SATURDAY, OCTOBER 7, 1922.

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*Editorial and Publishing Offices :*
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.



## Broadcasting in Great Britain.

THE Postmaster-General has, it is announced, decided temporarily to suspend the issue of licences for the reception of wireless telegraphy and telephony, except to those engaged upon experimental work. In an official statement sent out by the Post Office in relation to the broadcasting situation, it is explained that the Postmaster-General has been prompted to adopt the course he has taken in connexion with the issue of licences for reception purposes owing to the fact that there has been a divergence of views concerning the details with regard to the constitution of the company which it is proposed to form for the purpose of providing the broadcasting services. Not only have the proposed articles of association of the proposed broadcasting company proved unacceptable, as a whole, to the Postmaster-General and his advisers, but also, it would appear, that differences on essential points have also been manifest between the members of the committee dealing with the Postmaster-General in this matter. Considerable progress has, it is stated, now been made towards the solution of the differences between the members of the committee in question, and, at a conference held at the Post Office on September 12, an agreement was reached as to the conditions under which the Postmaster-General will issue the necessary licences for the erection of the broadcasting stations; it therefore now only remains for the Post Office officials and the committee representing the proposed company to settle certain details.

In the official statement in question it is announced that the Postmaster-General and the committee both desire it to be known that membership of the proposed broadcasting company will not, of itself, entitle a member to use the patents of other members in the manufacture of receiving apparatus. The manner in which the broadcasting situation is being handled by the Post Office has, in some quarters, caused considerable disquietude; the policy which is being pursued by the Postmaster-General, whereby an attempt is to be made to control the broadcasting situation by and through the means of the proposed articles of association of the company which it is proposed to license to provide the broadcasting services, certainly seems to be one of doubtful wisdom. As the provisions to be included in the proposed articles of association at the instance or with the approval of the Postmaster-General have not yet been made public, it would be premature further to discuss the matter at the moment.

A point of considerable importance, which requires early attention, is the attitude the Post Office is taking in connexion with the issue of licences for experimental work. In the official statement, to which reference has already been made, it is indicated that the Postmaster-General intends in future to issue licences for experimental stations alone to those who can satisfy him that they have a sufficient knowledge of the subject to enable them to make a proper use of such licences. It is surmised in some quarters that this departmental rule has been framed with the view of restricting the grant of licences for experimental work alone to trained scientific workers. In the interests of the progress of science it is essential that the terms and conditions under which it is possible to obtain a licence for experimental work shall not be made so exacting and stringent as to exclude the amateur from the field of wireless research.

The requirements in relation to the issue of licences for experimental stations are definitely laid down in clause 2 of the Wireless Telegraphy Act, 1904 (4 Ed. 7, c. 24), wherein it is provided that "where the applicant for a licence proves to the satisfaction of the Postmaster-General that the sole object of obtaining the licence is to enable him to conduct experiments in wireless telegraphy, a licence for that purpose shall be granted, subject to such special terms, conditions and restrictions as the Postmaster-General may think proper, but shall not be subject to any rent or royalty." The language used in this clause is sufficiently clear to show that it cannot have been the intention of the legislature in any way to penalise the amateur experimentalist in connexion with the procuring of a licence for experimental work. In the matter of the grant of such licences the amateur experimentalist and the trained scientific worker have an equal claim upon the Postmaster-General, provided that they can prove to his satisfaction that the station which they desire to equip is an experimental one, in contradistinction to one fitted up for commercial work. The amateur should receive the fullest encouragement and consideration from the Post Office. Mischief will alone result should the steps which the Postmaster-General and his advisers are contemplating with regard to the issue of licences for experimental work have the unfortunate effect of moving amateurs to evade the official regulations and the provisions of the Wireless Telegraphy Act, 1904.

## The Problem of Solution.

THE problem of solution has engaged the attention of many men of science from the time of Newton to the present day, and it cannot be said that a complete and all-embracing theory has yet been advanced that will interpret all the observed facts. The subject lends itself admirably to those who concern themselves with pointing out weaknesses of accepted conceptions without replacing these ideas by adequate substitutes.

A contributor, writing under the pseudonym Dr. B. Lagueur, in the *Chemical Age* of September 2, very ably and wittily adopts the style of the "Compleat Angler," and produces an imaginary conversation between a "Chymist" (baptised Henry), in whose chemical philosophy there has not arisen the necessity of adopting the ionic hypothesis, and a "Friend," who, being a creation of the author and therefore fundamentally of similar persuasion, is unable to make a satisfactory case for its adoption.

Of the theories advocated it is now generally recognised that the older conception of hydrate formation is insufficient to account for the experimental results obtained. The hydrone theory of Armstrong appears to be that beloved of the "Chymist," and explains solution by assuming the existence of new molecules formed by the union of the water with the solute. It has a certain measure of experimental support, but, despite this, despite the known complexity of water, and despite the crystal work of Bragg, it embodies a number of assumptions difficult to verify, and by itself is scarcely likely to displace the more firmly established hypothesis of Arrhenius, which, though revolutionary, imperfect, and easily attacked, yet fulfils the functions of a hypothesis, and therefore serves a useful purpose.

The ionic hypothesis has explained many facts hitherto extremely puzzling; it has opened out new lines of research, and "as a working hypothesis gives qualitative and quantitative explanation of a large number of chemical phenomena which can otherwise only be accounted for in a vague and unsatisfactory way." The solvate theory—a combination of the original ionic hypothesis with the hydrate and hydrone conceptions—has been the outcome of a long series of experiments on solution by Jones and his collaborators in America. The ionic hypothesis, shorn of the frills and furbelows given to it by enthusiasts, is generally accepted with certain mental reservations as to the existence of ions, except by those who, as Jones says, "oppose it after a careful study of the facts or are unable or indisposed to adapt themselves to new ideas."

Many hypotheses are at best unstable and transient, but before any are discarded they must be killed, and the death of the theory of electrolytic dissociation is not yet, notwithstanding the thrusts given to it in the article in our contemporary.

## The New Way of Thinking Physical Reality.

(1) *The Philosophy of Humanism and of other Subjects.* By Viscount Haldane. Pp. xiv+302. (London: J. Murray, 1922.) 12*s*. net.

(2) *L'Expérience humaine et la causalité physique.* Par Prof. Léon Brunschvicg. (Bibliothèque de Philosophie Contemporaine.) Pp. xvi+625. (Paris: Félix Alcan, 1922.) 30 frs.

(3) *La Notion d'espace.* Par Prof. D. Nys. (Fondation Universitaire de Belgique.) Pp. 446. (Bruxelles: Robert Sand; London: Oxford University Press, 1922.) 15*s*. net.

(4) *The Evolution of Knowledge.* By George Shann. Pp. vii+100. (London: Longmans, Green and Co., 1922.) 4*s*. 6*d*. net.

THE direction which scientific research has taken in the twentieth century is imposing on philosophy a task the magnitude of which is probably not yet realised by any one. Aristotle, in his doctrine of the four causes and in his discovery of the syllogism, the logical instrument which gave that doctrine the appearance of precision, determined the type and the mode to which all succeeding scientific research right up to modern times has adhered. The essential thing in the Aristotelian doctrine is that the analysis of the physical universe proceeds in precisely the same way as the analysis of the elementary conditions which govern the production of a work of art. There is, that is to say, a matter on which an agent impresses a form in order to express an end or purpose. The modern sciences of biology and psychology had already begun to undermine this æsthetic mode of thinking reality and now the Einstein theory in mathematical physics has swept away its foundations. The result is that once more in human history physics and metaphysics are joined together. The union has been brought about by physical science itself, without any betrayal of its positive and experimental character, by fearless acceptance of the apparently paradoxical results of experiments. It is the outcome, we can now see, of a historical progress of pure science in the last three centuries, continuous in its development from Galileo to Clerk Maxwell, Mach and Einstein, which has led to a complete revolution in the way of thinking physical reality.

The philosophical current of human thought, although always a reflection of the scientific current, has not the same rhythm. It happens at times, unexpectedly and as if by a sudden explosion, that the scientific current is interrupted; some wholly unlooked-for results of experimental investigation have occurred, and the human mind has sprung at once to the general principles whence those results proceed. A new vision of truth then opens out before human consciousness involving its whole conception of the universe and mind. It was such a vision which produced the new birth of modern philosophy in the seventeenth century. To-day a new and most startling discovery, following indeed a long historical development, but a development we can appreciate only now because the discovery has given us the vantage ground from which to look back on the history, is opening to us a new vision of truth and making us rethink our whole concept of the nature of physical reality.

(1) and (2) It is this new way of thinking physical reality which, each in his own way, the authors we have grouped together are seeking to express. In the case of Lord Haldane's "Humanism" and Prof. Brunschvicg's "L'Expérience humaine" there is full consciousness of it and a direct purpose of exposition. It is noteworthy that two such books, widely different in their method and scope and yet so singularly in agreement, both in their viewpoint and aim, should appear together. Lord Haldane, who is not a mathematician, devotes himself to detailed philosophical analysis of the new mathematical concept, while Prof. Brunschvicg, a mathematician of distinction and known to us chiefly by his *editio princeps* of Pascal's works, traces with an extraordinary grasp of details the historical development of the concept of physical causality which has resulted in the generalised theory of relativity; and both interpret to us the new concept of the physical universe in practically identical terms. The humanism of the one is the human experience of the other, and Lord Haldane's "foundational nature of knowledge" is Prof. Brunschvicg's "philosophie de la pensée."

The cosmology of Einstein differs fundamentally from every previous doctrine inasmuch as it discards both the factors which in the long history of human thought have contended against one another for pre-eminence. It regards neither the definition of the concept, whence deduction is made, nor the datum of experience, on which induction is based, as fundamental. Einstein's world is a world of figures, supposing neither *a priori* concepts nor sensible images. These figures, however, are not fictions, they are not even abstractions, they correspond to coefficients which reality furnishes. Mathematics determines for us the *invariant* which passes from one system to another.

Between Newton and Einstein, Prof. Brunschvicg tells us, there is this difference that according to Newton the thing to be measured has an absolute content, inaccessible it may be directly to man, but certainly accessible to God. That is to say, the Newtonian universe would be an object of intuition, that is, would form a picture, at least to God. According to Einstein, we cannot say, speaking absolutely, that there is any picture even for God. The picture is only known as a function of the frame. That is, the things measured are only known through the measurings, and the measurings are bound up with the things they serve to measure. The understanding of this reciprocity makes it impossible to separate and consider apart what, for the convenience of language alone, we distinguish as frame and picture. Science goes in a kind of perpetual oscillation, with an ever-narrowing adaptation, from the measured to the measuring, from the measuring to the measured. Thus, considered from the point of view of the measuring, it is impossible by any physical means whatever to reveal a uniform movement of translation in which both the observer and all that he observes participate. Considered from the point of view of the measured, the velocity of light is the only velocity which is unchanged when we pass from one system of reference to another, and in the electromagnetic universe this velocity plays the rôle which infinite velocity formerly played in the mechanistic universe. The constancy of the velocity of light implies further an irreducible plurality of physical measurements of times, because the various groups of observers cannot make clocks from which they can detach themselves and compare them as instruments with one another. They are themselves the inhabitants of a clock, prisoners in their own time-measuring instrument, bound to its state whether they suppose it at rest or moving.

To most of us, however, whether our interest in the principle of relativity is scientific or philosophical, the greatest stumbling-block is probably the hypothesis of a finite universe. This seems a contradiction in thought and at least an unnecessary appendage of the principle. Prof. Brunschvicg shows us very clearly why the equations lead necessarily to this hypothesis, for they allow us to show that without it the total reduction of inertia to reciprocal action between masses is impossible.

The metaphysics which the new physics implies means therefore a complete revolution both in philosophy and science. As metaphysics it claims neither priority over science nor independence of it, not even the independence implied by Kant in the theory that the conditions of experience are *a priori*. This is not because metaphysics has learnt to be humble or to be resigned, but because in reality there is a contradiction in the very notion that by reflecting on science we can disengage certain antecedent conditions capable of enclosing all past and future knowledge in static schemes. On the side of positive science we have come to see that by the pure experimental method we are not and cannot be brought into contact with elemental constituents of experience, whether material as Democritus conceived them, or intelligible as Plato conceived them, or sensible as Hume conceived them. The realities we are dealing with in physical science are statistical, so that all reflection on the results of experiment is, not an approach to the absolute, but a progress in the discovery of relativity. The early nineteenth-century ideal of a pure positive science perpetually progressive by means of a division of labour has given place in the twentieth century to a new and more subtle idea, the idea of a progress which is reflective.

(3) Prof. D. Nys's "La Notion d'espace" is a valuable book, but belongs to a different category from that of the two works we have mentioned. It is the fourth volume of his "Cosmologie ou Étude philosophique du monde inorganique," and is encyclopædic in its treatment of the subject. It includes in a general view of the various philosophical doctrines a very clear account of the recent theories with the criticisms upon them and is a model of careful compilation. It develops no original theory and is written from the point of view of neo-scholasticism.

(4) Mr. Shann's short treatise on "The Evolution of Knowledge" is the work of one who knows how to think out a problem for himself. It deals with a different aspect of relativity from that of the physical principle, namely, with the nature of the vital need which has produced in man and some animals the function of knowing. All those friends of Mr. Shann who have received from him from time to time his excellent privately printed pamphlets, bound in the well-known scarlet wrapper, will welcome this published work.

H. WILDON CARR.

## Ceremonial Exchange.

*Argonauts of the Western Pacific: An Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea.* By Dr. Bronislaw Malinowski. Pp. xxxii + 527. (London: G. Routledge and Sons, Ltd., 1922.) 21*s*. net.

IN this volume Dr. Malinowski has given the first-fruits of his extended stay in the Trobriands, a group of islands off the south-east of New Guinea. A good deal of more or less desultory information, published in Government reports and elsewhere, has indicated that these islanders differ in some respects from their neighbours; Dr. Malinowski now shows how intimately they are all associated with one another, not merely by ordinary trade, but by a hitherto unrecorded and very remarkable system of ceremonial exchange, known as Kula, with which this book is almost solely concerned.

The exchange takes place between partners who may reside in the same island, but for the most part in different islands. The Kula articles of value are shell-necklaces of a special type and armlets made of Conus shell. The former always travel N.-E.-S.-W., *i.e.* clockwise, and the latter in the contrary direction, but other articles of value may be implicated in the transactions in a subsidiary manner. The islands mainly concerned in Kula are those between Nada and the Trobriands, the Amphletts, part of the southern d'Entrecasteaux and the Tubetube group. The real Kula necklaces and the arm-shells have various worth, and highly valued ones have individual names, and their wanderings are followed with interest. The ownership, or rather trusteeship, of each object is temporary, and ranges from a few minutes to one year or possibly two, but a man who retains an object beyond a year is regarded as a mean person. The exchange is by the natives sharply differentiated from barter, as no haggling takes place. An equivalent gift is always expected, but cannot be demanded or enforced, the only punishment for failing in this being loss of esteem. If at any time an equivalent gift cannot be bestowed, intermediate gifts will smooth the way till the real repayment takes place. Meanness is the most despised vice, and generosity the essence of goodness. *Noblesse oblige* is in reality the social norm regulating their conduct. This does not mean that people are always satisfied and that there are no squabbles nor even feuds about the transactions. It is obvious that however much a man may want to give a good equivalent for the object received, he may not be able to do so; and then, as there is always a keen competition to be the most generous giver, a man who has received less than he gave will not keep his grievance to himself but will brag about his own generosity and compare it with his partner's meanness; the other resents it, and the quarrel is ready to break out. All the preparatory activities, as well as those connected with the voyages and the ceremonies of exchange, are permeated by magic, as indeed is the whole economic life of the people.

The most important character of Kula is the mental attitude of the natives towards it. The objects of the Kula are neither used nor regarded as currency, as they are never used as a medium of exchange or as a measure of wealth; they serve merely to be owned and displayed and then exchanged. It is through being the means of arousing envy and conferring social distinction and renown that these objects attain their high value and form one of the leading interests in native life. The ceremonial attached to the act of giving and the manner of carrying and handling shows distinctly that they are not mere merchandise, but something that confers dignity on a man, that exalts him, and which he therefore treats with veneration and affection. Nothing of the same kind has been described elsewhere, but something analogous may be discovered now that attention has been directed to it. The potlatch of British Columbia, for example, is worth reconsidering in the light of this book.

Dr. Malinowski has not confined himself to a mere detailed description of Kula, but he has endeavoured, apparently with great success, to explain its psychological significance. Kula so pervades the life, thought, and emotion of the people concerned in it that it seems in some respects to fulfil functions which are characteristic of many religions, but with magic supplying the place of spiritual powers. The system might almost be termed the Kula cult, as Dr. Malinowski seems to hint; but he distinctly states that the natives worship nothing.

The inter-insular Kula requires seaworthy canoes, and Dr. Malinowski describes how these are made, and the series of magical rites which accompany every stage in their manufacture, equipment, and sailing. The smaller fishing canoes are owned by one man, but the sea-going canoe is constructed by a group of people; it is owned, used, and enjoyed communally, and this according to definite rules, all of which are described with careful detail and psychological insight. To the natives a canoe of this type is a marvellous achievement, a thing of beauty, and an object permeated by magic. "He has spun a tradition around it, he adorns it with his best carvings, he colours and decorates it. It is associated with journeys by sail, full of threatening dangers, of living hopes and desires to which he gives expression in song and story. In short, in the tradition of the natives, in their customs, in their behaviour, and in their direct statements, there can be found the deep love, the admiration, the specific attachment as to something alive and personal, so characteristic of the sailor's attitude towards his craft."

An outstanding merit of this book is that it is a well-considered study in ethnographical method; indeed the author's remarks on field-work will prove of great value for the guidance of future workers. A large number of magical formulæ and oral texts is given in the native language and in translation, which provides unusual documentary evidence of exceptional value for the elucidation of native psychology. The book is well illustrated and of reasonable cost, for which the publishers are to be thanked. Mr. Robert Mond and others, by their liberality, have enabled these investigations to be made, and they have the satisfaction of knowing that they have afforded an opportunity for a young student to produce a work of absolutely first-class value. It is to be hoped that Dr. Malinowski will be able to publish in full the remainder of his material, which, judging from this sample, will mark a distinct progress in ethnographical research and interpretation. A. C. HADDON.

## Pure and Applied Electricity.

(1) *Einführung in die Theorie der Elektrizität und des Magnetismus. Zum Gebrauch bei Vorträgen, sowie zum Selbstunterricht.* Von Prof. Dr. Max Planck. Pp. v+208. (Leipzig: S. Hirzel, 1922.) 42 marks.

