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Science and Society

THE leading philosopher of the United States, Prof. John Dewey, has in his latest book ("Philosophy and Civilization" *) joined heartily in the campaign often urged in these columns for a larger scope for science and the scientific spirit, especially among educators and those responsible for social and political action. We are not offering an ordinary review of Prof. Dewey's book, as the bulk of it consists of reprints of articles on detailed philosophic questions. But the concluding essay, under the title at the head of this article, is freshly published and raises a large number of tremendous questions in small space. They all merit a treatise apiece, with several supplementary chapters on points suggested but not brought out. One need scarcely say that on the main contention we are in full accord with Prof. Dewey. He sums this up in his concluding paragraphs, that "the great scientific revolution is still to come", and that "it will ensue when men collectively and co-operatively organise their knowledge to achieve and make secure social values". "We are living in a period of depression. The intellectual function of trouble is to lead men to think. The depression is a small price to pay if it induces us to think about the cause of the disorder, confusion, and insecurity which are the outstanding traits of our social life. If we do not go back to their cause, namely, our half-way and accidental use of science, mankind will still pass through depressions, which are the graphic record of our unplanned social life. . . . But it is incredible that men who have brought the technique of physical discovery, invention, and use to such a pitch of perfection will abdicate in face of the infinitely more important human problem."

These are true, brave, and wisely hopeful words. We agree wholly with Prof. Dewey in his ultimate confidence, and sympathise with him in his chafing at the selfishness and obscurantism which prevent a more rapid advance. But one gains here and there in his article an inkling that the position in the United States must be in some respects more difficult than it is with us. For example, he refers in one place to "the obstacles against which social insurance with respect to accidents incurred in industrial employment had to contend", and says "that the idea of insurance against the risks of maternity, of sickness, old age, and unemployment is fought by all reactionary forces". Here, apparently, the Old World is actually more up to date

* Philosophy and Civilization. By Prof. John Dewey. Pp. 334. (New York: Minton, Balch and Co., 1931.) 5 dollars.

than the New. No one could use such language of the State insurance schemes now in operation in Great Britain. We have made mistakes of detail in framing them, but they were accepted and welcomed generally by all parties, and it is a commonplace among us that had it not been for such scientific prevision the aftermath of the War would have been incalculably worse—something, in fact, that we shrink from contemplating. Prof. Dewey invokes Condorcet, in his prison at the Revolution, as the pioneer in applying the calculus of probabilities to insurance against social risks. It is well to do so, for many of the most fruitful ideas which are now transforming society were first proclaimed at that time. But we on this side of the water should not forget to add the name of Josiah Royce, one of America's most profound thinkers, who worked out on a larger and more practical scale the idea of insurance which had dawned on Condorcet.

One gathers, indeed, not only from Prof. Dewey's book but also from many other sources, a picture of American mentality of extraordinary interest and acute contrasts. There is, on one hand, a much more widely diffused spirit of questioning and of eagerness for some new thing, and, on the other, a more obstinate individualism and a clinging to traditional views as a shibboleth. We have nothing quite like that in Great Britain, and it must make any advance on the path of organising society on a scientific basis much more difficult. If we may not interpret the legends of Genesis on scientific canons, how shall we fare in dealing with birth-control or the international settlement of the economic crisis ?

This brings us to the point for which this article is written—very far, of course, from sermonising to America, the advanced and generous spirits of which have laid the whole world so deeply in their debt. But the point is this. The science which is to regenerate or reorganise society must be a completely human creation, universal both in its origins and in its outlook. Prof. Dewey refers at some length, and with a qualified approval, to the Five-Years Plan in Russia. Both the reference and the qualified approval are natural enough, but he does not qualify for the most serious reason. Drastic political methods, though we may disapprove, are less serious ultimately if they remain domestic. The permanent menace and most solid ground for the criticism of the Russian experiment is that she has been proceeding in avowed hostility to the rest of the world. Her science is a thing of a special brand ; unlike that of the bourgeois world, and to be used to overthrow it. *In hoc signo non vinces !* A similar moral might be drawn, *mutatis mutandis*, from pre-War Germany. One does not wish now to be discussing war-guilt, but it is essential to notice that the application of science to social reform, if it is to be permanent and avoid the convulsions and setbacks of the past, must be on an international basis.

The working formula under which national and international applications of science to life are to be reconciled is now being worked out by mankind. It involves all the most delicate and complicated of contemporary problems, some of which find their solution by waiting and patient trial and goodwill. This, perhaps, may be the case with the currency question, but it is certainly not so with all. Some demand vigorous initiative and, above all, the alignment of more than one nation in the interests of all the rest. We know well that, when the great occasions come, we can count on a host of Americans, of whom Prof. Dewey is a notable exponent, to stand for a sane internationalism, scientific by the very nature of the modern world, but also humane. The latter condition, unhappily, does not follow as a matter of course. Our thoughts are now all turning to the world conference on disarmament. There is, no doubt, room for wide difference of opinion on the extent of the armed forces necessary for police and protective purposes by the several States, but there can be none as to the inhumanity and insane misuse of science in the continued elaboration of the submarine and poison gas, *et hoc gens omne* of modern warfare. America, we are confident, will stand by us in withstanding the whole hideous business, or at least in relegating it to an international police force, according to Major David Davies' carefully thought-out suggestion.

It will be said, no doubt, that it is a matter of education and that the governments of the world cannot go beyond the public opinion of their people. This is true only with such qualifications that it might almost be denied. All great populations, even the more educated, are capable either of mass suggestion or of intelligent guidance, if they are wisely led and the right method of approach is taken. Here is such a moment and an irrefragable cause, in March 1932.

For the ordinary education of the modern man in the ways of science and of peace, we should probably look, more than Prof. Dewey seems inclined to do, to the older literary and historical curriculum transfused by science. He speaks throughout of freedom and allowing the young to inquire and to think for themselves. Without disparaging this,

which is a common attribute of the young, mature opinion on this side would probably give the higher place to synthesis; to inducing in the minds of students the idea that harmony, both in our own minds and the world, is a possible ideal. Science was born from the agreement of minds, and we are now regaining a larger unity by the path of diverse specialities all subserving the common good, and an incomparable richness of knowledge drawn together by similar methods of thought. What we need to reform our higher education in Great Britain—we must leave America to speak for herself—is a strong strain of scientific thinking among those doing mainly literary studies, and for those on the 'science side', a recognition that science and technology have also their history, that they are the fruit of time and of collective and continuous effort, and that their results must go back to enrich the human soil from which they sprang. F. S. MARVIN.

Short Reviews

The Archæology of Berkshire. By Harold Peake. (The County Archæologies.) Pp. xi + 260. (London: Methuen and Co., Ltd., 1931.) 10*s.* 6*d.* net.

MR. PEAKE introduces us to his county with an apology. He points out that it possesses no monuments of outstanding importance—only two, the White Horse of Uffington and Wayland's Smithy, are widely known—and there are no ancient sites of exceptional interest within its borders, Silchester, by the vagaries of county boundaries, being assigned to Hampshire. Yet an area which has the Thames as one of its limits, lies next to Wiltshire, the great centre of prehistoric interest, and includes geographically, if not administratively, one of the important cities of the Roman organisation, could scarcely fail to afford material of archæological significance. In fact, it has produced evidence bearing on every period which falls within the scope of the "County Archæologies", from the earliest—two eoliths are said to have been found at Boxford—to the Norman conquest, when Abingdon was a monastic centre of importance and the county was fully occupied. On certain points, indeed, its archæological material is of considerable moment: such, for example, as the epipalæolithic culture of Thatcham, and the evidence from Wittenham and the neighbourhood, which shows continuous occupation through Romano-British and Saxon times. Questions of chronology depend upon the interpretation of the evidence of the terraced gravels of the Thames, but as Mr. Peake says, these must be regarded as still open. A carefully compiled gazetteer gives details, with bibliography, of all the archæological finds in the county, arranged under parishes.

The problem of setting out a coherent record of material, so much of which consists of isolated finds, is one of considerable difficulty. Mr. Peake has solved it happily by building up a picture of the succession of events through precise detail which conforms ultimately to a pattern determined by the geographical conditions of downland, river valley, and woodland. He has thus skilfully combined the interests of the specialist and the needs of the general reader—a perennial difficulty in a series of this kind, which must do its best to make the best of both worlds.

Science and Common Sense. By John Langdon-Davies. Pp. 284. (London: Hamish Hamilton, Ltd., 1931.) 10*s.* 6*d.* net.

MR. JOHN LANGDON-DAVIES published a year or two back an interesting and stimulating book on "Man and his Universe", of which the thesis was that the pursuit of science through the ages was the search for God. This was carried out by a sketch of the main steps in the evolution of science, and, being connected by the one master idea, it proved valuable to many lay minds who are perplexed by the intricacies and apparent *volte-faces* in present-day science. The second volume, which is now before us, attempts the more ambitious task of a philosophic survey of the whole field and discusses the relations of science with other branches of human thought; but, unfortunately, it does not take us very far. Aiming at being philosophical, it fails from want of philosophy. Where thorough and penetrating analysis is needed, it is content to put us off with superficial antitheses which lead to the devastating conclusion, often repeated, that "Reason as a leader of men is dethroned".

The fundamental fallacy is developed in the earlier part of the book, where it is shown that, as we are unable to reach the nature of 'things in themselves', the only reality within our ken is that of the relations between phenomena which are knowable only in mathematical form. These form 'reality' for the rest of the volume, and all other experience—ideas of love, beauty, goodness—are dismissed as 'make-believe'. The 'make-believe', we are led to conclude, have no substance, because they change from age to age or man to man. As if the conclusions of science were not equally liable on their own lines to evolutionary change! A more thorough analysis would give us a goal, real for all branches, though not attainable in its fullness, which is approached on converging lines in science, morality, and æsthetics. The lame conclusion of the book is a pity, because it begins with some excellent criticism of the tools of knowledge in our senses and language. But thoroughness and comprehensiveness in thought are often to seek in English books of this kind.

Perkin and Kipping's Organic Chemistry. Entirely new edition by Prof. F. Stanley Kipping and Dr. F. Barry Kipping. Pp. xi + 614 + xxix. (London and Edinburgh: W. and R. Chambers, Ltd.; Philadelphia: J. B. Lippincott Co., 1931.) 8*s.* 6*d.*

IT is nearly thirty-eight years since the first publication of this now world-famous textbook. This is its third complete revision, save for a partial one in 1922. Meanwhile its influence has become so

widespread that there is almost certainly not a single chemist under forty years of age in England who has not either studied direct from it or been taught by one who has.

That the book has only needed complete revision, in spite of its enormous sales, three times during four decades of organic chemical advance is an indication of the genius and scientific foresight of the original authors. Would that more textbooks were so conceived.

The sad reflection that one of the original authors, who approved in 1929 of this latest complete revision, did not live to see the work completed, is partly counteracted by noting that the son of the other author now collaborates with his father in bringing up to date one of the most valuable weapons in the hands of British chemists; a good textbook is surely no less than that. On the production side there is little to criticise, save the absence of a general title page for both parts and a combined list of contents at the beginning of the book.

Some of the greatest chemical advances of our time could doubtless be traced by comparing the 1894 and 1931 editions of "Perkin and Kipping". They would comprise whole areas of organic chemistry—the structure of the sugars and higher carbohydrates, the syntheses of polypeptides, investigations into the complex structures of alkaloids, sterols, and anthocyanins, the discovery of hormones and vitamins, and the steps taken towards isolating them and certain enzymes; indeed, these constitute but a small part of the investigations that will entitle the present century to be known as the age of organic chemistry. Perkin and Kipping should beyond a peradventure take no small part of that credit. A. L. B.

The Science Masters' Book. Part 1: Physics. Part 2: Chemistry, Biology, Conversazione Experiments. Experiments selected from the *School Science Review* by a Committee of the Science Masters' Association. Edited and arranged by G. H. J. Adlam, with the assistance of W. H. Barrett, F. Fairbrother, T. Hartley, O. H. Latter, E. J. Moore, G. N. Pingriff, V. T. Saunders, E. G. Savage, A. Vassall. Part 1. Pp. xvi + 256. Part 2. Pp. xvi + 267. (London: John Murray, 1931.) 7*s.* 6*d.* net each Part.

THE provision of lecture experiments to illustrate and emphasise scientific teaching is a matter of great importance, and the Science Masters' Association, in producing these two books, has succeeded in filling a marked gap in the literature. The volumes have been built up from the notes on apparatus and experiments which have appeared from time to time in the *School Science Review*. Members of the Science Masters' Association have contributed many of the experiments, and a number have been selected from the demonstrations given at the annual meetings of the Association. In this work are to be found more than four hundred experiments, distributed over the different branches of physics, chemistry, and biology. The descriptions are excellent, and a commendable feature is that, in many cases, actual figures obtained in the experiments show the reader what type of accuracy can be obtained. As appendices are given some very useful notes and experiments for conversazione use; also an excellent summary entitled "First Aid in the Laboratory", as well as information concerning the obtaining of duty-free spirit. The work is admirably balanced, well produced, illustrated with many diagrams, and is to be highly commended.

Principles of Electricity: an Intermediate Text in Electricity and Magnetism. By Prof. Leigh Page and Prof. N. I. Adams, Jr. Pp. xii + 620. (London: Chapman and Hall, Ltd., 1931.) 21*s.* net.

To any student with a good knowledge of mathematics and physics, and desirous of obtaining a sound basis of the principles of electromagnetism, this book can be recommended. It is clearly written and the symbols used are sufficiently close to the international symbols to be readily interpreted. The authors have decided that magnetic induction B and magnetic intensity H are measured in the same units (the gauss). Thus the permeability is a dimensionless ratio. If all teachers in Great Britain would agree, this would simplify teaching.

To introduce symmetry into the fundamental equations, Lorentz and Heaviside suggested a system of units which the authors call the h.l. system. The h.l. unit of charge repels an equal like charge at a distance of one centimetre away with a force of $1/(4\pi)$ dyne. We are told that the h.l. system of units is used almost universally by writers on electromagnetic theory at the present time. Future students will apparently have to learn not only the electromagnetic and the electrostatic systems of units, but also the h.l. system. We notice that 'capacity' is used and not 'capacitance'. We have difficulty in separating what the authors mean by 'proximity effect' from what they mean by 'skin effect'.

The Secret of the Golden Flower: a Chinese Book of Life. Translated and explained by Richard Wilhelm, with a European Commentary by C. G. Jung. Translated into English by Cary F. Baynes. Pp. ix + 151 + 11 plates. (London: Kegan Paul and Co., Ltd., 1931.) 12*s.* 6*d.* net.

THIS is a most welcome contribution to an understanding of Chinese spiritism. The "Golden Flower" epitomises the Chinese vision of the secret of the powers of growth latent in the psyche; while Jung's striking commentary gives a transcription of these same powers as they reveal themselves in the Western mind. In brief, the "Secret of the Golden Flower" attempts to show that the spirit must lean on science as its guide in the world of reality, and that science must turn to the spirit for the meaning of life. This main theme is developed in the Chinese version with all the poetical and mystical characteristics of Eastern wisdom. The running explanations and notes of Richard Wilhelm, who first translated this work from the Chinese, throws much light on its meaning and value. T. G.

The Origin of the Solar System

A COPY of a paper published in the *Messenger of Mathematics* in March 1898, entitled "On the Oscillations of a Heterogeneous Compressible Liquid Sphere and the Genesis of the Moon; and on the Figure of the Moon", has been sent to the Editor of NATURE by Mr. W. F. Sedgwick, who graduated from Trinity College, Cambridge, in the year 1894. Mr. Sedgwick has also submitted the manuscript of an unsuccessful essay sent in by him for the Smith's Prize at the end of the year 1895 "On the Vibrations of a Heterogeneous Liquid Sphere, with Applications to the Solar System; and on the Elastic Solid Theory of the Earth". He states that the applications to the solar system on pp. 170-171 of his published paper were based on considerations set out in much greater detail in his essay. His communications throw additional light on the history of ideas concerning the origin of the solar system. His paper has been generally overlooked in this connexion—not unnaturally, considering the somewhat distant relation between its subject and its setting—but there is no doubt of its relevance, and Sir James Jeans, in a letter to the Editor, remarks: "I regret that Mr. Sedgwick's work had entirely escaped my notice until my attention was recently directed to it. His theory of the origin of the solar system appears to have nothing in common with my own, except that both postulate tidal actions—of very different kinds. But I very gladly acknowledge that Mr. Sedgwick's hypothesis of a tidal origin for the solar system was earlier than my own."

In view of the interest and importance of the question, the Editor considers that a general survey of the hypotheses which have been advanced to account for the existence of the planets is desirable, and he has asked me to make such a survey. Presumably the choice has fallen on one so ill-qualified because a few years ago (NATURE, April 13, 1929), in reviewing a book by the late Prof. Chamberlin, it unexpectedly became my duty to comment on a controversy which had arisen in connexion therewith. Unwillingness to shirk any legitimate consequence of that review must be my excuse for accepting this further charge, but before proceeding with it there are three explanatory remarks which I wish to make.

First, this article is not to be regarded as the result of an exhaustive examination of scientific and quasi-scientific literature: it is simply an ordered account of material, most of which has been placed in my hands *ad hoc*. No claim on behalf of a hypothesis is more questionable than that of novelty. An idea which the author thinks original as likely as not proves aboriginal, and no experienced person would be unduly surprised if it transpired that modern ideas of the solar system were held by some mad precursor of Thales. If this article brings to light material so far overlooked, it will serve a useful purpose.

Secondly, no account is taken of other than published material. However strong the presumption might be that ideas in a certain unpublished paper antedated similar ideas presented in a later published paper, it is still a presumption and is consequently ignored. For the same reason no attempt is made to judge of independence or otherwise of thought. The dates of presentation or publication being given, the reader can form his own opinion on such matters.

Thirdly, the material is presented without comment on its value. It is admittedly an important matter whether a criticism of, say, Laplace's nebular hypothesis, is a legitimate one or not, but it is a matter which must be left to others to decide. Similarly, it is an important matter whether a casual mention of an idea is entitled to priority over a slightly later thorough exploration of it, but that also must be left to others to decide. In brief, this article is nothing but a probably incomplete statement of facts relating to dates of publication of relevant matter.

According to Dr. Harold Jeffreys (*Observatory*, **52**, 173; 1929), Buffon's "Natural History" (1750) contains the suggestion that the prevalence of direct revolution among the planets might be due to the system having arisen from a grazing impact between the primitive sun and a comet. (By a 'comet', it should be said, Buffon understood something much more dense and massive than a comet as we now picture it.)

Five years later Kant, in his "Universal Natural History and Theory of the Heavens" (1755), gave another explanation, bearing strong resemblances to Laplace's later and more famous nebular hypothesis. There were, however, some important differences, among which, perhaps, the chief was that Kant imagined the angular momentum of the system to be developed during its evolution, whereas Laplace put the angular momentum among the original data.

Laplace's hypothesis, which was published in his "Exposition du système du monde" (1796), is too well known to need description. Its author does not mention Kant's work, but devotes a few lines to Buffon, whose suggestion he rejects.

On the whole, the nineteenth century was satisfied with Laplace's hypothesis, but there were some dissentients, as well as some supporters, who offered what, in view of later work, are interesting additions. Thus Croll (*Phil. Mag.*, May 1868, p. 373; "Stellar Evolution and its Relations to Geological Time", 1889) conjectured that the original nebula which Laplace postulated might have been generated by the collision of two dark stars. Proctor ("Other Worlds than Ours", 1870), on the other hand, attacked Laplace's hypothesis and advocated the idea that the planets were built up by aggregation of meteorites. The revolt against Laplace was continued by Bickerton, who (*Trans. New Zealand Inst.*, **12**, 193-194; 1879, and subsequent papers) substituted for the nebular hypothesis an idea, similar to Buffon's, of a grazing collision between two stars,

followed by the building up of planets by accretion of small bodies.

The next idea appears to be due to Mr. Sedgwick, who, in his paper in the *Messenger of Mathematics* (1898), referring to the birth of the initial planet and satellites, wrote: "The initial satellite in each subsystem might be produced in the same manner as the moon on the hypothesis suggested" (that is, by tidal action of the sun coinciding in period with the natural oscillations of the primitive planets), "whilst the initial planet of the system might be caused by a similar, or different, agency in long distant periods", the "similar agency" being tidal action coinciding in period with the natural oscillations of the nebulous sun. Mr. Sedgwick's earlier unpublished Smith's Prize essay cannot be considered here for reasons already stated.

On Aug. 20, 1897, however, Prof. T. C. Chamberlin, at the Toronto meeting of the British Association, gave an address on "A Group of Hypotheses bearing on Climatic Changes"—this was published as a paper in the *Journal of Geology* (**5**, 653-683; 1897). Chamberlin criticised the nebular hypothesis—in particular, the idea that the earth was originally molten or gaseous—and proceeded to "follow the hypothetical growth of a planet built up by the slow aggregation of small bodies which join it at low velocities and develop a minimum heat". This, so far as we can gather, was the primal germ of what later came to be known as the planetesimal hypothesis. Chamberlin, whose arguments are geological, makes no reference to the similar astronomical ideas of Proctor and Bickerton.

About three years later, Chamberlin (*Journal of Geology*, **8**, 58; 1900) and, almost simultaneously, Prof. F. R. Moulton (*Astrophysical Journal*, **11**, 103; 1900) launched a more systematic attack on Laplace's hypothesis and concluded that it was definitely untenable. Chamberlin and Moulton were admittedly working in collaboration. Shortly afterwards, Chamberlin, in a paper published in the *Astrophysical Journal* (**14**, 17; 1901), and repeated in the *Journal of Geology* (**9**, 369; 1901), considered in some detail the consequences of a close approach of two stars to one another and showed that such an event might reasonably account for the existence of spiral nebulæ, meteorites, and comets. No suggestion was made, however, that the solar system might have originated in this way. Moulton's help was acknowledged, and so far as objective evidence is concerned the position may be summed up by saying that at this time Chamberlin and Moulton were collaborating on problems of cosmogony, including in particular the origin of the solar system, and that the influence of two near cosmic bodies on one another was among the problems they considered. A casual remark in 1900 by Keeler (*Astrophysical Journal*, **11**, 348) points to still more definite conclusions. Speaking of his studies of the spiral nebulæ, he says:

> If . . . the spiral is the form normally assumed by a contracting nebulous mass, the idea at once suggests itself that the solar system has been evolved from a spiral nebula, while the photographs show that the spiral nebula is not, as a rule, characterised by the simplicity attributed to the contracting mass in the nebular hypothesis. This is a question which has already been taken up by Professor Chamberlin and Mr. Moulton, of the University of Chicago.

It was not until 1904, however, that the embryonic planetesimal hypothesis actually came to birth. In the Year Book No. 3 (pp. 195-254) of the Carnegie Institution of Washington for that year (published in January 1905), Chamberlin, remarking that "a complete statement of the planetesimal hypothesis has not yet appeared in print", proceeded to supply one. His account reveals the hypothesis as primarily geological in character. Its central feature was the idea that the earth was built up by the aggregation of a large number of "planetesimals"; the production of these bodies from solar matter drawn out by a passing star was an inessential subsidiary hypothesis. Chamberlin says:

> As the basis for developing the typical form of the planetesimal hypothesis, I have assumed that the parent nebula had a planetesimal organisation from the outset. . . . To develop the hypothesis as definitely and concretely as possible, I have further chosen a special case from among those that might possibly arise, viz., the case in which the nebula is supposed to have arisen from the dispersion of a sun as a result of close approach to another large body. The case does not involve the origin of a star nor even the primary origin of the solar system, but rather its rejuvenation and the origin of a new family of planets. The general planetesimal doctrine does not stand or fall with the merits or demerits of this special phase of it, but to be of much real service in stimulating and guiding investigation, a hypothesis must be carried out into working detail so that it may be tested by its concrete and specific application to the phenomena involved, and hence the reason for developing a specific sub-hypothesis. This particular sub-hypothesis was selected for first development (1) because it postulates as simple an event as it seems possible to assign as the source of so great results, (2) because that event seems very likely to have happened, (3) because the form of the nebula supposed to arise in this way is the most common form known, the spiral, and (4) because spectroscopic observations seem at present to support the constitution assigned this class of nebulæ, . . .

From that time onwards the hypothesis has been developed in a succession of papers; its present state is described in Chamberlin's last book, "The Two Solar Families" (1928). The hypothesis of the passing star is there presented as essential to the theory, but the precise stage at which it attained that status does not concern us here.

Sir James Jeans seems first to have turned his attention to the problem in 1901. In that year he published (*Phil. Trans.*, A, **199**, 1; abstract in *Proc. Roy. Soc.*, **68**, 454; paper received, June 15, 1901) a detailed consideration of an aspect of Laplace's hypothesis under the title "The Stability of a Spherical Nebula". At the end of this paper occurs the following passage:

> In conclusion, two particular cases of 'irregularities' may be referred to. If the nebula is penetrated by a wandering meteorite, at a moment at which it is close to a state of instability, the presence of the meteorite

will constitute an irregularity, and may easily result in the formation of a satellite. And if a quasi-tide is raised in the nebula by the presence of a distant mass, the same result may be produced.

The suggestion contained here made no further appearance until it had blossomed into the formal 'tidal theory'. In a paper received by the Royal Astronomical Society on Nov. 3, 1916, and published in *Mem. R.A.S.*, **62**, part 1, 1917, Jeans considered "the motion of tidally distorted masses, with special reference to theories of cosmogony".

> In recent years [he wrote] the position of this hypothesis [Laplace's] has been challenged by speculations based ultimately upon the conception of tidal forces providing the required tendency to separation, the most complete and definite of these speculations being found in the Planetesimal Hypothesis of Chamberlin and Moulton. In the present paper I have attempted to follow up mathematically the changes in a mass of matter as the tidal forces acting on it continually increase.

As a result of the investigation the following conclusion was reached:

> The genesis of our solar system can very probably be attributed to tidal action; the explanation leaves room for a good deal of uncertainty in matters of detail, but does not demand anything impossible or very improbable. The evidence we have been able to obtain suggests that a system generated by tidal action might quite well have characteristics, both qualitative and quantitative, such as are observed in our system. The origin which seems most probable is not that of the planetesimal hypothesis.

Further developments—showing, like the planetesimal hypothesis, some modification of the original conjectures—are recorded by Jeans in "Theories of Cosmogony and Stellar Dynamics" (1919), Supplement to NATURE, March 1, 1924, and "Astronomy and Cosmogony" (2nd edition, 1929).

In *Ast. Nach.* 4308 (Jan. 1, 1909), T. J. J. See advanced the idea that the planets were not detached from the primitive sun but were "captured, or added from without, and have had their orbits reduced in size and rounded up under the secular action of the nebular resisting medium" formerly pervading our solar system. The idea was further developed in "Researches on the Evolution of the Stellar Systems", vol. 2, p. 357, 1910.

Dr. Harold Jeffreys discussed the planetesimal hypothesis in a paper in *Mon. Not. R.A.S.*, December 1916 (**77**, 84). He considered that it was open to the objection that the planetesimals would be fused and volatilised by collisions, and so could not build up the planets by the slow aggregation postulated by Chamberlin. In *Science Progress* (July 1917) he outlined some considerations on the early history of the solar system which were developed more fully in *Mon. Not. R.A.S.*, **78**, 424, April 1918. Starting, like Chamberlin, from geological data, he came to the opposite conclusion; namely, that the planets were formerly liquid or gaseous. Dismissing the nebular hypothesis of their origin by an argument described as "a modification of that of Jeans", he turned his attention to the tidal theory.

> This theory [says Jeffreys] forms part of the Planetesimal Hypothesis of Chamberlin and Moulton; its dynamical possibility has been proved by Jeans; and I have shown here and elsewhere [in *Science Progress*] that the system it would lead to would resemble our own in several striking features. It will be definitely adopted as a postulate in the present paper.

Jeffreys's further work is summarised in his book "The Earth" (2nd edition, 1929). The only subsequent development of significance here is the substitution (in *Mon. Not. R.A.S.*, **89**, 636, 731; 1929) of an actual collision for a close approach between the sun and the visiting star.

We end, therefore, where we began; the latest, like the earliest, known theory attributes our existence to the impact of another cosmic body on the primitive sun. HERBERT DINGLE.

