUARY 4.

SCIENCE MUSEUM, SOUTH KENSINGTON, at 4.30.—Sir Henry Lyons: Historic Meteorological Instruments.

KING'S COLLEGE, LONDON (at 40 Torrington Square, W.C.1), at 6.—S. P. Turin: Economic Conditions in Russia To-day: The Shortage of Qualified Labour and the Seven Year Plan.

FRIDAY, FEBRUARY 5.

UNIVERSITY COLLEGE, at 5.30.—H. N. Gresley: High Pressure Locomotives.—Prof. H. A. R. Gibb: The Climax of Arab Culture.

SATURDAY, FEBRUARY 6.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth-Davis: Shell-Fish in relation to Man.

Official Publications Received.

BRITISH.

Philosophical Transactions of the Royal Society of London. Series A, Vol. 230, A690: Photographic Investigation of Flame Movements in Gaseous Explosions, Parts 4, 5 and 6. By Prof. William A. Bone and Reginald P. Fraser. Pp. 363-385+plates 13-20. (London: Harrison and Sons, Ltd.)

University of Liverpool: Publications of the Hartley Botanical Laboratories. No. 7: Studies in Advancing Sterility, Part 5: The Theory of the Leguminous Strobilus. By Dr. John McLean Thompson. Pp. 79. (Liverpool.) 8*s*.

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information. Appendix 2: List of Seeds of Hardy Herbaceous Plants and of Trees and Shrubs. Pp. 59-106+ix. (London: H.M. Stationery Office.) 1*s*. net.

Empire Marketing Board. Imperial Sugar Cane Research Conference, London, 1931. Report of Proceedings. Pp. 171. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Forest Department: Trinidad and Tobago. Leaflet No. 3: Report of an Experiment on Air-Seasoning of Native Timbers. Pp. 22. Leaflet No. 4: Forest Trees of Trinidad and Tobago with Special Reference to their Timbers. Pp. 43. 6*d*. (Trinidad: Government Printing Office.)

India: Meteorological Department. Scientific Notes, Vol. 4, No. 33: Temperature Changes in Calcutta Thunderstorms. By V. V. Sohoni. Pp. 17-34. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1*s*.

International Research Council. Third Report of the Commission appointed to further the Study of Solar and Terrestrial Relationships. Pp. v+132. (London: Prof. S. Chapman, Imperial College of Science.)

Transactions of the Geological Society of Glasgow. Vol. 18, Part 3, 1928-1931. Pp. iii+361-651. (Glasgow.) 10*s*.

Proceedings of the Liverpool Geological Society. Session the seventy-second, 1930-1931. Edited by D. A. Allan. Part 4, Vol. 15. Pp. xiii+267-338. (Liverpool.)

British Industries Fair, 1932, Olympia, W.14, Feb. 22 to Mar. 3, White City, W.12, Feb. 22 to Mar. 5. Organised by the Department of Overseas Trade. Special Overseas Advance edition. Pp. xvi+464+Ad. 178+Ad. xiv. (London: Department of Overseas Trade.) 1*s*.

Leeds University Appointments Board. Report on the First Ten Years' Work of the Board. Pp. ii+8. (Leeds.)

Quarterly Journal of the Royal Meteorological Society. Vol. 58, No. 243, January. Pp. 88. (London: Edward Stanford, Ltd.) 7*s*. 6*d*.

Review of Agricultural Operations in India 1928-29. Pp. v+251+14 plates. (Calcutta: Government of India Central Publication Branch.) 3.2 rupees; 5*s*. 6*d*.

Department of Scientific and Industrial Research. Report for the Year 1930-31. (Cmd. 3989.) Pp. iv+186. (London: H.M. Stationery Office.) 3*s*. net.

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 11: July, August, September 1931. By Ernest A. Hodgson. Pp. 177-190. (Ottawa: F. A. Acland.) 25 cents.

Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending June 30th, 1931. Edited by Prof. Alexander Meek. Pp. 45. (Cullercoats.) 5*s*.

Board of Education. Educational Pamphlets No. 87: Memorandum on the Possibility of increased Co-operation between Public Museums and Public Educational Institutions. Pp. 45. (London: H.M. Stationery Office.) 9*d*. net.

FOREIGN.

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 4, No. 4, November. Pp. 273-326. (Kobe.)

Proceedings of the American Academy of Arts and Sciences. Vol. 66, No. 10: Radioactive Disintegration applied to the Measurement of Geologic Time illustrated by application to the Wilberforce Uraninite. By Gerhard Kirsch and Alfred C. Lane. Pp. 357-379. 60 cents. Vol. 66, No. 11: Bermuda during the Ice Age. By Robert W. Sayles. Pp. 381-468+13 plates. 2 dollars. Vol. 66, No. 12: On the Apsidal Motion of a Faint Eclipsing Binary. By Harlow Shapley. Pp. 469-477. 35 cents. (Boston, Mass.)