(2) *Elettrotecnica elementare con numerosi problemi.* By A. Occhialini. Vol. 1: *Magnetismo—Elettrostatica — Elettrochimica — Elettrodinamica — Elettromagnetismo — Induzione elettromagnetica.* Pp. v+344. (Firenze: Felice Le Monnier, n.d.) n.p.

(3) *Installations électriques industrielles: choix du matériel.* Par R. Cabaud. Pp. 316. (Paris: J.-B. Baillière et Fils, 1922.) 10 francs.

THE first of these three books discusses the groundwork of the theory of electricity, the next discusses the experimental laws and their laboratory applications, and the third is a severely practical work for the commerical electrician. They are all introductions to the subject, but they are intended for very different classes of readers.

(1) Dr. Max Planck's work is philosophical, and presupposes a knowledge of mathematics and of the mathematical theory of electricity which is possessed by few. The foundations on which the ordinary mathematical equations rest are examined, and particular stress is laid on the units in which they are measured. The Gaussian, the electrostatic, and the electromagnetic systems of units are considered. The work will be very welcome to the pure theorist and will increase his confidence in the soundness of the physical basis of the mathematical theory. The clear distinction made between magnetic force and magnetic induction is very convincing. The experimenter will find little that is directly helpful to him in this book, but he will appreciate, however, the author's method of getting the capacity of an ellipsoid and the deductions that can be made from it.

(2) The second work under notice is very similar to the standard English books on experimental electricity and magnetism. The author's descriptions of the main phenomena are very clear, and the numerous examples given are instructive. A very full discussion is given of the problem of a number of batteries of different electromotive forces and resistances in parallel with one another. A thorough knowledge of this problem is a great help to students when they come to the corresponding problems of dynamos or alternators running in parallel with one another. The definition given of the temperature coefficient of metals, however, is not sufficiently accurate for modern requirements. The rating of a dynamo depends on its temperature after a run at full load, and the temperature of the coils is computed from their measured resistance and a knowledge of the temperature coefficient of copper. As the problem is one of great commercial importance it is necessary to distinguish between the temperature coefficeint of the volume resistivity, the mass resistivity, and the constant mass resistance. These are all different and vary with the lower of the two temperatures considered. The approximate formulæ for the self-induction of a coil are given, but we think that their limitations should have been stated.

(3) M. Cabaud's book is very general and can be appreciated only by a technical expert. It presupposes a thorough knowledge of practical electrical engineering. In the first section of the book a general discussion is given of the kind of electric machine required to do special work; for example, whether a direct-current or an alternating-current machine will be the more useful. In the latter case also the question of whether it is to be single phase or polyphase is considered. The efficiency of the machine, its heating under load, the electric strength of the insulating wrappings, etc., have all to be considered. In the second section the characteristics of the machines, whether rotating or stationary, are described. In the last section the usefulness of the various characteristics are discussed, and the important question of the best guarantees that should be demanded from the manufacturers is considered.

## The Petroleum Industry.

(1) *Encyclopédie Scientifique: Bibliothèque de géologie et de minéralogie appliquées: Les Gisements de pétrole.* Par Jean Chautard. Pp. viii+viii+330. (Paris: Gaston Doin, 1922.) 14 fr.

(2) *The Oil Encyclopedia.* By Marcel Mitzakis. Pp. xvi+551. (London: Chapman and Hall, Ltd., 1922.) 21*s.* net.

(3) *The Economics of Petroleum.* By Joseph E. Pogue. Pp. ix+375. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 33*s.* net.

THE "Encyclopédie Scientifique" constitutes a comparatively new departure in French technical literature, and has for its scope the ultimate publication of some thousand volumes dealing with the various phases of pure and applied science. M. Jean Chautard's little book (1) is apparently one of the earliest of the series, and if it indeed sets the standard of future productions, this encyclopedia will undoubtedly prove of very great value. Well written, profusely illustrated with photographs, maps, plans, diagrams and sections, this particular volume covers a wide subject in a minimum of space. The major part is concerned with the geology of petroleum and a consideration of the petroliferous regions of the world. Other chapters deal with the nature of petroleum, natural gas and solid hydrocarbons, their origin, mode of occurrence, surface manifestations, exploration, and economic development.

The author has drawn on most of the more recent literature for his descriptions of the oil occurrences throughout the world, and in consequence the information given is most up-to-date; several minor errors occur in the spelling of place-names, but these will doubtless be corrected in a future edition. Not the least valuable of the contents of the book are the bibliography, and a noteworthy preface by M. Louis Mrazec, whose structural theories, incidentally, receive careful treatment in the text. At the present time, when scientific books are usually published at prohibitive prices, it is gratifying to be able to recommend a volume which is both an inexpensive and necessary addition to the library of petroleum technology.

(2) In the "Oil Encyclopedia," by Mr. Marcel Mitzakis, we meet with a very different type of book, one which will doubtless make its appeal more to the commercial than to the scientific community. To the many people whose province it is to control the destinies of oil-land development and economics—the administrative as distinct from the technical branch of the industry—this volume will prove of value, presenting as it does the many and varied phases of oil-mining in the form of an elaborate and explanatory index. The volume includes information of a biographical, geological, geographical, and chemical nature, apart from its treatment of the multitudinous technical factors pertaining to the oil industry, and as a source of broad reference to such matters, has much to commend it. It lacks in many cases, however, that atmosphere of authority and degree of accuracy which are to be expected in a work purporting to be for widespread use, and judged from the scientific point of view, leaves much to be desired. In several cases the definitions, especially of geological terms, are decidedly loose, if not actually erroneous, while some of the facts given are by no means correct, nor are they always up-to-date. As examples we may quote the definition of "æolian" given as "a special kind of sand found in oil-bearing strata," and the paragraph devoted to the explanation of the word "Cambrian" since "so many oil strata occur disseminated among Cambrian deposits." Further, the oil potentialities and realities of Great Britain are allotted space out of all proportion to their importance, while the remarks on the natural gas resources of Heathfield, Sussex, though optimistic, are unfortunately incorrect.

No work of this nature could possibly be complete, in the strict sense of the word, unless expanded into many volumes, and had the scope been a little less ambitious, the result would probably have proved far more satisfactory. The biographies could well have been dispensed with, similarly many of the definitions of the more complex chemical compounds, and thus space made available for the inclusion of many terms used in drilling, for example, which are unintelligible to the average non-technical man.

(3) The object of Mr. Joseph Pogue's book is to present, in perspective, the more important economic facts relating to petroleum, and it must be said that the author has certainly achieved his aim. He had every opportunity of producing an enormous compilation of statistics, relieved by a few terse, explanatory paragraphs and deductions, a veritable "blue-book" in fact, dreary, lifeless, and incomprehensible, as publications of that nature are usually wont to be. Instead, the author has given us a work of tangible value, one which seeks only to use past and present facts in order to foreshadow future possibilities.

People to-day are very apt to take things in general, and the petroleum industry in particular, for granted, and ignoring such factors as gradual and universal decline of oil production, more especially in the United States, they are blind to the economic situation which must inevitably be faced. Not only that, they are content to consume oil-fuel and allied products on a peculiarly wasteful scale at the present time, in a manner as complacent as it is incomprehensible to the careful thinker. We recognise in this the basis of Mr. Pogue's book. He says, "The point to be emphasized is the coming necessity for increasing the over-all efficiency of petroleum . . .", and having read that and other important observations made in his excellent preface, we are not surprised at the skilful manner in which he handles his ramified subject. The volume is very readable: indeed, it demands most careful perusal as it takes the reader rapidly from one aspect to another. Beginning with the economic organisation of the industry, it sets before us the salient features of the present trend of oil-field development, oil refinery practice, oil marketing, finance and the bearing of automotive transport on the industry, among other factors, while the chapters on resource situation, international aspects of petroleum, the full utilisation of petroleum, and the function of statistics in the industry, are especially good.

In the space at our disposal, it is impossible to review a work of this nature with justice, and likewise to indulge in that amount of constructive criticism otherwise desired; we would suggest that, in view of its importance as an ultimate source of fuel, considerably more space be devoted to the oil-shale question in future editions, while present refinery practice might with advantage be much more severely criticised, both with regard to technique and design. The author is to be congratulated on the achievement of a remarkably fine work, one that should be widely read by all serious servants of a great industry. H. B. MILNER.

## Our Bookshelf.

*Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain.* Vol. 20: *Lead and Zinc. The Mining District of North Cardiganshire and West Montgomeryshire.* By Dr. O. T. Jones. Pp. vi+207. (London: H.M. Stationery Office, 1922.) 7s. net.

LIKE the three previous volumes dealing with British lead and zinc ores which have been issued by the Geological Survey, it must be admitted regretfully that the present one has a scientific rather than an economic interest. Some of the mines described in the present volume, like Frongoch mine in Cardiganshire and the Van mine in Montgomeryshire, have been extraordinarily productive; the former has been worked for 59 years and the latter for 51 years, and from each more than 100,000 tons of lead and zinc ores have been produced in the course of its career, but in both cases the really productive period was something like half a century ago. The author suggests that it is just possible that these mines might show an improvement by sinking deeper and reaching harder rocks than the soft shales in which they are now bottomed; the prospect, however, is not a very promising one, and the present low price of lead affords no encouragement to spend money on prospecting operations of a highly speculative nature.

The real value of the present work lies in the excellent study of the formation of the faults and fissures and the mode of their filling which Prof. Jones has supplied in the introductory chapters. The first chapter on the general structure of the area gives a very valuable summary of its leading geological features, while the next two chapters are devoted to a discussion of the leading system of fissures to which the district owes its mineral wealth. Finally, the last chapter deals with a number of important points such as the probable age and sources of origin of the ore filling, and the influence upon it of the country rock traversed by the fissures. These chapters form a most valuable contribution to the study of mineral deposition, and from this point of view, quite apart from any possible remote economic possibilities, Prof. Jones's volume deserves the careful attention of the student of mineral deposits. H. L.

*Some Scottish Breeding Duck: Their Arrival and Dispersal.* By Evelyn V. Baxter and Leonora J. Rintoul. Pp. vii+90. (Edinburgh: Oliver and Boyd, 1922.) 5s. net.

THE problems of the increase and extension of range of ducks in Scotland, and in other countries, have long exercised ornithologists throughout the British Isles. As the authors of the volume under notice point out, protection and a better feeling towards and a greater interest in all wild birds are probably important factors in the case but do not explain everything. Certain species other than ducks are as steadily decreasing, and the rise and fall of a species is a complicated biological problem which may have but indirect association with human interference, or may be due entirely to other causes. The recent colonisation of Scotland by other birds, such as the starling, turtle-dove, and great-crested grebe, may be due to the necessity for an over-abundant species to find new areas and the possibilities of settling in an area where raptorial birds and other enemies have been largely destroyed by man's advance and action.

One factor the authors have not stressed, the growing habit of keeping pinioned ornamental fowl, though they mention bird sanctuaries. Passing birds are often "called down" by pinioned fowl, and some of them may elect to mate and breed. That the direction of spread differs in such ducks as the gadwall and wigeon is no argument against this fact, for the source whence come the visitors has no bearing on the influences which cause them to remain. Many pairs of ducks of various kinds have probably nested in out-of-the-way places for years and been overlooked, for it is only within the last thirty years or so that parts of Scotland have been systematically explored from the ornithological point of view. Sportsmen and keepers are not very particular about the species of the ducks which fill their bags.

We note that the authors use the correct spelling of two much-discussed names, wigeon and shoveler.

*An Introduction to Engineering Drawing.* By J. Duncan. (Life and Work Series.) Pp. x+158. (London: Macmillan and Co., Ltd., 1922.) 4s.

THE aim of Mr. Duncan's book is to enable young students of engineering to produce intelligible working drawings of the details of engineering machines and structures. The student is introduced to the proper workmanlike methods of actual engineering practice, and is not allowed the use of any special hybrid methods which are supposed by many to be sufficient for use in schools.

The book commences with a description of drawing instruments, their use and handling; from this, the student is led to the ordinary problems in plain geometry with practical engineering examples such as drawing cams, and plotting small surveys. Afterwards, a little solid geometry introduces the student to oblique and isometric projection, and prepares him for the drawing of engineering details. For this latter portion of the training the author strongly recommends the use of models. A commencement is made with simple fastenings such as bolts and nuts, then the more complicated connexions are dealt with, as exemplified in tie bar joints, cotter joints, and coupling boxes. The following chapters deal in succession with other engineering details, such as belt and rope pulleys, chain drives including sprocket wheels, bearings of various kinds, and details of shafting, cylinders, and pistons. Finally, structural details involving the usual angles, tees, and channels with the more elaborate columns, girders, and roof truss joints in which the sections are employed give the student a useful introduction to this side of engineering practice.

The book covers much ground in its 158 pages. It is very clearly written, and the publishers' part, in so far as concerns the type and diagrams, is quite perfect. For the purpose of familiarising the budding engineer with the elements of machines and structures the author has produced a most excellent book.

*Juvenile Delinquency.* By Henry Herbert Goddard. Pp. vi+120. (London: Kegan Paul and Co., Ltd., n.d.) 3*s.* 6*d.* net.

No student of modern life can fail to be perturbed by the number of juveniles who come before the courts yearly for offences covering a very wide range. That our present system does not deal with them adequately is obvious.

Delinquent behaviour is fundamentally unsocial behaviour, *i.e.* the child is obeying his own instincts instead of modifying them according to the demands of society. It becomes therefore necessary to ask why a child behaves unsocially. These unsocially behaved children fall into at least two groups, (*a*) those who are mentally too unintelligent to understand social behaviour; and (*b*) those known as psychopaths, who, while having normal intelligence, have not normal control.

The author suggests that these children should be cared for by some bureau organised by the State, which should undertake research work, be able to diagnose cases before the behaviour has become seriously wrong, and also to control the lives of those who will never be able to control them for themselves. He describes in this connexion the Ohio Bureau of Juvenile Research which, although only established in 1914, has yet justified itself by its work.

*Outwitting our Nerves: A Primer of Psychotherapy.* By Dr. Josephine A. Jackson and Helen M. Salisbury. Pp. viii+403. (London: Kegan Paul and Co., Ltd., n.d.) 7*s.* 6*d.* net.

THE stream of books concerned with explanations of modern psychologists in general, and of Freud in particular, for people of little or no psychological knowledge, still flows on. Many fail entirely in their avowed object, being either too condensed to be intelligible, or too popular to be scientific. The effect of a conversion to Freudian doctrines is, only too frequently, of the nature of a wholly uncritical acceptance of much that Freud would call problematical. It is therefore a relief to turn to this book, which not only gives a very fair and balanced account of the findings of psycho-analysis, but also keeps these findings in perspective, showing them in relation to the known laws of biology and psychology. The whole book is characterised by a sense of humour foreign to many writers on the subject, and by sanity of outlook. Written in an easy and popular style it can be safely recommended to the student of, or sufferer from, "nerves," and even to the reader already cognisant with the literature of psycho-analysis it will prove helpful and interesting.

*Imperial Institute: Monographs on Mineral Resources with Special Reference to the British Empire: Silver Ores.* By Dr. H. B. Cronshaw. Pp. ix+152. (London: John Murray, 1921.) 6*s.* net.

THIS addition to the useful Imperial Institute Monographs gives details and statistics of the sources of silver throughout the world. In 1918 the British Empire produced nearly one-fifth of the world's supply, Canada being responsible for the larger part of this amount. The United States headed the list of producers during the war period, but has now been passed again by Mexico. About two-thirds of the world's silver comes from base metal ores, and much of the remainder is obtained from ores worked primarily for gold, so that silver is mainly a by-product of other metallurgical operations. The extraction and uses of silver are dealt with only very briefly in this monograph, and some information as to the metallurgical processes employed in the most important mining regions would have added to its value. This remark applies particularly to the account of the rich and metallurgically interesting Cobalt district of Ontario, which is responsible for the greater part of the Canadian production. These monographs provide much information in a handy form.

*A Systematic Qualitative Chemical Analysis: A Theoretical and Practical Study of Analytical Reactions of the more Common Ions of Inorganic Substances.* By Prof. G. W. Sears. Pp. vi+119. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.) 8*s.* 6*d.* net.

THE introductory part of the work under notice contains a brief account of such matters as equilibrium, ionisation, and solubility product. The section on the detection and separation of the metals is in the form of numbered experiments, and is much less clear and useful than the usual arrangement in tables. The explanations of the reactions, however, are very clearly and fully described, and would be useful in supplementing analysis tables. The section on acids relies on precipitation methods with a single sample, and all preliminary tests are omitted. This seems to be a mistake, as many acids are readily found by simple preliminary methods. There appear to be no features which would indicate any marked superiority of the book over existing treatises.

*An Introduction to the Chemistry of Radio-Active Substances.* By Dr. A. S. Russell. Pp. xi+173. (London: J. Murray, 1922.) 6*s.* net.

THERE is at present a real need for a small but up-to-date book on radioactivity, in which the subject is dealt with from the chemical as well as the physical side. Dr. Russell's book would seem to supply this need very satisfactorily. It is not overburdened with detail, but gives a balanced account of the subject, which will be found very useful to students. A particularly good feature is the inclusion of the chemical methods of separation and analysis, which sometimes tend to get lost in theoretical speculations.

## Letters to the Editor.

*[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.]*

### Dampier's "Discourse of the Winds" and the Distribution of Wind on the Earth's Surface.

Dampier's "Voyages" are well known, at any rate by name, but his "Discourse of the Winds" is seldom referred to. It is, however, well worth careful examination and, so far as I can judge, contains as much information about the distribution of winds as any of the modern works on the same subject.

In this "Discourse" Dampier propounds no theories, but aims at setting down the general character of the winds encountered by ships in all parts of the world, using for this purpose his own observations, and such other information as he has gathered from sources which he considers trustworthy.

It must be remembered that in Dampier's time (late seventeenth and early eighteenth centuries), the ships employed even for the longest voyages were small, and the direction and strength of the prevailing winds were much more important to navigators than they are at the present time. It is true that there are still plenty of small sailing craft in various parts of the world, the captains of which are probably well acquainted with local conditions, but these men as a rule are not of the type who place their knowledge on record. With the "Discourse" Dampier publishes maps of the hemispheres in which his observations are summarised.

For his purposes he divides the earth's surface into four regions, namely, the two trade wind areas and those to the north and south of them. These latter he calls the "Regions of Variable Winds." The directions of the trades are indicated in the maps by lines and arrows, but naturally and rightly the regions of variable winds are left blank.