The History of Ergot

ERGOT has been under active scientific investigation for two generations, and has provided sociological problems for ten centuries; its secrets are now almost all laid bare, and at the moment when investigators are likely to turn aside from its study to that of other subjects, Prof. Barger has come forward to write its biography.* Usually a subject of so much interest attracts the notice of the mere collator; fortunately, ergot has not done so, and it has been left for the story to be written by a distinguished chemist, who may be congratulated on having sufficient imagination to realise how rich a story it could be. Few even of those who have worked on ergot would have guessed it.

The main importance of ergot in the past was not medicinal but as a cause of epidemic disease; instead of a healing draught, it was a scourge. Strange as it may seem to us in Great Britain, "rye is still the chief cereal in a large belt of Europe extending from Holland across Northern Germany, Czecho-Slovakia, Austria, Poland, and Central Russia", and in Poland, for example, four times more rye is eaten than wheat. From the ergot present in the rye have come the many epidemics of ergotism.

Ergotism occurs in two forms, known respectively as gangrenous and convulsive; in the first form the symptoms are due to the effect of ergot on the blood vessels, as a result of which the blood supply to the extremities is cut off, so that gangrene occurs and the limb drops off; loss of the leg below the knee is common. Convulsive ergotism, on the other hand, is not an affection of the blood vessels, but of the central nervous system; it is characterised by the appearance of areas of degeneration in the spinal cord, and the symptoms are convulsive seizures.

* Ergot and Ergotism: a Monograph based on the Dohme Lectures delivered in Johns Hopkins University, Baltimore. By Prof. George Barger. Pp. xvi+279+6 plates. (London and Edinburgh: Gurney and Jackson, 1931.) 15*s.* net.

The distribution of the two forms of ergotism has long been a mystery, which Prof. Barger has now solved by the light of the recent work of E. Mellanby in Sheffield. For example, about 1770 there was an epidemic of gangrenous ergotism in Sologne on the left bank of the Rhine, while in Hanover on the right bank there was an epidemic of convulsive ergotism. Why should there have been so sharp a difference in the symptoms in the two localities? Now Mellanby has shown that convulsive ergotism is readily produced in dogs which are given one or two grams of ergot daily, provided that the diet is free from vitamin A; but the same amount of ergot produces no harmful effect if vitamin A is added to the diet. Prof. Barger points out that the difference in the 1770 epidemics in Sologne and Hanover fits in admirably with this work; Sologne was a dairy-farming district where the inhabitants had milk and butter; the vitamin A present in the diet prevented the appearance of nervous symptoms. In Hanover, on the other hand, the soil was very poor and unable to support cattle, so that the peasants had little save rye to eat; in consequence the nervous type of ergotism appeared.

Records of gangrenous ergotism go back to A.D. 857, when the "Annales Xantenses" state that a great plague of swollen blisters consumed the people by a loathsome rot, *so that their limbs were loosened and fell off before death*. The early approach of the disease is marked by a feeling of intense heat in the part affected, and this was responsible for the name 'holy fire', which during the twelfth century became associated with St. Anthony, when many sufferers began to visit the saint's relics preserved in an abbey near Vienne in Dauphiné. There was a hospital attached to the abbey, and the sick either died within seven days of their arrival or were 'miraculously' restored to health by the wholesome food they received there. The historical details which Prof. Barger has collected make fascinating reading of a kind which is only too rare in modern scientific monographs; we learn how ergotism even prevented a military campaign in Russia in 1723.

The history of the introduction of ergot into medicine is also surprising; the earliest mention of its use as a drug is in the 1582 edition of Adam Lonicer's "Kreuterbuch", but its real entry into official medicine took place in the United States! "In the Medical Repository of New York there appeared in 1808 an 'Account of the Pulvis parturiens, a Remedy for quickening Child birth', in the form of a letter from Dr. John Stearns of Saratoga county to Mr. S. Akerly." The method of administration was either in decoction or in powder. "It expedites lingering parturition and saves to the accoucheur a considerable portion of time."

Prof. Barger's monograph includes also botanical, chemical, pharmacological and clinical, pharmaceutical, and forensic sections. While Tanret in 1875 was the first to isolate one of the ergot alkaloids in crystalline form, this substance, ergotinine, is inactive, and Prof. Barger himself, together with Dr. F. H. Carr, was responsible in 1906 for the isolation of ergotoxine, which is almost certainly the more important of the two active alkaloids. All four alkaloids, ergotinine, ergotoxine, ergotamine, and ergotaminine, have recently been obtained in crystalline form by S. Smith and G. M. Timmis, and are known to be separate chemical individuals. Ergotinine has the formula $C_{35}H_{39}O_5H_5$, while ergotamine and ergotaminine are isomers having the formula $C_{33}H_{35}O_5N_5$. Only the formula of ergotoxine remains in doubt, the probability being that it is also isomeric with ergotamine. There remains the puzzle of the occurrence of ergotamine, the active alkaloid isolated by Stoll; for no other worker has obtained ergotamine from ergot *of rye*, the claims of Forst to have done so being open to doubt. Smith and Timmis readily obtained ergotamine from the ergot of *Festuca elatior*, but failed to do so from any of the many samples of ergot of rye which they examined. Stoll's statement that ergotamine is present in ergot of rye is, therefore, lacking in confirmation.

Prof. Barger's book, in its completeness and in the care taken in its presentation, is a work of art; it is a model which should inspire others, particularly those interested in pharmaceutical science, to attempt to do the same for other drugs. One imagines that among the pharmacists the book has created a sensation, which will provide them with eager discussion for some months to come.

Obituary

PROF. E. WILSON

THE sudden death on Feb. 17 of Prof. Ernest Wilson, emeritus professor of electrical engineering and fellow of King's College, London, came as a shock to his many friends and caused a widespread feeling of loss in scientific and engineering circles. Though frail in appearance, he possessed a vitality which was the envy of his numerous friends, together with an engaging personality and a devotion to duty exhibiting the utmost selflessness, which endeared him to students and all with whom he came in contact.

Born in Lincolnshire, on Nov. 25, 1863, he joined the works of Messrs. Greenwood and Batley, Leeds, where he served his time as a six-o'clock lad, learning some of life's lessons, as well as laying a solid foundation for his life's work. It is interesting to note that while at this works he was engaged on the construction of the first Brush machine and the first Ferranti alternator made in England.

Making the most of his opportunities and attending technical classes at the Yorkshire College, Wilson secured a Whitworth scholarship, which enabled him to proceed to Germany, 1886–87, and take up further studies and gain engineering experience. During his study of electro-technology in Germany, he assisted Prof. Kohlrausch

in making elaborate tests on an early Lahmeyer dynamo with the object of verifying Dr. Frölich's theory of the dynamo.

Afterwards, Wilson became a draughtsman in the Woolwich works of Messrs. Siemens Brothers, where he was largely responsible for much of the pioneer electrical work and progress of that firm. While at Woolwich, he attended evening classes at Finsbury Technical College, where he came under the influence of John Perry and Silvanus Thompson. He was appointed assistant to Dr. John Hopkinson at King's College in 1890, and, following the tragic death of Hopkinson, in 1898 he was appointed to the chair of electrical engineering, from which he retired in 1930, after forty years of devoted service as a teacher and friend of hundreds of students.

Early in his career Wilson encountered a multitude of problems which then confronted electrical engineers, such as the design of the electric motors to be used on the three-wire system for the first locomotives for the City and South London Tube Railway. This experience led him to write "Electrical Traction", published by Edward Arnold in 1897. The second edition of this book, long recognised as a standard work on the subject, was written in collaboration with Mr. F. Lydall and appeared as two volumes in 1907.

Although engineers are slow, as a rule, to take up the pen, Wilson proved to be an exception, for he was a prolific writer. From 1892 on, he contributed no less than eighty papers of his own, and about thirty of joint authorship, to the *Philosophical Transactions* and *Proceedings of the Royal Society*, *Proceedings of the Physical Society*, numerous technical journals, and to the British Association. His first paper to appear in the *Journal of the Institution of Electrical Engineers*, vol. 26, 1897, dealt with the "Relative Size, Weight, and Price of Dynamo Electric Machines", and his first contribution to *Engineering*, in 1891, dealt with the electric lighting of the Royal Naval Exhibition (1891), where his control switch for the manipulation of searchlights was shown in use.

Besides assisting in joint experimental work with Hopkinson, Wilson engaged in many researches; he worked in the fields of alternating current instruments, radio telegraphy in its early phases, the magnetic properties of iron and various alloys, and especially studied the properties of aluminium and its alloys with reference to conductivity and deterioration. He published a number of papers on magnetic shielding and the susceptibility of feebly magnetic materials. One of his earliest inventions was that of the laminated-field single and polyphase alternating-current commutator motor in 1888 (British Patent 18,525), and his original machine is to be seen at the Science Museum, South Kensington. On being requested to do so by Sir William Preece, he carried out the first tests of Marconi's wireless apparatus on the terrace at King's College, and, so far as the writer is aware, gave a favourable report on the possibilities of the new device.

The Institution of Electrical Engineers awarded Wilson the Kelvin Premium in 1921, and, so recently as last year, a premium for his paper, "The Electrical Conductivity and Tensile Properties of Light Magnesium-Aluminium Alloys as affected by Atmospheric Exposure". He was elected a member of the Council of the Institution in 1929, thereafter taking an active part in the proceedings of its committees.

Wilson took a leading part in the development of the faculty of engineering of the University of London, and was a member of the various boards of the University until his retirement.

Possessing a retiring and modest nature, Wilson made little effort to bring himself or his work before the notice of the public or even of the engineering profession, but, on the other hand, few teachers could claim so large a circle of friends or so sincere a regard as that in which he was held. He had known many of the pioneers of electrical engineering and he had an almost unrivalled store of information about early experiments and the whereabouts of original pieces of apparatus, and his advice was always sought whenever such information was wanted.

Since his retirement from the William Siemens University chair of electrical engineering at King's College, London, in 1930, Wilson devoted himself whole-heartedly to the arduous task of advising engineer students, both past and present, as to their best way of securing employment. In this he was highly successful, and last year he assisted so many as one hundred young men to obtain posts in engineering work. Wilson leaves a widow, a son, and a daughter. J. K. C.-S.

Dr. W. D. Dye, F.R.S.

AFTER a very short attack of pneumonia following influenza, there passed away on Feb. 18, at the early age of forty-four years, an unusually brilliant experimenter in the person of Dr. W. D. Dye. After being educated at Portsmouth and the City and Guilds Technical College, Dye was appointed a student assistant at the National Physical Laboratory. At that time, Mr. Albert Campbell had completed his well-known standard of mutual inductance and was engaged on very precise comparisons of resistance with mutual inductance. Other work engaging Campbell's attention was an evaluation of the ohm by an alternating current method, and a study of experimental methods for the measurement of the length of wireless waves.

In this atmosphere of high precision alternating current measurement, Dr. Dye soon became at home. He noted, with some surprise, Mr. Albert Campbell's love of making, with his own hands, small and delicate instruments like thermocouples and galvanometer suspensions, and quickly acquired similar skill. Indeed, in this direction, he delighted to do what many others thought to be impossible. He made up his mind very quickly, and when an experiment failed to give results of immediate service, he abandoned it rather than modify small details. Alternative methods for achieving results came to his mind very quickly, and not infrequently he would scrap one method

and have an alternative one worked out within a few hours.

After the War, Dr. Dye succeeded Mr. F. E. Smith, now Sir Frank Smith, as head of the Electrical Standards Division, and established his reputation for highly accurate work in the measurements he carried out on the primary electrical standards and units, including standards of inductance and capacity. He devised a new method for accurate measurement of the vertical component of the earth's magnetic field, and the apparatus he constructed for this purpose is now the principal instrument in regular use for absolute measurements at the Abinger Magnetic Observatory. More recently he had devoted himself to the development of new methods of time measurement for precise standardisation of radio frequency, and had already achieved results of a very high order, using a specially controlled tuning-fork and a quartz oscillator. He was a member of the Radio Research Board and of the British National Committee of the Union Radio-Scientifique Internationale, of which he was secretary; and at the Congresses at Washington, Brussels, and, last year, at Copenhagen, he acted as chairman of the Commission on Radio Standards. He was elected a fellow of the Royal Society in 1928, and was a member of the Council of the Physical Society.

SIR ARTHUR DUCKHAM, G.B.E., K.C.B.

THE death of Sir Arthur Duckham, which occurred with tragic suddenness on Feb. 14, is a great loss to the nation. He stood in the forefront of British industries and, at the age of fifty-two years, in the fullness of his powers, seemed destined to play a great part in the campaign that lies before our industrial leaders. Trained as an engineer under the enlightened regime of Sir George Livesey at the South Metropolitan Gas Company's works, Arthur Duckham evinced at an early age the inventive skill, enterprise, and energy which bespoke a great future. In conjunction with Col. H. W. Woodall at Bournemouth, he brought to success the well-known Woodall-Duckham process for the continuous carbonisation of coal in vertical retorts. From this achievement he passed to other work connected with furnace construction and carbonisation, and built up the great organisation of Woodall-Duckham enterprises, of which he was the leading spirit.

Duckham's labours extended widely beyond this commercial enterprise. Early in the War he was brought into action in connexion with munitions supply and, by his exceptional gifts, soon attained a leading position in this exacting and vital work. His services were recognised by conferment of K.C.B. in 1917. He was a member of the Sankey Coal Commission in 1919 and, in an individual report, favoured State ownership of mineral rights but not of mines. In 1928 he spent seven months in Australia as chief of a small commission of English industrialists appointed to advise on trade opportunities with that country. Further recognition of his public services was marked by the conferment of G.B.E. in 1929.

Duckham had a full appreciation of the part to be played by science in modern industry. Without extended formal scientific training, he had the scientific instinct and outlook. In his own business he had an elaborate and highly efficient scientific intelligence service which secured all necessary aid for his various enterprises. He was ever ready to plead the cause of science, and he had occupied the presidential chair of the Institution of Chemical Engineers and the Society of British Gas Industries. He was president-designate of the Federation of British Industries for 1932.

Sir Arthur Duckham was endowed with qualities of character and temperament which, in all walks of life, made an instant appeal and secured for him a quite exceptional measure of regard. His loss will be felt as a personal bereavement throughout a very large circle.

WE regret to announce the following deaths:

Sir Frederick William Andrewes, F.R.S., emeritus professor of pathology in the University of London, a pioneer of bacteriology in Great Britain, on Feb. 24, aged seventy-two years.

Dr. George Claridge Druce, F.R.S., curator of the Fielding Herbarium in the University of Oxford, on Feb. 29, aged eighty-one years.

General G. Ferrié, formerly president of the Committee on Longitudes of the International Astronomical Union, on Feb. 16, aged sixty-three years.

News and Views

Prof. A. W. Williamson and Japanese Development

MUCH attention is being given at present to affairs in the Far East, in connexion with which it is of interest to recall the pioneer efforts of nearly seventy years ago of Prof. Alexander W. Williamson, F.R.S., the distinguished chemist, to enable Japanese youth of high rank to obtain a knowledge of European methods in education, the arts and sciences, commerce, and manufactures. In association with him was a small band of men, inspired by his enthusiasm and example. Williamson was born at Wandsworth in 1824, and he died in 1904. Educated mostly abroad, he was a pupil of Gmelin, at Heidelberg, and Liebig, at Giessen. In 1849 he was elected professor of practical chemistry at University College, London, with which the chair of general chemistry was later (1855) combined; he remained in the service of the College for thirty-nine years. Williamson was foreign secretary of the Royal Society from 1873 until 1890, and a Royal medallist of that body. On two occasions he was chosen president of the Chemical Society.

THE opening for Williamson's scheme came in 1863, when he received, through a London merchant having trading connexions in the Far East, an offer to send

him five Japanese youths to be housed and started in educational courses akin to English ideas and outlook. Thereupon Williamson undertook the necessary supervision, and he discharged his responsibilities thoroughly. It is sufficient to mention the after careers of these students of English methods to show this. One, who became the Marquis Ito, framed, in course of time, his country's constitution; a second, afterwards Count Inouye, aroused and developed commerce; a third, Viscount Inouye, inaugurated the Japanese railway system; a fourth, Viscount Yamao, became the first Minister of Public Works, and initiated a scheme of technological training, assisted by workers drawn from British sources. In all this early planning Williamson had a share, through his disinterested activity. The first contingent of youths was followed by a party of sixteen from Tokyo, sent by the Prince of Satsuma, also placed under Williamson's watchful eye. Among these were Mori, Yoshima, and Sameshima. Finally, just over half a century ago (1880), we find Williamson engaged in a research with Sakurai, the Japanese chemist, and others of his nationality.

Imported Scientific Films and Museum Specimens

BY the Finance Act of 1925, a customs duty of 33⅓ per cent was placed upon films imported into Great Britain. During the debate on the Finance Act of 1928, Capt. Ian Fraser, M.P., moved an amendment exempting from duty "cinematograph films . . . certified by the Royal Society of London for promoting Natural Knowledge to be solely an illustration of scientific investigation for exhibition before members of a recognised scientific body and imported only for the purpose of such exhibition free of charge". This amendment was accepted, and proved to be a small but much appreciated boon to scientific workers and others, who obviously benefit by the free international exchange of films recording their investigations. The new Import Duties Bill did not include such films in its list of imports exempt from duty, and Capt. Fraser put down an amendment the object of which was to retain the privilege. This amendment has now been taken over by the Chancellor of the Exchequer as an official amendment, and was incorporated in the Bill on report stage on Feb. 25. In a letter in the *Times* of Feb. 27, Sir Henry Wellcome refers to the position of material for exhibition in museums. A clause has been added to the Import Duties Bill exempting such material when it is more than a hundred years old, but this will not cover natural history, ethnographical, and other specimens required by research workers. The Museums Association, in a letter from its honorary secretary, Mr. D. W. Herdman, has endorsed Sir Henry Wellcome's statement, adding that its views have already been communicated to the Chancellor of the Exchequer. Museum material is clearly on the same footing as printed books, and we hope that it will be possible similarly to exempt it from import duty.

Prof. C. V. Boys's Apparatus at the Science Museum

PROF. C. V. BOYS has recently presented to the Science Museum, South Kensington, some very interesting examples of his early experimental work. His use of quartz is shown in one case, where the bow which he employed in 1889 in the preparation of quartz fibres by the well-known 'bow-and-arrow' method is exhibited, together with examples of arrows used with it. Several of the fibres made by him in this way are exhibited, as well as the first quartz bulb ever blown. Soon after his successful production of quartz fibres, Prof. Boys utilised this material in an attempt to determine the constant of gravitation with a modified form of the Cavendish apparatus. He showed that increase of sensitivity could be accompanied by a considerable reduction in size, thus greatly reducing convection troubles. A small experimental apparatus made in 1889 served to demonstrate that consistent and accurate results could be obtained in this way, and as a result of the experience thus gained, a somewhat larger apparatus was made and used between 1889 and 1894 for the determination of the gravitational constant. Both instruments are now exhibited together, and form a permanent record of Boys's classical determination of this most important constant. In addition to the above, the following pieces of apparatus due to Prof. Boys are also on exhibition: the original experimental radio-micrometer, a portion of a new form of difference engine, and two electrometers, both dating from about 1891.

Scientific Research at the British Museum

BY the establishment in April 1931 of the Research Laboratory at the British Museum as a permanent institution under the control of the Trustees, the experimental stage of the undertaking, which had been continued by the Treasury and the Department of Scientific and Industrial Research for no less than eleven years, was brought to a successful conclusion. In a paper read before the Royal Society of Arts on Feb. 24, the Director of Scientific Research, Dr. Alexander Scott, indicated the nature and variety of the work carried out in his laboratory and described some of the results which have been obtained. In discovering the best means of restoring and preserving museum objects, it is essential first to learn all that is possible regarding the previous history of each specimen; neglect of this essential has, in the past, led to many failures and has earned scientific men an evil reputation. The establishment of the research department on a permanent basis, however, is clear proof that the custodians of the nation's treasures have confidence in the methods which have been devised with so much care and applied with so much success.

Restoration and Preservation in Museums

DR. SCOTT referred to the disintegration of stone objects arising from the crystallisation of salts contained in the porous material, and to the extraction of the salts by means of wet paper pulp; salts are also removed from fragile brick tablets by first applying a celluloid coating, and then diffusing the salts into distilled water. Stains on old manuscripts can frequently be removed by the application of pyridine, and brown marks on water-colour pictures by the application of a solution of chloramine-*T*. The treatment of 'bronze

disease', a condition due to the presence of chlorine, by soaking in sodium sesquicarbonate solution followed by copious washing will often remove all the chlorine without attacking the patina, whilst in aggravated cases, soaking in citric acid solution or the use of an electrolytic process may be necessary. Fourteenth century glass from Wells Cathedral was found to be coated with material derived from the combined action of an impalpable powder arising from the limestone floor and sulphuric acid provided by the combustion of gas. Other problems the successful solutions of which were described by Dr. Scott included the corrosion of a silver chalice, the unrolling of a manuscript on fragile leather, and the cleaning of marble busts.

Chemical and Photochemical Reactivity

ON Dec. 17, 1931, the Chemical Society devoted an ordinary scientific meeting to a discussion on the critical increment of homogeneous reactions. It was immediately apparent that the material then presented and the observations then offered should be put on permanent record in an accessible form, and this has since been done by the publication of a separate pamphlet (1*s.* 6*d.*) bearing the imprint of the Society and following the form of its *Journal*. The discussion was opened by Mr. C. N. Hinshelwood, whose subject was the energy of activation of chemical reactions. The magnitude and nature of activation energy, catalytic phenomena, and the contributions of quantum mechanics to the problem were among the matters considered. Mr. E. J. Bowen followed with a paper on photochemistry and chemical reactivity, referring to photosensitisation, the phenomenon of 'predissociation' discovered by Henri, and the direct reaction of excited and normal molecules. Prof. A. J. Allmand's contribution dealt with the variation of quantum efficiency with wave-length in photochemical reactions; five different types of effect are distinguished, and their incidence in affecting the quantum yield was examined. Prof. E. K. Rideal discussed transition reactions, while Dr. F. G. Soper gave an account of researches on the effect of solvents on reaction velocity. Dr. T. Iredale communicated a short contribution dealing with the heat of activation of hydrogen iodide. In the spontaneous discussion which followed, Dr. R. G. W. Norrish, Mr. C. R. Bailey, Prof. Allmand, Mr. H. W. Thompson, and Mr. Hinshelwood took part. Their observations, together with the full text of the principal contributions, are to be found in the publication already mentioned.

Preservation of the Fauna of the Empire

IN a short address at the general meeting of the Society for the Preservation of the Fauna of the Empire, the chairman, Sir Peter Chalmers Mitchell, made a strong appeal for the consolidation of the position in regard to animal reserves within the Empire. At present the continued existence of faunal reserves depends upon the goodwill of individual governments or individual parliaments. The discovery of mineral deposits, the demand for timber, and other possible eventualities, may lead to particular reserves being thrown open to traffic or trade, with disastrous effects to the animal population, which cannot be herded into new areas at the will of man. What is needed for the permanent protection of those faunas, which are rapidly becoming relict faunas, is the raising of the status of their native territory in certain cases from temporary reserves to permanent national parks. The Society, which since its foundation has worked so strenuously on behalf of the Empire's threatened animals, has often appealed, with reasoned arguments founded upon the reports of its own observers, to the Colonial Office, but so far without success. The alteration would involve no extra expenditure; ultimately, indeed, the national parks by proper administration would bring in a certain amount of revenue; the surplus earned by the Game Department of Kenya, under strictly regulated conditions, was £15,022 in 1930. At present their creation would cost nothing, and would mean permanent security for the animals and plants in the reserved regions.

WE strongly commend the campaign which the Society has launched for the spread of news relating to wild life. A short time ago we read in a northern newspaper an account of life in the forests of British Guiana; and the article was to be followed in the course of a few days by a lecture. It is excellent propaganda, the educational value of which must be appreciated by everyone interested in Nature and its preservation. The Society has in all 867 members; it deserves and ought to have many more. May we suggest that somewhere, say on the blank cover of the *Journal*, from the December number of which we have quoted, a note should appear of the conditions of membership and of the amount of the annual subscription.

Frequency Range of Broadcast Receivers

IN opening a discussion on the selectivity of broadcast receivers at the Institution of Electrical Engineers on Feb. 24, Prof. C. L. Fortescue said that as the apparatus tested becomes more and more sensitive, components of higher and higher frequencies are found in it. The female voice is known to have components having frequencies so high as 10,000, and footfalls, hand-clapping, and the operation of typewriters are observed to have components of frequencies approaching 16,000. In broadcast transmitters provision is not usually made for such a wide range, and nearly every receiver has a much more limited range. A lower frequency limit of 50 and an upper limit of 5000 are usually considered to give good results. In the production of talking films, the audio-frequency output is, perhaps, subjected to the most careful scrutiny. In this case there is a noticeable tendency to try to get a full response up to a frequency of 10,000.

THE problem of getting uniformity of response over the whole audible range is more difficult. A highly trained observer detects, at particular frequencies, increases or diminutions in the loudness which the ordinary person does not notice. 'Musical' people are sometimes even the least critical of all in this

respect, owing to their peculiar power of imagining all the missing parts, just as in an ordinary telephone conversation the listener himself occasionally provides as much as fifty per cent of the intelligibility. It was mentioned that there is a good deal of evidence to show that many receivers accept high-frequency energy over a far wider range of frequency than is necessary. The result is that they suffer from serious interference, as the waves of transmissions on neighbouring frequencies and the programmes they carry are also heard. It would obviously be better to limit the high-frequency range. The question of whether the average purchaser of a broadcast receiver can be entrusted to get the best results from a sharply tuned high-frequency circuit is one that can only be settled by statistics.

Fisheries of the Thames Estuary

IN a note in NATURE of May 11, 1927, attention was directed to the unpublished reports of Dr. James Murie on the Thames Estuary fisheries. Before his death in 1925, Dr. Murie had published the first part of his "Report on the Fisheries of the Thames Estuary", containing Sections 1 to 3 and the greater part of Section 4. The second part, consisting of a large folio volume now in the Southend Public Library, was not published. Part of this is in galley proof, but the sixth section is in manuscript, and was written probably between 1895 and 1912. It was found in 1926 in an outhouse of Dr. Murie's cottage at Leigh, and consisted of a sodden mass of paper. The sheets were carefully separated, dried, and transcribed by the Borough Librarian, Mr. Pollitt, and a digest of this unpublished section is embodied in a long article by Mr. A. Laurence Wells, published in the *Southend Standard* (Jan. 7 and 14, 1931), entitled "Special Thames Estuary Fisheries". The matter is full of interest and covers a wide field. It consists mainly of detailed notes on the various fisheries in the Thames Estuary, especially those relating to the Leigh fishermen, and embraces the history of many of the older industries and the methods employed, both ancient and modern. These carefully collected data about each individual fishery are of historical value. Many of the methods are now obsolete, but most of the fisheries themselves are still flourishing.

WHITEBAITING is a comparatively recent industry among the Leigh fishermen. Some two hundred years ago it was practised up the river beyond Blackwall, but pollution of the water has driven the whitebait more to the Thames mouth, where the fishing is principally carried on. At first they fished only in spring, then in the original season from February to August; now they fish throughout the year. Shrimping, on the other hand, is an industry of long standing, begun about a hundred years ago. Starfish dredging used to be profitable, now it is almost extinct. The five-finger star is a great enemy of the oyster, and in dredging for them the fishermen not only helped the oyster but also utilised the starfish by selling them to the farmer for manure. Now, however, owing to chemical manure, the farmer no longer wants them. Other enemies which are much dreaded both by the whitebaiters and the shrimpers are the jelly-fishes and ctenophores, known by them as 'flat gall' and 'nut gall'. These come swarming from the sea during April and May, clogging the nets so that a continual and wearisome sorting is necessary. This manuscript is an important addition to the literature concerning the Thames Estuary fisheries, and all workers on the subject are indebted to those who have made it available to the public. Although containing about 22,000 words, it is obviously unfinished, for further sections were indicated consisting of notes on many other specialised forms of fishing.