Geological Survey of China. Geological Memoirs, Series A, No. 9: The Geology of the Tsinlingshan and Szechuan. By Y. T. Chao and T. K. Huang. Pp. viii+230+19 plates+Atlas. (Peiping.)

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1931. (Publication 3128.) Pp. vii+159. (Washington, D.C.: Government Printing Office.) 20 cents.

U.S. Department of Commerce: Coast and Geodetic Survey. Triangulation. (Serial 529.) Pp. 20. (Washington, D.C.: Government Printing Office.)

University of California Publications in American Archaeology and Ethnology. Vol. 28, No. 4: Ethnography of the Yuma Indians. By C. Daryll Forde. Pp. 83-278+plates 49-57. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 2.25 dollars.

Rubber Research Institute of Malaya. Bulletin No. 3: The Root Disease Problem on Old Rubber Areas in Malaya. By A. Sharples and A. R. Sanderson. Pp. ii+43+2 plates. (Kuala Lumpur.) 1 dollar.

Bulletin of the Shanghai Science Institute. Vol. 1, No. 6: Upper Carboniferous Brachiopods from North China. By Kin-emon Ozaki. Pp. 205+15 plates. (Shanghai.)

Journal of the College of Agriculture, Imperial University of Tokyo. Vol. 11, No. 3, November 20th. Pp. 241-357+plates 16-24. (Tokyo: Maruzen Co., Ltd.) 3.00 yen.

Proceedings of the Imperial Academy. Vol. 7, No. 9, November. Pp. xxv-xxvi+331-368. (Tokyo.)

Bulletin of the Earthquake Research Institute, Tôkyô Imperial University. Vol. 9, Part 4, December. Pp. 387-513+plates 44-56. (Tôkyô: Iwanami Shoten.) 1.70 yen.

Bulletin of the American Museum of Natural History. Vol. 63, Article 2: Anomuran, Macruran Crustacea from Panama and Canal Zone. By Lee Boone. Pp. 137-189. (New York City.)

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Vol. 6, No. 3, Décembre. Rédigé par E. S. Russell. Pp. 355-524. (Copenhague: Andr. Fred. Høst et fils.) 4.50 kr.

Transactions of the San Diego Society of Natural History. Vol. 7, No. 4: The Cool-water Timms Point Pleistocene Horizon at San Pedro, California. By Alex Clark. Pp. 25-42. Vol. 7, No. 5: A New Species and a New Subspecies of Pocket Gopher. By Laurence M. Huey. Pp. 43-46. Vol. 7, No. 6: A New Meadow Mouse from Lower California, Mexico. By Laurence M. Huey. Pp. 47-50. (San Diego, Calif.)

The University of Colorado Studies. Vol. 18, No. 4. Pp. 177-282. (Boulder, Colo.) 1 dollar.

U.S. Department of Agriculture. Circular No. 204: An Air-Pressure Extension Brush for applying Creosote to Gipsy Moth Egg Clusters. By C. W. Collins and J. V. Schaffner, Jr. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents.

Reprint and Circular Series of the National Research Council. No. 102: Directory of Research in Child Development. Compiled by J. Allan Hicks. Pp. 74. (Washington, D.C.: National Academy of Sciences.) 50 cents.

Meddelande från Lunds Astronomiska Observatorium. Serie 1, Nr. 127: Tätigkeitsbericht der Sternwarte Lund in der Zeit von 1898 bis 1930. Von Knut Lundmark. Pp. 23. Serie 1, Nr. 128: Über eine Periodenamplitudenbeziehung und eine Helligkeitsamplitudenbeziehung für anagalaktische und galaktische Cepheiden. Von Knut Lundmark. Pp. 25. Serie 2, Nr. 61: Über unregelmässige Störungen bei einem Cephei-Veränderlichen. Von Walter E. Bernheimer. Pp. 34. Serie 2, Nr. 60: On the Question of the Zero Point Determination in the Metagalactic Distance Scale. By Knut Lundmark. Pp. 23. 2.00 kr. (Lund.)

CATALOGUES.

B.D.H. Vitamin Products: Avoleum; Radiostol; Radiostoleum; Radio-Malt. Pp. 8+11+14+11. (London: The British Drug Houses, Ltd.)

Catalog and Price List of Eastman Organic Chemicals. Twenty-third edition. Pp. 104. (Rochester, N.Y.: Eastman Kodak Co.)

Refractories Bulletin. No. 1, January. Pp. 4. (Bonnybridge: John G. Stein and Co., Ltd.)