No indication is given of the directions of the wind on land, but what he calls coastal winds, that is winds the direction of which is influenced by the proximity of land, are shown in some detail.

Parts of the maps are here reproduced (on the original scale) which show that "coastal" influence in the trade wind areas extends farther to the west (*i.e.* to leeward) of the continents than to the east.

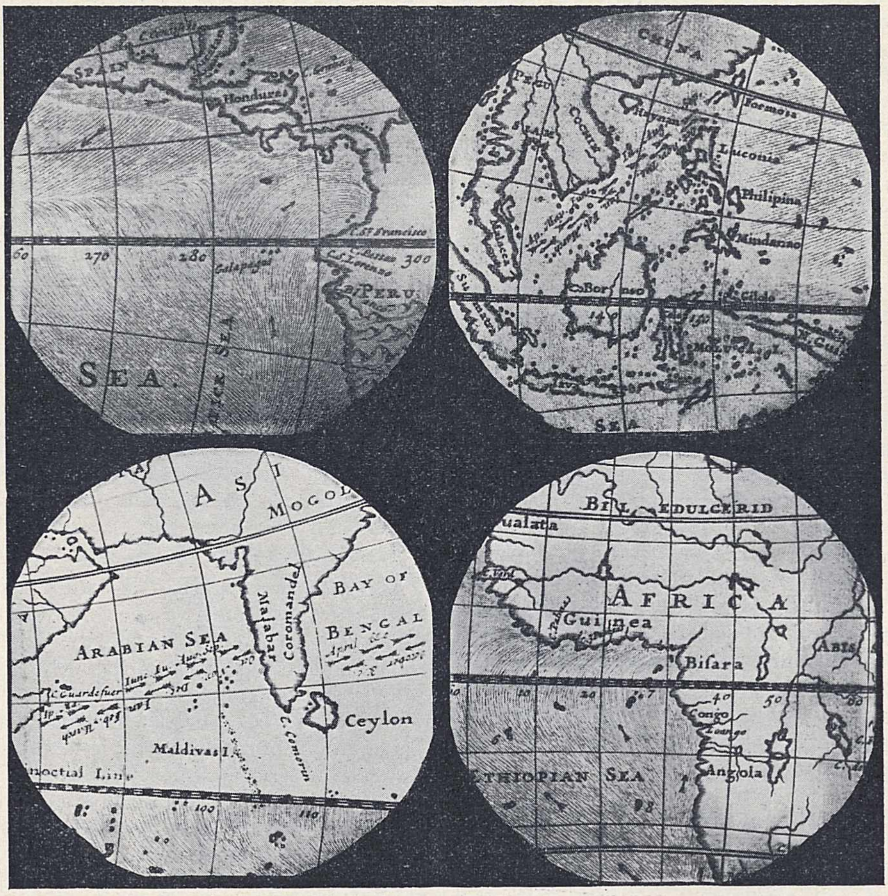


Fig. 1.—Reproduction of parts of Dampier's Maps to show coastal winds in the Trade wind areas.

Although it is impossible to determine *a priori* what the true wind should be at any given spot, it is not without interest to consider what would happen in certain imaginable conditions much simpler than those actually existing, and to see whether in such conditions the air currents, etc., would at all resemble those which are observed.

Starting with the earth as the only body in the universe, without rotation, and at a temperature of absolute zero, let its surface be uniform and level, and let its volume and that of adjacent space be divided into elementary conical cells proceeding from the earth's centre. Let the walls of the cells be non-conductors of heat but transparent to radiation.

Now let this earth be warmed by a source of heat equivalent to the sun, but in the form of a distant ring surrounding it in the plane of the equator. Let the atmosphere be transparent to radiation and take its heat only from the floor of the cell which contains it.

In the course of time the contents of each cell will reach the temperature of the floor, which will be a maximum at the equator, and will vary as the cosine of the latitude to absolute zero at the poles.

The barometric pressure in each cell will be the same; were all the cells removed the atmosphere would be in equilibrium. The equilibrium, however, would be unstable, and the least departure from the original stratification of density would cause ultimately a circulation to be set up, in which, in the absence of turbulence, warm air would flow from the equator towards the poles at high levels, while cooled air would travel in the opposite direction near the surface of the earth. A steady distribution of temperature would be reached when each element of the surface lost by radiation as much heat as it received from the source plus that supplied by the circulation, and this distribution probably would not differ much from that which now exists, though the fact that the real atmosphere is more or less opaque to long waves would introduce a sort of " green-house " effect, and raise the mean temperature above that appropriate to perfect transparency. Again if the imaginary earth were completely covered by a deep ocean, a separate circulation would be set up in the latter, and the temperature distribution would be somewhat modified in the direction of greater uniformity.

Since the energy of the circulation is derived from the source of heat, there will be no change of pressure due to the velocity, and supposing for the moment that the air is incompressible, then in the nearly horizontal path which constitutes the greater part of each stream line circuit, the cross-section velocity and dynamic head for each will be constant, though not necessarily the same for different streams. The cross section of the ascending and descending parts of the streams will bear to the cross section of the horizontal part the ratio of the length of the earth's quadrant to the height of the homogeneous atmosphere, and thus in the neighbourhood of the poles and the equator there will be a small increase of pressure. The form of the stream lines due to temperature circulation in a spherical shell is indicated diagrammatically in Fig. 2.

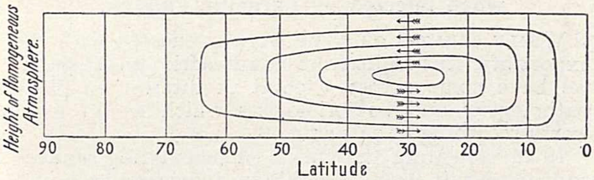


FIG. 2.—Stream lines of the circulation in a meridional element of a spherical shell, the density of the fluid being supposed constant.

As regards the distribution of temperature, the results would be much the same whether the earth were stationary or rotating, but the direction and velocity of the wind referred to a fixed point on the solid surface would be very different in the two cases. If, in the absence of surface friction, the earth were given its present angular velocity the apparent wind would have an easterly component of about 1000 miles per hour at the equator while at the poles there would be a calm. If, on the other hand, when the rotation was started, the air was given the same velocity as the surface under it, the apparent wind would vary in direction and force in a period equal to that of the circulation.

In the real atmosphere, the effects of turbulence, viscosity, and surface friction will ensure that the average velocity of the apparent wind shall in no place exceed 30 or 40 miles per hour. If unresisted air passes from lat. $\lambda$ to $\lambda \pm \Delta\lambda$ the change of the linear speed of the ground under it, *i.e.* the change in the E. or W. component of the apparent wind, is $R\Delta\lambda(1 - \sin\lambda)$ linear velocity in longitude, and if the apparent wind remains constant, it shows that surface friction is sufficient to accelerate or retard the atmosphere by this amount in the time taken in covering the distance $R\Delta\lambda$. In the case of the earth, this would imply that if the circulating velocity (*i.e.* the N. or S. component) is 15 m.p.h., surface friction suffices to change the speed of the apparent wind by about 15 m.p.h. per hour near the poles while in lat. 30° the corresponding change would be somewhat less than 2 m.p.h. per hour.

On the imaginary seasonless earth, the average wind would everywhere be a definite function of the latitude and coefficient of friction, provided that the going and returning parts of the circulation did not mix on the journey, and in low latitudes this would be true even when the effects of turbulence were taken into account. Farther north or south, however, the hot and cold streams would become interwoven in eddies the forms of which are incalculable, though the average winds would always be either from N. and E. or S. and W. Thus it might be expected that there

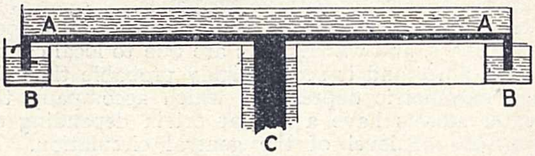


FIG. 3.—AA, Circular conducting plate and tank. BB, Annular hot water trough. C, Axis and cold-water tank.

would be calms at the equator, moderate and regular trade winds for some distance on either side, and beyond these, irregular winds, the intensity of which increased with the latitude. The barometric pressure would be nearly constant except in the eddies, and there the variation of pressure would depend, not on the actual velocity of the apparent wind, but on its difference from the average for the latitude.

Such a description with modification depending on the seasons, the presence of moisture in the air, and on the distribution of land and water agrees with the average conditions on the real earth. Dampier's maps show that coastal influence may be sensible through 10° of longitude or more, and it may be guessed that the direction of the monsoons is in some way influenced by the great area of land lying to the north of the parts where they blow.

There is not much information available concerning the wind structure of the atmosphere on the borders of the Trades, and a proper investigation of this subject would form an important addition to meteorological science; but such an investigation would require more than one *Challenger* expedition devoted to the exploration of the upper air instead of the deep sea.

Expeditions of this kind are not likely to be undertaken at the present time, but some notion of the manner in which the Trades break up might be gained by an experiment such as is indicated in Fig. 3, where a thick circular metal plate, provided with descending flanges at the circumference and a thick central axis, carries a shallow circular tank containing fluid. The flanges dip into a circular trough of warm water while the axis is kept cold. If the apparatus is stationary, a circulation is set up in the tank of the type shown in Fig. 2, but if it has an appropriate angular speed about the axis, the conditions will have a certain similarity to those existing in the atmosphere. The difference in the character of the circulation in the two cases could scarcely fail to give some useful hints.

Another illustration of the kind of flow to be expected near the borders of the Trades may be observed (although the analogy is not so close as in the experiment) whenever a current of water flows into a pond. The central part of the stream continues on its course for some distance unbroken, but the margins are bordered by eddies, which (looking down stream) are right-handed on the right, and left-handed on the left side, and consist of equal volumes of water from the stream and from the pond wrapped together after the fashion of a "roly-poly" pudding. When once formed, they have a certain life of their own, and follow erratic courses, often generating secondary eddies further from the main stream. In general their life is short, but occasionally vertical components in the flow of the main stream give rise to components in the eddies parallel to their axes, and in such cases the vortices may be sustained and intensified.

Much the same sort of action must be going on at the borders of atmospheric currents, and it must happen, especially in the turbulent regions, that either on account of the general circulation or from local causes, warm air will sometimes underlie colder strata, and this is what is required to prolong the life of eddies or vortices with vertical axes.

It may be said with some confidence that tornadoes, sand pillars, and waterspouts are due to local causes of this kind, and it seems highly probable that the deep barometric depressions which accompany the greater storms have a similar origin depending on inversions of level of the general circulation. In referring to warm and cold strata, the temperature must be supposed to be compared at the same altitude since, so far as thermometric readings are concerned, the upper air is always colder than that near the ground.

A. Mallock.

9 Baring Crescent, Exeter,
August 10.

### The Conditions of Sex-change in the Oyster (*Ostrea edulis*).

In the issue of Nature for August 12, p. 212, and in several previous numbers, Dr. Orton has given some interesting information concerning the old question of the breeding habits of oysters, especially sex-change and its conditions. This problem has been discussed in a certain number of ancient treatises (Davaine, Van Beneden, Lacaze-Duthiers, Hoek, etc.), but has been but little investigated in the course of the last few years. During my work at the Danish Biological Station I have, since 1919, been making experiments and investigations on the biology of the oyster in the Limfjord. As my results in several respects confirm and amplify those of Dr. Orton, I will give here a short account of some of the most important. In the course of the winter a more detailed paper will probably be published in the Report of the Danish Biological Station.

Dr. Orton confirms the observation, made by Möbius, that in European oysters a specimen directly after breeding produces spermatozoa, and I fully agree with him. In several cases I have proved, through experiments with oysters, in the shells of which a little hole had been bored, that an oyster in the course of less than a week changes from a female to a male.

Dr. Orton further mentions the interesting fact that he has been able to state that an oyster born in 1921 was spawning already in 1922; this phenomenon he ascribes, and very rightly, to the high temperature of the summer 1921. I have investigated several thousand oysters in the Limfjord: the youngest female found by me was at least three years old, which is no doubt due to the lower temperature of the Limfjord. Neither did I ever find that oysters had ripe spermatozoa in the summer in which they were born; in the Limfjord that phenomenon only occurs in the following summer. Formerly the earliest time for an oyster to breed was much discussed. If we examine from where the different authors have obtained their material, it appears that those who advocated early breeding had got theirs from Southern France, while those who advocated two to three years as the age for breeding had had material from the English Channel and the North Sea.

From my experiments, and from the study of previous papers on this subject, I have come to the conclusion that the duration of the male stage depends on temperature, so that the colder it is the longer the stage lasts. At the temperature which ordinarily prevails in the Limfjord (15°-16° in July), this stage will last three to four years. The oyster, therefore, breeds for the first time (the first stage being the male stage) when it is three to four years old; further, every single oyster individual in ordinary circumstances of temperature breeds only every third or fourth year, in especially cold years still less often, in warm years more often. These phenomena, together with the shorter duration of the female stage, explain the fact that in a certain number of oysters in the Limfjord we always find only a relatively small percentage of females. This likewise explains why the oyster breeds more sparingly the further north it is, and decreases regularly in number without any sharp boundary-line.

The breeding of the oyster is in at least three respects influenced by temperature. A high temperature increases the number of times an oyster may breed in its life, it shortens the time which the breed passes in the mantlecave of the mother animal, and, according to Hagmeier, it shortens the pelagic larva stage.

R. Spärck.

Copenhagen, September 5, 1922.

### Rise in Temperature of Living Plant Tissue when infected by Parasitic Fungus.

While engaged on some work connected with the export of citrus fruits from South Africa to England, we have come across a point of interest to plant pathologists and bacteriologists which would seem worth recording at this stage.

In investigating the effects of inoculating oranges and grapefruit with *Penicillium digitatum* we found that a very definite rise of temperature took place in the infected tissue. We are not aware of such an observation having been made before in connexion with the invasion of plant tissue by a parasitic fungus, and it will be interesting to ascertain whether a similar rise of temperature takes place in all cases where living plant tissue is attacked by parasitic fungi or bacteria.

To what extent direct reaction of the host is responsible for the rise of temperature is still to be determined; certainly no rise of temperature was observed when the host tissue was killed prior to inoculation. Mercury-in-glass thermometers were used in making these observations, but the employment of thermo-electric apparatus will naturally be necessary to carry the investigations further.

This observation of ours would seem to open up an entirely new field for research by botanists, and it is probable that it may have an important bearing on the problem of fruit and vegetable transport and storage.

An account of the experiments undertaken to illustrate the above will be published in due course.

I. B. Pole Evans.
Mary Pole Evans.

Office of the High Commissioner for the Union of South Africa,
Trafalgar Square, London, September 22.

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**Coral in Medicine.**

In the serious contributions published in recent issues of Nature on the subject of black coral, no one seems to have remembered that in the "Médicin malgré lui" Molière makes Sganarelle offer a medicinal cheese to Perrin for his mother, thus:

P. Du fromage, monsieur ?

S. Oui ; c'est un fromage préparé, où il entre de l'or, du corail et des perles, et quantité d'autres choses précieuses.

And Sganarelle's last words are, "Si elle meurt, ne manquez pas de la faire enterrer du mieux que vous pourrez." F. Jeffrey Bell.

September 20.

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**Biography of Sir Norman Lockyer.**

Miss Lockyer and I are preparing a biography of my husband, Sir Norman Lockyer, in a form which I hope will make it not only of interest to his many friends and admirers, but also a contribution to the scientific literature of the present day. If any readers of Nature happen to possess letters from my husband, I should be greatly obliged if they would give me the opportunity of seeing them. My object in making this request is that any matters of general interest which thereby come to light might be incorporated in the work.

The letters would not be quoted, except with the permission of their owners, and would be returned as soon as their contents had been noted.

T. Mary Lockyer.

Salcombe Regis, Sidmouth,
September 22.

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**Harpoons under Peat at Holderness, Yorks.**

At the recent meeting of the British Association at Hull there was a very lively discussion at Section H about some harpoons said to have been found under peat in Holderness. May I ask you to be so good as to spare a little space, in order that I may say more fully what time prevented me from saying then ?

There is a doubt about the authenticity of those harpoons. Mr. T. Sheppard believes them to have been *made* by the supposed finder; Mr. A. L. Armstrong, who introduced them to the meeting, believes them to be genuine. I also believe one of them to be genuine, the smaller of the two; about the other I am not so sure. But I expressed no opinion as to whether, if genuine, they were found locally or not, since I have no means of forming an opinion. It is possible that they—or the smaller of the two—were found in archæological excavations abroad; and a fictitious site in Yorkshire given to them later to enhance their interest.

Mr. Sheppard quite rightly says that the discovery of a flint axe of a certain type "in the neighbourhood" proves nothing. But I understood that it was found under a depth of peat. In type it is Campignian, exactly what one would expect to find associated with harpoons of early neolithic type.

There can be little doubt that in Holderness exist remains of the early neolithic age, remains which are older than the Long Barrows. Apart from surface-finds, the pile-dwellings or platforms at Ulrome are evidence of the existence of habitations there which seem to be neolithic; they contained stag's-horn axes of a well-known eariy neolithic type—though it is true that type survived right through the neolithic period on the continent. There is thus no *a priori* reason for rejecting the harpoons; they are just what I have always expected would be found in Holderness.

However, we cannot use suspect material as evidence, and the best thing to do is to go into the field and test it. If Mr. Armstrong will find a site where flint flakes and implements are to be found under the peat in sufficient numbers to justify digging, I will come and bring a spade with me.

O. G. S. Crawford.

Ordnance Survey Office, Southampton,
September 18.

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**A Curious Luminous Phenomenon.**

I hesitate to trespass on your space in describing an observation which may be more common than I suppose.

While standing about twenty yards from the sea-shore and looking due south out to sea, the horizon and a region slightly above it (elevation only about 1° or 2°) were lit up by a faint white light which extended laterally over a segment subtending an angle of about 30°.

The conditions under which this light was seen were as follows: Time, 7.15 p.m.; wind strong from the west, bringing up a good deal of low cloud and very fine rain in the air causing bad visibility; sea rather rough with four lines of breakers at the shore. The appearances of the light were not the same to my wife as to myself. Her impression of it was that it was a light which she saw only if her eyes followed it, yet it consisted of a long streak of light parallel to the horizon with a break in it and then another small streak. My impression was that of a light which appeared to flash up over the horizon, subtending the angles already noted, the flashes not succeeding each other regularly. I had the feeling that my eyes had to be just right for getting the impression at all.