Geodesy in India

THE Geodetic Report of the Survey of India, vol. 6, deals with the very varied and extensive work done during the period Oct. 1929–Sept. 1930. A regular latitude variation programme has been started, supplementing the regular longitude observations, and in due course will throw light on the existence or otherwise of crustal drift. The irregularities in the longitude results remain unexpectedly large: to improve the time-keeping, a Shortt clock has been obtained. The form of the geoid in India and the gravity work have now brought irrefutable confirmation of Burrard's Hidden Range, which at first was inferred from rather scanty deflexion data; the Hidden Range is found to be flanked on both sides by troughs. Again, the levelling results obtained in Bengal during the last seventy years have been discussed. The closing errors of the various circuits are found to be surprisingly large, much greater than should occur in the class of levelling explained. It appears that they can be simply and naturally explained by supposing that real changes of level have occurred. Parts of the alluvial plains of northern Bengal and Bihar seem to have been rising at the rate of one foot in twenty years; tidal records indicate that Calcutta is not sinking, so that the country farther north is presumed to be rising. Further, tidal predictions for the Indian Ocean have been published in a new and cheap form of greatly increased scope, on lines similar to those of the Admiralty Tide Tables.

British Museum (Natural History) Acquisitions

AMONG the recent acquisitions by the Department of Zoology are two important gifts from the Rowland Ward trustees, namely, the skull and horns of a fine specimen of the giant sable antelope from Angola and a group of the little ant-eater from northern Brazil. A valuable collection of birds has been received from Mr. R. E. Moreau, secretary and librarian of the East African Agricultural Research Station at Amani, Tanganyika Territory. This collection, which was made by the aid of a grant from the Godman Exploration Fund, consists of some four hundred specimens belonging to about two hundred species, of which eight appear to be new to science. Acquisitions in the Department of Minerals include a large block of granite showing quartz-porphyry and a vein of aplite, from Penryn, Cornwall, presented by Mr. Ernest H. Davison; samples of platinum ore from Southern Rhodesia, presented by the director, Geological Survey of Southern Rhodesia, and specimens from

other regions. A model of the largest platinum nugget found in the Urals and crystals of sulvanite (sulpho-vanadate of copper) from Utah have been purchased. The herbarium of the Royal Botanical Society of London has been presented by the Council to the Department of Botany. A valuable collection of about eleven thousand European mosses has been presented by the Rev. P. G. Rhodes; and Mrs. T. G. Elliott has presented about four hundred specimens of Ceylon ferns collected by her father, the late Rev. E. N. Freeman. The latter is of special interest as being the first large collection of localised Ceylon ferns received by the Department.

Hippophagy in Ancient Palestine

AN interim report from Sir Flinders Petrie on his excavations at Tell-el-Ajjul in southern Palestine, in the *Times* of Feb. 24, dwells on the significance of the exploration of this area for the history of the Hyksos domination in Egypt and Palestine. "The south of Palestine", it is said, "proves to be the best source for understanding this great catastrophe of ancient times." The date of the city is now fixed by scarabs of Apepa I. and the names of other Hyksos kings. The work of this season has brought to light a new custom. It will be remembered that last year the remains of a horse were discovered in one of the large pit-graves on the plain below the tell. The horse was disposed in the centre, while the bodies of the members of the family lay on shelves around the pit. Now the remains of a horse have been discovered which had evidently been sacrificed and its body buried under the foundations of a large building. Near by an oven had been built for the purpose of cooking the thigh and shoulders of the victim for a feast, while another horse had been completely cut up and the bones left on the ground after it had been eaten. Sir Flinders Petrie adds the interesting comment that no other example of hippophagy has been found in the east, and in the west the practice is not known later than the stone age.

Prof. W. E. Garner

THE course of lectures on detonating substances which was to have been given at the Royal Institution on March 1, 8, and 15 by Prof. W. E. Garner, Leverhulme professor of physical chemistry in the University of Bristol, has been postponed owing to an accident to him. Prof. Garner has been engaged for some time in a research on solid explosive substances. On Thursday, Feb. 25, when he was about to remove a crystal of pure lead azide from a cardboard pill-box containing about 5 mgm. of the material, as he raised the cover of the box with his right hand, the material exploded. Two of his fingers were seriously damaged and his left hand received lesser injuries. We are glad to learn that he is making very satisfactory progress.

French Exploratory Voyages

A USEFUL chart of the world showing all the great French voyages of exploration from the fifteenth to the early nineteenth century is included in the issue of *La Géographie* for July-August 1931. The chart, originally prepared by M. H. Roussilhe and L. Bergelin for the Exposition Internationale d'Anvers in 1930, is based on the original itineraries and charts of the voyages concerned, and though on a comparatively small scale, is remarkably clear. An old-world appearance is given to it by various reproductions of vessels of the periods of different voyages, taken from contemporary sources and suitably placed on the oceans.

New Land Speed Records

ON Feb. 24, at Daytona, Florida, Sir Malcolm Campbell set up a new record for land speed in his car *Blue Bird*. On two runs, northwards and southwards respectively, over a measured mile, his average time gave a speed of 253·968 miles an hour, thus beating his own record made last year at the same place and in the same car by about eight miles an hour. Sir Malcolm made a further attempt on Feb. 26, but his speed over the measured mile was returned as 251·748 miles an hour. His average for five miles, however, worked out at 242·751 miles an hour, thus beating his own previous record for this distance by more than thirty miles an hour. Sir Malcolm's car *Blue Bird* had been fitted with a new and more powerful Napier engine of approximately 1500 h.p.

Muslim Association for the Advancement of Science

THE objects of this Association, which was inaugurated at Aligarh about a year ago, are to stimulate research work amongst Mohammedans by means of grants in aid of special laboratory apparatus, research materials, and laboratory assistance. The Association is undertaking the publication of specialised memoirs by distinguished investigators in its *Proceedings*, and its constitution permits the creation of research professorships and visiting lectureships as soon as sufficient funds become available. Nawab Masood Jung, vice-chancellor, and Dr. R. F. Hunter, the present holder of the Nizam chair of chemistry in the Aligarh Muslim University, are the first president and vice-president respectively, but the Association's constitution has now been extended to include representation on its council from British India, Hyderabad, and Egypt.

The Hayden Memorial Gold Medal

IT is announced that the Academy of Natural Sciences of Philadelphia has awarded the Hayden Memorial Gold Medal for 1932 to Dr. Reginald Aldworth Daly, Sturgis-Hooper professor of geology in Harvard University. This is the outstanding American award for pre-eminence in geological and palæontological research. Prof. Daly's work chiefly involves the study of igneous rocks, their genesis, and the mechanics of their intrusion into the mountains of the earth. Other of his outstanding contributions to geology are his glacial-control theory of coral reefs, his work on the eustatic shift of oceanic level, and his researches on the constitution of the earth. He has presented many of his ideas in popular form in his book, "Our Mobile Earth" (1926). The Hayden award, which is made every three years, was founded in 1888 by Mrs. Emma W. Hayden, of Philadelphia, as

a memorial to her husband, Dr. Ferdinand V. Hayden, director of the United States Geological and Geographical Survey in the early days of that organisation.

Botanic Gardens in South Africa

IN Part 17 of the *Journal of the Botanical Society of South Africa* (1931) is published an excerpt from the report written by Sir Arthur Hill to the Union Government after his tour in South Africa in 1929, which was referred to in NATURE of Feb. 7, 1931, p. 217. The report states that at present, owing to lack of funds, the Director of the Kirstenbosch Botanic Garden is working single-handed and the garden staff is inadequate. This refers to 1929, and in the present *Journal* the Gardens have to report a ten per cent reduction of the Government grant which they share in common with other State-aided institutions. On the whole, the moment scarcely seems propitious for the consideration of Sir Arthur Hill's suggestion that South Africa should try to maintain three botanic gardens, with the development of a sub-tropical botanic garden at Durban and a botanic garden with arboretum at Pretoria. It is good to see that the body of supporters for the Kirstenbosch gardens, provided by the Botanical Society of South Africa, continues steadily to grow in numbers. In this same report Sir Arthur Hill presses for the policy of making Table Mountain into a Nature reserve, and it is good to learn that action has now been taken by the Administrator of the Cape Province which gives complete legal protection to the flora and fauna of the Mountain.

Biology and Quantum Theory

PROF. NIELS BOHR, of Copenhagen, has brought together a collection of articles dealing in a rather general way with modern physics, under the title "Atomtheorie und Naturbeschreibung" (Berlin: Julius Springer, 1931. 5·60 gold marks). Reference is made in several of the articles to the question of the relation between the development of quantum theory and the formulation of the fundamental problems of biology. The point of view which is taken is that a consideration of the new ideas and methods of physics, often essentially foreign to ordinary conceptions and experience, may indicate how the discussion of the place of living organisms in our scheme of things should be approached. Prof. Bohr directs attention to the existence of a natural limit to the investigation of life in the inevitable death of an organism which is subjected to a complete physical investigation of its atomic constitution. A recognition of the importance of such matters is perhaps becoming rather general, as we find Dr. P. A. M. Dirac grouping the problem of life with the relativistic formulation of quantum mechanics and the nature of atomic nuclei—as a "more difficult" problem—in the introduction to a paper on quantised singularities in the electromagnetic field, in the *Proceedings of the Royal Society* for last September, but it can scarcely be irrelevant to refer here also to Samuel Butler's ingenious treatment of a similar topic in "The Book of the Machines", sixty years ago, in "Erewhon".

Announcements

BY an order of the Committee of Privy Council, Mr. W. S. Morrison, M.P., has been appointed a member of the Medical Research Council, on the retirement of Major A. G. Church.

PROF. G. ELLIOT SMITH, professor of anatomy in University College, London, has been given the honorary degree of M.D. by the Egyptian University, Cairo, on the occasion of its first convocation, held on Feb. 27. Prof. Elliot Smith was at one time professor of anatomy in the Government Medical School, Cairo.

THE third Pedler lecture before the Chemical Society, entitled "The Life and Work of Otto Wallach", will be delivered by Prof. L. Ruzicka, of Zurich, on March 10, at 5.30 P.M. The lecture will be given in the Meeting Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1. Tickets of admission will not be required.

AT the annual general meeting of the Association of Economic Biologists held on Feb. 26, the following officers were elected: *President*, Dr. W. B. Brierley; *Vice-Presidents*, Dr. W. R. Thompson and Mr. A. D. Cotton; *Hon. Treasurer*, Dr. J. Henderson Smith; *Hon. Editors*, Dr. W. B. Brierley and Mr. D. Ward Cutler; *Hon. Secretaries*, Prof. J. W. Munro and Prof. W. Brown.

WE have already referred to the sixteenth Annual of the Paris Academy of Sciences (Feb. 6, p. 199), which contains a complete list of members, going back to 1795. The Academy has now issued a small volume containing a list of members and *correspondants* during the period 1666–1793 (Paris: Au Palais de l'Institut, 23, quai de Conti. 1931). This list was compiled by M. A. Lacroix, and gives the dates of birth and death, biographical notes, and posts held by the members.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant biochemist at the General Hospital, Birmingham—The House Governor, General Hospital, Birmingham (March 12). An aircraft and engine inspector under the Government of India—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (March 12). A principal of the Sheffield City Training College for Teachers—The Director of Education, Education Office, Sheffield (March 14). An assistant medical secretary of the British Medical Association—The Medical Secretary, British Medical Association, Tavistock Square, W.C.1 (March 14). A professor of education and head of the men's training department of the University College of South Wales and Monmouthshire—The Registrar, University College of South Wales, Cardiff (March 22). A professor of geology in the University of Birmingham—The Secretary, University, Birmingham (April 11). A woman lecturer in biology at Edge Hill Training College, Liverpool—The Principal, Edge Hill Training College, Liverpool (April 19). An assistant bacteriologist in the Central Tuberculosis Laboratory of the King Edward VII. Welsh National Memorial Association—The Bacteriologist, Institute of Preventive Medicine, The Parade, Cardiff.

Letters to the Editor

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

Metastable Atoms in Mercury Fluorescence

MERCURY vapour of low pressure stimulated by the resonance line λ2537 emits fluorescent light for a time of the order of 10^{-3} sec. This allows the fluorescence, when generated in a moving current of vapour, to travel away from its place of origin. The fluorescent light shows a spectrum of continuous bands. No complete or satisfactory account of this phenomenon has yet been given, and I do not think that the facts so far available are enough to make it possible.

It has been suggested by Franck and others that metastable mercury atoms or molecules are involved. I do not here enter upon any speculative considerations, but wish to give a short preliminary account of some experiments which prove that both kinds of metastable mercury atoms are in fact present in the stream of fluorescent vapour, when it is excited in the first instance by the resonance line.

Metastable atoms are not readily brought into evidence directly, but they can be tested for by

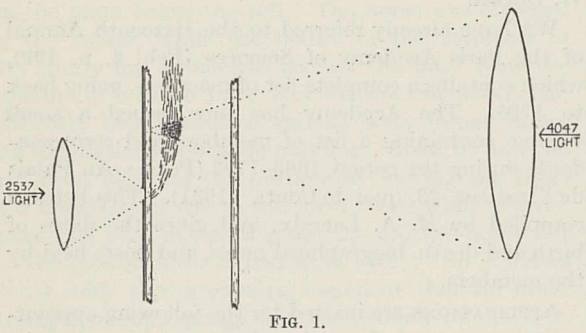

FIG. 1.

applying further excitation and observing the result. The lower kind of metastable atom, $2\ ^3P_0$, requires the higher frequency (violet) to bring it to $2\ ^3S_1$; the higher kind, $2\ ^3P_2$, is raised to the same level by green radiation. The achievement of the level $2\ ^3S_1$ is brought into evidence by the complete visual triplet being emitted, and we can look for whichever component of the triplet is most convenient.

Fig. 1 will help to explain the method of applying the test. The exciting resonance radiation comes in from the left through a small aperture in a metal diaphragm. The green fluorescence is seen to spring from the place where it enters the vapour, streaming up with the vapour as indicated. This fluorescence by no means distributes itself over the whole cross section (2 cm. square) but remains isolated, with comparatively slight lateral spreading. At a distance of, say, 1 cm. up, it meets with the converging beam of violet light, λ4046, coming from the right, and where the violet beam traverses it, a marked increase of luminosity is observed. This consists mainly of the green line λ5461, and indicates the presence of $2\ ^3P_0$ atoms, which are raised to $2\ ^3S_1$ by absorption of the violet line, and then (no doubt) emit the complete visual triplet. The green component is the best to observe, because there is no false light of this wave-length present. Moreover, it has the advantage of being favourable for visual observation. The beam of violet light can be swept up and down, and the local development of the green mercury line can be watched, following closely the contour of the initial green fluorescence which has a continuous spectrum.

A similar experiment proves the presence of $2\ ^3P_2$ atoms, but in much smaller numbers. In this case the auxiliary illumination from the right consists of the green line λ5461, which is absorbed by $2\ ^3P_2$ atoms and raises them to the $2\ ^3S_1$ level. The visual triplet is generated as before. The glare of green light already present makes it impracticable to observe the secondary development of this line, and the observation was made photographically by means of the blue and violet lines.

The same method is applicable to determine the distribution of $2\ ^3P_1$ atoms, but is not nearly so convenient for this purpose as the direct photography of resonance radiation. I do not enter into this matter here, beyond remarking that the $2\ ^3P_1$ atoms do not follow the distribution of the green fluorescence, their distribution being altogether different.

RAYLEIGH.

Terling Place, Chelmsford,
Feb. 11.

Light as a Factor in Sexual Periodicity

IN the discussion which followed the papers by Dr. J. R. Baker and Mr. R. M. Ranson and Prof. T. H. Bissonette, read before the Royal Society on Feb. 4, I suggested that their conclusions concerning light as a factor in sexual periodicity involved a principle of wide application. Dr. Baker had referred in his paper to the practical application of this principle by the poultry industry, and I remarked that Mr. Hammond had pointed out to me that it was possible to construct graphs for the principal countries of the world showing a well-marked correlation throughout the year between egg production and the incidence of daylight. I stated further that the effects of artificial illumination were known also to breeders of canaries and other cage-birds, and that within my own experience the collared turtle-dove which has been kept under conditions of domestication for many generations will breed freely under ordinary room conditions in mid-winter under the added stimulus of artificial light in the evenings. I might have added that in tropical countries where environmental conditions are similar throughout the year, such as the Cameroons, the native birds have no restricted breeding season but breed at any time. Moreover, in the case of the Brent goose and various other species of geese, although pinioned birds may be kept for years in a state of perfect health in semi-captivity, they never or very rarely breed, and I suggested that such birds require the stimulus of prolonged daylight, which they obtain in their normal breeding habitat within the arctic circle, in order to excite the activity of the reproductive organs.

In the discussion, criticism was afterwards made as to the general application of the principle, and it was remarked that nocturnal animals, such as the bat, and animals that live underground, such as the mole, breed at certain seasons without the stimulus of daylight. Owing to lack of time, the discussion closed and it was not possible to reply to this criticism; otherwise I might have pointed out that the bat in its reproductive processes is a peculiar animal, at least in the case of the common pipistrelle and some other British species, since normally they copulate in the autumn and do not ovulate until the spring. It

(*Continued on p.* 361.)

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Reviews

A Programme for Human Genetics

Genetic Principles in Medicine and Social Science. By Prof. Lancelot Hogben. Pp. 230. (London: Williams and Norgate, Ltd., 1931.) 15*s*. net.

WHEN the history of genetics comes to be written, the beginnings of human genetics will not form its most creditable chapter. Theory outran practice in its development. The biometricians used the coefficient of correlation as a universal tool; the Mendelians attempted to force the data into the even more Procrustean frame of 1 : 1 and 3 : 1 ratios; the eugenists proposed the solution of very complex social problems on the basis of quite inadequate data. Meanwhile, opponents of the genetical point of view asserted that innate factors are of no serious importance in determining human conduct. Human genetics to-day are still in this highly uncritical stage of development, but Prof. Hogben's book is at least the herald of a more scientific epoch.

The book is mainly occupied with criticism of former work in the same field. The first chapter deals with the relative importance of nature and nurture as revealed by the study of monozygotic twins and of adopted children. Its results will disappoint fanatical believers in the omnipotence either of heredity or environment. But at least they show that the problem can be solved, and that any solution must be quantitative. For any given character showing variation in a given population, it should ultimately be possible, by Fisher's method for the analysis of variance, to estimate the fractions of the total variance due to differences of environment, differences of ancestry, and segregation, respectively. The results will differ widely, not only for different characters, but also for the same character in different communities. Thus, at present adult illiteracy is mainly determined by nature in England, nurture in India. But a vast amount of further work is required before quantitative results are possible.

Geneticists will find the next three chapters most interesting. Prof. Hogben gives a critical analysis of the evidence that some human characters, such as albinism and colour-blindness, are inherited according to Mendel's laws. While the figures for colour-blindness agree perfectly with theory, those for albinism deviate by 4·7 times the standard error. This is not, of course, surprising, seeing that several distinct combinations of genes will yield a pink-eyed white rabbit, but it shows the danger of assuming determination by a single gene without critical and quantitative testing of the data. Unfortunately, it is doubtful whether Prof. Hogben's method of analysis is the best possible. It is, at least, a vast improvement on none at all. The inheritance of the blood group genes and Bernstein's beautiful and powerful method for investigating linkage are next described. Then follows a discussion of the genetical basis of mental defect. It emerges that while, for example, amaurotic family idiocy is a simple and recessive character, Mongolian idiocy is mainly determined by an unknown environmental factor, and feeble-mindedness, an extremely ill-defined condition, depends both on nature and nurture, even if the former is the more important. Among the most interesting characters considered is the possession of blue sclerotics, generally with fragile bones. It appears that this condition can be caused either by a dominant gene or by prenatal environment in a mother carrying this gene. Frost found that seed colour in *Matthiola* is determined in exactly the same way.

A chapter on race, which demonstrates the lack of evidence concerning innate psychological differences between races, is followed by a discussion of selection. As this is largely a résumé of my own work, I should like to emphasise that it was Punnett in 1917 who first calculated the extremely slow rate at which rare recessive characters would disappear from a population were their bearers prevented from breeding. It is pointed out that the effect of eugenic measures would depend on the mode of inheritance of the characters encouraged or discouraged, and that cousin marriage may be a fruitful source of human abnormalities. Thus, in a group of mental defectives here cited, only

5 per cent had defective parents, whilst in a group of insane, 8 per cent were the offspring of marriages between first cousins. If these figures are representative, a revival of the prohibition of cousin marriage might be a more eugenic measure than the sterilisation of the feeble-minded.

In the last two chapters, Prof. Hogben gives his views on the social application of eugenic principles. He is careful to point out that such views are inevitably biased by the writer's political and other opinions. He succeeds, however, in demonstrating that there is no necessary connexion between the study of eugenics and the ultra-conservative opinions so often associated with it.

The book does not attempt to cover the whole field either of human genetics or of eugenic proposals. It contains one or two very dubious statements; for example: "The genetic constitution of an individual depends on the identity of the parents. It does not depend on whether he or she happens to be the first or fifth child of a family." This neglects the fact that both linkage and selective elimination may vary with age. Nevertheless, no serious student either of genetics or eugenics can possibly afford not to read the book. If it provokes an answer on the same scientific level from a holder of what may be called the orthodox eugenic view, it will have done an immense service to the eugenic movement. Until such an answer is forthcoming, the present unfortunate breach between genetic research and eugenic propaganda is likely to be widened. An adequate answer to certain of Prof. Hogben's criticisms would serve to heal this breach. It is doubtful if anything less will do so. J. B. S. HALDANE.

Psychology with an Anthropological Background

The Psychology of a Primitive People: a Study of the Australian Aborigine. By Prof. Stanley D. Porteus. Pp. xvi + 438 + 48 plates. (London: Edward Arnold and Co., 1931.) 30*s.* net.

IN these days of specialisation, when a specialist has been defined as a person who knows something about his own subject and nothing about any other, a book such as this, which successfully combines two methods of approach to the problem in hand, is of exceptional interest and importance. Its author, primarily a psychologist, is also an experienced field anthropologist, who knows how to make friends with primitive folk, and how to take full advantage of opportunities for personal contact with them in their natural surroundings. Consequently, he realises the importance of certain aspects of the problem he has set himself which are too often overlooked by writers on racial intelligence. As one out of many instances may be cited the emphasis here laid on recognition of the fact that intelligence is manifested not only by capacity to meet new situations (which is, on the whole, the quality brought out by mental tests) but also by the ability "to deal with the age-long problems of the race, the struggle for survival and the reconciliation of man's individual and social needs".

The first portion of the book is accordingly devoted to a description of the country and the natives "under the guise of a narrative of the expeditions", so vividly written that it must surely put before the unaccustomed reader a picture scarcely less clear than the memories it will call up to those who are familiar with country of the kind described. "As far as we could see there was no living thing visible, it was . . . as though Life had taken one look at the place and gone away. Yet somewhere out on those wastes . . . are groups of natives maintaining a precarious existence, ceaselessly hunting for food day after day from dawn to dark." Against this background the author makes his natives live and move before us, and then—but not until then—he proceeds to analyse their behaviour, and to show how "at every point this behaviour is attuned to the hard conditions of their lives". He acknowledges, as must everyone who writes on Australian aborigines, his debt to Spencer and Gillen, but his account is full of first-hand experiences, since he gained the confidence of the natives so far as to be admitted to their ceremonies and shown their most secret treasures.

Social anthropologists will be interested in the chapters giving an analysis of native customs and institutions from the point of view of a psychologist. In discussing the characteristic features of Australian native society, such as their initiation rites, their marriage regulations, and the position accorded to their old men, the author develops his view that these and other observances have as their purpose "to knit the bonds of social cohesion closer, and to provide a counterbalance against socially disintegrating tendencies".

The third section of the book deals with mental tests and physical measurements, to which are added some interesting comparative data. The author does not assume too much knowledge on the part of his readers, but gives full descriptions of both tests and measurements, in terms intelligible to the non-specialist. In view of the unfortunate absence of uniformity which prevails

among physical anthropologists, he might well have gone a step further and stated exactly what technique was used, particularly in the case of sitting height and head length. He gives a detailed statement of the present position in regard to the vexed question of the relation between head size and intelligence, a subject to which he has devoted much attention in earlier studies of mental defectives and others.

In regard to the mental tests, Prof. Porteus is very clearly aware of the exceptional difficulties encountered when these are applied to people of primitive culture, and is correspondingly cautious in his interpretation of the results obtained. Of special interest is the attempt to devise tests in harmony with the cultural background of the natives, with the view of examining "the capacities fundamental to some aboriginal aptitude or skill". Thus their well-known ability as trackers suggested a test consisting in matching a series of photographic reproductions of footprints. The disadvantage of such specially designed tests lies in the difficulty of adequate standardisation, to ensure that the results of tests devised to suit different cultural conditions may be usefully interpreted and reasonably comparable. But apart from this, there would appear to be a definite place for such tests, if they really differentiate between degrees of capacity within a group. Many teachers of American Indian children in government schools have told me how thankful they would be for a test which would help in grading new-comers from the reservations, since much time and labour is wasted before the most suitable treatment for these children is discovered in the course of the ordinary school routine.

Special mention must be made of the photographs, which are noteworthy both for their intrinsic interest and for their technical excellence.

Some minor criticisms of format suggest themselves. The concluding summary might with advantage be given due prominence, instead of being tucked away in a single paragraph at the bottom of a page which has a sectional heading. The references, given as footnotes, would be more useful if listed together at the end of the volume.

This book should be included in the kit of everyone who sallies forth to study primitive people, no matter what his transport difficulties may be. That is the highest praise a field worker can bestow. The stay-at-home student will find it equally stimulating, and, indeed, it will appeal to anyone, whether student or not, who enjoys an account of real adventure.

BEATRICE BLACKWOOD.

Scottish Prehistory

Skara Brae: a Pictish Village in Orkney. By Prof. V. Gordon Childe. With Chapters by Prof. T. H. Bryce and Prof. D. M. S. Watson. Pp. xiii + 208 + 63 plates. (London: Kegan Paul and Co., Ltd., 1931.) 31*s.* 6*d.* net.

NORTH Scottish prehistory has not perhaps always received much attention at the hands of non-Scottish prehistorians. This has been largely due to the geographical position of the country, which has been assumed to have been rather at the end of the world, at least until the arrival of the Scandinavian sea-raiders in historical times. It is probable, however, that the north of Scotland was by no means thus always 'the back of beyond'; and in this area, as well as in the nearby islands, there lived folk whose culture, though simple, was both interesting to the student and not entirely autochthonous in growth. The present book deals with a series of explorations and excavations made under the supervision of Prof. V. G. Childe in the prehistoric village of Skara Brae, in Orkney, which was in process of being conserved by H.M. Office of Works at the time.

The importance of Skara Brae lies in the fact that the village was engulfed by a sand dune, and thus everything up to a height of some eight or nine feet has been preserved. Further, since wood always seems to have been rare in those parts, the villagers had to use stone where wood, if available, would doubtless have served throughout, and thus much that normally would have perished has been preserved. Culturally speaking, the whole can only be described as Neolithic; but actually in time the period of occupation was far less remote in all probability, and was contemporary with Bronze Age cultures, or even perhaps with the Iron Age elsewhere. The folk themselves were breeders of sheep and cattle. But everything cannot be dated to one age. Indeed, no less than four periods can be determined. Around and sometimes over certain of the buildings there has accumulated midden material which is itself also divisible into layers of different ages; and it has been found possible in some cases to assign these various midden deposits to one or other of the four periods just mentioned. Further, the earliest midden actually antedates the construction of the huts themselves, though a hearth typical of later times occurs in it. Culturally speaking, there is little change throughout the whole duration of the occupation.

Causes of several abandonments of the village may well have been the steady encroachment of the sand, with which the occupants seem to have been unable to cope. The final abandonment at the end of the fourth period may have been due to violent gales which produced rapid sand incursions. Afterwards, except for spasmodic returns and casual visitors, one of whom was a viking whose tomb has been found in the upper layers, Skara Brae remained unoccupied until the time of its recent excavation.

It is difficult to give an actual date for the habitation of the village, owing to the isolated life lived by these primitive island folk. Metal has not been found, but pottery techniques recall those of the later Bronze Age. Then, again, knobbed balls occur, and these have been considered by many archæologists to belong to the Iron Age. Prof. Childe himself has shown that their general distribution is similar to that of the Scottish Pictish symbols. Again, brochs occur in Orkney, yet Skara Brae seems to have been uninfluenced by their intrusive culture. Are we to consider that this village is post-broch, in spite of many of the objects found? Or can we consider that it is of older origin, influenced by, if not truly belonging to, the Scottish Bronze Age, but untouched by the broch-building invaders who dominated the country for a time, only to disappear later, leaving the Skara Brae folk to continue as their forefathers had always lived?