As to the cause, I think we can eliminate that of distant lightning; the weather had not been for many days of a thundery type, and it is unlikely that distant flashes would light up a streak of the distant sky embracing such a wide lateral angle and yet be restricted to an elevation of not more than 2°.

The sky above the horizon was darkly and uniformly clouded at the time, so that the horizon was barely visible, but white-capped waves could be seen far out at sea. The brightest objects in the field of view were the lines of breakers at the shore, and it may be that the retinal images of these being very near to that of the horizon were the cause of the phenomenon. Perhaps some readers of Nature are familiar with this sort of observation and will point to the obvious cause. S. R.

Aldwick, Sussex,
September 16.

## A Fifty-foot Interferometer Telescope.[1]

By Dr. GEORGE E. HALE, For.Mem.R.S.

THE angular diameter of a star was measured for the first time by Mr. Francis G. Pease at the Mount Wilson Observatory on December 13, 1920, with a 20-foot Michelson interferometer attached to the 100-inch reflecting telescope. The method employed is due to Prof. Michelson, who had adjusted the interferometer and tested it on stars during the previous summer, with the assistance of Mr. Pease. Since that time Mr. Pease has measured the diameters of Betelgeuse, Arcturus, Aldebaran, and Antares. On the basis of the best available values of their parallaxes, the corresponding linear diameters are 215,000,000, 21,000,000, 270,000,000, and 400,000,000 miles respectively. These stars are all in the giant stage, with densities ranging from 0·000001 (Antares) to 0·0002 (Arcturus). The Sun, a dwarf star 866,000 miles in diameter, in a much more advanced state of development, has a density of 1·4 (water = 1).

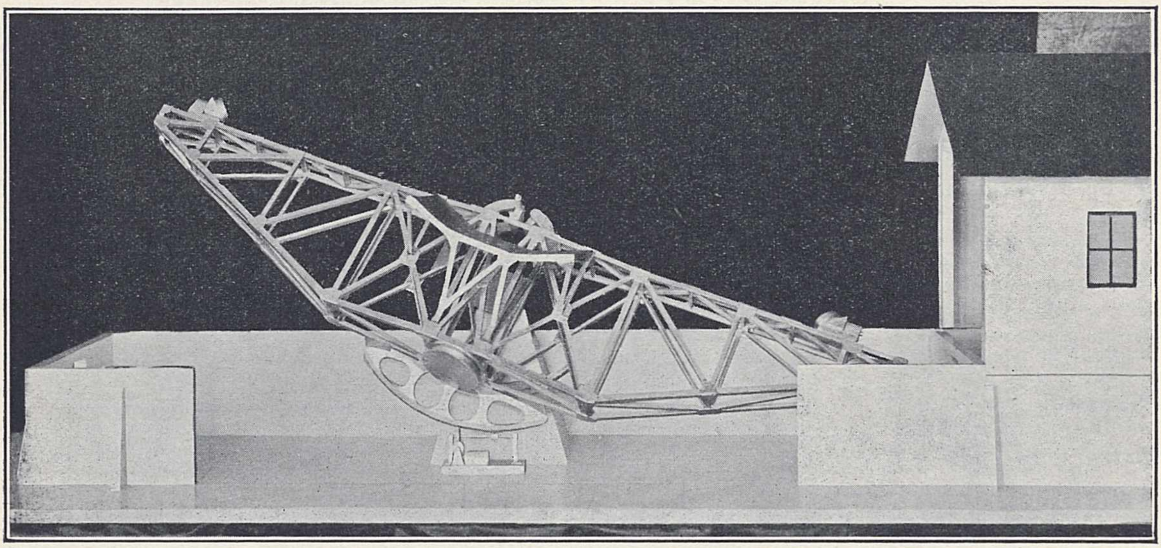

FIG. 1.—50-foot interferometer telescope for the Mount Wilson Observatory. Model seen from the north (part of wall removed to show 36-inch mirror cell and driving mechanism).

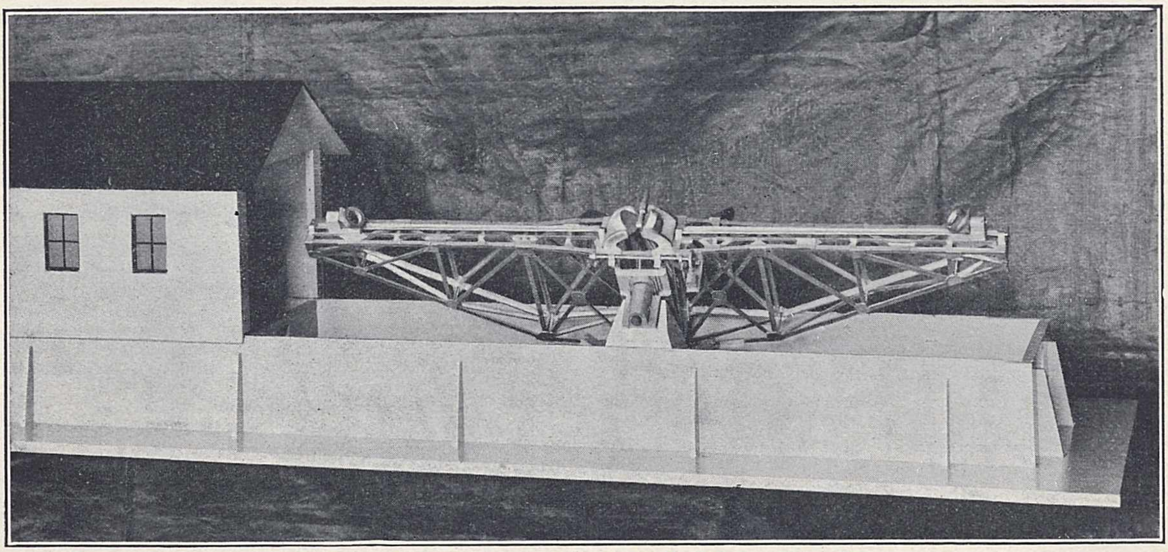

FIG. 2.—50-foot interferometer telescope for the Mount Wilson Observatory. Model seen from the south, showing movable house that covers the instrument when not in use.

It would evidently be of great interest to measure the diameters of other stars, of various spectral types, because of the direct bearing of the results on the problem of stellar evolution. Unfortunately, very few are within the range of the 20-foot interferometer, and neither the capacity of the telescope mounting nor the width of the observing aperture in the dome will permit a larger instrument to be used with the 100-inch re-

[1] The substance of this article was communicated to Section A of the British Association at Hull on Monday, Sept. 11, by Prof. H. H. Turner, who showed the photographs of the model on the screen.

flector. Immediately after the first successful measures by Mr. Pease, both he and I made several designs of large interferometers with independent equatorial mountings, but their cost would have been too great to warrant their construction. It was also thought advisable to postpone further instrumental developments until they could be undertaken in the light of prolonged experience with the 20-foot interferometer.

The method has since proved so successful, and its wider application so desirable, that the mechanical problem has recently been taken up anew. Optically the 20-foot instrument leaves nothing to be desired. The new instrument is therefore simply a larger Michelson stellar interferometer adapted for the observation of fainter and smaller stars, embodying no new optical features, but carried by a mounting so simplified in design as to reduce the cost of construction to a minimum. My specifications for the mounting, which have been improved in certain respects and developed into working drawings by Mr. Pease and his associates in the Division of Instrument Design of the Mount Wilson Observatory, call for a light but very rigid skeleton girder about 54 feet long and 10 feet deep at its centre, where its cross-section is about 4½ feet (Figs. 1 and 2). This is to be built of standard steel shapes, cut to length at the mill and riveted together on Mount Wilson. The girder will be bolted to a heavy plate carried by the upper extremity of the polar axis, which is a short steel forging turning in standard roller bearings, mounted on the upper face of a massive concrete pier. The polar axis passes through the centre of gravity of the girder, thus assuring its balance in all positions. A worm-gear sector of long radius, bolted to the girder, is driven by a worm connected with a driving-clock fixed near the north face of the pier. The range of motion in right ascension is 1½ hours east and west, thus allowing ample time for the observation of a star when near its meridian passage.

The optical parts comprise a paraboloidal mirror of 36 inches aperture and about 15 feet focal length, mounted within the girder, as shown in the illustrations. The two outer plane mirrors, each 15 inches in diameter, mounted at 45° on carriages which slide along rails bolted to the upper face of the girder, receive light from the star and reflect it to two similar 45° plane mirrors, fixed in position above the 36-inch mirror, to which they send the two parallel beams. These are returned as converging beams toward the focus, but are intercepted by a (Newtonian) 45° plane mirror above the centre of the girder, which sends the light to the focal plane, in the direction of the north pole. The observer, seated on a platform carried by the girder, makes the necessary adjustments and determines the visibility of the interference fringes corresponding to various settings of the outer 45° mirrors, which are periodically moved apart by a single long screw driven by an electric motor. The distance between these mirrors, when the fringes disappear completely, gives the angular diameter of the star if the mean wave-length of its light is known.

To reach stars north or south of the equator, the two outer 45° mirrors are rotated simultaneously by synchronous motors about the axis joining their centres. In this way any star from the pole to 30° south declination can be observed when near the meridian.

Throughout the design precautions have been taken to reduce the amount of large and expensive machine work to a minimum. The girder need be only approximately straight, as the rails, carefully planed in 12-foot lengths (the limit of our planer bed), will be optically lined up by adjusting screws. The final compensation for length of path will be effected by a sliding wedge, of the type designed by Prof. Michelson for the 20-foot interferometer. Comparison fringes, adjustable for visibility, will be provided as an aid to the observer. The instrument will be covered when not in use by a sheet steel house with double walls, the upper part of which can be rolled away longitudinally by an electric motor.

This interferometer should permit the measurement of more than thirty stars brighter than the fourth magnitude, representing a wide range of spectral types. It is now under construction in the instrument and optical shops of the Mount Wilson Observatory.[2]

2 For a brief account of the 20-foot interferometer and its method of operation, see the chapter on "Giant Stars" in the writer's recent book "The New Heavens," reviewed in NATURE of July 11, p. 2. Full details are given by Messrs. Michelson, Pease, and Anderson in the *Astrophysical Journal*.

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## Motorless or Wind Flight.

By Dr. S. BRODETSKY.

RECENT achievements in motorless flight, variously designated as *gliding*, *soaring*, and *sailing*, have attracted considerable attention, and much discussion has arisen as to the practical and military value of this new development, as well as to its scientific significance. While many authorities anticipate nothing more than the emergence of a new "sport," and ascribe little importance to motorless flights, others of a more imaginative turn of mind foresee great possibilities in this type of aerial navigation. The motorless flying machine has even been proclaimed as heralding the doom of the engine-driven aeroplane!

It is certainly premature to attempt a forecast of the future of flight in a glider. The art of gliding is, of course, older than that of flight in an engine-driven machine: Lilienthal's experiments with gliders were made more than a generation ago, long before any aeroplane containing a motor rose into the air and executed a real flight. But Lilienthal, Pilcher, Chanute, Orville Wright, and others were not able to stay aloft in a glider more than a few minutes; whereas during the recent competitions in Germany, Martens remained in the air nearly three-quarters of an hour, and Hentzen stayed in the air two hours, and later three hours, performing evolutions of an intricate character. It is therefore clear that the art of gliding has entered upon a new phase, and the scientific problems involved merit careful discussion.

As already indicated, there is considerable diversity in the names given to the flights thus carried out without the aid of a motor. All the three names mentioned above are really unsuitable. The term gliding is reminiscent of descent in an aeroplane, while the real interest of recent events has been in the fact that pilots were able to stay in the air very long without the help of a motor, and in fact performed climbing feats. The term soaring is less unsuitable, but it suggests climbing as the essential thing, whereas, in reality, horizontal flight in a glider is just as different from aeroplane flight as climbing in a glider. Finally, sailing is quite inappropriate as a description of the flight in question. Perhaps the term *wind-flight* is a really suitable name for flying without a motor, as distinguished from *engine-flight* in an aeroplane.

The wind is indeed the main instrument of motorless flight. Whether birds and other natural flyers do or do not derive energy from the air in some mysterious manner of which we have, as yet, no knowledge is a question that does not arise in the present connexion. The successes achieved have been the outcome of careful study of design and of movements in the air. In construction the gliders used look like aeroplanes without engines, and the determining factors in the flights were the various types of winds that blew while the machines were in the air.

It is clear that in a quiescent atmosphere the net result of any motion through the air in a motorless machine must be a diminution in the total energy, *i.e.* in the sum of the kinetic and potential energies. It follows that in the absence of wind, real flight, namely, flight in which the machine maintains its level for some considerable time, or rises still higher above the ground, is not possible without a source of energy like an engine. It is the presence of wind that puts in the hands of the pilot a source of energy, which can be used to neutralise the loss of energy involved in motion through the atmospheric resisting medium.

Although it should be obvious that the wind must be upwards or unsteady in order to supply this energy, it is necessary to say a few words about the case of a steady horizontal wind, since it has been claimed that "once the airman has left the ground he gets his energy from *the wind*, which may be level and steady." This is not correct, as can be proved quite simply. If we write down the equations of motion of a glider through the air under the action of gravity, we get three types of terms:

(1) Accelerations in terms of the motion of the glider relative to the earth;

(2) Gravity components;

(3) Forces and couples due to air resistance, these being functions of the motion of the glider relative to the air.

It is useful to write the first terms, the accelerations, with reference to the motion of the glider relative to the air. When this is done for a steady wind, the resulting equations are exactly of the same form as if there were no wind at all, since the moving "air axes" move uniformly as seen from the "earth axes." This means that when there is a steady wind, we get the actual motion of the glider as seen from the earth, by adding the velocity of the wind to the motion of the glider in still air; in other words, to an observer travelling with the wind, the motion of the glider would not reveal any effects that can be attributed to the steady wind.

In a horizontal steady wind, therefore, real flight is no more possible without an engine than in absolutely windless air. Any argument that leads to a contrary conclusion must have a fallacy somewhere, if we are to have any confidence in the principles upon which all our mechanics are based. It is true that a steady horizontal wind can be used as an aid in gliding. Thus, by pointing his machine into the wind the pilot can get off the ground with less initial speed than in still air. Further, when the machine is already in the air the pilot can, by pointing it with the wind, increase the horizontal distance travelled before reaching the ground again. But a steady horizontal wind cannot make the machine stay at the same level in the air for any length of time, or climb. For these purposes the wind must be upwards or variable.

If the wind is steady, but has an upward component, it helps in the attainment of real flight, which we can call wind-flight. Thus, if a glider is so constructed that in still air it performs a straight line glide with speed U at gliding angle $\theta$ below the horizontal, then a steady wind of speed U, blowing at an angle $\theta$ above the horizontal, will keep the glider suspended in the air indefinitely, if it points into the wind. And, more generally, if the steady wind has speed $U'$ at an angle $\theta'$ above the horizontal, where $U' \sin \theta' = U \sin \theta$, then the machine will fly horizontally with speed $U \cos \theta - U' \cos \theta'$ relative to the earth, if it is given this speed initially against the wind. If $U' \sin \theta'$ is greater than $U \sin \theta$, so that the vertical component of the wind is greater than the rate of vertical fall of the glider in still air, then the glider will climb with horizontal speed $U \cos \theta - U' \cos \theta'$ and upward vertical speed $U' \sin \theta' - U \sin \theta$.

These results are simple and obvious. Given a steady wind with sufficient upward vertical component, a glider can perform real flights and make evolutions similar to those of ordinary aeroplane flight.

It is not necessary, however, to postulate steady upward wind. If the wind is variable, and this is, of course, usually the case, energy can be derived from the wind, even if it is horizontal, or downwards. This can be seen by a little analysis based on the ordinary equations of motion of the glider. Thus, suppose that the wind is in a straight line, but of varying speed. If we write the accelerations in these equations in terms of the motion relative to the air, we readily find that the motion of the glider relative to the air is the same as if the air were at rest, and a force per unit mass were given to the glider, in a direction opposite to that of the wind and proportional to the acceleration of the wind. If the wind rises steadily from zero to $U'$ in time $t$, the motion of the glider is found by taking the air to be at rest and assuming that on each unit mass there acts, in addition to the weight, a force $U'/gt$ in a direction opposite to the wind.

If, then, the machine is pointed into the rising wind, and the wind varies quickly enough, flying becomes possible. If the wind is being retarded, similar propulsive effect is obtained by pointing the machine with the wind. It follows that in a fairly sudden gust, which can be taken to consist of a quickly increasing wind, followed by a quickly decreasing wind, the pilot can take advantage of both phases by pointing the machine into the rising wind, and with the falling wind. Quick manœuvring is, of course, essential, as well as an intimate acquaintance with the movements that are always taking place in the air.

With more complicated variations in the wind, more complex results are obtained. It is now clear, however, that the future of wind-flight is associated with three main lines of study:

(1) The motions that are continually taking place in the atmosphere need to be studied, not only the meteorological wind phenomena as ordinarily understood, but particularly the detailed air motions, the "internal structure of the wind."

(2) Motorless flight presents problems of design that are different from those of ordinary aeroplanes. This is because the glider is a much lighter machine than the aeroplane. Stability is essential, but easy control is a *sine qua non*, since so much depends upon taking as full advantage as possible of any temporary, and often unanticipated, motion in the air.

(3) The rigid dynamics of wind-flight is also an important factor in the progress of the art. Only in very exceptional circumstances can the motion of a glider be steady. Upward steady winds, or uniformly varying winds, are only of rare occurrence and brief duration, and in trying to perform real flight in an engineless machine the pilot must make use of any stray wind that comes to his aid. The motion in wind-flight must consequently be very variable. In this respect wind-flight must generally differ in essence from engine-flight. In the latter steady flight is the rule, in the former steady flight is bound to be a comparative rarity. The pilot must therefore learn from experience and from calculation to know what to expect from his machine under different conditions. The dynamics of wind-flight should be a fruitful subject of study both for the aviator and the mathematician.

## The Influence of the late W. H. R. Rivers on the Development of Psychology in Great Britain.[1]

By CHARLES S. MYERS, C.B.E., M.A., M.D., Sc.D., F.R.S.

A MOURNFUL gloom has been cast over the proceedings of our newly born Section. Since its inauguration twelve months ago this Section, as, indeed, psychology in general, has suffered an irreparable loss through the sudden death, on June 4 last, of him who was to have presided here to-day. When, only a few weeks ago, it fell to me, as one of his first pupils, to occupy Rivers's place, I could think of little else than of him to whom I have owed so much in nearly thirty years of intimate friendship and invaluable advice; and I felt that it would be impossible for me then to prepare a presidential address to this Section on any other subject than on his life's work in psychology.

William Halse Rivers Rivers was born on March 12, 1864, at Luton, near Chatham, the eldest son of the Rev. H. F. Rivers, vicar of St. Faith's, Maidstone, and of Elizabeth, his wife, *née* Hunt. Many of his father's family had been officers in the Navy—a fact responsible, doubtless, for Rivers's love of sea voyages. The father of his paternal grandfather, Lieutenant W. T. Rivers, R.N., was that brave Lieutenant William Rivers, R.N., who, as a midshipman in the *Victory* at Trafalgar, was severely wounded in the mouth and had his left leg shot away at the very beginning of the action, in defence of Nelson or in trying to avenge the latter's mortal wound. So at least runs the family tradition; also according to which Nelson's last words to his surgeon were: "Take care of young Rivers." A maternal uncle of Rivers was Dr. James Hunt, who in 1863 founded and was the first President of the Anthropological Society, a precursor of the Royal Anthropological Institute, and from 1863 to 1866 at the meetings of this Association strove to obtain that recognition for anthropology as a distinct Subsection or Section which was successfully won for psychology by his nephew, who presided over us at the Bournemouth meeting in 1919, when we were merely a Subsection of Physiology.

*Our* "young Rivers" gave his first lecture at the age of twelve, at a debating society of his father's pupils. Its subject was "Monkeys." He was educated first at a preparatory school at Brighton, and from 1877 to 1880 at Tonbridge School. Thence he had hoped to proceed to Cambridge; but a severe attack of enteric fever compelled him to take a year's rest, and thus prevented him from competing for an entrance scholarship at that University. He matriculated instead in the University of London, and entered St. Bartholomew's Hospital in 1882, sharing the intention of one of his father's pupils of becoming an Army doctor. This idea, however, he soon relinquished; but, like his desire to go to Cambridge, it was to be realised later in life.[2]

When he took his degree of Bachelor of Medicine in 1886 he was accounted the youngest Bachelor ever known at his hospital. Two years later he graduated as Doctor of Medicine, and he spent these two and the two following years in resident appointments at Chichester (1888) and at St. Bartholomew's (1889) hospitals, in a brief period of private medical practice (1890), and in travelling as ship's surgeon to America and Japan (1887), the first of numerous subsequent voyages.

In 1892 he spent the spring and early summer at Jena, attending the lectures of Eucken, Ziehen, Binswanger, and others. In a diary kept by him during this visit to Germany the following sentence occurs: "I have during the last few weeks come to the conclusion that I should go in for insanity when I return to England and work as much as possible at psychology." Accordingly, in the same year he became clinical assistant at the Bethlem Royal Hospital, and in 1893 he assisted G. H. Savage in his lectures on mental

[1] From the presidential address delivered to Section J (Psychology) of the British Association at Hull on Sept. 11.

[2] For many of the above details of Rivers's early life and antecedents I am indebted to his sister, Miss K. E. Rivers.

diseases at Guy's Hospital, laying special stress on their psychological aspect. Meanwhile, at Cambridge, Michael Foster was seeking some one who would give instruction there in the physiology of the sense organs, McKendrick having, as examiner in physiology, recently complained of the inadequate training of the Cambridge students in this branch of the subject. Foster's choice fell on Rivers, and in 1893 he invited him to the University for this purpose. Rivers went to Germany for a short period of study under Professor Kräpelin, then of Heidelberg, whose brilliant analysis of the work curve and careful investigations into the effects of drugs on bodily and mental work had aroused his intense interest. At Cambridge he set himself to plan one of the earliest systematic practical courses in experimental psychology in the world, certainly the first in this country. In 1897 he was officially recognised by the University, being elected to the newly established lectureship in physiological and experimental psychology. But the welcome and encouragement he received from cognate branches of study at Cambridge could scarcely be called embarrassing. Even to-day practical work is not deemed essential for Cambridge honours candidates in elementary psychology; psychology is not admitted among the subjects of the Natural Sciences Tripos; and no provision is made for teaching the subject at Cambridge to medical students. Rivers first turned his attention principally to the study of colour vision and visual space perception. Between 1893 and 1901 he published experimental papers "On Binocular Colour-mixture" (Proc. Cambs. Philosoph. Soc., vol. viii., pp. 273-77), on "The Photometry of Coloured Papers" (*Jour. of Physiol.*, vol. xxii., pp. 137-45), and "On Erythropsia" (Trans. Ophthal. Soc., London, vol. xxi., pp. 296-305), and until 1908 he was immersed in the task of mastering the entire literature of past experimental work on vision, the outcome of which was published in 1900 as an article in the second volume of the important "Text-book of Physiology," edited by Sir Edward Sharpey Schafer. This exhaustive article of 123 pages on vision by Rivers is still regarded as the most accurate and careful account of the whole subject in the English language.

In 1896 Rivers published an important paper "On the Apparent Size of Objects" (*Mind*, N.S., vol. v., pp. 71-80), in which he described his investigations into the effects of atropin and eserin on the size of seen objects. He distinguished two kinds of micropsia which had hitherto been confused—micropsia at the fixation-point due to irradiation, and micropsia beyond the fixation-point, which is of special psychological importance. Rivers came to the interesting conclusion that the mere effort to carry out a movement of accommodation may produce the same micropsia as when that effort is actually followed by movement. In other words, an illusion of size may be dependent solely on central factors. His later work, in conjunction with Prof. Dawes Hicks, on "The Illusion of Compared Horizontal and Vertical Lines," which was published in 1908 (*Brit. Jour. of Psychol.*, vol. ii., pp. 241-60), led him to trace this illusion to origins still less motor in nature. Here horizontal and vertical lines were compared under tachistoscopic and under prolonged exposure. The amount of the illusion was found to be approximately the same for tachistoscopic as for prolonged exposure of the lines, but in the former the judgment was more definite and less hesitating—in other words, more naïve, more purely sensory, more "physiological"—than in prolonged exposure. Although this result is not inconsistent with the view that visual space perception depends *for its genesis* on eye movement, it compels us to admit that visual space perception, *once acquired*, can occur in the absence of eye movement; or, in more general language, that changes in consciousness, originally arising in connexion with muscular activity, may occur later in the absence of that activity. The provision of experimental evidence in favour of so fundamental and wide-reaching a view is obviously of the greatest importance.

In 1898, in which year he was given the degree of Hon. M.A. at Cambridge, Rivers took a fresh path in his varied career by accepting Dr. A. C. Haddon's invitation to join the Cambridge Anthropological Expedition to the Torres Straits. This was the first expedition in which systematic work was carried out in the ethnological application of the methods and apparatus of experimental psychology. His former pupils, Prof. W. McDougall and I, assisted Rivers in this new field. Rivers interested himself especially in investigating the vision of the natives—their visual acuity, their colour vision, their colour nomenclature, and their susceptibility to certain visual geometric illusions. He continued to carry out psychological work of the same comparative ethnological character after his return from the Torres Straits in Scotland (where he and I sought comparative data), during a visit to Egypt in the winter of 1900, and from 1901–2 in his expedition to the Todas of Southern India. His psychological investigations among the Torres Straits islanders, Egyptians and Todas (Reports of the Cambridge Anthrop. Exped. to Torres Straits, vol. ii., Pt. I., pp. 1-132; *Jour. of Anthrop. Inst.*, vol. xxxi., pp. 229-47; *Brit. Jour. of Psychol.*, vol. i., pp. 321-96) will ever stand as models of precise, methodical observations in the field of ethnological psychology. Nowhere does he disclose more clearly the admirably scientific bent of his mind—his insistence on scientific procedure, his delight in scientific analysis, and his facility in adapting scientific methods to novel experimental conditions. He reached the conclusion that no substantial difference exists between the visual acuity of civilised and uncivilised peoples, and that the latter show a very definite diminution in sensibility to blue, which, as he suggested, is perhaps attributable to the higher macular pigmentation among coloured peoples. He observed a generally defective nomenclature for blue, green, and brown among primitive peoples, both white and coloured, and large differences in the frequency of colour-blindness among the different uncivilised peoples whom he examined. In his work on visual illusions he found that the vertical-horizontal-line illusion was more marked, while the Müller-Lyer illusion was less marked, among uncivilised than among civilised communities; and he concluded that the former illusion was therefore dependent rather on physiological, the latter rather on psychological factors, the former being counteracted, the latter being favoured, by previous experience, *e.g.* of drawing lines or of apprehending complex figures as wholes.

In 1903, the year after his return from the Todas, and the year of his election to a Fellowship at St. John's College, Rivers began an investigation, continued for five years, with Dr. Henry Head, in which the latter, certain sensory nerves of whose arm had been experimentally divided, acted as subject, and Rivers acted as experimenter, applying various stimuli to the arm and recording the phenomena of returning cutaneous sensibility. The exact interpretation of this "Human Experiment in Nerve Division," published at length in 1908 (*Brain*, vol. xxxi., pp. 323-450), has been disputed by subsequent workers, whose divergent results, however, are at least partly due to their employment of different methods of procedure. Head's experiment has never been identically repeated, and until this has been done we are probably safe in trusting to the results reached by the imaginative genius and the cautious critical insight of this rare combination of investigators.

While working upon Head's arm, Rivers's indomitable activity led him to simultaneous occupation in other fields. In 1904 he assisted Prof. James Ward to found and to edit the *British Journal of Psychology*, and in that year he also received an invitation to deliver the Croonian Lectures in 1906 at the Royal College of Physicians, of which in 1899 he had been elected a Fellow. The study of drug effects had long interested him. So, reverting to the work he had done under Kräpelin many years previously, he chose as his subject for the Croonian Lectures, "The Influence of Alcohol and other Drugs on Fatigue" (Arnold, 1908). But although he utilised Kräpelin's ergograph and many of Kräpelin's methods, Rivers's *flair* for discovering previous "faulty methods of investigation" and his devotion to scientific methods and accuracy could not fail to advance the subject. Of no one may it be more truly said than of him,—*nihil tetigit quod non ornavit.* He felt instinctively that many of the supposed effects of alcohol were really due to the suggestion, interest, excitement or sensory stimulation accompanying the taking of the drug. Accordingly he disguised the drug, and prepared a control mixture which was indistinguishable from it. On certain days the drug mixture was taken, on other days the control mixture was taken, the subject never knowing which he was drinking. He found that the sudden cessation of all tea and coffee necessary for the study of the effects of caffeine induced a loss of energy, and that other mental disturbance might occur through giving up all forms of alcoholic drink. Therefore most of his experiments were carried out more than twelve months after the taking of these drinks had been discontinued. Instead of recording a single ergogram Rivers took several sets of ergograms each day, each set consisting usually of six ergograms taken at intervals of two minutes, and separated from the next set by an interval of thirty or sixty minutes. He arranged that the drug mixture or the control mixture should be taken after obtaining the first set of ergograms, which served as a standard wherewith subsequent sets on the same day might be compared. He worked with Mr. Webber on alcohol and caffeine, and was followed by the similar work of Dr. P. C. V. Jones in 1908 on strychnine, and of Dr. J. G. Slade in 1909 on Liebig extract.

With these vast improvements in method Rivers failed to confirm the conclusions of nearly all earlier investigators on the effects of from 5 to 20 c.c. of absolute alcohol on muscular work. His results with these doses, alike for muscular and mental work, were mainly negative, and indeed with larger doses (40 c.c.) were variable and inconclusive; although an equivalent quantity of whisky gave an immediate increase of muscular work—a result which strongly suggests the influence of sensory stimulation rather than the direct effect of the drug on the central nervous system or on the muscular tissues. Rivers concluded that alcohol may in some conditions favourably act on muscular work by increasing pleasurable emotion and by dulling sensations of fatigue, but that probably its most important effect is to depress higher control, thus tending to increase muscular and to diminish mental efficiency.

From the concluding passages of these Croonian Lectures the following sentences may be aptly cited: "The branch of psychology in which I am chiefly interested is that to which the name of individual psychology is usually given. It is that branch of psychology which deals with the differences in the mental constitutions of different peoples, and by an extension of the term to the differences which characterise the members of different races. . . . These experiments leave little doubt that variations in the actions of drugs on different persons may have their basis in deep-seated physiological variations, and I believe that the study of these variations of susceptibility may do more than perhaps any other line of work to enable us to understand the nature of temperament and the relation between the mental and physical characters which form its two aspects." Throughout his life Rivers was steadfast to this biological standpoint, correlating the psychological with the physiological, and hoping to discover different mental levels corresponding to different neural levels.

Now we approach the last phase of Rivers's psychological work, the outcome of his war experiences. In 1907 he had given up his University teaching in experimental psychology; for six years before the war he had published nothing of psychological or physiological interest. This was a period in which Rivers devoted himself wholly to the ethnology and sociology of primitive peoples. The outbreak of war found him for the second time visiting Melanesia for ethnological field work. Failing at first to get war work on his return to England, Rivers set himself to prepare the Fitzpatrick Lectures on "Medicine, Magic and Religion," which he had been invited to deliver to the Royal College of Physicians of London in 1915 and 1916. In 1915 his psychological and ethnological researches were recognised by the award to him of a Royal Medal by the Royal Society, of which he had been elected a Fellow in 1908. In July 1915 he went as medical officer to the Maghull War Hospital, near Liverpool, and in 1916 to the Craiglockhart War Hospital, Edinburgh, receiving a commission in the R.A.M.C. In these hospitals he began the work on the psychoneuroses that led him to his studies of the unconscious and of dreams, which resulted in his well-known book, "Instinct and the Unconscious," and in a practically completed volume on "Conflict and Dream," which is to be published posthumously. From 1917 he acted as consulting psychologist to the

Royal Air Force, being attached to the Central Hospital at Hampstead.

This period marks not merely a new phase in Rivers's work, but is also characterised by a distinct change in his personality and writings. In entering the Army and in investigating the psychoneuroses he was fulfilling the desires of his youth. Whether through the realisation of such long-discarded or suppressed wishes, or through other causes, *e.g.* the gratified desire of an opportunity for more sympathetic insight into the mental life of his fellows, he became another and a far happier man. Diffidence gave place to confidence, hesitation to certainty, reticence to outspokenness, a somewhat laboured literary style to one remarkable for its ease and charm. More than forty publications can be traced to these years, between 1916 and the date of his death. It was a period in which his genius was released from its former shackles, in which intuition was less controlled by intellectual doubt, in which inspiration brought with it the usual accompaniment of emotional conviction—even an occasional impatience with those who failed to accept his point of view. But his honest, generous character remained unchanged to the last. Ever willing to devote himself unsparingly to a cause he believed right, or to give of his best to help a fellow-being in mental distress, he worked with an indomitable self-denying energy, won the gratitude and affection of numberless nerve-shattered soldier-patients, whom he treated with unsurpassed judgment and success, and attracted all kinds of people to this new aspect of psychology. Painters, poets, authors, artisans, all came to recognise the value of his work, to seek, to win, and to appreciate his sympathy and his friendship. It was characteristic of his thoroughness that while attached to the Royal Air Force he took numerous flights, looping the loop and performing other trying evolutions in the air, so that he might gain adequate experience of flying and be able to treat his patients and to test candidates satisfactorily. He had the courage to defend much of Freud's new teaching at a time when it was carelessly condemned *in toto* by those in authority who were too ignorant or too incompetent to form any just opinion of its undoubted merits and undoubted defects. He was prepared to admit the importance of the conflict of social factors with the sexual instincts in certain psychoneuroses of civil life, but in the psychoneuroses of warfare and of occupations like mining he believed that the conflicting instincts were not sexual, but were the danger instincts, related to the instinct of self-preservation.

Thus in the best sense of the term Rivers became a man of the world and no longer a man of the laboratory and of the study. He found time to serve on the Medical Research Council's Air Medical Investigation Committee, on its Mental Disorders Committee, on its Miners' Nystagmus Committee, and on the Psychological Committee of its Industrial Fatigue Research Board. He served on a committee, of ecclesiastical complexion, appointed to inquire into the new psychotherapy, and he had many close friends among the missionaries, to whom he gave and from whom he received assistance in the social and ethnological side of their work.

In 1919, in which year he received honorary degrees from the Universities of St. Andrews and Manchester, he returned to Cambridge as Prælector in Natural Sciences at St. John's College, and began immediately to exercise a wonderful influence over the younger members of the University by his fascinating lectures, his "Sunday evenings," and above all by his ever-ready interest and sympathy. As he himself wrote, after the war work "which brought me into contact with the real problems of life . . . I felt that it was impossible for me to return to my life of detachment." And when a few months before his death he was invited by the Labour Party to a still more public sphere of work, namely, to become a Parliamentary candidate representing the University of London, once again he gave himself unsparingly. He wrote at the time: "To one whose life has been passed in scientific research and education the prospect of entering practical politics can be no light matter. But the times are so ominous, the outlook both for our own country and the world so black, that if others think I can be of service in political life I cannot refuse." On several occasions subsequently he addressed interested London audiences, consisting largely of his supporters, on the relations between psychology and politics. It was one of these very lectures—on the herd instinct—at which it happened that I took the chair, which was to have formed the basis of his Presidential Address to you here to-day.

Rivers's views on the so-called herd instinct were the natural outcome of those which he had put forward during the preceding five years and collected together in his "Instinct and the Unconscious." His aim in writing this book was, as he says, "to provide a biological theory for the psychoneuroses," to view the psychological from the physiological standpoint. He maintained that an exact correspondence holds between the inhibition of the physiologist and the repression of the psychologist. He regarded mental disorders as mainly dependent on the coming to the surface of older activities which had been previously controlled or suppressed by the later products of evolution. Here Rivers went beyond adopting Hughlings Jackson's celebrated explanation of the phenomena of nervous diseases as arising largely from the release of lower-level activities from higher-level controls. He further supposed that these lower-level activities represent earlier racial activities held more or less in abeyance by activities later acquired. This conception he derived from his work with Henry Head on cutaneous sensibility. Rivers could see but "two chief possibilities" of interpreting the phenomena disclosed in the study of Head's arm. Either epicritic sensibility is protopathic sensibility in greater perfection, or else protopathic sensibility and epicritic sensibility represent two distinct stages in the development of the nervous system. Failing to see any other explanation, he adopted the second of these alternatives. He supposed that at some period of evolution, when epicritic sensibility, with its generally surface distribution, its high degree of discrimination, and its power of accurate localisation, made its appearance, the previously existing protopathic sensibility, with its punctate distribution, its "all-or-nothing" character, and its broad radiating localisation, became in part inhibited or "suppressed," in part blended or "fused" with the newly acquired sensibility so as to form a useful product. He supposed that the suppressed portion persisted in a condition of unconscious existence, and he emphasised the biological importance of suppression. He considered at first that the protopathic sensibility "has all the characters we associate with instinct," whereas the later epicritic sensibility has the characters of intelligence or reason. So he came to hold that instinct "led the animal kingdom a certain distance in the line of progress," whereupon "a new development began on different lines," "starting a new path, developing a new mechanism which utilised such portions of the old as suited its purpose."