These are but a few of the many things described and problems discussed in this fascinating book by Prof. Childe. While Skara Brae cannot be said to have played a vital part in the building of European civilisation, it does present an exceedingly interesting problem of study for the prehistorian. At the end of the book there are two chapters by Prof. T. H. Bryce and Prof. D. M. S. Watson, on the skeletal finds and the animal remains respectively. In the case of the former, the result of an exhaustive examination seems to show that the population of Skara Brae belonged to the same sort of mixed types as might inhabit the place to-day. The animal bones present no special difficulties. They include the sort of food fauna we should expect to find in a village of domestic animal breeders.

Prof. Childe is to be congratulated both on his work in the field and on his book. It may further be added that the illustrations, which include a coloured plan, are exceptionally fine and numerous.

M. C. Burkitt.

A Classic of Farming

Thomas Tusser 1557 Floruit: his Good Points of Husbandry. Collated and edited by Dorothy Hartley. Pp. 195. (London: *Country Life*, Ltd., 1931.) 21*s.* net.

TUSSER'S book was written in the middle of the sixteenth century and ran through many editions, mostly in the nature of enlargements. The first, 1557, consists of a "hundreth good pointes of husbandrie". To this in 1571 were added a "Beleef" (creed), "a hundrethe good pointes of Huswifry, and divers proper lessens for housholders". In the 1573 edition, the hundred good "pointes of husbandrie and huswifry" had each become five hundred, and lessons on gardening, "hopps and other needeful matters", with an abstract before every month, were subjoined. Here first appeared the autobiography of Tusser—in verse. The last edition issued in the author's lifetime was that of 1580, but from time to time reprints have appeared.

The autobiography is full of grim humour. The woes of a chorister are set forth, followed by those of a reluctant scholar at Eton—"fifty-three stripes at once I had, for fault but small or none at all". Thence Tusser went to Trinity College, Cambridge, and afterwards to Court. After this he engaged in farming in various places, Cattewade in Essex, Suffolk, Norwich, and elsewhere. He lived for a time in London, whence he fled during the plague, and returned to Cambridge.

Although his book abounds in good advice, and its worth is attested by its popularity, poor Tusser died in a debtor's ward, bequeathing the money owed to him as his only wealth.

The book, as enlarged in the later editions, is a sort of 'enquire within upon everything' concerning a farmer's life. In addition to the purely farming matters, Tusser writes of herbs, family doctoring, the upbringing of children, the use of tools, and of many country themes.

The editor's foreword says truly: "If there be earth magic through a quill, it is here; for between the uncouth lines we hear the year pass". This for the general reader; for the country man there is much beside—the sixteenth century life and management of a small farm, the old recipes, the economies no longer practised. The rotation of crops was already known, and Tusser advises fallow–barley–peas–wheat–fallow. Grain should always be followed by a pea crop, which, failing a good sale, would fatten swine. Rye was a regular crop and ingredient of bread, and brank (buck-

wheat) was grown both for feeding stock and as manure for the land.

Even the 'weeds' had their uses. Mare's-tail was gathered for polishing purposes and used by fletchers and combe-makers. Whin was put up for fencing against sheep, and broom-water used as a remedy for scab. Mast was gathered and stored for the swine. Wormwood was laid on the floors of houses as a preventive of fleas.

On the veterinary side there are interesting notes. Thus we read that horses must be bled at Christmas time, and that a bullock off his feed can be cured by slicing his tail and rubbing in soot and garlic; even to-day this legendary cure is practised. Surely too we have a 'vitamin' treatment in the giving of verjuice, made from crab apples, to the cows, a pint at a time between Christmas and May.

We get a very clear picture of the communal life of a farm, where work was hard, but was broken by feasts and holidays, each with the appropriate good fare shared by master and man, mistress and maid.

> Forget not the feasts that belong to the plough
> . . . . . .
> For comfort with labour should sometime be had.

Such feasts are here set forth. On the other hand, we have Tusser's warnings against unprofitable servants.

> Trust never to boyes, if thou trust well to spede.
> Kepe never such servants as doth thee no good.
> No breakfast of custome provide for to save
> But only to such as deserveth to have.
> Children were better unborne than untaught.
> Good servants hope justly some friendship to fele.

Miss Hartley has added, in the form of footnotes, recipes and notes from contemporary sources, and the book is set with illustrations, English and Flemish, of approximately Tusser's date. A book to be savoured slowly, not taken at a gulp, but truly good fare. E. G.

"... and brought forth fruit ... an hundredfold"

Ministry of Agriculture and Fisheries. Bulletin No. 28: Artificial Fertilizers in Modern Agriculture. By Sir E. J. Russell. Pp. viii + 202. (London: H.M. Stationery Office, 1931.) 3*s.* net.

ARTIFICIAL fertilisers and the breeding of new varieties of plants constitute the two really spectacular achievements of scientific agriculture, for by augmenting production they have contributed materially to human welfare. "Too materially," says the sceptic; "we have far more wheat, barley, sugar, etc., than we can consume." Such a view, however, ignores the fact that about two-thirds of mankind, residing in the Far East and Russia, 'enjoy' a very low standard of living compared with that of most western peoples, and that China alone is said to lose several millions of population every year from starvation, direct or indirect. From the world point of view, Malthus has been right: population has tended to outstrip food supplies; but whether this tendency will persist depends upon many factors—for example, how the use of fertilisers, improved organisation of resources, transport, and distribution will affect supply, and how movements of population, the practice of birth-control, and pursuit of a high material standard of living will influence demand.

Although the consumption of fertilisers has made great strides recently, really high consumption is confined to a very few countries, and the scope for further increase is very great. Apart from financial stringency, the chief obstacle appears to be lack of knowledge, and no better book for combating this ignorance can be imagined than this recent contribution from the pen of Sir John Russell, assisted by his able staff at Rothamsted. The book—somewhat ungenerously termed a 'bulletin'—may not be a farmer's book, but it should be indispensable to agricultural teachers and advisers, as well as to the man who farms scientifically. It is a model of sound, impartial, and lucid workmanship, and the perusal of it leaves us asking for more.

The bulk of the book is devoted to descriptions of the chief nitrogenous, phosphatic, and potassic fertilisers, their effects on the growth and composition of crops, how these effects vary on different soils, and how they are influenced by the weather. History is not neglected; practical considerations like amounts, times, and rates of application of fertilisers are adequately treated; and there is a short chapter on the new concentrated complete fertilisers. Results obtained at Rothamsted occupy the centre of the stage, but there are also valuable references to work done in Germany and elsewhere. If the 'bulletin' had not been intended mainly for practical farmers in Great Britain, the author might have gone even farther afield and told us of the 'epic of superphosphate' in Australasia and South Africa, of the virtues of potash, 'super', and sodium nitrate in the great cotton-belt of America, and of the surpassing value of ammonium sulphate

for crops like sugar-cane, paddy rice, oranges, and tea in the tropics and sub-tropics; but perhaps he has these things in reserve for a future occasion.

Not the least interesting feature of the book is the statistical and economic information supplied; for example, that relating to the average crop increases that are obtainable over a series of years from the use of ammonium sulphate. Basic figures of this kind are badly needed for many countries, for when supplemented by cost figures and by prices which farmers receive for their produce at the farm, they give us the essential data required to answer the question 'How much fertiliser does it pay me to put on?' The evidence given in this book certainly indicates that in normal times the use of fertilisers for nearly all crops is extremely profitable, at any rate in countries which lie within the ambit of the world's trade; but more light is required on possibilities in territories like parts of China, Siberia, and India, which, owing to deficient transport, depreciated exchange, or other causes, are cut off from the great world markets.

It seems, however, impossible to set a limit to the appetite of the hungry earth for fertilisers, both natural and artificial. What would Lawes have thought had he lived to learn that the world was consuming some fifteen million tons of superphosphate per annum only eighty-seven years after he had started its manufacture at Deptford? And how would Crookes have reacted to the news that thirty-two years after his famous utterance at Bristol the world was using more than eleven million tons a year of nitrogenous fertilisers, more than one-half of which was derived from atmospheric nitrogen? Much has indeed been done, but more remains to be done.

The Thames Estuary

The Geography of London River. By Prof. Ll. Rodwell Jones. Pp. x + 184 + 4 plates. (London: Methuen and Co., Ltd., 1931.) 21*s.* net.

THERE are rivers mightier and nobler than the Thames: broad and stately floods, masses of moving waters, which impress the onlooker with a sense of immense and overwhelming power. Even within the narrow limits of the British Isles, the Thames has no priority of length and size. But there are few waterways anywhere in the world which rival it in historical interest and significance, or in the wide range of its commercial activities. The Thames is as much a part of the fabric of English history as is the great city on its banks, for which it is the main avenue of communication with the outer world and the chief means of transport for its trade. It is impossible to imagine London without the Thames, or to picture what the English capital would have become if it had continued to be identified with Winchester or York. To the Londoner, the Thames is a source of local patriotic pride. It is his heritage, his especial possession. "Are not Abana and Pharpar, rivers of Damascus, better than all the waters of Israel?" So Prof. Rodwell Jones, with every justification, adopts the unofficial designation of the mariner and calls it the "London River".

Undoubtedly, there is scope for such a work as this. The City and Port of London have both been the subject of exhaustive and authoritative treatises. The River rightly claims a share of notice. To be really representative, the notice should embrace the stream from its remote source in the Cotswolds to its mouth. Prof. Rodwell Jones, however, does not attempt a task of such magnitude. He is content to undertake a portion of it. His book is "about the Thames Estuary, its physical conditions and economical activities", and he deals more particularly with these matters within the limits of the nineteenth century and the first thirty years of the twentieth, contrasting the port in its physical and commercial aspects as it was a hundred and thirty years ago and as it is to-day.

By way of introduction, there is a description of the general physical setting, with a concise geological survey showing that the Thames is characterised by a duality of basins: a 'catchment basin' at its source among rocks of Jurassic age, and a 'structural basin' which is entered through Goring Gap and is constituted by the synclinorum between the Chilterns and the North Downs, containing Tertiary and Quaternary deposits. After that comes a short description of the primitive site and a discussion of the early settlements along the banks, with a consideration of the circumstances which favoured their origin and growth, grouped under such types as the bridge-port, the estuarine bluff, and the ford.

This is followed by an account of the river, as developed by natural causes and artificial measures and exploited for navigation and commerce at the beginning of the last century, this period being taken as a convenient starting-point for the main theme of the book. The physical features of the date are based on Bullock's chart of 1830, compared with one or two earlier but less reliable

and sectional publications. Prof. Rodwell Jones summarises the position as follows :

"At the opening of the century there were no considerable docks, save only that of Mr. Perry at Blackwall, and the Howland Wet Dock on the Surrey side of Limehouse Reach. On the North shore, continuous settlement had proceeded eastwards only as far as Shadwell, except that along a road used by traffic for the East India Company's store at Blackwall. On the south side, continuous settlement reached only as far as Rotherhithe. The pools were lined with wharves on both sides and various stairs led down to the shipping and to ferry-ways. There was very considerable shipping at Blackwall, Deptford, Woolwich, Erith, and Northfleet. The marshlands and marsh shores were almost free of buildings. The western embanked shore of the Isle of Dogs was the site of numerous windmills."

As regards trade, circumstances tended to concentrate shipping in or near the Pools, which were becoming congested. The Report of the Commission of 1796 furnishes statistics which show that the total tonnage of vessels engaged in the foreign trade, which entered and left the port at that date, was just over a million (1,051,508), while the coast-wise tonnage was fully a million and a half (1,662,700). The latest figures of tonnage in the book are those of 1929, but since those of 1930 are higher, we may not unjustifiably contrast the two million and a half tons of 1795 with the fifty-eight millions of 1930. It is only right to add that the returns for 1931 are showing a falling-off, due, to some extent, to the prevailing economic depression. Here it may be remarked that a comparison of Prof. Rodwell Jones's figures for 1929 with the figures for the same year as recorded in the Annual Report of the Port of London Authority, suggest that, in the former, either coast-wise tonnage is not included or that some other exclusion is made. The tonnage figures for 1929 in Table I. (page 132) aggregate only 40·55 millions.

So considerable a mass of material in the book cannot be discussed in detail, but it is desirable to mention two matters of outstanding interest : the tides and the river walls, or embankments. The two are interdependent, since the walls were constructed on account of the tides. As is well known, both sides of the river from London to the sea are bordered by earthwork embankments of appreciable height, which serve to protect the low-lying marshlands (covering an area of more than forty square miles) from inundation. These river walls, as they are termed, aggregating a hundred miles or more in length, contain an enormous mass of material, both clay and stone, the deposit and facing of which must have occasioned a tremendous outlay in the first instance. The origin of the work is lost in obscurity : the walls, or the main parts of them, date back, at least, to the twelfth century, but whether they were constructed by the Normans or by the Saxons or even, more remotely, by the Romans is open to conjecture. Whatever the date and nature of their origin, they play an essential part in confining and defining the bed of the river, and in providing an extensive area of reclaimed land for agriculture and building purposes below the high-water level of many tides.

The tides of the river Thames, though not of the same order as those of the Bristol Channel or even of the Mersey, are, nevertheless, considerable. In general terms, the range of spring tides is about twenty feet, but between the level of the lowest recorded low-water and that of the highest high-water there is a difference of so much as forty-one feet. Exceptional tides have taxed the resistance of the river walls to the utmost, as was recently exemplified in the disastrous experience of Jan. 7–8, 1928, when, under the influence of a surge, or disturbance, in the North Sea, due to meteorological causes, immediately following a period of heavy rainfall on a frozen surface in the Thames Valley, which produced an abnormal discharge of upland waters, the spring tide rose to exceptional heights in the estuary, topping the river walls in places and causing numerous breaches of greater or less extent, and, unfortunately, causing loss of life in the Westminster and Hammersmith districts.

The able discussion of these and other matters in Prof. Rodwell Jones's book makes it one of considerable interest to the geographer, the meteorologist, the historian, the engineer, the economist, and, in fact, all those whose studies are in any way connected with the estuary of the Thames. The book is well printed in bold type and the diagrams are clearly drawn. One or two slips of the pen should be noted : Dart on p. 9 should be Darenth (the mistake is repeated in the index) ; Mr. (now Sir F.) Palmer's Christian name is Frederick, not Frank (p. 98). On p. 169, the "Daily Telegraph Mills" should be the "Dartford Paper Mills", the connexion with the London journal having ceased. Also, there is another important paper mill at Dartford and one at Greenhithe not shown on the diagram, Fig. 43, on p. 168. The depth of the sill at the entrance to the Royal Victoria Dock is now 20 ft. 6 in., not 28 ft. as given in Fig. 37 (p. 150). The entrance has been altered and converted into a barge entrance. BRYSSON CUNNINGHAM.

Geology of Malaya

The Geology of Malaya. By J. B. Scrivenor. Published with the Authority of the Federated Malay States Government. Pp. xx+217. (London: Macmillan and Co., Ltd., 1931.) 16*s.* net.

READERS of Mr. Scrivenor's book on "The Geology of Malayan Ore-Deposits" will welcome this companion volume on the geology of the fascinating and enigmatic land which has claimed the author's attention since 1903. In the introduction, an interesting and instructive account is given of the history of geological investigations in Malaya, including a brief account of the Kinta tin-field controversy. It is justly pointed out that the Kinta valley does not provide a key to the geology of the country, and that while debate has been focused on that small and intricate area, the Survey Department has been occupied with the whole of Malaya. Progress has now reached the stage where linking up with the Netherlands Indies, Indo-China, and Lower Burma has become practicable. In all these lands closely accordant results have been achieved.

After a general statement of the leading geological and geographical features of the Peninsula, there are chapters dealing with the late Palæozoic and Triassic sediments and the associated Pahang Volcanic Series. During this long period, the site of Malaya was a sea of moderate depth which was finally silted up by sediment from the east. Great crustal movements occurred later and led to great intrusions of granite, which are responsible for the valuable tin deposits of the country.

An important chapter is devoted to the granite and the associated igneous rocks. A post-Triassic age now appears to be well established, and although there are no Cretaceous sediments in Malaya, the evidence from adjoining countries suggests that the intrusions may be of late Cretaceous age. The post-granitic rocks include Tertiary coal measures; high-level alluvium which appears to be Pleistocene or older; and recent alluvium and pumiceous ash.

The remaining chapters deal successively with weathering and laterite; metamorphism, with special reference to a puzzling series of tourmaline-corundum rocks, thought provisionally to be altered bauxite; various minerals and tektites; and materials of economic interest other than ores. The book concludes with a bibliography complete to 1930 and a good index. A noteworthy feature is a colour-printed geological map of Malaya, on the scale of 12 miles to the inch, which is folded in a pocket at the end of the volume.

The book is written throughout in a clear and pleasant style, enlivened with flashes of humour and local colour. Mr. Scrivenor is to be warmly congratulated on having made available in so acceptable a form the conclusions he has reached after more than a quarter of a century's arduous work in a tantalising land that has become notorious for the difficulty of its geological problems.

Physics in the Making

Recent Advances in Physics (Non-Atomic). By Prof. F. H. Newman. Pp. ix+378. (London: J. and A. Churchill, 1932.) 15*s.*

FRANKLY, we find the title of Prof. Newman's new book a little puzzling. He sets out to deal with recent advances in non-atomic physics, and, knowing his flair for exposition, we looked forward to a readable account, with due emphasis given to the experimental side, of recent developments in what we might call macroscopic or molar physics. His account is readable enough, and interesting experimental detail bulks largely therein, but the choice of topics bears singularly small relation to the title. Wave mechanics; statistical mechanics; electromagnetic radiation, including a discussion of infra-red spectra; γ-rays, cosmic rays, and the scattering and diffraction of X-rays; ninety pages on modern magnetics, and, under the heading electricity, a discussion, *inter alia*, of electrolytic conduction and of super-conductivity. These be strange themes to meet in a work where we had hoped a comfortable certainty would reign supreme and electron waves would cease to surge and roar.

The balance is to some extent redressed by a chapter on sound, which includes discussions on architectural acoustics, on sound-ranging, filters, and ultra-sonics, another chapter dealing with low temperatures and their measurement, and sections treating of high pressure researches and of atmospheric electricity. Nay, with a little twisting of the terms of reference, we may even include such topics as liquid viscosity and surface tensions, certain aspects of which Prof. Newman discusses in fairly full detail.

Truth to tell, it is impossible to make a division of topics which shall be strictly logical and shall avoid serious overlap. Prof. Newman points out, perhaps a trifle optimistically, that "the whole trend of modern science is, as it should be, towards correlation". Nevertheless, we may make a very convenient, if rough division, into molar physics, atomic physics—where the concept of the billiard-ball atom still subserves a useful purpose—and

sub-atomic physics. The difficulties and overlappings inherent in such a classification are obvious, but the section first-named will include topics which could very well replace some of the 'sub-atomic' sections of Prof. Newman's book. Photo-elasticity; recent developments in measurements of high precision; advances in applied physics, of which the Michell thrust block may be cited as an example; geophysical measurements; pyrometry—these are but a few of the topics which we should rejoice to see Prof. Newman handling and elucidating with his wonted skill.

We wish it to be clearly understood that we are suggesting substitution rather than addition. The subjects which Prof. Newman has discussed are so many and so diverse that some of them are necessarily treated in a cursory manner which, perhaps, makes the matter seem rather easier than it really is. But we do not desire to seem ungrateful. Prof. Newman has collected a vast mass of information in the three hundred and seventy pages of his text, and the book should prove very useful to a hard-pressed generation of students which has neither the leisure nor the will, among the multiplication of subjects which crowd our syllabuses, to scan critically and to abstract for itself original papers of importance. It should be added that for those who have time and inclination to refer to original sources, Prof. Newman provides carefully selected bibliographies of the various topics discussed.

ALLAN FERGUSON.

Biophysics in Muscular Action

Adventures in Biophysics. By Prof. A. V. Hill. Pp. ix + 162. (London: Oxford University Press, 1931.) 12*s.* 6*d.* net.

THE attractive title of this book is fully justified by its contents. Anyone who wished to sing with the Greek poet the praises of the inventive wit of man, σοφόν τι τὸ μηχανόεν τέχνας ὑπὲρ ἐλπίδ' ἔχων, could have no better example than some of the adventures in biophysics, of which Prof. Hill here gives an account. Technical skill and ingenuity in the use and construction of thermopiles made it possible to measure the rate at which a muscle liberates heat, when it is at complete rest, the basal metabolism of the living tissue. This basal rate was measured with the muscle in air or oxygen, and in nitrogen free from oxygen. It was about twice as great in oxygen as in nitrogen. The life of a tissue may be regarded as consisting in the balancing of destructive catabolic changes by reconstructive anabolic changes: heat may be supposed to be liberated by both kinds of change. In the absence of oxygen the anabolic changes would not appear.

When the muscle becomes active as a result of stimulation, additional heat is of course produced, whether oxygen is present or not. If oxygen is present, heat is produced for some time after the activity has ceased, and is a measure of the anabolic processes by which the muscle recovers from the changes attending activity, but finally the original basal rate is reached at the same level as before; the return is slow but complete. In nitrogen the return is rapid but incomplete. It is rapid because the slow anabolic processes involving oxidations are impossible without oxygen; the fact that it is incomplete seemed to mean that the effect of activity was to increase the instability of the living system and so lead to an increased rate of catabolic change. A very interesting observation and a very plausible interpretation; only it was surprising that the rate of catabolic change should increase directly in proportion to the amount of activity.

Among the tests to which the observation was put, was one in which hydrogen was used instead of nitrogen to displace the air surrounding the muscle. The result was that the basal metabolic rate after activity seemed to have been increased more than it would have been in nitrogen; and the plausible, interesting explanation became impossible. The phenomenon was then proved to be due to the lowering of the vapour pressure of the muscle by the activity. In activity, a few large molecules break down into a larger number of smaller ones, the osmotic pressure rises and the vapour pressure falls. Consequently, water from the solutions in the instrument, with which the vapour pressure of the muscle was previously in equilibrium, condenses on the muscle, and it is the heat released by this condensation that accounts for the apparent increase in metabolic rate of the resting muscle. In hydrogen the effect is greater because of the more rapid diffusion of water vapour in the less dense gas.

The thermopile has thus proved to be an incredibly sensitive means of recording minute differences of vapour pressure; 1 mm. on the galvanometer scale corresponding to a change of vapour pressure of the order of $0{\cdot}1\mu$ of mercury, or to an addition of less than 1 mgm. of lactic acid to 100 gm. of the solvent system of muscle. It is possible to calculate from the known chemical changes in an active muscle that these are capable of accounting for not more than four-fifths of the observed change in vapour pressure, and Prof. Hill argues from this as to the incompleteness of our knowledge of the

chemistry of muscle. It is similarly possible to calculate whether all the water in muscle (or in egg white or blood or other such fluids) is free, in the sense that it is available for the exercise of osmotic pressure by substances dissolved in it, and the result obtained is that, within at any rate about five per cent, all of it is free.

With this technique and the assistance of his colleagues, Prof. Hill has collected many new data on the fascinating questions involved in the relation between the osmotic pressure of sea water and the body fluids of its inhabitants, or the descendants of its inhabitants, including man. In man, he has found that the osmotic pressure of the blood, one of the primary physiological constants, but one which is two per cent lower in females than males, may be increased more then ten per cent by muscular exertion, and indeed probably as much as twenty per cent in an extreme case. The experiments on marine animals performed at Plymouth have brought out a number of new facts of the greatest interest in extension of those described by Prof. W. J. Dakin more than twenty years ago.

The last two of the five lectures are devoted to some of the latest work on the time relations of the heat production in muscle, and the attempt to correlate these with the more recent data upon the chemistry of muscle, the influence of viscosity on muscle mechanics, etc. Prof. Hill's record of adventures in these subjects extends now over some twenty years, and the latest of them are as full of interest as any. Blessed are they that seek, for they shall find what they were not looking for.

Progress in Physical Chemistry

(1) *Photochemical Processes: a General Discussion held by the Faraday Society, April 1931.* Pp. 353-573. (London: The Faraday Society, 1931.) 10*s.* 6*d.* net.

(2) *Recent Advances in Physical Chemistry.* By Dr. Samuel Glasstone. Pp. vii + 470. (London: J. and A. Churchill, 1931.) 15*s.*

(1) THE Faraday Society's general discussion on "Photochemical Processes", held at Liverpool on April 17–18, 1931, follows a similar discussion at Oxford after an interval of less than six years. The interval has been marked by a rapid development of our knowledge of molecular spectra, so that it is now possible to foresee in a much more definite manner the mechanism by which the molecule is activated by the initial absorption of light. In particular, it is possible by a study of absorption spectra to distinguish mere electronic activation from a *primary dissociation*, in which the molecule is immediately shattered by the incident light, and from *predissociation*, in which the activated molecule lives long enough to execute a few vibrations and thus to give rise to a band spectrum, but not long enough to exhibit a quantised rotation, so that the absorption bands are devoid of fine structure.

At the Liverpool meeting, of which a report has now been issued as a separate volume, this aspect of modern photochemistry was admirably set out by Prof. Mecke, in an introductory address to the section of the discussion on molecular spectra in relation to photochemical change. A similar introduction to the section on photochemical kinetics in gaseous systems was given by Prof. Bodenstein. This address was noteworthy for the evidence submitted that, whilst chain reactions are a frequent sequel to photochemical activation, it is extraordinarily difficult to identify the links in the chain. In the photochemical combination of hydrogen and chlorine, where the largest number of data are available, no theory has yet been developed which explains all the known facts, and it may be suspected that in other cases the completeness of the explanation may be due to lack of data rather than to correctness of theory. It is, however, now possible to identify certain molecular fragments, such as the hydroxyl radical, by means of their band spectra, and thus to establish their real existence as intermediate products of photochemical change; and Prof. Bodenstein has himself proved the intervention of ClO_3 by isolating this radical in a polymeric form as Cl_2O_6.

Prof. Berthoud's introduction to the section on photochemical change in liquid and solid systems was concerned mainly with the mechanism of activation and deactivation, and with the problem of explaining the influence of wave-length and temperature on photochemical efficiency. Finally, the introductory address to the last section of the discussion was given by Prof. Baly, on photosynthesis, and described experiments made during the past three years to secure increased photochemical efficiency by the preparation of better catalysts, and in particular by freeing them from alkaline impurities.

Papers on the photographic process were contributed by Prof. Eggert, of Leipzig, who was present and took part in the discussion, and by Prof. Weigert, of Berlin. Prof. Warburg, of Berlin, read a paper on the application of the law of photochemical equivalence to vital processes. Dr. Franckenburger, of Ludwigshafen, also read

two papers, but Dr. Herzberg, of Darmstadt, and Prof. Rollefson, of Berkeley, were unable to present their papers in person. The organising committee (Profs. Allmand, Baly, and Porter, Dr. Griffiths and Dr. Norrish), the members of which contributed six papers to the discussion, were fortunate in securing such widespread support, and have added another item to the record of successful efforts which stand to the credit of the Faraday Society as an organiser of discussions of international interest and scope.

(2) Dr. Glasstone has had a straightforward and congenial task in giving an account of "Recent Advances in Physical Chemistry", since his book is addressed to senior students, who may be assumed to possess all the preliminary knowledge that is needed in order to appreciate the most recent developments of physical chemistry. On the other hand, he has not abused this advantage by wandering unnecessarily into the domain of pure physics or by using mathematical methods that are beyond the capacity of the majority of chemists.

Dr. Glasstone's first chapter is a long one on the electronic theory of valency. This is developed on simple lines from a consideration of quantum numbers, without introducing a detailed theory of atomic spectra. The various types of valency are then discussed, the 'co-ordinate link' being represented by a single arrow, which the author finds it necessary to distinguish from the directional arrow of a chemical equation by printing the latter in heavier type. In this connexion, attention may be directed to the real advantages which follow from representing these mixed valencies by making use of the hypothesis of localised atomic charges, which was developed for this purpose by the reviewer in 1922, and has now been sanctioned from the point of view of wave mechanics by its systematic use in Pauling's recent paper. In the present chapter it would have eliminated a fictitious lack of symmetry from the formulæ assigned to the sulphite, sulphate, acid fluoride, borofluoride, and ammonium ions, when formulated as products of co-ordination; it would also have got rid of a similar lack of symmetry in the formulæ for the polymeric forms of the water molecule, and have prevented an obvious error in the translation into electronic nomenclature of Moore and Winmill's formula for the undissociated form of ammonium hydroxide.