*Evolutio per saltus* was thus the keynote of Rivers's views on mental development. Just as the experience of the caterpillar or tadpole is for the most part suppressed in the experience of the butterfly or frog, so instinctive reactions tend to be suppressed in intelligent experience whenever the immediate and unmodifiable nature of one becomes incompatible with the diametrically opposite characters of the other. Just as parts of the protopathic fuse with the later acquired epicritic sensibility, so parts of our early experience, of which other parts are suppressed, fuse with later experience in affecting adult character. "Experience," he explained, "becomes unconscious because instinct and intelligence run on different lines and are in many respects incompatible with one another."

From his point of view Rivers was naturally led, wherever possible, to interpret abnormal mental conditions in terms of regression to more primitive, hitherto suppressed activities. He held that the hysterias are essentially "substitution neuroses," connected with and modified by the gregarious instincts, and are primarily due to a regression to the primitive instinctive danger reaction of immobility, greatly modified by suggestion. So, too, he held that the anxiety neuroses, which are for him essentially "repression neuroses," also show regression, though less complete, in the strength and frequency of emotional reaction, in the failure during states of phantasy to appreciate reality, in the reversion to the nightmares, and especially the terrifying animal dreams, characteristic of childhood, in the occurrence of compulsory acts, in the desire for solitude, etc. He criticised Freud's conception of the censorship, substituting in place of that anthropomorphically-coloured sociological parallel the physiological and non-teleological conception of regression.

We are now in a position to examine Rivers's treatment of the gregarious behaviour of animal and human life, on which he was still engaged at the time of his death. In the gregarious instinct he recognised a cognitive aspect which he termed "intuition," an affective aspect which he termed "sympathy," and a motor aspect which he termed "mimesis." He used "mimesis" for the process of imitation so far as it was unwitting; "sympathy" he regarded as always unwitting. "Intuition" he defined as the process whereby one person is unwittingly influenced by another's cognitive activity. But I feel sure that the term "unwittingly" is not to be considered here as equivalent to "telepathically." All that Rivers meant was that the person is influenced by certain stimuli without appreciating their nature and meaning. He preferred to employ the term "suggestion" as covering all the processes by which one mind acts on or is acted on by another unwittingly. He supposed that in the course of mental evolution epicritic characters displaced the early protopathic characters of instinctive behaviour owing to the incidence of gregarious life, especially among insects, and owing to the appearance and development of intelligence, especially in man. The suggestion inherent in gregarious behaviour implies some graduation of mental and bodily activity—an instinctive and unwitting discrimination distinct from the witting discrimination of intelligence.

Were he here to-day Rivers would have carried this conception of the evolution of gregarious life still further by distinguishing between the more lowly leaderless herd and the herd which has acquired a definite leader. He would have traced the development of the new affect of submission and of the new behaviour of obedience to the leader, and he would doubtless have accredited the leader with the higher affects of superiority and felt prestige, with the higher cognition that comes of intuitive foresight, and with the higher behaviour of intuitive adaptation, initiative, and command. I expect, too, that he would have sketched the development of still later forms of social activity, complicated by the interaction and combination of intellectual and instinctive processes—the witting deliberations and decisions on the part of the leader, and the intellectual understanding of the reasons for their confidence in him and for their appropriate behaviour on the part of those who are led.

But it would be idle further to speculate on the ideas of which we have been robbed by Rivers's untimely death. Let us rather console ourselves with the vast amount of valuable and suggestive material which he has left behind and with the stimulating memories of one who, despite the fact that his health was never robust, devoted himself unsparingly to scientific work and to the claims of any deserving human beings or of any deserving humane cause that were made upon him. There are, no doubt, some who believe that Rivers's earlier experimental psychological work—on vision, on the effects of drugs, and on cutaneous sensibility—is likely to be more lasting than his later speculations on the nature of instinct, the unconscious, dreams, and the psychoneuroses. No one can doubt the scientific permanence of his investigations in the laboratory or in the field; they are a standing monument of thoroughness and accuracy combined with criticism and genius. But even those who hesitate to suppose that at some definite period in mental evolution intelligence suddenly made its appearance and was grafted on to instinct, or that epicritic sensibility was suddenly added to a mental life which had before enjoyed only protopathic sensibility—even those who may not see eye to eye with Rivers on these and other fundamental views on which much of his later work rested, will be foremost in recognising the extraordinary stimulating, suggestive, and fruitful character of all that he poured forth with such astounding speed and profusion during the closing years of his life. Above all, we mourn a teacher who was not merely a man of science devoted to abstract problems, but who realised the value of and took a keen delight in applying the knowledge gained in his special subject to more real and living problems of a more concrete, practical, everyday character. Rivers's careful methods of investigating cutaneous sensibility and the *rationale* of his successful treatment of the psychoneuroses were directly due to his psychological training. So, too, his epoch-making discoveries and his views in the field of anthropology on the spread and conflict of cultures were largely due to the application of that training. Shortly before his death he was developing, as a committee member of the Industrial Fatigue Research Board, an intense interest in that youngest application of psychology, namely, to the improvement of human conditions in industrial and commercial work by the methods of experimental psychology applied to fatigue study, motion study, and vocational selection.

Unhappily, men of such wide sympathies and understanding as Rivers, combined with a devotion to scientific work, are rare. He himself recognised that " specialisation has . . . in recent years reached such a pitch that it has become a serious evil. There is even a tendency," he rightly said, " to regard with suspicion one who betrays the possession of knowledge or attainments outside a narrow circle of interests" (*Brit. Jour. of Psychol.*, vol. x., p. 184). Let his life, his wisdom, his wide interests, sympathies and attainments, and the generosity and honesty of his character, be an example to us in the common object of our meeting this week—the advancement of science.

## Obituary.

### PROF. F. D. BROWN.

WE regret to announce the death, on August 2, at Remuera, New Zealand, of emeritus professor Frederick Douglas Brown, at the age of seventy years. Prof. Brown began the study of chemistry in 1870, under Dr. Matthiessen, at St. Bartholomew's Hospital. On the death of Dr. Matthiessen, he continued his studies at the Royal College of Science, South Kensington and afterwards in Leipzig. On his return to England about 1876, he began research work at the London Institution with Prof. Armstrong, whom he had known at St. Bartholomew's. He then spent some time in Prof. Guthrie's laboratory and afterwards in the University Laboratory, Oxford. During this period, he was concerned in the teaching of chemistry at Cheltenham and Clifton Colleges and he also supervised the construction of the chemical laboratories in University College, Nottingham.

In 1883, Brown was appointed professor of chemistry and physics in Auckland University College, a post he held until 1914, when he came to England; but he was so upset by the conditions of the war, especially the bombing, that he gave up his intention of settling here and, in 1918, returned to the quiet of New Zealand. He did the greatest possible service to the cause of scientific education in New Zealand, where he was generally held in high esteem.

A man of original and independent, aristocratic mind but entirely unobtrusive though charming manner, firm and clear in his convictions and with a specially developed sense of accuracy and thoroughness, Brown's scientific work was of a classic character, though through force of circumstances it could not be large in amount: however, he not only made the best of the material that was at his disposal in Auckland but was also successful in inspiring those who studied under him with his own high conceptions of scientific duty. The work by which he is best known probably is that relating to fractional distillation, a subject on which he was an authority in early days; he also paid much attention to the cyanide process of extracting gold.

### PROF. F. T. TROUTON, F.R.S.

AT Trinity College, Dublin, in the 'eighties of last century, there assembled under Prof. FitzGerald a small band of enthusiastic physicists of great ability and originality, brought together by a common admiration and affection for their chief. Names which will always be connected with this brilliant school of physics are Joly, Preston, and Trouton. FitzGerald himself did not live to be fifty, Preston died in his fortieth year, and now, to the great grief of all those who ever knew him, Trouton has left us at the age of fifty-eight, after having been kept by illness for the past ten years from the researches he loved.

Trouton was born in Dublin in November 1863, the son of a family well known in that city. As a student at Trinity College he gave early evidence of that versatility and quickness of grasp which characterised his scientific career. He studied both engineering and the physical sciences, and before graduating had already on one hand taken a leading part in surveying for a railway, and on the other enunciated that connexion between latent heat and molecular weight which is known as Trouton's Law.[1] He closed a brilliant undergraduate career by taking degrees in engineering and science at the same time, being awarded the coveted Large Gold Medal, rarely bestowed for science. He at once became assistant to the professor of physics at Trinity College, and until FitzGerald's death in 1901 he remained the cherished colleague and intimate friend of that great man. They carried out in collaboration many experiments, including an important series confirming, to a high degree of accuracy, Ohm's law for electrolytes. Trouton never spoke of FitzGerald without emotion characteristic of his generous nature.

The Dublin school was immediately struck with the importance of Hertz's experiments on electromagnetic waves, which were published in 1887 and 1888, and Trouton was one of the first to repeat them and to carry out original work on the subject. He settled the long-disputed question as to the relation between the direction of the vibration in the wave-front of an electromagnetic (light) wave and the plane of polarisation, by showing that the electric vector is normal to, and the magnetic vector in, the plane of polarisation. He demonstrated many analogies with optical experiments by suitably increasing the size of the apparatus to correspond to the great wave-length of the Hertzian waves—thus a wall built of bricks of paraffin wax was used to replace the soap film of ordinary light experiments. Trouton's work did much to establish the common electromagnetic nature of ordinary light and of Hertzian waves.

[1] If M be the molecular weight, L the latent heat, T the absolute temperature, then $ML/T$ is constant.

FitzGerald was deeply interested in the question of the possibility of detecting the earth's motion through the æther, and Trouton eagerly took up a suggestion to investigate the mechanical effect of charging a condenser moving in the plane of its plates through the æther. The experiment, which is well known to all students of relativity, gave a negative result. It was in 1902, just after this research, that Trouton was appointed to the Quain professorship of physics at University College, London. He had at the time been for some years a Fellow of the Royal Society. His first work here was to repeat, with Noble, the condenser experiment in an improved form. Later he devised another experiment, designed to detect the FitzGerald shrinkage, which consisted in comparing the electrical resistance of a wire when moving in and across the æther stream. This was carried out in collaboration with Mr. (now Prof.) A. O. Rankine, and led to a negative result. The results of these experiments are in accord with the theory of relativity, for which they offer important evidence.

Trouton carried out researches in a variety of directions, including some on the viscosity of solids, and others on the condensation of water vapour on different surfaces, the latter of which led to the discovery of an interesting analogy to the James Thomson portion of an isothermal. His last work was on the adsorption of dye-stuffs on sand at various concentrations, and gave results of an intriguing nature which cannot be described here. It was while engaged on these investigations in 1912 that Trouton was attacked by a severe illness. He recovered from a prolonged prostration sufficiently for it to be hoped that he would be able to attend the meeting of the British Association in Australia in 1914, and he was elected president of Section A for that meeting. He prepared his presidential address, but was unable to travel, as an early operation was advised. It was held to be partly successful, but he never walked again. When he resigned his professorship at University College he received the title of emeritus professor.

The investigation of newly discovered or of neglected phenomena had a great fascination for Trouton; he was always breaking fresh ground, and had little inclination for working over subjects on which many investigations had been carried out—"pouring water on a drowned rat," as he characteristically expressed it. In daily life he was a man of great charm and sincerity; his wit, his buoyancy, and his whimsical and incisive phrases were a constant delight. He never lost an opportunity of helping a student or colleague, and his kindliness was evident in all his actions, a kindliness which had its roots in strength, and not weakness, of character. When in the prime of life he was struck down by a cruel and lingering illness he carried his cheerfulness to his couch, and would receive visitors with something like the old twinkle in his eye. Fate did not spare him; he lost two hopeful and beloved sons in the war, and saw all hope of recovery slowly pass from him. He died peacefully at his house at Downe on September 21, and, although his death was not unexpected, it brought to his friends a distress no less poignant for that.

E. N. DA C. A.

WE regret to see announcements of the following deaths:—Prof. Arthur Mayer, formerly director of the Botanic Garden at Marburg, at the age of seventy-two years; Dr. William Kellner, formerly chemist to the War Department, aged eighty-two; on September 25, Prof. J. P. Kuenen, of the University of Leyden, aged fifty-five; on September 27, Mr. C. Michie Smith, late director of the Kodaikanal and Madras Observatories; and on September 28, Major-General James Waterhouse, from 1866 to 1897 Assistant Surveyor-General in charge of photographic operations in the Surveyor-General's Office, Calcutta, at the age of eighty years.

## Current Topics and Events.

THE hundreth anniversary of the birth of Mendel was celebrated in Brünn on September 23 last. The Government of Czecho-Slovakia placed generous funds at the disposal of a local committee, which arranged the centenary celebrations with the liberality and efficiency that we have learnt to expect from the new Czecho-Slovakian state. Credit is especially due to the committee for having made the centenary an occasion for bringing together, for the first time since the war, geneticists of all lands, the visitors comprising representatives of America, Austria, Denmark, England, Finland, Germany, Holland, India, Japan, Jugoslavia, Norway, Poland, Sweden, and Switzerland. The official proceedings opened with a visit to the monastery in which Mendel had lived, and to the adjoining garden in which he made his experiments. Wreaths were laid before the monument of Mendel which was erected in 1910, and speeches were made by the chairman of the local Naturwissenschaftlicher Verein, by the official representative of the Government, by the Burgomeister, by Prof. Erwin Baur (Berlin), Prof. Chodat (Geneva), Prof. Němec (Prague), Mr. S. Pease (Cambridge), and Prof. Iltis (Brünn). At the luncheon which followed, the principal speaker was Prof. Wettstein (Vienna), who emphasised particularly the international significance of the event. Prof. C. B. Davenport (Washington) replied, and the official proceedings terminated with a speech by Prof. Richard Hertwig (Munich). In the evening, a special performance was given at the opera, to which the guests were invited: it was the first occasion in Brünn on which the works of Czech and German composers had appeared on the same programme, a matter locally of much comment and great importance. The next day an expedition to recently discovered and very remarkable caves in the Moravian Karst was arranged. It is to be hoped that the success of this gathering will encourage others to organise congresses that are international and not merely inter-allied, in order that the friendships and intercourse which the war destroyed may be once more built up.

A KINDLY function was fulfilled at the London School of Tropical Medicine on Monday evening of last week, September 25, before a company of friends of the School and the family, when the first mint of the new medal instituted in memory of Sir Patrick Manson was presented to his widow. Major-General Sir William Leishman, who made the presentation, explained that the medal was the sub-issue of a project by friends of Sir Patrick Manson to present to the School a portrait of its illustrious originator. As the result of an appeal for this purpose, subscriptions in excess of the actual requirements quickly came in from many parts of the world, accompanied by numerous very cordial tributes of approval. The portrait had been presented, and when all expenses had been met there still remained a balance which the committee of subscribers thought would find its most happily inspired application in a medal commemorative of Sir Patrick Manson's unique position in the history of tropical medicine. In a graceful speech Sir William Leishman alluded to the many ways whereby, outside the laboratory, quite as effectively as within it, a wife can further her husband's work, and said that it was with a full appreciation of the circumstances from this point of view, and not as a mere compliment, that the committee desired to offer the first-minted medal to Lady Manson.

M. LE TROCQUER, Minister of Public Works, was present at tests on September 26, in connexion with the utilisation of tidal power at Aberwrach, near Brest. The scheme is to comprise a barrage 150 metres in length, which will permit of the storage in a tidal basin of from one to four million cubic metres of water, depending on the tidal range. Four turbines are to be installed, working both on the ebb and flow of the tide and capable of delivering 750-1200 h.p. These are coupled to alternators delivering current at 1500 volts. This station is to work in conjunction with a water-power station developing power from river-flow, and the latter is to be used to regularise the intermittent output from the tidal-power scheme. Should the results of this investigation prove satisfactory it is intended to develop a much larger scheme on the Rance, and, according to the *Times* of September 28, the minister expressed the opinion that this would enable electrical energy to be supplied to the whole of Western France.

WE learn from the *Chemical Age* that the chairman of the Allied Chemical and Dye Corporation of New York has offered, through the American Chemical Society, an annual prize of 25,000 dollars "to reward the chemist, residing in the United States, who in the opinion of a properly constituted jury has contributed most to the benefit of the science and of the world." In communicating the offer, the chairman of the Corporation writes: "Realising, as we do, the enormous influence which chemists working in all the fields of that science will have on the welfare of the world, we desire by this prize so to encourage the workers that even larger benefits should accrue than those which have already placed the world under such a debt of gratitude to the profession." Last week reference was made in our columns (p. 466) to numerous substantial gifts by industrial concerns in Germany to German universities to assist in the teaching of scientific subjects, particularly chemistry. Thus in both the United States and in Germany, commercial men and manufacturers are showing their appreciation of the value of what may be termed, research in pure science.

ACCORDING to *Science*, the American Medical Association has agreed to co-operate with the directors of the Gorgas Memorial Institute of Tropical and Preventive Medicine in establishing the institute, and a committee of the Association has issued an appeal for subscriptions. The committee is agreed that the most suitable memorial to Major-General William C. Gorgas would be such an institute, and considers that no more appropriate place than Panama City, where General Gorgas's great work in stemming tropical diseases was done, could have been selected. The Government of Panama has given the Santo Tomas Hospital, and also the land on which it is proposed to build the laboratories and departments for research, to constitute the memorial institute; Dr. R. P. Strong has been appointed scientific director. It is also intended that a Gorgas School of Sanitation shall be established in Tuscaloosa, Alabama, for training public health workers and sanitary engineers especially for work in the Southern States of America. An endowment of some 1,300,000*l*. will be necessary to carry out in full the proposed memorial.

PROF. SANTIAGO RAMÓN Y CAJAL has retired from the chair of histology and pathological anatomy in the University of Madrid. This distinguished man of science, who is a Foreign Member of the Royal Society, has been the recipient of numerous honours in Spain, including the Echegaray medal, presented to him in the Royal Academy of Sciences by the King of Spain. The Spanish Government has introduced a bill for the construction of a building for the Cajal Institute, constituted in 1920, which carries with it an appropriation of nearly 36,000*l*., divided into four sums to be expended annually from 1922 to 1925 on the building designated as Cajal's Biological Institute; in addition, a grant of about 1700*l*. is to be provided for maintenance. The work of the institute will be directed by a board of trustees under the chairmanship of Cajal himself.