The second chapter describes the applications of the parachor to valency problems, including the much-debated single electron bond, on lines that are already familiar from Sugden's own book on the "Parachor and Valency". The third and fourth chapters are on dipole moments and molecular spectra. Useful summaries of recent work are given in each case, and these two chapters may be regarded as completing the section of the book in which the structure and properties of chemical compounds are discussed.

The central section of the book is concerned with chemical reactions, and also includes four chapters, since a chapter on homogeneous gas reactions is followed very logically by one on photochemical reactions, whilst the chapter on heterogeneous catalysis is rightly preceded by one on the properties of surfaces. The remaining three chapters are concerned with solutions, under the three headings of "Solubility", "Strong Electrolytes", and "Acid-Base Catalysis", leading up to the modern theory of acids and bases and their activity as catalysts.

It is not practicable in a brief review to refer in detail to these individual topics, but at each point at which the reviewer has sought to check up the information given, it has been found that recent advances have been correctly recorded and adequately discussed. The book can therefore be recommended without hesitation to those advanced students who may wish to supplement the information given in the more systematic books on physical chemistry by studying some of the 'live topics' which are now conspicuous in physical and chemical literature. T. M. L.

Properties of Steam

The Revised Callendar Steam Tables (1931). Calculated by Dr. Herbert Moss from the New Data and Formulæ of the late Prof. H. L. Callendar. Published for the British Electrical and Allied Industries Research Association. Pp. 56. (London: Edward Arnold and Co., 1931.) With thumb index, 12*s.* 6*d.*; without thumb index, 10*s.* 6*d.*

THE "Enlarged Callendar Steam Tables" published in 1924 gave the properties of steam up to 2000 lb. per sq. inch. It was known, however, that the quantities above 500 lb. per sq. inch would require revision when more exact experimental information became available. With the assistance of the British Electrical and Allied Industries Research Association, Prof. Callendar was enabled to extend the researches by making direct measurements of the total heat of both water and steam at pressures up to 4000 lb. per sq. inch, and temperatures up to 750° F. The measurements covered the whole of the critical region and showed that the objection to the Joule-Thomson equation, first applied to steam by Callendar in 1900, had no

foundation in fact. A general account of the theory and equations was communicated to the Royal Society in 1928, and a set of skeleton tables, calculated from the modified equation, was included in the Report to the Research Association and reprinted in a paper presented to the Institution of Mechanical Engineers in 1929.

Dr. Herbert Moss has increased the debt which engineers owe to the late Prof. Callendar by his work, which has led to the present volume of tables. He has re-calculated the whole of the values at lower pressures and has extended the tables to 4000 lb. per sq. inch and 1000° F. The values of the saturation temperatures at the higher pressures and the corresponding values of the other properties of saturated steam differ slightly from those given in the skeleton tables of 1929. A redetermination of these saturation temperatures has been made by Mr. G. S. Callendar and Mr. A. C. Egerton, and their values appear in the present tables.

Three tables in all are given: Table I. includes the properties of dry saturated steam and water at saturation temperature from 29·6 inches of mercury vacuum to 30 inches of mercury positive gauge pressure. Table II. (pp. 16-55) gives the properties of dry saturated and superheated steam from 1 lb. to 4000 lb. per sq. inch. Table III. shows the values of $P^3/_{13}$ for use in calculating adiabatic heat drops. Fahrenheit units are used throughout. The tables are preceded by a short account of the Callendar equations with the new constants, together with explanations of methods of interpolation. The size of page adopted, 11 inches by 8 inches, enables each table to be clearly presented and easily read. The printing is beyond reproach and the thumb index is a useful adjunct. No engineer engaged in steam engine and steam turbine design can afford to dispense with this volume.

Stainless Steels

Stainless Iron and Steel. By J. H. G. Monypenny. Second and revised edition. Pp. ix + 575 + 55 plates. (London: Chapman and Hall, Ltd., 1931.) 25*s.* net.

DURING the five years which have elapsed since the publication of the first edition of this work, the metallurgy of the stainless steels has developed very rapidly. Much research, in which Great Britain has taken its full share, has been carried out upon their metallography and properties. As a result many new types of stainless steels with much higher contents of chromium, with or without nickel, copper, tungsten, etc., have been developed. In order to deal with these newer materials, the present edition has been almost completely rewritten and more than doubled in size. It is a book of first-class merit, prepared by one who is perhaps the foremost authority in this particular field.

How complex this group of steels has become may be realised from the fact that no less than thirty-seven pages are required for the consideration of the principles underlying the choice of a particular steel for a specific purpose. Further, steels which started their public life less than twenty years ago merely as materials resistant to atmospheric corrosion or to chemical attack have developed, in addition, into alloys the mission of which is to resist oxidation and to retain their strength at high temperatures. Nearly sixty pages are, therefore, devoted to the discussion of the rate of oxidation and the mechanical properties of certain of these steels at temperatures up to 1000° C.

From the time at which the steel leaves the manufacturer's hands to that at which the finished article is ready to be put into service, it may pass through many processes of fabrication and much harm may be done. Much good material has been irretrievably ruined by the use of processes—of welding, for example—which have proved quite satisfactory when applied to ordinary carbon steels. The dangers which beset the fabricator, and the precautions to be adopted, are matters which demand full and specific consideration. In discussing such matters the author's wide practical experience enables him to be of very real assistance. Although certain difficulties are still incompletely overcome, the knowledge where trouble may occur is of itself a valuable asset. Even if it does no more than carry one to those to whom these steels have been made a subject of special study, much that is good will have resulted. These materials are of great complexity and their metallographic characteristics still very far from being completely elucidated, a fact which the very tentative nature of the author's attempts to deal with the effects of chromium upon the iron-carbon diagram emphasises.

That the book represents a most important addition to the metallurgical literature of the special steels no one can doubt. The first edition has been out of print for three years, but in the result the delay in presenting this second edition has been eminently justified.

There is one further incidental point which deserves mention. A very considerable amount of the new data contained in this volume has been

obtained by the author in the laboratories of the firm with which he is associated. Permission to publish this mass of information would, even a very few years ago, have been almost unthinkable. It argues well for the enlightened views of this firm that it is now possible to do this, and is a good augury for a much more rational attitude on the part of other industrial organisations to an interchange of knowledge which, in the end, will be to the good of all. F. C. T.

Harmonic Analysis

The Theory of Spherical and Ellipsoidal Harmonics. By Prof. E. W. Hobson. Pp. xi + 500. (Cambridge: At the University Press, 1931.) 37*s.* 6*d.* net.

THE need for a treatise on harmonic analysis, more particularly on spherical harmonics, has been recognised for a long time by mathematicians who teach the subject or who find it necessary to use spherical harmonics in their investigations. Those who had the good fortune to be introduced to the study of the subject by the author of the present work had always hoped that he would find time to undertake the preparation and publication of such a treatise. It may be said at once that the work now published fulfils the expectations they had formed. Although many books which contain information about spherical harmonics have appeared since the publication of Heine's "Kugelfunctionen", none of them has claims to be considered a complete treatise on the subject, and Heine's work, though it has proved of great service to students of the subject and to mathematicians who had occasion to use harmonic analysis in their investigations, is a compilation of results which contains the material for a treatise rather than a treatise. Much has been written on the subject since the appearance of Heine's two volumes. The mere perusal of the literature involves much labour, and the task of selecting from this mass of literature what is of prime importance to students of the subject and what is necessary for the mathematical physicist is one which demands a wide knowledge of the related branches of mathematics and of applied mathematics. That the author has fulfilled these requirements the present treatise is the evidence.

The first four chapters give a complete account of the origin of the ordinary spherical harmonics; Legendre's coefficients of the first and second kinds and the associated functions are treated in detail, their more important properties are developed, and their expression in the form of series and of definite integrals is investigated. Solid harmonics are discussed fully, the addition theorem for ordinary spherical harmonics is established, and the connexion of the functions with potential theory is dealt with. The results given in this part of the treatise are sufficient for the solution of the problems of potential theory and of other branches of mathematical physics where the space under consideration is the space inside or outside the surface of a sphere or the space between two concentric spheres.

Spherical harmonics of general type are then discussed; the treatment follows the lines of the author's classical memoir on the subject, which was published in the *Philosophical Transactions* for 1896,* and contains the principal results, including expressions for the functions in the form of series and of definite integrals; the further developments which have been made later are also taken account of. Asymptotic expressions for the Legendre functions are obtained, the order of the approximation in different cases is carefully discussed, and the same methods are applied to obtain the corresponding results in the case of the general harmonic functions. The representation of a function by a series of Legendre coefficients or of Laplace coefficients is fully investigated on the same lines as Fourier series have been treated in the author's treatise on functions of a real variable. The corresponding series which occur in the theory of potential when the space is not that between two concentric spheres might have been treated in much the same way. An interesting chapter is devoted to the addition theorem for general Legendre functions. The zeros of the spherical harmonics as functions of the argument and also as functions of the order are fully discussed, and this is followed by an account of the properties of the spherical harmonics which occur in the theory of potential and kindred problems in connexion with the ellipsoids of revolution, the anchor ring, the cone, and the spherical bowl. It may be noted that Mehler's functions are not the harmonics which occur naturally in problems of potential theory when the space has as part of its boundary a cone.

There is a short account of ellipsoidal harmonics which contains most of the results which are required in ordinary applications; reference to Green's work in this field in his memoir on the "Laws of Equilibrium of Fluids Analogous to the Electric Fluid" (*Camb. Phil. Trans.*, 1833) might have been useful.

Ample references to the originals have been given

* "On a Type of Spherical Harmonic of Unrestricted Order and Argument."

throughout the book, and a useful index has been appended. The author is to be congratulated on his success in presenting the results of different investigators as a connected whole, and on having produced a treatise which will be the standard treatise on the subject for a long time.

Mathematics for the Practical Man

Mathematics for Self-Study Series. By J. E. Thompson. (1) *Arithmetic for the Practical Man.* Pp. xiii + 269. (2) *Algebra for the Practical Man.* Pp. xviii + 291. (3) *Trigonometry for the Practical Man.* Pp. x + 204. (4) *The Calculus for the Practical Man.* Pp. x + 323. (London: George Routledge and Sons, Ltd., 1931.) 7*s.* 6*d.* net each volume.

(5) *Mathematics: a Text-book for Technical Students.* By Bevis Brunel Low. Pp. vii + 448. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 12*s.* 6*d.* net.

THE science of mathematics, the most fundamental of all intellectual activities, has been studied since the dawn of history, and almost certainly before that. The motives which impel this study are various, but it would scarcely be an exaggeration to say that everyone uses mathematics in one form or another. In the past, many of the advances of pure mathematics have been bound up with practical applications. For example, it is probably not often realised that the Gibbs phenomenon of Fourier series was brought into prominence by results obtained in using the harmonic analyser of Michelson and Stratton, and was at first attributed to an inaccuracy in the machine itself.

The fascinating study of pure mathematics for its own sake is an occupation which is of necessity confined to a few who have their own specialised literature available. The corresponding class of students of advanced applied mathematics are also catered for. But beyond these specialists there remain two other larger classes; those who are interested in scientific activities generally, especially such aspects as can be appreciated by a general knowledge of elementary mathematics, and those who regard mathematics as a working tool in their daily pursuits and wish to extend their knowledge for severely practical aims. To treat these as potential specialists in mathematics would be a great mistake, and it is only fair that literature should be available which will meet their needs.

The books listed above are essentially intended for the student who is interested in the meaning and simpler technique of mathematics but has no teacher to help him. They are written in a pleasant and somewhat diffuse style so as to anticipate, so far as possible, the difficulties of those who have to follow a written explanation unaided. A paragraph from the preface of (2) deserves to be quoted, and points a moral which should not be overlooked by teachers of elementary mathematics.

"The book is rigorous in that it is scientific in its approach. It attempts to explain and not to side-step obstacles and difficult points. There can be no non-mathematical book on mathematics, and popularisation may only be gained through clarity of expression and through a human and common-sense approach with a minimum of formality."

An author who expresses this view demands respect, the more so since he has acted upon the principle here stated throughout the four books of the series.

The book on the calculus deserves special notice on account of its novel manner of approach, namely, by the method of rates and not by the method of limits. The idea of limit is of course implicit in that of rate, so that the student starts at a more advanced point than usual, but at a point which appeals to the practical mind and from which it is possible to obtain and employ the simpler results and methods without straining the reader's capability. This book has been written with amazing skill, and forms a fitting conclusion to a series which certainly fulfils the author's aim of catering for those who wish to obtain a practical mastery of some of the more usual and directly useful branches of mathematical science.

The books are well worth reading, they are eminently readable, and, in spite of the impression which might be conveyed by the titles, they do not make the main ideas subservient to practical problems. They have a wealth of fully worked examples and plenty of exercises.

(5) This book is of a rather different character from the foregoing, as it supplies a comprehensive course in analysis of a rather more advanced kind. It is intended for those who wish to make practical use of the subject in engineering, physics, chemistry, and other technical sciences. The author, however, does not call his subject "Practical Mathematics", for, as he justly points out, there is plenty of room for a difference of opinion as to what is practical. The book covers a wide range from simple equations to elementary differential equations. An excellent feature is the plentiful use of diagrams, of which there are 409. There are many well-chosen, worked examples and numerous exercises. The book can be recommended.

L. M. MILNE-THOMSON.

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is just possible that the delayed ovulation in these animals is correlated with the comparative absence of the light stimulus. However, the common bat does come under the influence of daylight to a certain extent, as may be seen even in mid-winter on any mild days. Thus, in January, which was notoriously mild, I observed bats in the late afternoon flying in the light of the setting sun, and Dr. Rastall observed them at mid-day. Moreover, as described by Heape in his lately published posthumous book, several species of bats are migratory and 'follow the twilight'. With regard to the mole, it is well known that these animals do spend some time above the surface of the ground. For a description of their habits in this respect, Millais's book on the "Mammals of Great Britain and Ireland" may be consulted.

It is obvious, however, that although the principle enunciated by Dr. Baker and Prof. Bissonette is probably of extensive application, as shown by the general tendency for animals to breed in spring, the degree of response varies greatly for different species, and in some, possibly, scarcely any light at all is necessary. Furthermore, it is evident that the recurrence of breeding must depend upon other factors, of which the natural internal rhythm is most certainly one. The black swan and the *Cereopsis* goose in captivity in England, as well as other animals referred to in my "Physiology of Reproduction", illustrate this point.

It is interesting to note that Dr. A. S. Parkes had at one time contemplated the possibility of light as a factor in determining the onset of reproductive activity, for, working with Miss M. Hill, he exposed two anœstrous ferrets to ultra-violet light but found that this had no effect on the sexual processes of the animals, a negative result on which he comments.[1] Mr. S. Zuckerman, in his recent book, in describing this experiment, remarks that light appears to be an unimportant factor in determining the onset of sexuality, but he refers to Dr. Baker's results in a footnote. Had Dr. Parkes made use of rays from the other end of the spectrum, as was done by Prof. Bissonette for starlings, he would probably have obtained a positive result.

Lastly, it may be remarked that if any cogency is attached to the argument derived from the bat and the mole, it applies equally against the now universally accepted view as to the physiological action of ultra-violet light.

F. H. A. MARSHALL.
Christ's College, Cambridge,
Feb. 8.

[1] *Proc. Roy. Soc.*, 1930.

Number of Free Protons in the Nucleus

WHEN one tries to establish a connexion between the nuclear spin and the number of protons (not bound in α-particles) in the nucleus, one is led to examine the possibility that not as many protons as possible are combined as α-particles; very suggestive in this respect is the case of bismuth (nuclear moment $\frac{9}{2}h/2\pi$), the nucleus of which may be assumed to be

$$A = 209 = 52\alpha + 1p + 22e \text{ or, as a first trial,}$$
$$A = 209 = 50\alpha + 9p + 26e.$$

From a general point of view, one now would expect that in the neighbourhood of $A = 100$ (A = atomic weight), one α-particle must be assumed to be split up into protons and electrons.

This assumption has an influence on the energy of binding E_b of the nucleus, which is given by the equation

$$E_b = [n_\alpha . m_\alpha + n_p . m_p + n_e . m_e] - A,$$

where n_α, n_p, n_e, m_α, m_p, m_e are the numbers and the masses of the α-particles, free protons, and free electrons contained in the nucleus. In the following the term $n_e . m_e$, as being small, will be neglected.

If one more α-particle is assumed to be split up, the new value of the energy of binding will be

$$E_b' = [(n_\alpha - 1)m_\alpha + (n_p + 4)m_p] - A.$$

This differs from the first expression by an amount of $42{\cdot}3 \times 10^{-6}$ ergs or about 0·030 mass-units ($He/4$).

All this is well known.[1] It seems, however, that the above-mentioned assumption, when brought into relation with the curve of energy of binding for all

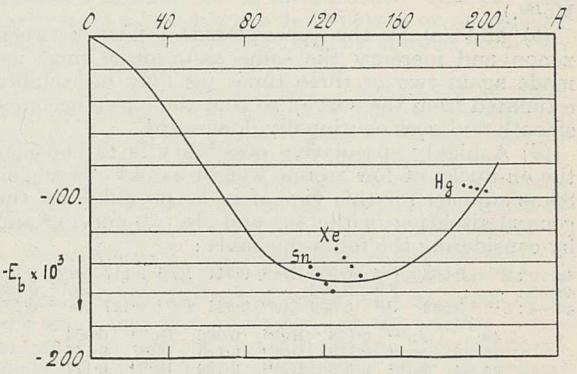

FIG. 1.

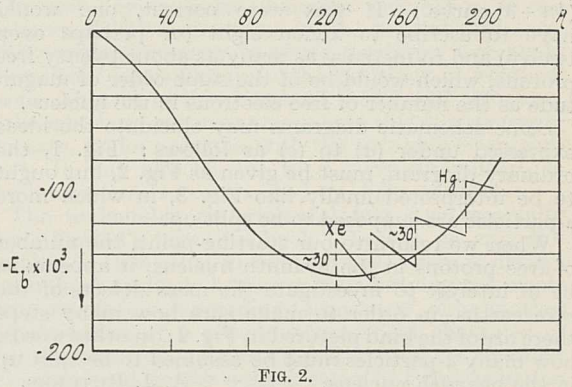

FIG. 2.

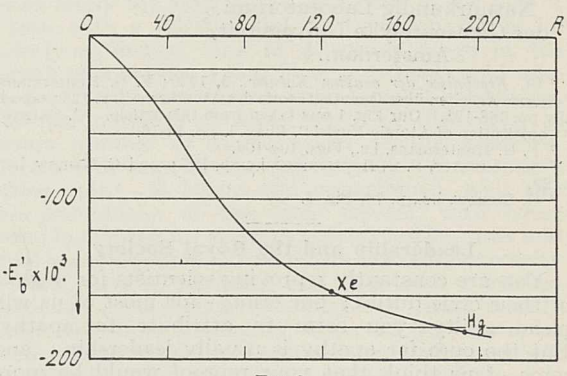

FIG. 3.

elements, may be of interest with respect to some difficulties one meets there. These difficulties are: [2]

(*a*) The points representing xenon are very much off the curve.

(*b*) After xenon the curve goes up again, which means instability of all elements heavier than xenon.[3]

(*c*) Wherever in this second part of the curve a series of points has been measured, the slope of these local curves does not fit in with the general slope (Hg^{196}, Hg^{200}, Hg^{204}, Pb^{208}, Hg^{201}, Bi^{209}, Hg^{198}, Hg^{202}, Pb^{206}, Hg^{199}, Pb^{207}).

(*d*) The points can best be represented by plotting separately the nuclei of the four different types with atomic weights $4n$, $4n+1$, $4n+2$, and $4n+3$. The difference between the $(4n)$ and the $(4n+3)$ curve is about 0·025 mass-unit.

These difficulties can be removed in the following way:

(*a*) In the case of xenon, one α-particle is assumed to be split up into protons and electrons. Then the energy of binding increases ~0·030 mass-unit and all xenon points fit the curve. (The same holds for Mo^{100}.)

(*b*) and (*c*) In the (unexplored) region between xenon and mercury the same assumption must be made again two or three times (as may be roughly estimated from the curve), so that the curve becomes smooth and goes continually downward.

(*d*) A highly speculative possibility is to consider the $4n$-nuclei of low atomic weight as $(4n+4)$-nuclei. Some support for this view may be provided by the general situation of the $4n$- and $(4n+3)$-curves,[4] and by considering the following table:

$4n$:	C^{12}	0·003	O^{16}	0·009	Ne^{20}	0·011	Kr^{84}	0·117	Sn^{112}	0·142
$4n+3$:	—		F^{19}	0·032	—		—		Sn^{115}	0·168
$4n+4$:	C^{12}	0·033	O^{16}	0·039	Ne^{20}	0·041	Kr^{84}	0·147	Sn^{112}	0·172

$4n$	Sn^{116}	0·148	Hg^{196}	0·090	Hg^{204}	0·094
$4n+3$	Sn^{119}	0·173	Hg^{199}	0·113	Pb^{207}	0·117
$4n+4$	Sn^{116}	0·178	Hg^{196}	0·120	Hg^{204}	0·124

(The missing values can be interpolated from the $(4n+3)$-curve.) If this were correct, one would have to ascribe to xenon eight (or perhaps even twelve) and to mercury as many as about twenty free protons, which would be of the same order of magnitude as the number of free electrons in the nucleus.

Some schematic diagrams may elucidate the ideas expressed under (*a*) to (*c*) as follows: Fig. 1, the ordinary diagram, must be given as Fig. 2, but ought to be interpreted finally like Fig. 3, in which more α-particles are supposed to be split up.

When we return to our starting-point, the number of free protons in the bismuth nucleus, it appears to be of interest to investigate the mass defects of the rare earths, in order to make sure how many steps there are of the kind pictured in Fig. 2; in other words, how many α-particles must be assumed to be split up in the bismuth nucleus.

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[1] Cf. *Ergebnisse der exakten Naturw.*, **9**, 1930; F. G. Houtermans, "Neuere Arbeiten über Quantentheorie des Atomkerns", p. 123; especially pp. 188-191. Our Fig. 1 was taken from this article. G. Gamow, "Constitution of Atomic Nuclei", Chap. i. pp. 14-16.

[2] F. G. Houtermans, l.c., Figs. 10*a*-10*d*.

[3] See, however, F. G. Houtermans, l.c., p. 197; and G. Gamow, l.c., p. 20.

[4] G. Gamow, l.c., p. 16, Fig. 3.

Leadership and the Royal Society

YOU are constantly reproving scientists for neglect of their civic duties; our crime—for most of us will plead guilty—you seem to attribute to apathy. But the cure for apathy is usually leadership; and some of us think that your reproof would be more effective if it was directed to our natural leaders. Such, for example, is the view of "H. E. A.", who, in NATURE of Dec. 26, calls on the Royal Society to take the lead. You do not support him, because you consider (NATURE, Jan. 9) that the Society is hampered by its official connexions. That may be so; but the question remains whether the Society was wise to allow its hands to be tied; your excuse does not exonerate it, unless advising the Government and administering its funds is the most important function of the Society, to which all others should be sacrificed.

Inside the Society the most various views of its functions appear to be held. I have heard prominent fellows protest that it is still, as it was originally, a club for the social intercourse of congenial intellects, and that any public interest in its doings is impertinent. But outside there is no doubt at all. There it is held that the Society exists to recognise merit by the conferment of its fellowship—a title with a financial value that few older men can afford to disdain, and a moral value that inspires genuinely many of the ablest and keenest of their juniors. Any attempt to ignore this is simply disingenuous; for the belief that the Society is an accepted aristocracy of the scientific profession determines the conduct towards it of the whole outside world, scientific and lay. It explains why the Society, subject to so much hole-and-corner criticism, is so seldom openly attacked: for a critic, if a non-fellow, lays himself open to a charge of envy; if a fellow, to a charge of disloyalty to his order. And—more important for the present purpose—it explains why it is impossible for any other body to assume the mantle of leadership, while the Society refuses either to wear or to discard it.

Whether this all-important function of the Society is compatible with its relations to the Government, I leave others to determine, noting only—for my business here is merely to say openly what so many say privately—that its recent action in choosing two Government servants for its officers has been widely condemned as an unnecessary riveting of its fetters. For my main contention is that the Society had already made it impossible for itself, or for any other body, to lead the scientific profession, by far more fundamental and disastrous practices. In the article on "Exposition and Authority" in NATURE of Jan. 30, much of the public failure to appreciate science is attributed to our jealous individualism and our unworthily narrow conception of personal merit. There is clearly, in the article, no thought of the Royal Society in this connexion; but I maintain that it is directly responsible. It has not, of course, created these original sins of the scientific temperament; but it has committed the equally serious crime of encouraging them, and has thereby made itself one of the main obstacles to the advance of the scientific outlook in this country.

I maintain, first, that the Society, by the demands it makes on candidates for election, sets up a standard of scientific merit that is false and unworthy in precisely the manner you describe. The whole practice of requiring applicants for a public distinction to expound their qualifications might be ridiculed; and I do not suppose that the Council actually pays much attention to the application forms. But it is obvious that if any evidence of scientific merit is demanded, that evidence will come to be regarded as the basis of election. Now, the only evidence demanded is a complete list of the candidate's scientific publications. He is not asked to give a general account of his work or to distinguish between the important and the trivial; no inquiry is made concerning his knowledge or interests outside the narrow range of his specialisation; his power of influencing colleagues, pupils, and the outside world by personal intercourse or 'popular' exposition is ignored; nothing matters (it is suggested) except an imposing list of strictly technical publications. Is it surprising, then, that our journals are filled with masses of unreadable trash; that sordid disputes about priority and credit rend the scientific world; and that the world outside still regards general imbecility and narrow-mindedness as the necessary accompaniment of scientific eminence?

My second, and more serious, charge is that the Society has allowed itself to become an aristocracy without the tradition of personal service, a form of institution that has destroyed every community in which it has arisen. Election to fellowship confers rights and privileges; it imposes no duties. Of course, many fellows have done and are doing noble work for science; but in recent times no fellow has been disgraced for dereliction of duty. That can scarcely be because the Society has never admitted a black sheep to its fold; many years ago I heard two young men declare that, once they had got their F.R.S. and a comfortable job, they would do no more research; and one, at least, of them has kept his promise. Is it surprising that science lacks leaders, that we are narrowly individualistic and lack the power of combination in defence of our common interests, when we so freely give and so willingly accept coveted distinctions without demanding or offering in return the smallest exertion for the general good?

It is not for me to suggest remedies, but perhaps I may indicate what kind of body the Royal Society of my Utopia would be. It would be a body truly representative of science, because election to it would be, not the conferment of an honour, but the recognition of honour already attained. Its members would be those who were already so widely respected in their profession that the assignment of a formal title could excite no jealousy. Each member would regard it as his duty and his privilege to serve his humbler colleagues, even at the expense of his immediate interests. *Noblesse oblige* would be his motto, and any self-seeking would be a confession of unworthiness of his rank, to be visited with expulsion.

The immense influence that such a position would inevitably give would enable these leaders of science to play in the councils of the nation and of the world the part that "H. E. A." assigns to them. But such a position could only be built gradually; and even if the Royal Society mended its ways to-morrow, a generation must probably elapse before it can play the great part to which its history calls it. Meanwhile, at the risk of an anti-climax, I want to make one very minor suggestion, partly because it is immediately practicable and partly because it illustrates so well the evils of our present state.

The commercial firm by which I am employed invites all genuine seekers after knowledge to ask for such advice and information as its scientific staff can give. Its motives need not concern us; the important fact is that a surprisingly large number of persons accept the invitation, including many (such as university students) who might be expected to find help nearer at hand. It is clear that the counsel and encouragement that beginners in research (or in research in some new direction) ought to receive as a matter of course from their seniors is not always forthcoming. I suggest that here is an opportunity for the Royal Society to display immediately the spirit that is needed to reform the scientific profession. Let it be publicly declared that every fellow regards it as his duty and his privilege to give advice to colleagues on all matters in which he is expert—to give it freely, without stint, and without any idea of recompense or credit. If it would at least consider that suggestion, the Society would show at last that it is still animated by the spirit of its founders, and that it still cares as much for the welfare of science as for the dignity of its fellows.

NORMAN R. CAMPBELL.

155 Hagden Lane, Watford,
Herts, Feb. 7.

Cause of Twinning of Crystals

IN the course of an investigation[1] of optically active uniaxial crystals, I expressed the view that the possibility of twinning of a crystal was connected with a definite pseudo-symmetrical character of its *structure as a whole*. This statement was seriously attacked by Prof. Friedel, as may be clear from the following quotation of his paper:[2] "La formation de la macle est totalement indifférente à la symétrie ou à la pseudo-symétrie de l'édifice cristallin ou des groupes d'atomes qui le constituent. Elle est due uniquement à la rencontre de symétries ou de pseudo-symétries dans les *périodes* (mailles, simples ou multiples) de cet édifice."

With regard to this question, I should like to make some comments. The fact that, generally speaking, the influence of the forces exerted by atoms (ions) on the surrounding atoms (ions) does not extend over much more than their immediate neighbours, makes one inclined to believe that the fundamental cause of twinning must be looked for in the 'force-relations' in the immediate neighbourhood of the last-formed layer of the growing crystal.[3] These relations, which govern the addition of new atoms or ions, must be of such kind that the 'normal'—or the 'twin'—continuation of the structure represent growing-possibilities of nearly equal probability. For this reason it seems plausible to us to expect that they will show a (pseudo-) symmetrical character with regard to one or more definite directions in the crystal structure. This pseudo-symmetry, however, needs not necessarily show itself immediately in the positions of identical atoms, that is, in the *pattern* of the crystal structure, although there are instances where this is apparently the case, as, for example, with the twinning of aragonite.[4] It may also be due to a quasi-equivalence in the interatomic forces exerted by *different* atoms.

The undeniable experimental fact (see especially Prof. Friedel's beautiful book "Leçons de cristallographie", 1926) that in twin-crystals there is always a simple or multiple lattice unit underlying the whole twin structure is, according to my view, only another manifestation of a pseudo-symmetrical character of the structure of the untwinned crystal *as a whole*. To conceive it as the unique cause of twin-formation would imply the assumption, especially in the case of a twin with a relative high multiple-number of its underlying lattice, that at a certain stage in the growth of a crystal a new layer of atoms could take up the 'twin-orientation' only because, so to say, after the addition of some fourth or fifth layer, a certain number of atoms would occupy positions, which can be considered as lattice-points of a multiple lattice unit.[5] It leaves also unexplained, why two twin-possibilities of the same crystal, with equal multiple-number for their underlying lattice units and equal approximation of these units to exact periodicity in both parts of the twin, can show such a marked difference in occurrence that one of them is only rarely, the other frequently, observed (for example: calcite; see Friedel, "Leçons de cristallographie", pp. 463-464); or why cubic crystals, which, while having identical *lattice symmetry* conditions, display great differences in twinning-multeity.

Without being able to give an explanation of these remarkable facts, I only wish to point out the necessity of assuming, besides the (pseudo-) symmetry relations of the *lattices* of the crystals in question, other factors playing a part in the formation of twins.[6] In this connexion attention may be directed to two very interesting papers, one by F. Heide (loc. cit.) and one by G. Aminoff and B. Broomé,[7] in which the authors arrive at the conclusion that in definite cases *the faculty of twinning of a substance is apparently*

connected with its faculty of being able to crystallise in more than one modification.

With regard to the possibility of examining the structure of twinned crystals by means of X-rays, Prof. Friedel fears [8] that the structure arrived at in this way will have an illusory value, in particular because it will relate to an incorrect lattice unit, namely, the lattice unit underlying the whole twin structure, which may be a *multiple* of the real unit cell of the untwinned crystal. While not in the least denying the presence of such a multiple unit, we deduced from our considerations [9] that, if indeed the X-ray investigator did find an *incorrect* unit cell, the danger would be greater that he would find a *sub-multiple* of the true cell than a multiple.

It is interesting to note that precisely this anticipation occurred in a recent X-ray investigation of crystals of the mineral boleite by B. Gossner and M. Arm,[10] who attributed to these crystals a *cubic* unit cell with side-length $a = 15{\cdot}40$ A. This statement was in contradiction with a crystallographic study of this mineral by Prof. Friedel (dating from as early as 1906 [11]), who from an examination of the cleavage of boleite crystals concluded that the cubic appearance is only a consequence of mimetic twinning of perpendicularly crossing biaxial quadratic lamellæ with an axial ratio $c : a$ very close to the value *four*. Now, from a careful X-ray investigation of a small untwinned birefringent fragment of a crystal of boleite, R. Hocart [12] in Prof. Friedel's laboratory could show that on his rotation photographs about the *c*-axis of the crystal some faint layer lines appeared, lying between those observed by Gossner and Arm, from which it followed that the *c*-axis of the unit cell of the untwinned crystal is 62 A., that is, practically four times as great as the *a*-axis. Without discussing in how far the *weakness* of these interadjacent layer-lines on Hocart's photographs is still an indication for the possibility of subdividing the true unit cell of boleite in four *structurally* closely related *sub*-cells,[13] their presence, on one hand, confirms beautifully Prof. Friedel's prediction of the axial ratio of the untwinned crystal; on the other hand, it is in striking agreement with my own prediction about the danger of finding by X-rays a sub-multiple of the true unit cell instead of a multiple.

W. G. BURGERS.

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N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Holland, Jan. 18.

[1] W. G. Burgers, *Proc. Roy. Soc.*, A, **116**, 553; 1927.
[2] "Au sujet d'un Mémoire de M. W. G. Burgers sur les cristaux uniaxes à pouvoir rotatoire", *Comptes rendus*, **186**, 1788; 1928.
[3] Compare, for example, the explanation of some twin structures exhibited by quartz crystals, by Sir W. H. Bragg and R. E. Gibbs, *Proc. Roy. Soc.*, A, **109**, 405; 1925.
[4] W. L. Bragg, *Proc. Roy. Soc.*, A, **105**, 16; 1924.
[5] Similar remarks have been made by F. Heide, *Z. Krist.*, **66**, p. 255; 1928.
[6] It may be remarked in this connexion that even Prof. Friedel himself, notwithstanding his definite statement about the cause of twinning quoted above, has made similar remarks in other passages of his treatises, as, for example, in "Leçons de crist.", p. 459.
[7] *Z. Krist.*, **80**, 355; 1931.
[8] "Leçons de cristallographie", pp. 392-398; compare also *Comptes rendus*, **182**, 741; 1926.
[9] *Proc. Roy. Soc.*, loc. cit., pp. 560-561.
[10] *Z. Krist.*, **72**, 218; 1929.
[11] See *Z. Krist.*, **73**, 147; 1930.
[12] *Z. Krist.*, **74**, 20; 1930.
[13] Compare, for example, W. H. Bragg, "An Introduction to Crystal Analysis" (London, G. Bell, 1928, pp. 134 and following); also W. T. Astbury, *Proc. Roy. Soc.*, A, **112**, 448; 1926.

Polarisation of Downcoming Wireless Waves

IN a method which has previously been used [1] for determining the state of polarisation of downcoming wireless waves, the frequency of a transmitter was varied so as to produce interference maxima and minima at the receiver in the well-known way. By analysing the signal variations at the receiver, it was possible to deduce the state of polarisation of the downcoming waves. The method suffered from two disadvantages, as follows:

(1) In order to interpret the results, it was necessary to assume that the intensity and state of polarisation of the waves had remained constant during the making of the frequency change. This restricted the observations to a period just before sunrise, when the downcoming wave was found to be sufficiently constant.

(2) It was possible to carry out the experiments only in conjunction with special transmitting stations such that the requisite frequency change could be made. This restricted very much the geographical locations of the transmitting stations.

We have now developed a method of observation which gives a pictorial representation of the state of polarisation on an oscillograph screen, and can be used to analyse the wave from any transmitter emitting a steady or a modulated wave. It may also be used when the nature of the polarisation is changing rapidly; so the two objections to the original method are removed.

In the new method, the normally polarised and abnormally polarised components of the downcoming wave are received on two separate aerial systems, and, after being amplified, are applied to opposite pairs of plates of a cathode ray oscillograph. The ground wave may be eliminated by the use of suitable aerial systems. The phase relations in the receivers are adjusted correctly by employing a small local transmitter placed in such a position that it induces into both systems. The sense of rotation of an elliptically polarised downcoming wave is determined by momentarily detuning one of the amplifiers slightly.

The apparatus has been used to investigate the downcoming waves from the London National transmitter received at Cambridge during the evening hours from sunset until midnight. The distance of propagation is 56 km. and the wave-length 216 m. It is found that the type of polarisation changes very rapidly—an appreciable change taking place in half a second. The commonest form of polarisation observed approximates to a circle, but straight lines and narrow ellipses often inclined to the vertical plane of propagation are frequently observed. Although the type of polarisation varies considerably, it has been found that the sense of rotation of the figure is always the same. Observations on five different nights and on three different settings of the calibration apparatus have shown that the sense of rotation is anti-clockwise if we look along the ray in the direction of travel.

These preliminary results therefore confirm the previous results of Appleton and Ratcliffe, and lend support to the theory outlined by them and recently mentioned by Prof. Appleton.[2]

J. A. RATCLIFFE.
F. W. G. WHITE.

The Cavendish Laboratory,
Cambridge,
Feb. 5.

[1] Appleton and Ratcliffe, *Proc. Roy. Soc.*, A, **117**, 576; 1928.
[2] NATURE, **128**, 1037, Dec. 19, 1931.

Perception of Gravity by Roots of *Vicia Faba*

UNTIL recent years it was a generally accepted view that the region of perception of gravitational stimuli in roots was the extreme tip of the root. Cholodny,[1] however, performed experiments in which he replaced the root tip in maize by the tip of the coleoptile, and the fact that a positive curvature was still obtained suggested that the function of the root tip might not be so simple as had hitherto been supposed. More

recently, Keeble, Nelson, and Snow [2] performed experiments in which positive geotropic curvatures were obtained when unstimulated root tips were stuck on to stimulated root stumps which had been decapitated before stimulation.

It was pointed out to me by Dr. T. A. Bennet-Clark that opposite stimulation of root and stump would give more exact information of the functions of tip and stump in the perception of gravity. Accordingly, four parallel series of experiments, using seedlings of *Vicia Faba*, were carried out, as follows (about forty seedlings being used in each series):

(*a*) A number of roots were decapitated and placed in a horizontal position in a damp chamber for 3-4 hours, after which these roots were re-headed with tips from other roots which had also been stimulated in a horizontal position for the same period of time. These tips were stuck on in such a manner that the side of the tip which had been lowest during stimulation was exactly *opposite* the side of the stump which

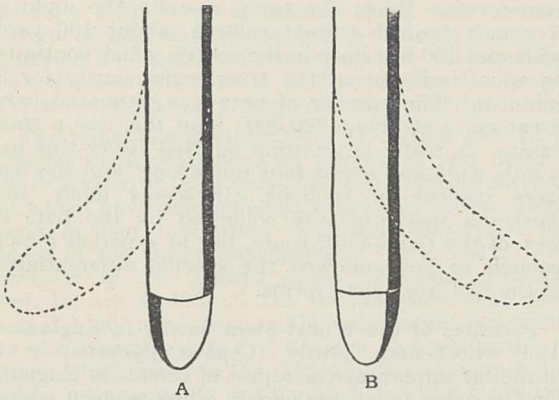

FIG. 1.—*A*—Diagrammatic representation of a root in series (*a*). *B*—Diagrammatic representation of a root in series (*b*). The thick black line indicates the under side of the root during stimulation, and the dotted line indicates position of root after response.

had been lowest during stimulation (Fig. 1, *A*). The roots were then placed in a vertical position.

(*b*) A number of roots were treated similarly to those in series (*a*), but the new tips were stuck on in such a manner that the side of the tip which had been lowest during stimulation was on the *same* side as the side of the stump which had been lowest during stimulation (Fig. 1, *B*).

(*c*) The roots from which the tips had been cut to re-head series (*a*) were also placed in a vertical position.

(*d*) Normal roots were stimulated and then placed in a vertical position.

The results obtained were as follows:

Series *a*. 67·5 per cent curved towards the side of the tip which had been lowest during stimulation.

15 per cent curved towards the side of the tip which had been uppermost during stimulation.

17 per cent remained straight.

Series *b*. 70 per cent curved towards the side which had been lowest during stimulation.

30 per cent remained straight.

Series *c*. 63 per cent gave a positive curvature.

37 per cent remained straight.

Series *d*. 70 per cent gave a positive curvature.

30 per cent remained straight.

From the results of series (*a*), it can be seen that, in decapitation experiments with *Vicia Faba*, the root tip has a much stronger directional influence on response to gravity than the root stump. The results of series (*a*) are seen to be significant, since the percentage response obtained in the control series (*b*), (*c*), and (*d*) is of the same order as that in series (*a*).

It is hoped that a full account of this work will be published later.

LILIAN E. HAWKER.

Department of Botany,
Victoria University of Manchester,
Feb. 12.

[1] *Ber. deut. bot. Ges.*, **42**, 1924.
[2] *Proc. Roy. Soc.*, B, **105**, 1929.

Molecular Structure of Cellulose and of Amylose

FROM the purely chemical properties of cellulose, recent experiments have enabled us to gain further information as to the nature and length of the cellulose chain. It will be remembered that earlier work from this Laboratory showed that cellulose contains repeated units of β-cellobiose, and the present views on the intimate structure of this polysaccharide are based on these researches published in 1925–27.

We have now obtained evidence that cellulose, in the form employed in our experiments, is a straight chain of limited length containing not more than 100 cellobiose units or 200 glucose units. This represents a molecular weight of about 30,000. The lower possible limit is 25,000.

This result was attained by preparing in one operation completely methylated cellulose from its acetate and submitting this to hydrolysis with aqueous hydrochloric acid at 0°. The cleavage products from 200 gm. yielded almost quantitatively the methylglucosides of the methylated glucose fragments, and by fractional distillation under diminished pressure, using a special column, a yield of 0·55 per cent of tetramethyl methylglucopyranosides was obtained. The remaining fractions consisted only of 2 : 3 : 6-trimethyl methylglucosides.

Control experiments were conducted by distilling an artificial mixture of 2 : 3 : 4 : 6-tetramethyl methylglucosides and 2 : 3 : 6-trimethyl methylglucosides and determining the quantity of the former which was separable. This was found to be almost quantitative.

It is clear, therefore, that in our specimen the cellulose chain was not endless, since to the extent indicated above, one of the glucose units formed an end group containing one more methyl residue than did the intermediate members. It was thus possible to assay this component by quantitative methods, and hence determine the molecular size of the cellulose derivative. This evaluation corresponds very nearly to that derived by Svedberg's method for the high polymeric forms of a number of natural products. Dr. H. Machemer has collaborated with me in this work.

Applying this procedure also to the amylose portion of starch, we have found that a much larger proportion (5 per cent) of the tetramethyl glucose component can be recovered by hydrolysis of completely methylated amylose. This result, on the above interpretation, corresponds to only ten maltose units or twenty α-glucose units in a chain which is not endless, or a molecular weight of not more than 4000. This conclusion is unexpected, and we are led to believe that similar experiments on the amylopectin portion of starch will yield a much higher value for the molecular size. Dr. E. L. Hirst, Dr. M. M. T. Plant, and Miss Wilkinson are specially identified with this work.

We are reserving the application of this experimental method to glycogen, inulin, xylan, and other types of polysaccharides, and this work is already in hand.

W. N. HAWORTH.

University, Birmingham,
Feb. 18.

Research Items

Australian Female Skull.—Prof. F. Wood-Jones points out in *Man* for February that the statement frequently made that 1000 c.c. is the lowest capacity occurring in skulls that can be classed as normal and human is erroneous. The female Australian skull is not only remarkably small, but also falls below this figure. It is due to this misconception that the discovery of a female Australian skull of 960 c.c. was hailed with such enthusiasm as having the lowest known cubic capacity of any human skull (MacKenzie). Hrdlička's average for 395 female crania is: max. length 179·4, max. breadth 127·6, basibregmatic height 127·4, modiolus, 144·8. Among these normally small-headed females there is a very definite element, especially in the central-northern and western portions of Australia, of unusually small-headed women. Sir William Turner, in his *Challenger* report (1884), found in 11 skulls an average cranial capacity of 938 c.c.; while in 30 adult Australian female skulls with a modiolus of 139 or less, which were measured by Hrdlička or the writer, the averages were as follows:—max. length 169·7, max. breadth, 120·7, basibregmatic height, 121·9, modiolus 137·5. Although the capacity was not measured directly, some guide to the relation between the modiolus and the cranial capacity is furnished by the following correlations:

Designation of Skull.	Modiolus.	Measured Capacity.
M. U. Wimmara . .	132·3	900 c.c.
Sir W. Turner, avge. .	135·0	938 c.c.
M.U. 54, 94, 5, 37 . .	138·3	960 c.c.

The so-called 'Jervois' skull, which has no claim to antiquity, yields a modiolus of 139·3, and a cranial capacity, measured (MacKenzie) 956-980 c.c. It cannot, therefore, be regarded as a remarkably small Australian skull. It exhibits no craniological characters which differentiate it from the accepted standards of the normal recent female Australian skull.

Prehistoric Domestic Pottery from Southern India.—Mr. L. A. Cammiade describes in the *Indian Antiquary* for February pottery from some ancient soak-pits found in old and now exhausted brickfields at Chetput, Madras. Fragments of pottery of urn-burial types were found scattered over an area of ten acres at the bottom of clay pits at a depth of 15-20 ft. below the present ground level. They were derived from the bottom of silted-up wells which had been 24-30 inches in diameter. The wells had been constructed of pottery $\frac{5}{8}$ in. thick made in sections about sixteen inches in height, flanged at the base, and curved slightly inward at top. Wells of this type are not now made. In two wells examined there were about four feet of broken pottery mixed with bones. The pottery included fragments of large broad-mouthed pots of the usual urn types, and fragments of shallow oval or coffin-shaped troughs about twenty-four inches in length. There was also a large-necked pot of unusual type about thirty inches in diameter. Most of the smaller pots had globose bodies with narrow vertical rimless necks. Some had six holes at the base of the neck for suspension. Finally, there were fragments of polished red ring stands about ten inches in diameter. The importance of these types from the wells, or rather soak-pits, is that they represent domestic pottery—differing in certain respects from the funerary pottery—of the cist and urn-burial period, which has not hitherto been studied.

'Flying Foxes' in Australia, and their Economic Significance.—The Australian Council for Scientific and Industrial Research, in *Bulletin* No. 53, has published a work of extraordinary interest to the naturalist, embodying the results of co-operative investigations between different State departments, correlated and controlled by F. N. Ratcliffe. It is shown that, contrary to general belief, flying foxes (large bats of the genus *Pteropus*, some measuring almost four feet from wing-tip to wing-tip) are not a serious menace to the commercial fruit industry; and since the numbers are much greater than had been supposed, the serious control of the various species is regarded as beyond compass at reasonable cost. But we turn rather to the natural history of these bats. They live in 'camps', and a typical Queensland 'camp' during the day, when the animals hang asleep upon the trees, covered 5-10 acres of rain forest. When the camp rose for the night at 6 P.M. it formed a great column, about 100 yards wide and 100 feet deep in the centre, which continued to spue itself out of the trees continuously for 25 minutes. The number of bats was estimated (with great care) at about 220,000; and this was a small camp. A really large camp on Red River was half a mile wide and about four miles long, and the bats were present in millions. It seems likely that Australia was originally colonised by the bats by way of the Cape York route, but at a period remote enough to have allowed the specific differentiation of the five Australian forms.

Parasites of the Wheat-Stem Sawfly in England.—The wheat-stem sawfly (*Cephus pymœus*) is of negligible importance as a pest of cereals in England. On the other hand, the closely allied western wheat-stem sawfly (*C. cinctus*) is a very serious enemy of the wheat crop in western Canada. The English species appears to be heavily parasitised, and it is likely that one or the other of its parasites might prove suitable for introduction into Canada. Little, however, was known respecting the economy of *C. pygmœus* until the matter was studied by Dr. G. Salt of the Imperial Institute of Entomology (*Bull. Entom. Res.*, Dec. 1931). As the result of his investigations he finds that several species of hymenopterous parasites attack *C. pygmœus*, and one of them, the ichneumon fly, *Collyria calcitrator*, is of major importance. This insect attacks and destroys its host so heavily that it is evidently a highly important factor in the control of the stem sawfly under English conditions. Dr. Salt describes the life-history and figures the larval stages of this and other *Cephus* parasites. From the economic point of view, however, the *Collyria* appears to be the only one of primary importance. Its perfect adaptation to and complete concentration on wheat-feeding Cephidæ: its independence of alternative hosts: its ability, as indicated by its wide range, to exist under different climatic conditions: all these factors give promise that its introduction into Canada will lead to beneficial results. This conclusion led to Dr. Salt directing the collection of many thousands of *Collyria calcitrator* and their shipment to the Dominion Parasite Laboratory at Belleville, Ontario. The handling and transmission from Belleville to western Canada of this material was superintended by Mr. C. W. Smith of the Dominion Entomological Branch. Liberations were made in suitable areas in Manitoba, and a short paper on the experiment is contributed by Mr. Smith in the same issue of the journal already mentioned. Since the actual liberation only took place in 1930 it is pre-

mature to forecast its results. It is encouraging, however, to note that Mr. Smith finds that the parasite has shown itself capable of attacking the Canadian *Cephus* and has succeeded in establishing itself.

Potato Sickness.—The peculiar disease of potatoes known as 'sickness' has baffled students of plant pathology, but we have now a very definite pronouncement on the subject ("Potato Sickness", by W. A. Millard, S. Burr, and L. R. Johnson; *Gard. Chron.*, Jan. 9, 1932, p. 28) as the result of co-operative study by the zoologists and botanists of the University of Leeds Agricultural Department. The cause of the sickness has been previously ascribed to two different fungus diseases as well as to eelworm injury, so the experiments under review were designed to test the effect of these three agencies, both singly and in different combinations. Photographs of typical plants which are published with the account show that only when eelworms (*Heterodera Schachtii*) were inoculated on to the plants did symptoms of 'sickness' appear. It seemed to matter little whether fungi were inoculated along with the eelworms or not, so it is concluded that the disease in question is caused by the latter agents. It is pointed out, however, that under field conditions the fungus *Corticium solani* may aggravate the malady.

Cambrian Conchostraca.—E. O. Ulrich and R. S. Bassler have completed an important and detailed investigation of those small Cambrian Crustacea, most of which have been referred previously to the Ostracoda, in their publication "Cambrian Bivalved Crustacea of the Order Conchostraca" (No. 2847. *Proceedings of the United States National Museum*, vol. 78, art. 4, 1931). The authors show that these certainly do not belong to that superorder but rather to the Branchiopoda. A scheme of classification is given which includes the Cambrian Conchostraca and allied genera, and it is suggested that the Ostracoda were derived from the earlier Bradoriidæ and Beyrichonidæ. The chief differences are the position of the main muscle spot, the composition of the shell, and the incomplete separation of the valves. In the Bradoriidæ the margins of the valves, except along the back, are apart, the edges being so opposed that a narrow slit separates them. The illustrations to this monograph have been very carefully prepared, most of the figures being photographs which have been touched up slightly, the specimens having been whitened by the ammonium chloride process before being photographed. The result is excellent and the ten plates show up the specimens in a most satisfactory manner.

Philippine Earthquake Epicentres.—The Rev. W. G. Repetti, *S.J.*, Chief of the Seismic and Magnetic Division of the Manila Observatory, has written a valuable report on the epicentres of the Philippine earthquakes (1920–29) that lie north of Manila or lat. 14° 30′ N. (Manila: *Seismological Bulletin for 1930*, pp. 71-85; 1931). None of the earthquakes considered was of destructive violence, though some were strong enough to crack walls. The earthquakes (300 in number) are divided into four groups according to the accuracy of the determinations. They lie almost entirely in the western part of Luzon and in the China Sea. The submarine epicentres lie along four lines, the most important of which is about twenty-eight miles off the west coast and in its southern portion is parallel to it. It lies along the eastern and steeper slope of the Abra Deep, a basin that rapidly descends to a depth of more than three miles.

Uraninite from Henvey Township, Ontario.—H. S. Spence has described an occurrence of uraninite with thucholite, cyrtolite, and oily hydrocarbons from the Besner pegmatite in the Parry Sound District (*Am. Mineral.*, Nov. 1930). Three analyses of the uraninite by H. V. Ellsworth appear in the same journal for last December. Among the results are the following:

U	68·29	67·26	67·30
Th	1·56	1·52	1·85
Pb	8·04	7·51	7·57
$\frac{\text{Pb}}{\text{U}+0{\cdot}38\ \text{Th}}$	0·117	0·111	0·111

The material has evidently been somewhat altered, but, in view of his work on the Villeneuve uraninite, Ellsworth concludes that the alteration of the Besner uraninite has not gone far enough to render the lead-ratio unreliable and that the true age is indicated by a value between 0·11 and 0·12. The granites with which the pegmatite is associated have been regarded by Quirke as Killarnean (latest pre-Cambrian granitic intrusions), but it is pointed out that whereas indubitable Killarnean granites have $K_2O > Na_2O$, the Henvey Township granite has $Na_2O > K_2O$. In this respect the latter granite resembles those of the Grenville sub-province for which lead-ratios of 0·15-0·16 are typical. It is therefore by no means certain that the Henvey granite is of Killarnean age.

Selective Heating by Short Radio Waves.—The November number of the *Canadian Journal of Research* contains a paper by Prof. J. C. McLennan and A. C. Burton in which a general theory of the heating of an object in the condenser of a high-frequency circuit is developed, and the essential result of the theory, that the action is selective for electrical as well as thermal reasons, is demonstrated by a number of ingenious experiments. With meat, the change in temperature was followed with a paint which changes colour on heating, and it was shown that different parts of this behaved quite differently on changing the wave-length of the oscillations from 10 metres to 25 metres. Eggs and chicken embryos were examined by a thermojunction method, and the white and yolk of a broken egg with a mercury-in-glass thermometer: the last case, again, showed a definite reversal of the effectiveness of this method of generating heat as the frequency was changed from 10 metres to 190 metres, and this was also found to occur with calves' liver and heart *in vitro*. The possible importance of this selective action in medical application must of course depend on the rapidity with which equalisation of temperature can be brought about in living tissues, and can only be settled by direct experiment.

The Raman Effect.—The second December number of the *Physical Review* contains a valuable account from Prof. R. W. Wood of his technique for producing Raman spectra by the light from a mercury arc. This is inferior in some ways to helium excitation, but is in general far more convenient, since mercury arcs are readily obtained from commercial sources. Prof. Wood mounts the arc beneath the tube containing the substance to be studied, with intermediate colour filters; these appear to be essential if unambiguous results are looked for. The light is concentrated by making a liquid filter also serve as a cylindrical lens, and by having a metal reflector on top of the tube holding the substance under investigation. A critical account is given of the Raman spectra of a number of aromatic compounds, and the important observation is made that the presence of several faint lines which are now recorded with certainty for the first time apparently depends upon the actual wave-lengths used to excite them.

River Pollution.—We have received the Report of the Water Research Board for the year ended June 30, 1931 (London: H.M. Stationery Office,

9*d.* net). The report deals with the flow of water from the upper Tees and movements of water in the estuary and tidal portions of the river below Stockton, and the effects on plant and animal life, particularly fish. The death of fish caused by the water was shown to be partly due to toxic substances in the water, including phenol and other tar acids, hydrocarbons such as naphthalene, and in some cases cyanides in concentrations found to be lethal to smolts under experimental conditions. The breakdown of sewage in the river has also been studied. In summer the river purifies itself more rapidly and completely than in winter. In summer the river is practically purified about six miles from the point where the sewage enters, whilst in winter the self-purification may not be complete before the industrially polluted zone is reached. The Board puts forward suggestions for improving matters, among them that manufacturing processes should be modified so that no polluting effluents need be discharged. Several authorities in industry have, it is stated, expressed the opinion that in addition to avoiding pollution, the costs of making the necessary modifications for the re-use of part of the water are at least counterbalanced by the resulting economies.