ABOUT a year ago the Chemical Society issued an appeal to its fellows to assist in the alleviation of distress among chemists and other scientific workers in Russia. Since then a sum of more than 210*l*. has been received, and about 170*l*. of it was devoted to the purchase of clothing, which has been distributed among men of science in Ekaterinburg, Moscow, and Petrograd. In addition, three cases containing clothing and books have been sent to the latter two cities. It is now known definitely that the packages have reached those for whom they were intended, so that the possibility of gifts going astray need no longer deter possible subscribers. There is every reason to fear that during the coming winter distress will be as acute as it was a year ago, and the Chemical

Society appeals to all British chemists to give assistance. Gifts of money, clothing, books, and recent chemical literature should be addressed to the Assistant Secretary, The Chemical Society, Burlington House, Piccadilly, W.1.

In his presidential address delivered before the Royal Anthropological Institute (vol. lii. part i.) the late Dr. Rivers laid special stress on the difficulties which impede research by the excessive cost of printing and book production, and the rise in rent and taxes for accommodation used by scientific societies. He pointed out how closely all the branches of anthropological work—physical, sociological, archæological, psychological—are connected. Numerous societies, like the Royal Asiatic, African, and Japan societies, with the Hellenic and Roman societies and that specially devoted to folk-lore, should become more closely allied than is the case at present. The provision of a common building with adequate accommodation for a lecture room, library, and secretarial quarters would do much to reduce expenditure and promote efficiency. The leading society, the Royal Anthropological Institute, is most inadequately housed, while the Folk-lore Society has no headquarters of its own. It is quite time that an earnest effort was made to reorganise the work of these and similar societies. Individual jealousies and prejudices must be encountered, but the spirit of conciliation, reinforced by the difficulties of the present situation, should succeed in framing a scheme of co-operation.

In accordance with arrangements followed for many years past there is to be a series of meetings, generally on alternate Mondays at 5 p.m., at the Meteorological Office, South Kensington, for the informal discussion of important contributions to meteorological literature, especially in foreign and Colonial journals. The meetings will commence on Monday, October 16, when, as customary at the first meeting, the discussion will be opened by Sir Napier Shaw. The subject is a paper by V. Bjerknes "On the dynamics of the circular vortex with application to the atmosphere and atmospheric vortex of wave motions."

The third of the series of lectures, under the auspices of the Institute of Physics, on physics and the physicist in industry will be given by Mr. Clifford C. Paterson, who will take as his subject, "The Physicist in Electrical Engineering." The lecture will be delivered on Wednesday October 18 at 6 p.m. at the Institution of Electrical Engineers, Victoria Embankment, W.C.2.

On the recommendation of the committee of management of *Science Abstracts*, the council of the Institution of Electrical Engineers has appointed Mr. W. R. Cooper to be editor of the publication in succession to the late Mr. L. H. Walter. Mr. Cooper was acting editor of *Science Abstracts* in the first year of its existence, 1898, and afterwards was editor from 1899 to 1901.

The Home Secretary gives notice that summer time will cease this year at 3.0 a.m. (summer time) in the morning of Sunday, October 8, when clocks will be put back to 2 a.m. The shorter period of summer time prescribed by the Summer Time Act, 1922, does not operate this year.

## Our Astronomical Column.

October Meteor Showers.—The month of October is usually one of the best periods for observing meteors. The moon will interfere this year in the early part of the month, but during the last half, observations may be satisfactorily made. The chief shower generally visible falls in the third week of the month, and is directed from a radiant point at $91° + 15°$ on the north-eastern borders of Orion. There is also a strong shower which supplies slow and often brilliant meteors at about the same time as the Orionids, but this radiant in the eastern region of Aries at $42° + 21°$ appears to be visible for a long period, and is also seen in the months of November and December. The Taurids often form a conspicuous display towards the end of October, but they are generally more abundant in November than at any other time of the year. The latter shower yields meteors very similar to the Arietids, and fireballs are frequently intermingled with the smaller members of the stream. The chief radiant is at $64° + 22°$; it is difficult to define the date of maximum, but it usually occurs between November 20 and 23.

The meteoric activity of October is not confined to a few systems, for a very large number, certainly several hundreds, may be recognised. They are, however, for the most part feeble, like the majority of the systems which are distributed over the firmament.

Parallaxes of 22 Cepheids.—Dr. Harlow Shapley's estimates of the distances of the globular clusters rest largely on the assumed absolute magnitudes of B stars and Cepheid variables. It is very desirable to have as many independent determinations as possible of the distances of the brighter Cepheids, in order to check their assumed absolute magnitudes. Dr. S. A. Mitchell has determined the trigonometrical parallaxes of 22 of them, and publishes the results in the *Observatory* for September. Perhaps the most doubtful point is the mean parallax of the comparison stars; they are of the 10th magnitude, assumed parallax $0''.005$. The deduced absolute parallaxes for the Cepheids range from $+0''.046$ ($\rho$ Cassiopeiae) to $-0''.018$ (41 Cygni). There are only 3 negative parallaxes. The mean parallax agrees very closely with the mean of the spectroscopic values; rejecting $\rho$ Cassiopeiae, the mean difference, Mitchell *minus* spectroscopic, is only $0''.0003$. It is concluded that the latter are very accurate.

Nova T Coronae (1866).—This Nova is exceptional in two ways. It is the only Nova that was a catalogued star before the outburst (BD $+26°$ 2765), and it is much farther from the Galaxy than other Novae. Mr. K. Lundmark investigates its proper motion and parallax in Publ. Ast. Soc. Pacific, August 1922. The proper motion is given as $0''.012$ annually, towards position angle $41°$; from this the parallax is inferred to be $0''.0010$, while the spectroscopic parallax is $0''.0014$. Adopting $0''.0013$, its present absolute magnitude is $+0.2$, while that at the outburst was $-7.4$, in good agreement with the maximum value for other Novae. The star is an M giant, and apparently is now in the same condition as before the outburst. If the above parallax is near the truth, the star is considerably more remote than Nova Persei (1901) or Nova Aquilae (1918).

## Research Items.

THE STATUE OF SOPHOCLES IN THE LATERAN MUSEUM.—The chief glory of the Lateran Museum is the great statue usually supposed to be that of the poet Sophocles. This identification is disputed by Mr. Theodore Reinach (Journal of the Hellenic Society, vol. xlii. Part 1), who, after a full discussion of the evidence, identifies it with the famous statue of Solon of Salamis, dating about 391 B.C., the work of the artist Kephisodotus, whose son and pupil seems to have been Praxiteles. This new work by a great master thus stands out as the herald of a new dawn of art, the real link between the divine Phidias and the divine Praxiteles.

EXCAVATIONS AT THE SITE OF BETHSHEAN.—The town of Bethshean, afterwards, for some unexplained reason, known as Scythopolis, lay between the Little Hermon and Gilboa ranges, on a plain about three miles west of the Jordan. Permission to excavate the site by the University Museum, Philadelphia, having been granted by the Archæological Department of Palestine, the work was started in 1921 under the superintendence of Mr. C. S. Fisher. Fortunately no Mahomedan tombs or other buildings on the mound interfere with the work of excavation. The stratification shows a continuous occupation of the site from Arab, Byzantine, and Classical times down to the early Semitic period. The results of the excavations, so far as they have proceeded, are described in the March issue of the *Museum Journal*. The most important discovery made is that of a large basalt stele with an Egyptian inscription of Sety I. (1313–1292 B.C.). When the lowest stratum is reached it is hoped that much light will be thrown on early Semitic life and religion.

BANTU THROWING-STONES AND BRASS.—In the Report of the South African Museum for 1921, Dr. Péringuey discusses some large rounded stones, perforated in the manner of the Bush *Kwe*, and weighing about 18 lb. He does not think that they could have been used to weight digging-sticks or as rolling mill-stones. With them were some stones, also perforated, but rather flat, with a sharp edge. These, it is said, were carried on a stick by the Bantu, and used for throwing at the legs of bucks. This explains the use of some heavy brass rings found in Swaziland, and the question arises whether the brass was made in that country or was imported. The Chief Regent of Swaziland says that the former was the case, and adds: "The process of separating was by melting the minerals and certain chemicals known to our ancient blacksmiths and founders. In the making of brass and other metals, copper, lead, and zinc were used for the manufacture of bangles, etc., which were worn only by Royalties. The bangle in this form is known as Itusi; it is the form in which brass is kept, instead of making it into bars as the Europeans do." Specimens in the museum show that the Bantu had also a bronze industry, but the rarity of such objects is rather remarkable, and Dr. Péringuey suggests as the reason the very early supersession of bronze by iron in South Africa.

PHYSICAL NATURE OF VERSE.—A recent number of the *Wiener Medizinische Wochenschrift* reports a lecture at the University of Vienna by Prof. E. W. Scripture, of London and Hamburg, on recent researches in experimental phonetics. Speech is registered by physical means on a recording drum, and the resulting curves are analysed and measured under a microscope. One of the latest problems is that of the physical nature of verse. Verse is shown to be a continuous vocal gesture. There are no syllables, no feet, no measures, no possibility of such notions as iambus or trochee. The entire system of metre as taught in modern prosody is held to be a fantastic construction that has not the slightest relation to verse as actually spoken. Any attempt to fit it to verse or fit verse to it results in such monstrosities as some of the present corrections to the text of Shakespeare, with apologies for the bad verse he is supposed to have written. Verse, from a physical point of view, is shown to be a flow of speech energy with regularly recurring regions of greater density. The total of this energy can be treated as if condensed at certain points—centroids or centres of gravity. These centroids recur at regular intervals and give the effect of beats. This regular recurrence of centroids constitutes the whole of the system of verse. Another topic presented was the recent work on registering speech in nervous diseases. Three diseases—epilepsy, disseminated sclerosis, and general paralysis—show specific peculiarities in the records. A diagnosis thus becomes an automatic thing; the speech is registered, the curves are analysed and measured, and the result appears of itself.

THE SITE AND GROWTH OF LONDON.—The relation of topography and underlying structure to the growth of London are traced in some detail by Mr. C. E. M. Bromehead in a paper in the *Geographical Journal* for August. After describing the extent of alluvial and river gravels and the course of the Thames tributaries in the area now covered by London, Mr. Bromehead points out that the narrowness of the river and the approach by gravel banks from either side marked the present site of London Bridge as the lowest ford. Around this, especially on the better situated northern bank, the original London grew. The essentials of the site, in addition to the ford, were twin hills capped by water-bearing gravels separated by the valley of the Wall Brook, bounded on the west by the Fleet and on the east by the low ground of the Thames marshes. To the north was the forest area of the London clay, but the river gravels were comparatively bare. The early Roman camp, which was the earliest historic London, was on the east hill; on the west hill the brick earth was worked until the city grew over it. Mr. Bromehead traces the growth of London through Saxon times and up to the Great Fire in 1666. After that event London rapidly expanded. The limit of the gravels for a long time set a limit to building operations. Wells sunk through the gravel, seldom more than 25 ft. in thickness, were sure to tap water, but it was not realised till recent times that better supplies could be obtained beneath the clay at depths of 150 ft. and more. It was for this reason that the areas of bare London clay remained unoccupied until the advent of steam pumping and iron water mains. Once these difficulties of water supply were overcome, the clay areas were rapidly built over and outlying hamlets became linked up with London.

MEDIAN PROLIFICATION OF FLOWERS OF HEMEROCALLIS.—We learn from Dr. J. C. Costerus, of Hilversum, Holland, that he has observed numerous central floral prolifications in *Hemerocallis fulva* in gardens at Hilversum, in the botanic gardens at Amsterdam and Utrecht, and also at Twickenham in this country, during the past summer. Apparently the prolification resembled closely a "doubled" flower. Median prolification of flowers of Hemerocallis, although apparently rare, has been noted on several occasions and is referred to in "Vegetable Teratology," by the late Dr. Maxwell T. Masters. While it is difficult to suggest a reason for the phenomenon with any degree of certainty, it is probable that the condition may have been more prevalent than usual this year owing to the prolonged drought of 1921 and the early months of 1922, placing a check upon normal development, followed by a rush of vigorous growth brought about by the wet summer months. A check to growth followed by a sudden change to first-rate growing conditions often brings about fasciation, and the median prolification of flowers of Hemerocallis may be regarded in a rather similar light to fasciation.

LIFE-HISTORY OF THE NEUROPTEROUS INSECT ITHONE.—In the Bulletin of Entomological Research, vol. xiii. pt. 2, August 1922, Dr. R. J. Tillyard gives a very detailed account of the biology of *Ithone fusca*, an Australian moth-lacewing. It appears that the complete life-history occupies two years, and the eggs are laid in soft or sandy ground, each being rolled separately in the sand, which adheres to its sticky surface, forming a protective covering. The larvæ are very different from those of other Neuroptera Plannipennia, being curved and more or less scarabæiform in their general features. There appear to be at least five instars instead of the usual three or four present in other members of the sub-order. The cocoon is spun from the anal end of the body, and the pupa is armed with large jaws for cutting a way out for the emergence of the imago. The larval food appears to be mainly scarabæid grubs, and Dr. Tillyard is so impressed with the value of Ithone in reducing the numbers of these organisms, that he has decided to test its capabilities as an aid to agriculture in New Zealand. Some 7000 fertile eggs of *Ithone fusca* have been introduced, and it remains to be seen whether the larvæ will succeed in establishing themselves under the new conditions, and serve as a help towards controlling the "grass-grubs." The latter are serious pests with but few natural enemies in New Zealand.

THE MAGNIFICENT SPIDER (*Dicrostichus magnificus*, Rainbow).—In the Proceedings of the Royal Society of Queensland (vol. xxxiii. 1921, pp. 91-98, pls. 7 and 8) Mr. H. A. Longman gives an interesting account of this very large and handsome spider. It appears that the creature constructs egg-cocoons of a more or less elongate-fusiform shape, each being suspended by a pedicel attached to a bush. Their total length measures from three to four inches with a maximum diameter of about one inch. The cocoon is double, one cocoon lying within the other, and between them is a loose packing of delicate silk. Within the inner cocoon are the eggs, which number more than 600, and, taking five cocoons as an average, each spider lays about 3000 eggs. After hatching, the young spiders climb up the surrounding leaves and spin fine threads. On the latter they are floated, or ballooned, through the air to start life on their own account. The author gives a detailed account of how this remarkable cocoon is spun by the parent, which, although skilful in this art, had neither the capacity nor inclination to mend a rent in it when it was torn by a cricket-like insect. The spider constructs no web for ensnaring prey, but shortly after sunset it hangs suspended from a horizontal line near its cocoons. From this slender bridge it spins a short filament which hangs downwards and terminates in a globule of viscid matter a little larger than the head of an ordinary pin. The filament is held out by one of the front legs, and, on the approach of an insect, the spider whirls it with surprising speed; this is undoubtedly the way in which it secures its prey. Mr. Longman has repeatedly found the spider sucking a common species of Noctuid moth which it captures in this manner.

IMPROVED RIVER DISCHARGE MEASUREMENTS.—In the measurement of river discharge special difficulties are encountered in the case of sluggish streams such as the Blue Nile at Soba during low water. In a report on "Investigations into the Improvement of River Discharge Measurement," Pt. II. (Government Press, Cairo), Mr. E. B. H. Wade gives the result of his experiments with an improved current meter for streams of this type. It is a helical current meter in which the helix is driven not by the stream but by an independent constant power. The effect of the stream is merely to increase or diminish the rate of the helix by an amount which serves as a measure of the stream's velocity. An instrument on these lines is being constructed by Messrs. Kent and Co. The distinctive feature of the model is that gear is dispensed with, and instead of a weight with one or two kilogrammes falling about thirty centimetres, a weight of 25 to 50 grammes falls a distance of one metre. The good results of this model are said to be due, in large measure, to the directness of its action and the avoidance of dissipation of energy in gear work. Experiments made with instruments of this type gave satisfactory results. The probable error for a single determination was found to be $\pm 0{\cdot}03$ second, but Mr. Wade believes that this will be reduced in the perfected instrument.

TURBULENCE ON A LARGE SCALE.—To say that a gas has viscosity, is a device to compensate in the bulk for the motions which are ignored in detail. Thus if the ignored motions are those within only a cubic tenth of a millimetre the viscosity, for air, is roughly $0{\cdot}0002$ cm.$^{-1}$ grm. sec.$^{-1}$. If, however, we ignore the gusts in a wind, then we must attribute to the smoothed wind a much greater viscosity, ranging, in the same unit, from 1 to 100. In this way the increase and veer of the mean wind in the first kilometre above ground have been explained by Åkerblom, Taylor, Hesselberg, Sverdrup, Schmidt, etc. Recently Albert Defant of Innsbruck has gone a stage further by asking what the viscosity must be if we ignore even the cyclones and anticyclones, so that we are left with a smooth general circulation of the atmosphere proceeding along the paths commonly shown in maps of the globe. A review of Defant's first paper on this subject appeared in NATURE of April 15 last, p. 469. In a second paper, "Die Bestimmung der Turbulenzgrössen der atmosphärischen Zirkulation aussertropischer Breiten" (Wien, *Akad. Wiss.*, 1921), he re-examines, by other methods, the viscosity to be attributed to this general circulation, and finds, as before, values round about $10^8$ cm.$^{-1}$ grm. sec.$^{-1}$, that is to say, a billion times as great as that arising by ignoring molecular agitation only. This large value, $10^8$, applies to friction across vertical planes, but apparently the friction across horizontal surfaces is an affair of gusts, not of cyclones. When the viscosity is known the conductivity for heat and for water vapour can be found by the theories of G. I. Taylor and W. Schmidt. The methods whereby Defant obtains this viscosity include a computation of "eddy-stresses" in accordance with Osborne Reynolds' theory from the hourly values of the wind at various heights. The direct eddy-stresses are in some cases as big as $0{\cdot}3$ millibar. Defant also makes a determination by way of the scattering of air to north and south of the mean-current after a passage of 3 days, using a formula due to L. F. Richardson.

## A Florentine School of Physics and Optics.

By Dr. L. C. MARTIN.