Tannins and Fatty Acids in Hops.—The true nature of the so-called tannin constituents of hops has always been a matter of doubt, but the results of work published in a recent series of papers by L. Heintz (*Wochenschrift für Brauerei*, **48**, 315-335; 1931) even imply that hops contain no true tannin at all. The hops were first extracted exhaustively with ethyl ether and then with 95 per cent alcohol, and the residue after evaporation of the extract, which constituted 15 per cent of the original weight, was tested for tannins. It was found to reduce Fehling's solution and to precipitate cinchonine sulphate solution, though on the other hand it contained about two per cent of nitrogen, whilst other tannin reagents gave inconsistent results. The cinchonine, ferric chloride, and other reactions for tannins are criticised, but it should be pointed out that so far as actual determinations of tannin are concerned the cinchonine sulphate method proposed by Chapman in 1907 has always given consistent and satisfactory results. Hops stored in warm surroundings sometimes develop rancidity, and the author suspected that this was derived from non-resinous substances, probably fatty acids, extracted in petroleum spirit from the stalks of the ground hops. He therefore separated them from the resins by esterification in ethyl alcohol, neutralisation, and removal from the resin soaps in petroleum spirit. As a rule, 1 to 2 per cent of fatty acids were obtained, according to the nature and age of the hop, about 90 per cent of which were soluble in petroleum spirit and appeared to be oleic acid, whilst the remainder contained saturated acids. In addition, about 1 per cent of neutral unsaponifiable matter was isolated.

Astronomical Topics

Atmospheric Changes and Climate.—Dr. R. T. A. Innes contributes a paper on this subject to *Scientia* for January. He points out that the former presence of glaciers in many places that are now too hot for them indicates secular changes of climate. He considers that changes in the amount of solar radiation would be compensated by increased cloud formation, and would not greatly affect the surface temperature. He assigns more weight to small changes in the chemical composition of the atmosphere, especially to the percentage of carbon dioxide in it; the large amount of coal, etc., that is now burnt would have some slight effect on this percentage; Dr. Innes thinks that some gas may have been introduced into the atmosphere by collisions with comets. The density of the comæ of comets is known to be very low, so a very long period of time would be necessary for the introduction of any appreciable amount of gas from this source.

A Science Service Bulletin, dated Jan. 8, describes a study of the atmosphere and the importance to life of the small percentage of carbon dioxide; this is by Dr. W. J. Humphreys, of the United States Weather Bureau. Carbon dioxide is essential to plant life, and that, in turn, is directly or indirectly the necessary food of animals. He further explains the importance of the layer of ozone in the upper air. If it were removed, the excess of ultra-violet radiation would be injurious to the eyes; while a great excess of ozone would stop all ultra-violet radiation, which would also have an injurious effect on life.

Dr. Maud W. Makemson is making a research of a somewhat similar character at Rollins College, Florida (Science Service Bulletin, Jan. 12). The air in that district is free from contamination by smoke, etc.; she takes advantage of this to collect meteoric dust in pans, placed on a high tower; "the fragments resemble volcanic glass or obsidian, while in colour they range from clear glass to amber". She proposes to continue the research for some time, and to correlate it with the number of meteors observed in the different months by the American Meteoric Society.

The Expanding Universe.—Mr. M. E. J. Gheury de Bray contributes a note to *Astr. Nach.* 5844 in which he points out that Mr. Van Maanen's photographs of the spiral nebulæ appear to indicate both a rotational and an outward motion in the bright condensations in the outer whorls of the spirals. Van Maanen's results have been criticised as being probably too large, but they are likely to give the correct direction of motion. There is a difference of opinion whether the outward motion of the spirals as a whole extends to the individual members of each spiral; Prof. de Sitter holds that it does, Sir Arthur Eddington that it does not.

It will need a much longer time before Mr. Gheury de Bray's suggestion of a general rotational movement of the system of spirals can be verified. In any event, it could be verified only if the angular velocity varied with the distance. He suggests that the angular velocity increases with the distance, but gives no reason to support this, and it appears improbable.

The Red Spot on Jupiter.—This spot has been in existence at least since 1879, but has varied greatly in visibility, being at times scarcely traceable except by the bay that it produces in the neighbouring belt. Some drawings taken by M. R. Cheveau about a year ago are reproduced in *L'Astronomie* for January. The spot appears to have been plainly visible, though somewhat paler than the adjacent region of the belt. Two of the drawings show a dark stripe across the spot from north to south, suggesting a tendency to divide into two; the other two drawings do not show this stripe, though one of them is intermediate in time between those showing it.

British Industries Fair

THE British Industries Fair, 1932, to which brief reference was made in our issue of Feb. 20 (p. 273), has again provided a most striking and significant visual demonstration of the extent, range, variety, and excellence of British manufactured products. It would be futile to attempt, within the limits of a short article, to review the exhibits shown at Olympia and the White City, in London, and at Castle Bromwich, in Birmingham. We must be content to note certain features, likely to be of special interest to readers of NATURE, of the scientific exhibits in the general section at Olympia. Before we come to particulars, however, it may be worth while to emphasise a point that was made last year in our review of the 1931 Fair.

The convenient arrangement of grouping the exhibits according to industries necessarily created a succession of mass effects, with the result that the visitor (who, it will be remembered, was primarily a buyer) could not escape receiving, even if only subconsciously, a general impression of each particular industry as a whole. No visitor going through the Fair could fail to get, for example, from the china and glassware displays, a vivid impression of the vigour and efficiency of the respective industries, apart from, or rather in addition to, the individual effects created by the exhibits of the several firms. In this connexion the British scientific instrument manufacturers who displayed their products at Olympia are to be congratulated on having achieved, in this mass effect, a still further advance upon the very remarkable advance they made last year. They will do better still next year in the measure that the individual firms in the industry realise the importance of, and their responsibility for, creating a good psychological impression of what the industry as a whole is like.

To come to some of the individual exhibits, Adam Hilger, Ltd., demonstrated, among other things, the textile mutochrome and the blancometer. The mutochrome is a projection lantern device by means of which the colours and shades of individual portions of a pattern or design can be changed at will. Thus a large number of colour compositions of a design can be rapidly investigated and selection can be made of those most pleasing or appropriate for a given purpose. The instrument is finding increasing use in the textile industries. All the experimental work previously requiring the production on the loom of a collection of mixed patterns, from which choice might be made, can be done with the mutochrome in less time and without waste of material. The design is projected on a screen so that it may be viewed simultaneously by a number of observers; not only the colour but also the brightness of each element of the design may be altered independently, the colour variations being obtained by the use of colour filters, and variations of shade or brightness by means of calibrated iris diaphragms. The blancometer is an instrument designed for the accurate numerical specification of nearly-white colours. Its chief applications are to papers, fabrics, paints, powders, and other raw materials and products of industry where fine discrimination is required between nearly-white specimens. By its aid it is possible to measure accurately, without the interposition of a visual judgment, the amount of light of different portions of the spectrum reflected from a sample under test, compared against light reflected in precisely similar circumstances from a standard white surface.

Among the exhibits of Ross, Ltd., were an educational cinematograph projector for use in schools and institutions, and a new epidiascope. Special features claimed for the cinematograph projector are the great amount of light transmitted and the steadiness of the picture. Cooling by blower is so efficient that, with the full light on, the film can be stationary for hours without detrimental effects. It also embodies all the necessary precautions against fire prescribed by the L.C.C. regulations. A novel feature of the epidiascope is that it has a single lamp capable of yielding 500 watts or 1000 watts as desired. By the single movement of a lever the instrument can be changed from diascope to episcope, or vice versa. The whole instrument is made to slide easily over the book or other object under projection, so that various parts of the object may be shown. The lenses for episcope and diascope are anastigmats, and there are various attachments to facilitate micro-projection and standard film projection.

R. and J. Beck, Ltd., showed, besides types of their well-known microscopes, a high power binocular attachment for the microscope. It is claimed that the design of this attachment renders it suitable for use with any type of monocular microscope, without the disadvantage of increasing to any great extent the working height of the instrument. The optical principle permits as well any power of object-glass or eyepiece as any type of illumination to be employed. There were also to be noted a new pathological microscope and an eyepiece camera by this firm. To give great rigidity, the base and pillar of the microscope are in a heavy solid casting with large spread ($7\frac{1}{2}$ in. × $5\frac{1}{2}$ in.), enabling the microscope to stand firmly in either the vertical or the horizontal position.

The Thermal Syndicate, Ltd., exhibited a remarkable fused quartz celostat plano-mirror, eighteen inches in diameter. The blank had been manufactured by the firm and then ground, polished, and silvered by Sir Howard Grubb, Parsons and Company. Another noteworthy exhibit of the Thermal Syndicate was a vitreosil (pure fused silica) sunshine lamp. The lamp has been designed to provide a very close approximation to sunshine, including that proportion of ultra-violet radiation which is now known to have an important beneficial effect on human health. The approximation to true sunlight is produced by balancing the blue-green of the mercury arc with the correct amount of the light from gas-filled filament lamps, which has an excess of yellow and red. The vitreosil bowl of the sunshine lamp filters out the shorter ultra-violet rays, that is, below approximately 2950 A., but allows the rays of the near ultra-violet, which are present in sunshine, to pass freely. Another effect of the vitreosil bowl is to eliminate glare.

Of the interesting exhibits of the chemical sections we must be content to mention two novelties shown by Imperial Chemical Industries, Ltd. This organisation has produced the 'pioneer partition block' for the construction of partitions in modern buildings, in the ways that breeze blocks are used. It is claimed that the mineral from which the blocks are made is highly standardised and unusually inert; it does not soften, move, or deteriorate with variation of humidity or with actual wetting; and, chemically, in the sense of attack on paints and pigments, it is safer than any other analogous material yet used. The other exhibit was a demonstration of the use of solid carbon dioxide as a refrigerant. This product, marketed under the name of 'Drikold' by the Imperial Chemical

Industries, Ltd., has a density 1·35-1·45, and evaporates slowly without melting, to give a tasteless, odourless, non-poisonous, and incombustible gas. It has a temperature of −110° F., and is being largely used as a refrigerant in the ice-cream industry, in road and rail transport, and in the dairy industry.

Limitations of space preclude the mention of any of the many other scientific exhibits. One impression produced by these exhibits may finally be noted, namely, the growing application to industry of instruments previously regarded as appropriate only to the academic field.

Scientific Publications in 1931

REFERENCE has been made from time to time in notes and articles in our columns to the ever-increasing flood of books and other publications with which scientific workers have to cope. Apart altogether from the question of expense—and that has become serious enough, as letters in NATURE a few years ago can testify—even the specialist has difficulty in finding time to keep up with the literature of his own department of work.

If any confirmation of these statements be required, it is given in Table I. This has been compiled from the monthly lists of "Recent Scientific and Technical Books" published in NATURE during 1931 and represents, roughly, a year's output of priced scientific and related publications; it does not include periodicals. The entries have been classified by subject and country of origin, and volumes actually received by NATURE for notice are marked by an asterisk. Turning first to the totals at the bottom of the table, it will be seen that the titles of 3227 publications were recorded in the NATURE Supplements during 1931, of which no less than 1357 were actually received at NATURE Office for notice. Incidentally, these figures in themselves should make it obvious that, in the limited space at our disposal, we cannot attempt to notice every publication received. Of the subject totals, the most prominent are mathematics and physics, engineering, chemistry, geography, biology, and philosophy, indicating corresponding activity in those fields.

TABLE I.—TITLES ANNOUNCED IN NATURE SUPPLEMENTS IN 1931

COUNTRY	TOTALS	MATHS & PHYSICS *	ENGING. *	CHEM.Y *	TECH.Y *	ASTRON.Y *	METEOR.Y *	GEOL.Y *	GEOG.Y *	BIOLOGY *	HORT. &c. *	ANAT.Y *	ANTHROP.Y *	PHILOS.Y *	BACT.Y *	MISC.Y *
ARGENTINE	1	1														
AUSTRIA	18	1 1	1	2		1			3	1	2		1	5		
BELGIUM	1			1												
BRITISH	1488	99 85	66 53	79 12	21 47	6 3	22	32 6	37 165	154 62	38 37	53 14	75 24	94 57	18 9	113 7
CHINA	3									2						1
CZECHOSLOVAKIA	2	1														1
DENMARK	3									2				1		
ESTHONIA	2							1		1						
FRANCE	173	31 14	4 24	8 10	2 11	3 2		1 1	2 9	11 5	1 3	4 3	11 5	2 2		4
GERMANY	1138	22 85	3 118	32 165	5 74	2 9	10 11	17 48	4 123	50 120	1 35	3 48	2 35	4 96	10	1 5
HOLLAND	11	1		1					5		2		1	1		
ITALY	16	4 3	1	3	1			1	2				1			
LATVIA	1									1						
POLAND	2															2
ROUMANIA	1	1														
RUSSIA	3	1						2								
SIAM	2								1	1						
SPAIN	1								1							
SWITZERLAND	15	2 1			1			1	5		1	1		3		
U.S.A.	346	19 17	20 30	29 8	2 19	6 1	1	16 1	10 17	25 6	6 25	4 3	7 15	15 22	3 1	17 1
RECEIVED*	1357	181	93	150	30	18	33	68	54	246	46	64	98	117	21	138
NOT RECEIVED	1870	208	227	200	153	15	11	59	330	195	105	69	79	185	20	14
	3227	389	320	350	183	33	44	127	384	441	151	123	177	302	41	152

Turning now to the 'cross-totals', which show the numbers of scientific and technical publications issued by various countries, the lead is taken by Great Britain with 1488, but Germany makes a good second with 1138; the total for the United States is 346, and the aggregate for the other countries listed is 255. Thus, according to the titles shown in our Supplements, Great Britain is responsible for about 46 per cent, and Great Britain, Germany, and the United States together for about 92 per cent of the world's scientific and technical publications.

Table II. has been compiled from the indexes of the last two volumes of NATURE and shows the number of publications actually noticed in our review columns during 1931. The subject classification here differs slightly from that in Table I., but will serve to

show that the number of volumes noticed in a particular field follows roughly the number published; thus mathematics and physics heads the subject list of publications both as regards number published and number received for notice, and a larger number of

TABLE II.—BOOKS REVIEWED IN NATURE DURING 1931

	Jan.-June.	July-Dec.	Totals.
Agriculture, Forestry, and Horticulture	9	7	16
Anthropology, Archæology	35	30	65
Biology	66	41	107
Chemistry	27	55	82
Engineering	19	17	36
Geography, Travel	13	9	22
Geology, Mineralogy, and Mining	12	17	29
Mathematical and Physical Science	68	79	147
Medical Science, Physiology	8	22	30
Metallurgy	3	7	10
Meteorology	7	2	9
Miscellaneous	31	29	60
Philosophy, Psychology	20	19	39
Technology	10	10	20
	328	334	672

works on these subjects were noticed in our columns. It is also worth noting that while mathematics and physics claims 22 per cent of our review notices, biology comes second with 16 per cent.

The total number of publications reviewed during the year also requires comment. This number, 672, does not include the numerous references to publications made in "News and Views", "Research Items", "Astronomical Topics", "University and Educational Intelligence", and also in articles; many such publications are included in Table I. Hence we are justified in saying that considerably more than one-half of the publications received by NATURE are dealt with in our columns.

Stock Diseases and Poisonous Plants

A PAPER upon the "Poisonous Action of Ingested Saponins", published as *Bulletin* 50 by the Council for Scientific and Industrial Research of the Commonwealth of Australia, has very general interest to stockbreeders and all who are interested in obscure diseases of stock in various parts of the world.

Prof. A. J. Ewart, of the University of Melbourne, suggests that various obscure stock diseases of Australia, America, New Zealand, and South Africa, like the 'walkabout disease' of horses in Australia, may be caused by the saponins present in the tissues of plants on which the animals graze. In the case of the 'walkabout disease', Prof. Ewart, in conjunction with Mr. D. Murnane, in 1927, produced the disease in six horses by feeding them, for periods of a month or more, with *Atalaya hemiglauca*, a plant rich in a hæmolytic saponin. Later, however, Dr. Seddon found that horses could be fed on fresh leaves of this plant for many months, in New South Wales, without any symptoms of disease developing.

Prof. Ewart now shows that, whilst the plant grows abundantly down to the twenty-fifth parallel, 'walkabout disease' only appears north of the nineteenth parallel. The reason seems to be that in the more southerly latitudes this plant contains less saponin and more of a tannin which protects against the hæmolytic action of the saponin. Tests of saponins by intravenous injection or by hæmolysis experiments are both difficult and expensive. Prof. Ewart shows that very good evidence of the toxic nature of the saponin (or extract) under investigation may readily be obtained by the use of the water snail *Bulimus*. Only plants containing a relatively higher percentage of saponin are likely to prove toxic, and then under conditions providing for continued grazing on the plant, as the saponins do not dialyse readily and only a small fraction of the ingested saponin is absorbed in the alimentary canal. This percentage absorption is increased by the use of purgatives or by inflammation of the alimentary canal. Species of *Solidago*, *Aster*, and *Senecio* are amongst the plants suspected of producing diseases of stock from this cause, the percentage of saponin in the dry leaves varying from 2 to 8 per cent in these species.

The Winton diseases of horses and sheep in New Zealand, characterised in chronic cases by pronounced cirrhosis of the liver, can be produced artificially by continuous feeding on the ragwort, *Senecio Jacobœa*.

Post-Glacial Prehistory in Ireland

OUR knowledge of the post-glacial prehistory of northern Ireland is summarised by Mr. C. Blake Whelan in a recent communication to the Société Préhistorique française (*Bull.* 1931, 7-8). Although Chellean and Acheulean do not appear, it is possible to find in the gravels of north-east Ireland rare and doubtful specimens which appear to be humanly worked and may be examples of a pre-Mousterian, or even older, culture. The interesting Clactonian station of Rosses Point, Sligo, is an example. Yet up to the present, undoubted evidence of a true Mousterian of the Laufen interval between Würm I. and II. appears to be lacking. Man may have retreated southward and not returned until the great glaciations had definitely retreated from Ireland.

The same uncertainty obtains regarding post-Würm II. The only undoubted Aurignacian station is on Rathlin Island. There may also be a true Aurignacian tradition in the implements from below the ancient flood level of the lower Bann. Although of undoubted antiquity, it is difficult to bring such finished specimens into relation with the crude implements which follow. To the Buhl-Gshnits interval belong a series of a palæolithic industry of remarkable facies from the 50 ft. raised beach of Antrim (see NATURE, July 26, 1930, p. 133), which may belong to a period anterior to the Baltic Lake. It may be a belated Magdalenian or a new industry; but it has nothing in common with the European microlithic culture extending from the Reindeer period to the Maglemose. The period in Ireland really corresponding to the Baltic Lake is found in the peat at the base of the deposits of the estuary of the Lagan (Belfast), which are covered by an ancient estuarine clay, itself underlying the gravels of the 25 ft. raised beach.

In an analogous deposit at Larne is an industry thought to represent the final phase of the northern Magdalenian (see NATURE, Sept. 6, 1930, p. 352). In the 25 ft. raised beach are found 'Asturian picks' mixed with a great quantity of roughly made implements which in the north are contemporary with the decline of the Magdalenian in the south-west. These may be the work of a race of pre-Mousterians driven north by the Aurignacians. At Glenarm is the pre-Campignian transition, and at Strangford Lough a number of stations mark the arrival of the true Campignian. Then comes the hiatus, followed by the neolithic and chalcolithic ages with their implements of classic upper palæolithic types, the final puzzle of the Irish stone age.

University and Educational Intelligence

BIRMINGHAM.—At the annual meeting of the Court of Governors held on Feb. 25, the vice-chancellor (Sir Charles Grant Robertson) stated that the University is making special efforts to forward the study of biology by increasing the supply of competent teachers available for schools and universities. He directed attention also to the highly successful work of the Appointments Board, the annual number of posts found by this board for Birmingham graduates having increased from 226 in 1924 to 346 in 1930, making a total of 1727, at a cost of about £100 a year. The economical working is due largely to the co-operation of the staff.

Prof. W. S. Boulton, professor of geology since 1913, is retiring at the end of the present session.

CAMBRIDGE.—J. O. Girsavicius (Gonville and Caius College) has been appointed to the Benn W. Levy research studentship in biochemistry for one year.

LONDON.—The following degrees have recently been conferred: D.Sc. (Botany) on Mr. M. A. H. Tincker, for seven published works dealing with the physiology of economic plants, together with four subsidiary contributions. D.Sc. (Physics) on Mr. F. H. Schofield, for eight published works on thermal conductivity and precision measurements of high temperatures, together with three subsidiary contributions. D.Sc. (Geology) on Mr. R. W. Pocock (Birkbeck College), for a thesis entitled "Contributions to the Geology of the West Midlands", consisting of four papers (*Geol. Survey*, 1921 and 1925, and *J. Geol. Soc.*, 1930–31).

THE result of the appeal made last year to former students of the Heriot-Watt College, Edinburgh, and friends and colleagues of the late Sir Francis Grant Ogilvie, the first principal of the College, has made possible the establishment of a Grant Ogilvie Memorial Prize Fund. The income of the Fund will provide two prizes, which will be awarded annually to the best students in the final years of the diploma course in electrical engineering and chemistry.

A NEW list of holiday courses in Europe has recently been compiled and published by the League of Nations Institute of Intellectual Co-operation, in three languages, English, French, and German (Oxford University Press, Warwick Square, London, E.C.4. Price 1*s*.). This list of courses open to foreign students contains all the essential information on 135 holiday courses to be held during 1932 in 17 different countries and 82 cities.

DOCTORATES conferred in the sciences by American universities are reviewed year by year for the National Research Council, Washington, and the titles of the theses, arranged under subject group headings, are published with statistical summaries in the Council's Reprint and Circular series. The review for 1930–31 shows that the number of these doctorates has increased steadily since the series began in 1920, from 330 conferred by 31 universities to 1147 conferred by 63. It provides data for what may, perhaps not too fancifully, be called the climatology of scientific research. Chemistry, as usual, claims a third of the aggregate of the labours of the new doctors—in Ohio State University, Columbia, and Illinois, one-half. Next to chemistry comes zoology, in which from fifteen to twenty per cent of the doctorates were conferred in California, Harvard, Johns Hopkins, Iowa State College, Michigan, Wisconsin, and Yale. Next in order come psychology, physics, botany, mathematics, each of which is responsible for more than seventy doctorates, followed by physiology, agriculture, geology, bacteriology, pathology, engineering, and public health. Of the twenty theses on public health subjects, no less than sixteen belong to Johns Hopkins University. In the lists of titles, students will find indications of the lines of research favoured in America; that, for example, much of the research in psychology is concerned with observations of conditioned reflexes in white rats. Cancer research is conspicuous by its absence from the lists. Looking back over the records of ten years, the only important exceptions to the general increase by two hundred or more per cent in the number of doctorates conferred under the several subject group headings are physics (160 per cent), geology (170 per cent), and pathology (decrease by 4 per cent).

Calendar of Geographical Exploration

March 7, 1778.—Cook's Last Voyage

Capt. Cook reached the north-west coast of America in about lat. 44½° N. In the summer of 1776, Cook, in the *Resolution*, accompanied by Charles Clerke in the *Discovery*, had sailed on a voyage of exploration for the British Admiralty to the northern region of the Pacific coast of America, with the view of discovering a route thither via the Arctic. A few new islands were discovered in the Pacific, including the atoll named Christmas Island, where an eclipse of the sun was observed on Dec. 30. On Jan. 18, Hawaii was discovered, and the group was named the Sandwich Islands, after the Earl of Sandwich, who had done so much to encourage Cook's explorations; the Spaniards had probably visited the group in the sixteenth century. The coast of America north of 40° N. was practically unknown before Cook's visit. His vessels anchored in Nootka Sound, and thence proceeded north, naming islets and inlets as they went. Cook's Bay was thoroughly explored, and conclusive proof was obtained that no passage through to Hudson's Bay existed. The coast of the Alaskan Peninsula was surveyed, and Cape Prince of Wales reached and named. Crossing the strait to the Asiatic side, Cook made acquaintance with the Chukchee, returned to the American side, and pushed north to Cape Lisburne. Ice on both coasts and in the open sea compelled the vessels to return. On the west coast of Hawaii, Cook was murdered by the natives. Capt. Clerke took charge and decided to continue Cook's work in the northern Pacific, but he died on Aug. 2, 1779, and was buried at Petropavlovsk (Kamchatka). The vessels then returned, reaching the Nore in 1780. Cook's previous voyages contributed so much to exploration that his remarkable achievement in these northern regions is sometimes overlooked.

March 7, 1925.—Eastern Bolivia

Col. P. H. Fawcett, leading an expedition to explore eastern Bolivia, reported from Cuyaba, Brazil, that his party was fit and his instruments were in good condition. Fawcett stayed at Cuyaba until April 20, and thence started on his proposed exploration of the Xinga, Araguaya, and Tocantin regions. A dispatch, dated May 30, 1925, from a camp in lat. 11° 43′ S., long. 54° 35′ W., was the last that was heard of him and his son and a young Englishman, R. Rimell. G. M. Dyott left for Brazil in 1928 to search for the party, and succeeded in crossing from Cuyaba to the Kulisehu River and thence reached the Xingu, following it to the Amazon. His journey was a remarkable feat of exploration, but it failed to find Fawcett and his party, and Dyott concluded that they had been

murdered by Indians. Fawcett's previous work had included many explorations in Eastern Bolivia, and he had acted as chief commissioner on the Bolivia-Brazil boundary commission in 1906.

March 9, 1914.—Capt. Shakespear in the Arabian Peninsula

Capt. Shakespear reached the Malham oasis, previously unvisited by Europeans. He left Koweit in February, determined to penetrate into the heart of the desert peninsula of Arabia and to cross it from the Persian Gulf to Egypt. He covered some 1200 miles of unknown country, and for the whole of his journey he kept up a continuous route traverse, checked by observations for latitude; he also took hypsometric readings for altitude. Thus for the first time a complete traverse of the lower Wadi er Rumma was achieved, the first reliable map of the Tuwaik settlements was made, and a new route from Buraida to Jauf followed. From 1909, when he was appointed political agent at Koweit, Shakespear had made annual excursions into the comparatively unknown hinterland, and these paved the way for his last journey. In 1915 he was killed in a skirmish between the forces of Ibn Saud and his rival Ibn Rashid.

Societies and Academies

LONDON

Royal Society, Feb. 25.—**D. M. Needham, J. Needham, E. Baldwin, and J. Yudkin**: A comparative study of the phosphagens, with some remarks on the origin of vertebrates. Arginine phosphate exists in all the invertebrate phyla of which representatives were studied, though in the cœlenterates it was only found in a ctenophore. This compound may be associated with ciliary as well as muscular movement. Creatine phosphate is not confined to the vertebrates, but was found in echinoderm jaw muscle and enteropneust tissues. If any evolutionary significance may be attached to these findings, it is probable that they support the echinoderm-enteropneust theory of vertebrate descent (Bateson: MacBride: Garstang).—**G. Phillips**: Myotatic reflexes in sympathectomised muscle. After excision of its sympathetic innervation, skeletal muscle exhibits quantitative changes in proprioceptive reflex activity. Simultaneous myotatic contractions of two soleus muscles when subjected to the same passive stretch have been recorded by a 'double' isometric myograph and a twin string galvanometer. Three conditions of stretch-stimulation have been regarded as essential in making comparable records. These are, a small passive increment of length, performed at an even rate, from an initial posture of minimal tension. Under such conditions the latent period of the myotatic reflex determined by the time of onset of the first action current wave is shorter in the sympathectomised muscle. Soleus muscle deprived of its sympathetic innervation some weeks previously loses in great degree its power of maintenance of any postural contraction of other than low tension. The available evidence denies the existence of any sympathetic nervous mechanism responsible for the direct qualitative control of postural reactions; and suggests quantitative changes following sympathectomy are produced by a disturbance of the excitability of proprioceptive end-organs in sympathectomised muscle.—**J. C. Eccles and H. E. Hoff**: The rhythmic discharge of motoneurones. The events during the rhythmic cycle are described in terms of the 'activity' of the rhythmic centre, by which is meant the propensity of the rhythmic centre to set up a reflex discharge.

Geological Society, Jan. 13.—**F. B. A. Welch**: The geological structure of the eastern Mendips. The area discussed comprises the Beacon Hill pericline, the most southerly situated of the four echeloned Mendip periclines and that bordering the Radstock coalfield. As in the other three cases, the structure is anticlinal with a steeply folded north limb: the core is formed of Old Red Sandstone and Silurian, the Avonian outcropping on the flanks. The south limb is much concealed by Mesozoic strata, which also stretch across the eastern part of the area, so that the Avonian can only be seen in deep ravines. The whole sequence of events appears to have been the northward drive of the east-and-west pericline against the southern 'nose' of the coal measure basin (with a north-and-south axis). Maximum resistance was offered to this movement along the line of this axis, and in this line lies the central fault block.—**E. S. Hills**: Upper Devonian fishes from New South Wales. The greater part of the material comes from Harvey's Range, north-north-east of Parkes, but there is a single specimen from the Jemalong Gap, another single specimen from the western flank of the Canoblas Mountains, and a few plates preserved in limestone from an unknown locality. The faunal list is enumerated. *Remigolepis* is a new genus lately erected by Stensiö to embrace remains found in East Greenland, and its presence in the collection was recognised by him. Not only does the present record of Upper Devonian fishes from New South Wales greatly extend the known range of these forms in south-eastern Australia, but also it affords valuable evidence for the correlation of the Devonian rocks of that district. It is suggested that the shallow marine deposits of the Lambian (Upper Devonian) series may be, in the main, older than the continental deposits of that epoch, and that the Upper Devonian rocks of Victoria may be the equivalent of only the top of the series as it is developed in New South Wales.

Physical Society, Jan. 15.—**Shih-Chen T'ao and William Band**: Some thermomagnetic effects in nickel and iron. The paper relates to the production of an e.m.f. in nickel and iron wires by the simultaneous application of a longitudinal magnetising field and a temperature gradient.—**W. A. Leyshon**: On periodic movements of the negative glow in discharge tubes. The effect is produced when traces of hydrocarbon vapour are present in the tube in addition to the filling gas (neon, in most of the experiments here described). The jumping glow may be due to internal flashing at that part of the surface of the cathode which is not covered by negative glow. The flash may be caused by the electrical breakdown of a partially insulating hydrocarbon layer, as a result of the collection of positive ions, or by a surface chemical action occurring when the reaction products of the discharge have reached a certain concentration at that surface. It is supposed that the electron emissivity of the surface is increased by the flash, and that the main glow jumps to the activated surface. The process is reversible and hence may be periodic.—**G. I. Finch and R. W. Sutton**: A cathode-ray oscillographic method of measuring inductance. The voltage fluctuations across the condenser in a damped oscillatory circuit, comprising inductance, capacity, and resistance, are recorded by means of a cathode-ray oscillograph.—**H. R. Nettleton and F. H. Llewellyn**: On the measurement of electrical resistance in terms of a mutual inductance and a period. It is shown that if the ratio a/a of the radii of the concentric circles forming a simple inductometer is $0{\cdot}50607_8$, the mutual inductance is so accurately proportional to the angle through which the turning coil is displaced that the rising deviation from a linear law is

less than 5 parts in a million at 7° of deflexion. If the outer circle is replaced by two twin circles which are separated symmetrically with regard to the turning coil, the ratio a/a must be increased to bring about a similar approach to linearity. If a heavy dynamometer is constructed on this principle, then, over the range indicated, the deflecting couple is strictly proportional to the current-products.

PARIS

Academy of Sciences, Jan. 18.—E. Jouguet: Cooled diffusors.—L. Cayeux: The interpretation of the deposits of magnesian limestone of Bimont (Oise) and of Étretat (Seine-Inférieure). The magnesian formations at Bimont and Étretat have important characters in common. Both appear to have been caused by a local modification of the submarine medium. The hypothesis of modifications of the original limestones by the action of mineral springs charged with magnesium salts can be dismissed.—Charles Achard and Maurice Piettre: Some physical and chemical properties of the mucine of the synovial articulations.—André Blondel: Calculations concerning high voltage lines with use of transformers.—A. Recoura: New researches on the hydrated chromic chlorides. Starting with ordinary chromic chloride, usually considered to be $[Cr(H_2O)_4Cl_2]\ Cl\ .\ 2H_2O$, and drying in a vacuum for three to four days, anhydrous ether extracts a brown chloride which is probably $[Cr(H_2O)_3\ .\ Cl_3]$. A second method, using acetone, is also given for preparing the brown chloride.—René Maire and Louis Emberger: The vegetation of the Anti-Atlas.—Ch. Porcher and L. Jung: The intensity of the mammary circulation in the goat during lactation.—Gaston Julia: The structure of multiple convex areas.—Radu Badescu: Certain uniform transcendentals represented by series of rational functions.—Jean Pierre Robert: The generalisations of a singular integral equation of H. Lebesgue.—Lars Ahlfors: A generalisation of Picard's theorem.—Henri Poncin: Elliptic cavitations.—A. Guerbilsky: Recording the deformations and vibrations of the wing of an aeroplane in flight.—A. Danjon: The apparent displacement of the stars in the neighbourhood of the eclipsed sun. A discussion of the observed results compared with those predicted by the theory of generalised relativity.—Ernest Esclangon: Remarks on the preceding paper. The deviation observed is the result of an extrapolation, and the question cannot be regarded as definitely settled without many additional observations.—L. Brillouin: The statistics and magnetism of the free electrons.—Paul Le Rolland and Tchang Te Lou: A new electrical method for the determination of the dew point, applicable to thermal machines. The method is based on the fact that when water vapour is condensed on the surface of an insulator, the latter becomes conducting. The change in the resistance of the surface can be arranged to produce a sound in a telephone or to illuminate a neon tube.—M. Pauthenier and Mme. M. Moreau-Hanot: The study of the motion of a heavy sphere in an ionised electric field.—L. Néel: The magnetic susceptibility of iron some degrees above the Curie point.—Félix Esclangon: The realisation of monochromatic sources of red and yellow light. With tubes without electrodes containing mercury, sodium, or cadmium, the high frequency discharge takes place at temperatures of 80° C., 250° C., and 260° C. respectively. If some argon (pressure of the order of 0·1 mm.) is introduced into these tubes, mercury lights up at the room temperature, sodium at 180° C., and cadmium at 200° C. These facts can be applied to simplify the production of monochromatic light.—J. P. Mathieu: The optical properties of 1·4-naphthalene-bisimino-camphor.—Constantin Salceanu: The variation with the temperature of the magnetic double refraction of some aromatic compounds in the fused state.—Mme. Irène Curie and F. Joliot: The emission of protons of high velocity by substances containing hydrogen under the influence of very penetrating γ-rays.—M. Haïssinsky: The electrolytic deposit of polonium in an alkaline medium.—Desmaroux and Mathieu: The structure of nitrocellulose films.—Henri Muraour: A theory of explosive reactions.—Jean Challansonnet: The constitution, spontaneous graphitisation, and thermal hysteresis of low carbon cast iron containing titanium. Silicon and titanium modify the characters of cast iron in the same direction. Both favour the formation of graphite on solidifying and on annealing. They also reduce the thermal hysteresis of the change (α-iron $-$ C) $\rightarrow$ Fe + Fe_3C.—M. and Mme. Leclère: The separation of the thiophene hydrocarbons contained in oils with high sulphur. A method of controlled sulphonation followed by hydrolysis of the thiophene sulphonic acids was found to be the best method of separation.—R. Lespieau: Study of a method of preparation of true acetylenic primary alcohols. Description of the properties of the alcohol $HC\vdots C\ .\ (CH_2)_2\ .\ CH_2OH$ and of some compounds derived from it.—Roger Dolique: The influence of some impurities on the critical temperature of the solution of phenol in water. Impurities in the phenol of the order of 0·1 per cent may cause differences of 0·2°-0·66° C. in the critical solution temperature.—Houllier: The formation of travertine and peat in the Somme valley.—H. Arsandoux: The morphological evolution of the dome of Mt. Pelée.—Francis Ruellan: The transversal deformations in the relief of the Japanese Archipelago.—Henri Coupin: Loss of sexuality by a fungus.—Bogdan Varitchak: Nuclear evolution in *Pericystis apis*.—Obaton: Mannitol as food for *Sterigmatocystis nigra*.—D. Montet: The action of weak radioactivity on the germination of seeds. Black oxide of uranium was used as the radioactive material. Each kind of seed showed an effect, with an optimum varying with the nature of the seed and its surface.—A. Perrier: Researches on the fermentation of coffee. From the results of experiments detailed it is concluded that the fermentation of coffee is not essential for the preparation of a fine product. On the contrary, if the fermentation is prolonged there is a prejudicial effect on the colour and aroma. Hence the fermentation of coffee is on a different footing from cocoa and tobacco, where the fermentation would appear to be indispensable.—N. Liatsikas: The presence of brown steppe soils in the plain of Thessaly.—A. Demolon and Mlle. J. Brigando: The fixation of proteins by the soil.—Louis Fage: The seasonal vertical migration in the Mysidaceæ.—Mlle. M. Gex: Remarks on the neutralisation curves of biological systems, and of sera in particular.—R. Legroux and Kemal Djemil: Transmissible lysis.—A. Trillat: Attempts at vaccination through the air (chicken cholera).—Jean Régnier, Robert David, and Mme. Alice Kaplan: Contribution to the numerical study of microbial multiplication. The existence of the latent phase.—C. Levaditi, J. Bardet, A. Tchakirian, and A. Vaisman: The therapeutic properties of indium in trypanosomiases and in experimental syphilis. Indium resembles gallium in its active therapeutic action in certain trypanosomiases and experimental syphilis. Its preventive and curative activity is satisfactory in the infection produced in mice by *Trypanosoma Evansi*, but is uncertain in the treponemosis of the rabbit (*Treponema pallidum*).

ROME

Royal National Academy of the Lincei: Communications received during the vacation, 1931.—G. A. Crocco: Aerothermodynamic bodies.—N. Parravano

and **V. Caglioti**: Alloys of zinc and manganese. X-ray investigation of these alloys reveals the existence of γ, ϵ, and η phases with structural characteristics analogous to those of the brasses. The hexagonal ϵ phase is stable at ordinary temperature over the range 33-24 per cent of manganese, and the cubic γ phase, with 52 atoms in the unit cell, has a region of existence between 22·26 and 8·09 per cent of manganese and is stable at the ordinary temperature. The η phase, composed of solid solutions of manganese (about one per cent) in zinc, is unstable and, as it ages, undergoes de-mixing with formation of a eutectic of zinc with another phase (γ' or β'), probably cubic.—**P. Rondoni** and **G. Mezzadroli**: Action of ultra-short electromagnetic waves on the transplantable adenocarcinoma of the rat. These waves accelerate the growth of the tumours considerably.—**G. Barba**: Generalised parallelism in a V_3 (2).—**G. Krall**: The adiabatic invariant in the free motion of gyroscopes.—**A. Rosenblatt**: The stability of laminar movements of viscous liquids (2). Exponential damping at infinity.—**E. Oddone**: A contribution of seismometry to the history of the earth. Seismometric evidence supports G. H. Darwin's hypothesis of the birth of the moon by tidal action exerted by the sun on the earth.—**V. Ricca**: Raman spectrum of ammonia in solutions of different concentrations. Aqueous solutions of ammonium salts exhibit no Raman line attributable to the NH_4 ion, and aqueous ammonia shows a Raman spectrum identical with that furnished by liquid ammonia. It may, therefore, be concluded that, in aqueous solution, ammonia exists partly as NH_3 and partly as NH_4OH, the reaction $NH_3 + H_2O \rightarrow NH_4OH$ representing an equilibrium.—**F. De Carli**: Viscosity of mixtures of stannic chloride with aromatic hydrocarbons (2). At ordinary temperatures, homologues of benzene exhibit a distinct tendency to associate with stannic chloride. Such associations, which are detectable only in the liquid state and are almost completely destroyed at 30°, behave similarly to the compounds of the same hydrocarbons with sulphur dioxide. Confirmation is obtained of the view that the substituent groups of the benzene ring contribute markedly to the greater stability of the complexes formed by derivatives of aromatic hydrocarbons.—**V. Famiani**: The beri-beri quotient (Qb) in nutrition with polished rice and autoclaved grain. Experiments with the same experimental animals (pigeons) fed with polished and washed rice, or grain autoclaved either dry or moist or in presence of alkali, reveal no substantial differences in the values of the beri-beri quotient or in the symptoms observed.—**G. Amantea** and **V. Famiani**: The possibility of obtaining permanent beri-beri phenomena in the pigeon by deprivation of the β factor.—**A. Baroni**: Solid solutions between alkali halides. X-ray investigation of the system KCl-KI fails to show even partial miscibility between the two salts in the solid state. The results of thermal and X-ray analysis of the systems KCl-KBr and KBr-KI confirm those of other authors and show that a metastable equilibrium is reached, true equilibrium being attained only from aqueous solutions.—**V. Zagami**: The effects on albino rats of feeding with seeds of *Lathyrus sativa L.* alone. These seeds form an incomplete or a qualitatively deficient food for growing rats. Although no nervous or motor phenomena related to those described as lathyrism were observed, the young rats displayed diminished resistance, torpor, and pronounced slowness in growth, more particularly of the genital organs and skeleton.—**G. B. Cacciamali**: Contortions of the Ercinian in Alpine orogeny.—**G. Mezzadroli** and **E. Vareton**: Influence of Italian radioactive soils on the development of silkworms. Exposure of silkworms to these soils exerts a favourable action on the development of the worms, their growth being enhanced so as to increase the weight by 32-45 per cent, and the weight of the cocoons increased by 5·8 per cent.—**Celso Guareschi**: Fusion of otocysts in xenoplastic grafting between Anura and Urodela.—**Teodoro Perri**: Behaviour of optical vesicles of *Triton* grafted on to embryos of *Rana esculenta* (destructive processes and power of recovery) (2).—**M. Curzi**: Cases of pedal gangrene from *Sclerotium* observed in Italy.

Forthcoming Events

FRIDAY, MARCH 4

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society) (Annual General Meeting), at 3.—Presidential Address.

INSTITUTE OF MARINE ENGINEERS, at 6.—Annual General Meeting.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Prof. W. G. Fearnsides: The Carboniferous Rocks of Derbyshire Derwent (Lecture).—W. Pulfrey: On the Occurrence of Radiolarian-bearing Nodules at the Base of the Edale Shales, near Calver, N. Derbyshire (In Abstract).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Harold Hartley: Michael Faraday and Electro-Chemistry.

SATURDAY, MARCH 5

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lord Rutherford of Nelson: Discovery and Properties of the Electron (2).

MONDAY, MARCH 7

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

UNIVERSITY OF LEEDS, at 5.15.—Prof. H. J. Fleure: Races and their Evolution (Lecture).

UNIVERSITY COLLEGE, LONDON, at 5.30.—M. Jacques Maritain: Quelques Aspects de la philosophie Thomiste (Lecture) (*in French*).

ROYAL SOCIETY OF ARTS, at 8.—A. E. L. Chorlton: Oil Engine Traction (Howard Lectures) (1).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Sir Douglas Mawson: The B.A.N.Z. Antarctic Research Expedition, 1929–31.

TUESDAY, MARCH 8

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. L. J. Witts: The Pathology and Treatment of Anæmia (Goulstonian Lectures) (3).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.—Prof. J. K. Catterson-Smith: Everyday Uses of Electricity (Faraday Lecture).

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—F. Wokes: The Importance of Ergot in Pharmacy (Lecture).

WEDNESDAY, MARCH 9

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M.—Reading and Discussion of Papers.

SCHOOL OF ORIENTAL STUDIES, at 5.15.—H. J. Braunholtz: The Craft of the African Potter (Lecture).

UNIVERSITY COLLEGE, LONDON, at 5.30.—E. A. Savage: Recent Changes in the Classification of Books in General and Special Libraries (Lecture).

ROYAL SOCIETY OF ARTS, at 8.—Prof. E. P. Stebbing: The New Afforestation Work in the Central Plateau of France.

THURSDAY, MARCH 10

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M.—Reading and Discussion of Papers.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. C. E. Lakin: The Borderlands of Medicine (Lumleian Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. B. S. Haldane: Heredity in Man (4).

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Prof. L. Ruzicka: The Life and Work of Otto Wallach (Pedler Lecture).

FRIDAY, MARCH 11

ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee), at 4.—Miss C. H. Wedgwood: Stages of Economic Development in Melanesia.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Meeting.

SATURDAY, MARCH 12

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Lord Rutherford of Nelson: Discovery and Properties of the Electron (3).

Official Publications Received

BRITISH

Philosophical Transactions of the Royal Society of London. Series A, Vol. 230, A692: On the Groupings and General Behaviour of Solid Particles under the Influence of Air Vibrations in Tubes. By Prof. E. N. da C. Andrade. Pp. 413-445+plates 21-26. (London: Harrison and Sons, Ltd.)

Nigeria. Ninth Annual Bulletin of the Agricultural Department, 1st August 1930. Pp. 248. 5*s*. Third Special Bulletin of the Agricultural Department: The Maintenance of Soil Fertility in Southern Nigeria. By C. J. Lewin. Pp. 43. 2*s*. 6*d*. Annual Report on the Agricultural Department for the Year 1930. Pp. 14. 1*s*. 6*d*. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.)

Canada: Department of Mines: Geological Survey. Memoir 165: Studies of Geophysical Methods, 1928 and 1929. (No. 2666.) Pp. vi+227. 45 cents. Summary Report, 1930, Part A. (No. 2292.) Pp. 196A. Summary Report, 1930, Part B. (No. 2289.) Pp. 103B. Summary Report, 1930, Part C. (No. 2293.) Pp. 131C. (Ottawa: F. A. Acland.)

Proceedings of the Royal Irish Academy. Vol. 40, Section B, No. 11: Reports from the Limnological Laboratory. 2: The Diurnal Migrations of the Crustacea of the Plankton in Lough Derg. By R. Southern and A. C. Gardiner. Pp. 121-159. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*. 6*d*.

Nigeria. Identification of Timbers available in the moist Deciduous to Savannah Forests in Lagos Colony, Abeokuta, Ondo and Oyo Provinces. Pp. 10. (Lagos: Government Printer.)

Sydney University Reprints. Series 1 (Agricultural and Veterinary Science). Vol. 1, Nos. 18-24. Series 4 and 5 (Engineering and Architecture). Vol. 1, Nos. 1-3. Series 6 (Geology and Geography). Vol. 2, Nos. 12-23. Series 8 (Medical Sciences—Clinical). Vol. 1, Nos. 22-32. Series 9 (Medical Sciences—Non-clinical). Vol. 3, Nos. 1-19. Series 11 (Physics, Mathematics and Astronomy). Vol. 1, Nos. 20-25. Series 12 (Social Sciences—Economics, Education, History, Philosophy, Psychology and Anthropology). Vol. 1, Nos. 20-23. Series 13 (Zoology). Vol. 1, Nos. 36-41. (Sydney.)

Forest Bulletin No. 76: List of Plants collected in West Nepal. Pp. ii+9. (Calcutta: Government of India Central Publication Branch.) 4 annas; 5*d*.

Publications of the South African Institute for Medical Research. No. 29: Immunological Studies in Reptiles and their relation to Aspects of Immunity in Higher Animals. By Dr. E. Grasset and A. Zoutendyk. Pp. 377-459. (Johannesburg.)

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 29, January. Edited for the College by Dr. S. Graham Brade-Birks. Pp. 63. (Wye.) 2*s*. 6*d*.; residents in Kent and Surrey, 1*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1411 (Ae. 532—T. 3020): Effect of Lateral Stabilizers on Take-off of a Flying Boat. By L. P. Coombes and R. H. Read. Pp. 5+4 plates. 4*d*. net. No. 1412 (Ae. 533—T. 3092): Theoretical Investigation of the Take-off Time of *Singapore II*. By W. G. A. Perring. Pp. 10+4 plates. 9*d*. net. No. 1415 (Ae. 536—S. and C. 396): Moments of Inertia of Aeroplanes. By S. B. Gates. Pp. 8+5 plates. 9*d*. net. No. 1416 (Ae. 537—S. and C. 401): Effect of Centrifugal Force on the Controls in a Spin. By S. B. Gates. Pp. 3. 3*d*. net. No. 1428 (T. 3154): Discrepancies in Performances of Aircraft of Same Type. By W. G. Jennings. Pp. 5+2 plates. 6*d*. net. No. 1424 (M. 74—I.C.E. 792): Adhesion and Fatigue of Thin Coatings of White Metal deposited on Mild Steel Surfaces. By T. E. Stanton. Pp. 8+2 plates. 6*d*. net. No. 1380 (Ae. 505—T. 3044, 2925): Pressure and Force Measurements on Airscrew-Body Combinations. By H. Bateman and F. C. Johansen. Pp. 62+13 plates. 3*s*. net. No. 1402 (Ae. 523—T. 3158): Growth of Circulation about a Wing and an Apparatus for measuring Fluid Motion. By Dr. P. B. Walker. Pp. 75+41 plates. 4*s*. 6*d*. net. (London: H.M. Stationery Office.)

The National Institute of Agricultural Botany. Twelfth Report and Accounts, 1930-31. Pp. 24. (Cambridge.)

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 57, Part 1, January. Pp. 156+lii+xx+46 plates. (London.) 7*s*. 6*d*.

The National Opportunity: a Fresh Call for Service. An Address by H.R.H. the Prince of Wales, delivered at the Royal Albert Hall on January 27th, 1932. Pp. 10. (London: The National Council of Social Service.) 6*d*.

Proceedings of the Royal Society. Series A, Vol. 135, No. A826, February 1. Pp. 281. (London: Harrison and Sons, Ltd.) 9*s*. 6*d*.

The Carnegie Trust for the Universities of Scotland. Thirtieth Annual Report (for the Year 1930-31) submitted by the Executive Committee to the Trustees on 10th February 1932. Pp. iv+87. (Dunfermline.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 70, No. 422, February. Pp. 189-296+xx. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

FOREIGN

U.S. Department of Commerce: Coast and Geodetic Survey. Serial No. 522: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory near Honolulu, Hawaii, in 1925 and 1926. By Daniel L. Hazard. Pp. 109. 45 cents. Serial No. 523: Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, in 1925 and 1926. By Daniel L. Hazard. Pp. 100. 45 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 79, Art. 33: A New Middle Cambrian Merostome Crustacean. By Charles Elmer Resser. (No. 2899.) Pp. 4+1 plate. Vol. 80, Art. 11: North American Two-Winged Flies of the Genus Spathimeigenia, with Descriptions of Five New Species. By J. M. Aldrich. (No. 2911.) Pp. 10. Vol. 80, Art. 17: A New Marine Shell of the Genus Xenophora from Florida. By Paul Bartsch. (No. 2917.) Pp. 2+1 plate. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Office of Education. Bulletin, 1931, No. 17: Bibliography on Education of the Negro; comprising Publication from January 1928 to December 1930. Compiled by Ambrose Caliver and others. Pp. iii+34. 10 cents. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928-1930. Chapter 2: Elementary Education. By Bess Goodykoontz, Mary Dabney Davis and Mina M. Langvick. Pp. 62. 10 cents. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States. Chapter 3: Secondary Education. Pp. 23. 10 cents. (Washington, D.C.; Government Printing Office.)

American Institute of Weights and Measures. Scientific Papers of the Institute. The Dimensional Problem in International Standardisation. By Luther D. Burlingame. Pp. 12. (New York City.)

Geological Survey of China. Palæontologia Sinica, Series C, Vol. 6, Fascicle 4: Struthious Remains from China and Mongolia, with Descriptions of *Struthio wimani*, *Struthio anderssoni* and *Struthio mongolicus* Spp. nov. By Percy Roycroft Lowe; with a Note on Remains of Carinate Birds, by Dorothea M. A. Bate. Pp. 47+4 plates. (Peiping.)

Proceedings of the Imperial Academy. Vol. 7, No. 10, December. Pp. xxvii-xxviii+369-395. (Tokyo.)

University Observatory, Oslo. Publication No. 2: On the Theory of Oscillating Fluid Globes. By S. Rosseland. Pp. 22. (Oslo: A. W. Brøggers Boktrykkeri A.-S.)

Memoirs of the College of Science, Kyoto Imperial University. Series B. Vol. 6, No. 5, Article 7: Contributiones ad Caricologiam Asiae Orientalis. By Jisaburo Ohwi. Pp. 239-270. Vol. 6, No. 6, Article 8: Über die Dorsiventralität der unifazialen Blätter von *Iris japonica*, Thunb. und ihre Beeinflussbarkeit durch die Schwerkraft. Von Shun-ichiro Imamura. Pp. 271-331+plates 21-22. (Tokyo and Kyoto: Maruzen Co., Ltd.)

Holiday Courses in Europe, 1932. Compiled by the League of Nations' Institute of Intellectual Co-operation. Pp. 56. (London: Oxford University Press; Boston, Mass.: The World Peace Foundation; Paris: Libr. Vuibert; Leipzig: Alfred Lorentz.) 1*s*.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 1, Janvier. Pp. 48. (Prague: Regia Societas Scientiarum Bohemica.)

Statens Skogsförsöksanstalt. Flygblad No. 40: Skogsträdens fruktsättning år 1929. Av L. Tirén. Pp. 19. 30 öre. Flygblad No. 41: Skogsträdens fruktsättning år 1930. Av L. Tirén. Pp. 19. 30 öre. Flygblad No. 42: Skogsträdens fruktsättning år 1931. Av L. Tirén. Pp. 19. 30 öre. Meddelanden, Häfte 26, 1930-31. Pp. iv+582. 9.00 kr. (Stockholm.)

The University of Colorado Studies. Vol. 19, No. 1: Abstracts of Theses for Higher Degrees, 1931. Pp. 75. (Boulder, Colo.) 1.00 dollar.

Field Museum of Natural History: Department of Anthropology. Guide, Part 5: Ethnology of Melanesia, Joseph N. Field Hall (Hall A, Ground Floor). By Albert B. Lewis. Pp. 209+64 plates. (Chicago.) 1.75 dollars.

Cornell University: Agricultural Experiment Station. Bulletin 530: A Study of Phosphatic Limestone as a Mineral Supplement. By Chester Tolle and L. A. Maynard. Pp. 27+2 plates. Memoir 136: Studies on the Fire-Blight Organism, *Bacillus amylovorus*. By A. L. Pierstorff. Pp. 53+3 plates. Memoir 137: Some Nitrogen Relationships in Muck Soils. By B. D. Wilson and G. R. Townsend. Pp. 14. Memoir 138: The Effect of Pruning Apple Trees at Planting Time. By Joseph Oskamp. Pp. 50. (Ithaca, N.Y.)

Proceedings of the United States National Museum. Vol. 80, Art. 7: A Second Collection of Birds from the Provinces of Yunnan and Szechuan, China, made for the National Geographic Society by Dr. Joseph F. Rock. By J. H. Riley. (No. 2907.) Pp. 91. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the American Academy of Arts and Sciences. Vol. 66, No. 13: Records of Meetings, 1930-1931; Officers and Committees for 1931-1932; List of the Fellows, Associates and Foreign Honorary Members; Statutes and Standing Votes; Rumford Premium; Index. Pp. 479-565. 1.35 dollars. Vol. 67, No. 1: Volume—Temperature—Pressure Relations for several Non-volatile Liquids. By P. W. Bridgman. Pp. 27. 60 cents. Vol. 67, No. 2: Physical Properties of Single Crystal Magnesium. By P. W. Bridgman. Pp. 29-41. 40 cents. (Boston, Mass.)

Ministerio da Educação e Saude Pública: Observatorio Nacional do Rio de Janeiro. Taboas das Marés para o Ano de 1932 nos Portos do Rio de Janeiro, Belém, S. Luiz, Amarração, Camocim, Fortaleza, Natal, Cabedelo, Tambaú, Recife, Aracajú, Baia, Ilhéos, Santos e Paranguá. Pp. 185. (Rio de Janeiro.)

Ministerio da Educação e Saude Pública. Anuario publicado pélo Observatorio Nacional do Rio de Janeiro para o Ano de 1932. Ano 48. Pp. xv+408. (Rio de Janeiro.)

Société Française de Physique. Annuaire 1931. Pp. 111. (Paris: Société Française de Physique.)