THE city of Florence, deservedly famous as a place of pilgrimage for lovers of art, is no less worthy of a visit on the part of students of science. The famous Museo di Fisica, with its Tribuna di Galilei and its collection of priceless instruments, will always attract the lion's share of attention, but a visit to the charming southern suburb of Arcetri, with the astronomical observatory and the newly erected Institute of Physics and Optics, will amply repay the time spent in making it.

On driving out from the city by the cypress avenue of the Villa Poggio Imperiale, the observatory is seen to the left crowning a lofty hill, on the side of which the red roofs of the Institute can be seen among the green of the surrounding gardens and vineyards. A wide view over the peaceful countryside is obtained on reaching the terrace.

The building is of the square form with centre courtyard usual in Italy, and is only two stories high. A cloister surrounds the courtyard on the ground level, and above the cloister a wide closed corridor affords interconnexion between the rooms on the upper floor. It is commonly held that a similar form of building is not suitable for the British Isles on account of the colder climate, but it may be doubted whether this view is correct; the arrangement has in the present case certainly proved most successful from many points of view. The rooms and corridors are light and airy, while the building is extremely compact and its low height makes for stability. There is little or no trouble from vibration, all machinery being housed in one side of the square at the back of the building. Lastly, and not least, a way has been found to combine beauty with utility, and it was not thought wasteful even in these modern times to follow the charming traditions of Florence by planting a garden to surround the well in the courtyard. This is shown in Fig. 1.

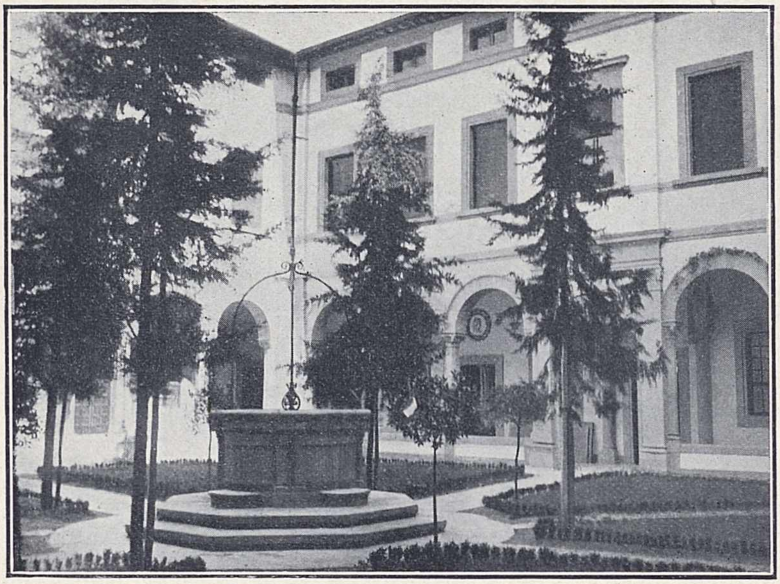

FIG. 1.—The Courtyard of the Physical Institute at Arcetri, Florence.

The Institute was erected immediately after the war to serve for post-graduate and research work in physics and optics. The physical laboratories are under the direction of Prof. A. Garbasso, who, during the last year, has served as Mayor of Florence. The optical laboratory is directed by Prof. A. Occhialini, the well-known editor of the *Revista d' Ottica*. In the coming year it is proposed to build an annexe devoted entirely to technical optics. Up to the present the teaching activity has been restricted to the physical side, but courses on optical subjects are being arranged and research and testing are already in progress. Accommodation is provided for thirty to forty students taking post-graduate courses in physics. The present students are drawn largely from the University of Pisa.

In the course of a short visit it is scarcely possible to notice all the features deserving attention. The arrangement of lecture theatre, class rooms, and research rooms is generally excellent, and it is evident that the needs of experimental work have been considered during design; for example, in one corner of the building it is possible to obtain the equivalent of a vertical circular shaft by removing the coverings of holes in the roof and floors, an arrangement which is of the greatest value in optical testing.

The usual wiring and switchboard for the distribution of electric current is provided, and there is also a separate high-tension circuit. Another point which seems admirable is the construction of the roomy apparatus cupboards in which three sides are of glass; they stand in the corridor on the first floor and exhibit the apparatus to advantage, a matter of importance in a teaching institution.

In the matter of equipment the usual lines have been generously followed. For example, the optical apparatus includes 40 and 20 plate echelons with appropriate spectroscopes, a Fabry and Perot interferometer, and a Nutting spectrophotometer, all by A. Hilger, Ltd. There is also a large spectrometer (with four reading microscopes for the circle) by the Société Genevoise. Other branches of physics seem to be supplied in a corresponding manner. Those who know something of the present cost of equipment of this kind will appreciate the intensity and vigour of the effort which Italy is making in the founding of this Institute.

In Florence as in few other cities one loses that sense of the remoteness of the past which oppresses the mind in more modern surroundings, and the splendour of bygone days seems still our own for guidance and inspiration. Such thoughts find a fitting expression in two frescoes which are seen on leaving the Institute by the main staircase. On the one side is seen Youth in the quietness and cool of the evening drinking of the fountain of ancient wisdom, while opposite we see Humanity in the glory of morning sunlight pressing upwards with eagerness and hope towards the hilltops.

I am indebted to Profs. Occhialini and Garbasso for photographs and information for the purposes of this article.

## Fruit-Growing and Research.

THE application of scientific methods and principles is steadily gaining ground in fruit culture as in other branches of agriculture, and the numerous publications on the subject provide evidence of a widening interest in the matter, both as regards the scientific and the practical worker.

The earlier work of Spencer Pickering and the Duke of Bedford stimulated interest in the root systems of fruit trees, and at Long Ashton [1] the matter of root development under various conditions is being followed up. It appears that the method of treatment at the time of planting has little effect on the type of root produced, a new root system being derived from the collar region of the tree and little growth occurring elsewhere; aeration is considered to be a dominant factor in determining the actual point of origin of the new roots. Root formation and growth are most active at the beginning and towards the end of the season, the greatest increase in root length occurring during the latter period, at the time when shoot growth is rapidly decreasing. Other experiments deal with the extension of the root system throughout the soil, a matter which has a direct bearing on the degree of overlapping of roots when too close planting is practised.

On the pathological side special attention has been directed to leaf-scorch on fruit trees, and the trouble has been found to be due to various causative agents. Among the chief of these are unfavourable soil conditions, due to deficient food or water supply or to defective aeration owing to the mechanical character of the soil. Scorching is also attributed to the direct action of wind, to excessive heat falling on the leaf, or to injury to the vascular system of the plant, such as may be caused by ringing or by the presence of a fungus which penetrates the vascular tissue and interferes with the water supply to the leaves.

The importance of spraying to combat disease is now widely recognised, and at East Malling [2] direct experimental work is being carried out with fungicides on apple trees. Every fungicide tested reduces apple scab (*Venturia inæqualis*), though the degree of effectiveness varies, Bordeaux mixture usually proving the best. Generally speaking, the crop and the size of the fruit are improved by spraying, with certain exceptions, and there are indications that summer spraying may improve the keeping quality of the fruit by reducing attacks of brown-rot (*Sclerotinia fructigens*). An interesting point is that the effects of spraying are cumulative, sprayed trees being less heavily affected in the succeeding years.

A critical examination of the stocks used for stone fruits [3] shows that little or no attempt has hitherto been made to group them as has been done for those used for apples and pears, rapidity of growth and general availability being usually the deciding factors in the selection of stocks in any particular instance. The descriptions worked out at East Malling are the beginnings of an attempt to set up a permanent standard of classification and identification with the view of the ultimate improvement of stone fruit cultivation.

In an interesting survey on progress in methods of practical fruit-growing in the Journal of the Royal Agricultural Society of England,[4] the whole business, from the selection of a holding to the final packing of the fruit, is traced. Laying out and planting the fruit farm, raising and selecting trees, pruning, manuring, diseases, and pests are all brought under consideration in a way that provides suggestive reading for all interested in the subject, and its value is enhanced by a useful bibliography. In this connexion also attention may be directed to the collected leaflets [5] on fruit recently reissued by the Ministry of Agriculture, in which various problems the practical fruit-grower encounters in his work receive detailed consideration.

[1] Annual Report of the Agricultural and Horticultural Research Station, Long Ashton, 1921.
[2] Grubb, N. H. (1921), *Journal of Pomology*, II., No. 2.
[3] Hatton, H. G. (1921), *Journal of Pomology*, II., No. 4.
[4] Hatton, H. G., 1921, Journ. Roy. Agric. Soc., England.
[5] Collected Leaflets on Fruit, 1921. Sectional volumes, No. 4. Ministry of Agriculture and Fisheries.

## Volcanic Activity in Nigeria.

IN NATURE of July 15, p. 97, an account was given of volcanic activity in Nigeria during March-May last. The following extracts, from the reports of Mr. H. S. Cameron, acting Supervisor of Plantations in Nigeria, furnish some later information. They are placed at our disposal through the courtesy of the Colonial Office :—

On June 17 the manager of Bibundi informed me by telephone that lava streams had commenced to flow again; also that heavy damage was being done by floods. On June 18 I went to Bibundi, and going by trolley to Dollmanshöhe I found the roadway of the bridge entirely swept away by floods and also one of the four piers gone. I went up the river, and after about a mile reached the first flow of lava, which had been advancing the day before but had now cooled and was stationary. Crossing from there to Wernerfelde, progress was shortly prevented by advancing lava; the stream here was molten, but its advance, which was more "creeping" than "flowing," was over a very wide area and on a gentle slope, and it seemed probable that eventually it would cool and turn the main lava stream down the old course of the Njonge river and extend into the sea, as part of the flow was then doing.

The flooding damage was considerable and I think unpreventable; the amount of water is so great that it is impossible to direct it. More than fifty inches of rain fell in the first seventeen days of June, and the water from an area which formerly fed three rivers and part of a fourth has now no channel: not only is an exit lacking, but rain falling on lava does not sink in and percolate through but rushes at once to the lowest level, so free drainage is more necessary than ever.

On June 22 I received a letter stating that the lava had broken through near Dollmanshöhe bungalow, followed the course of the stream, and was threatening the hospital, which had been abandoned. On reaching the bridge-end at Dollmanshöhe on June 25, I found that the whole of that division above the iron road had been covered with lava, and cascades of molten lava were flowing down the banks of the ravine. It was really a wonderful sight. The river bed was full of detached flows of lava fed from the Dollmanshöhe plateau, where it had been massing during the past week. I inspected the whole length from near the Thormählenfelde bungalow to the director's house, finding flowing lava everywhere. By afternoon the ravine was filled, and by 11 P.M. the lava had crossed the rail where the Government road turns off and was advancing down the latter and towards it from various points along the river course on the left.

Owing to the steady progress between June 18 and 25, and the rapid flow on the latter date, I considered it advisable to order the removal of all the machinery and the salving so far as possible of all building materials worth removing from machine house, cacao house, hospital, and director's house.

On July 11 I again visited Bibundi. The lava had advanced considerably since June 25, but its activity is gradually dying out, though the lava streams from the crater, so far as can be seen in this very misty weather, continue as strong as ever. Probably there will be another period of rest and banking up to be followed by a further advance, and everything points to this following the line of the iron road and Government road to the cacao store and machine house, and possibly breaking through the main portion of Thormählenfelde to the Ninonne River higher up.

On July 15 the manager of Bibundi reported: "The main lava stream is quiet; but for the last three nights I have seen a large new stream coming down the mountain. It is very bright and much closer to this side than before."

## The Royal Photographic Society's Exhibition.

THE Annual Exhibition of the Royal Photographic Society at 35 Russell Square remains open until October 28. Admission is free. The natural history section of the scientific and technical division has improved considerably in recent years. There are still a good many single photographs of an animal, a flower, or an insect that have no particular interest, or if they have it is not indicated; but there are many series showing progressive changes, such as Dr. S. Hastings's nine illustrations of soil formation in the Alps, in which he shows the bare rock covered at first with crustaceous lichens, and traces the stages of vegetation until an alpine meadow is produced. Other series show many varieties of the same kind of thing, as Mr. C. H. Caffyn's thirty sections of calcareous, arenaceous, and igneous rocks, and Dr. Rodman's animal and vegetable hairs. With scarcely any exception the photography in this section is excellent.

Among the "Technical Applications of Photography" Dr. J. S. Plaskett shows four photographs taken at the focus of the 72-inch reflecting telescope at the Dominion Astrophysical Observatory, Victoria, B.C., which also give evidence of the accuracy of figure of the mirror. The Mount Wilson Observatory, Carnegie Institution of Washington, contributes specimens of the work of the 100-inch Hooker reflector and of the 60-inch reflector, as well as photographs of the unusual spectra of seven stars, made with these instruments. Enlarged negative prints of a latitude variation plate and a wave-length plate are among the exhibits of the Astronomer Royal, Greenwich.

The production of accurate comparative scales by photographic means is fully described and illustrated by Mr. A. E. Bawtree, and Mr. Wilfred Mark Webb shows how, by chemical and photographic means, a Russian internal passport was made to yield deleted details which showed that the document had done duty on four separate occasions for as many different persons.

Mr. G. A. Clarke illustrates upper cloud formations which support the theory of Prof. Bjerknes that depressions have their origin in the meeting of a warm, moist, equatorial current and a cold, dry, polar current. Cloud formation and structure is shown from the upper side by Mr. F. W. Baker.

There are many exhibits that deal with the technicalities of gelatine plate manufacture and the statistical properties of plates by workers in America, as well as in this country. We may refer specially to the beautiful photomicrographs of silver bromide crystals, at 3000 diameters, by Mr. A. P. H. Trivelli, and the characteristic curves of modern high-speed dry plates with photomicrographs of the grains that constitute the sensitive material by Mr. J. W. Grundy. Mr. Grundy also contributes a fine series of photographs taken under various conditions from a height of about 14,000 feet.

Among numerous radiographs by several workers the effect of the Potter-Bucky diaphragm is shown by Mr. R. B. Wilsey. This diaphragm consists of a grid made of parallel strips of lead foil, the planes of which are in line with the direction of the radiation from the tube. It is placed between the patient and the film, and moved during the exposure so that it may not show on the radiograph; it absorbs a large proportion of the scattered rays.

There is a large collection of colour transparencies, and among them some of scientific interest, but the most remarkable are the stereoscopic slides made on autochrome plates by Mr. S. Pegler. The successful reproduction of the colour and the brilliancy of silver plate, various articles of jewellery, and coloured stones, together with the realistic appearance, demonstrates possibilities of this method that are little known. C. J.

## University and Educational Intelligence.

LONDON.—The senate of the university includes sixteen members elected by registered members of convocation and sixteen by the faculties. Of the former, six are elected by the registered graduates in science; and of the latter, the faculty of science appoints four. There are two vacant seats in science, and five candidates have presented themselves as candidates for them. The candidates are: Dr. George Senter, principal of Birkbeck College, and author of a number of papers and other works on chemistry (Dr. Senter is a member of the faculty of science, and is therefore eligible for election as a representative of the faculty in the senate); Mr. T. Ll. Humberstone, an old student and associate of the Royal College of Science, well known to be particularly familiar with the work of the University and educational problems generally; Dr. Jessie White, who is especially interested in methods of teaching science; Dr. J. S. Bridges, director of education, Willesden; and Mr. C. W. Crook, headmaster, Central Secondary School, Wood Green. The poll closes on Tuesday next, Oct. 10, and it is hoped that graduates will not fail to send in their voting papers before that date.

ST. ANDREWS.—The honorary degree of LL.D. was conferred upon the Prince of Wales on September 28. In an address to his Royal Highness after the presentation, Dr. J. C. Irvine, principal of the university, reminded him that St. Andrews was not only a place of beauty and the home of a noble game, but also a centre from which great movements had sprung and powerful influences had spread far and wide. The ancient university was ever ready to enlarge its activities, blending the wisdom of the past with the spirit of progress.

## Calendar of Industrial Pioneers.

**October 8, 1862. James Walker died.**—An eminent civil engineer, Walker constructed many works of the greatest magnitude, and as engineer to the board of the Trinity House built the Bishop's Rock Lighthouse and the Smalls Lighthouse. In 1834 he succeeded Telford as president of the Institution of Civil Engineers, and held that position for eleven years.

**October 9, 1902. George Wightwick Rendel died.**—Born in 1833, Rendel was the second son of James Meadows Rendel. Trained under his father, he gained experience in bridge building in India, and in 1858 became a partner with Armstrong at Elswick, where, with Andrew Noble, he directed the ordnance works for twenty-four years. He was intimately associated with the development of the hydraulic system of gun mountings—the first mounting being fitted in H.M.S. *Thunderer* in 1877—and he was also a pioneer in the application of forced draught to warships. From 1882 to 1885 he was a civil lord of the Admiralty.

**October 10, 1854. John Augustus Lloyd died.**—At an early age Lloyd left England for South America, where he became an officer in the army of Bolivar. In 1827 he made a survey of the Isthmus of Panama. From 1831 to 1849 he was colonial engineer and surveyer of Mauritius, where he constructed many roads and bridges, a patent slip for ships, a breakwater, and the colonial observatory. Among his writings was a paper read to the Institution of Civil Engineers on "Facilities for a Ship Canal between the Atlantic and Pacific." He died in the Crimea while on a Government Commission.

**October 11, 1705. Guillaume Amontons died.**—Employed for many years on public works in France, Amontons was a member of the Paris Academy of Sciences, and was known for his improvements in barometers and other instruments. In 1684 he suggested a means of signalling long distances by a type of semaphore telegraph.

**October 12, 1859. Robert Stephenson died.**—The only son of George Stephenson, whom he assisted in the construction of the Liverpool and Manchester Railway, which was opened in 1830, Robert Stephenson became engineer to many of the early railways. Among his most famous works were the High Level Bridge at Newcastle, the Tubular Bridge over the Menai Straits, and the Victoria Bridge at Montreal. He was elected a fellow of the Royal Society in 1849, and during 1856–57 served as president of the Institution of Civil Engineers. He was buried beside Telford in the nave of Westminster Abbey.

**October 13, 1902. Peter Brotherhood died.**—After studying at King's College, London, Brotherhood worked as a mechanical engineer at Swindon and at Maudslay's, Lambeth; in 1867 he set up in business for himself in London. In 1872 he introduced the three-cylinder engine adopted extensively for torpedoes, and in 1875 built the first steam engine coupled direct to a dynamo—this being fitted in the French battleship *Richelieu*. He also made many improvements in air-compressing machinery.

**October 14, 1906. Sir Richard Tangye died.**—One of the five brothers who built up one of the most important engineering works in Birmingham, Tangye and his brothers migrated to that city from Redruth. Setting up as tool and machine makers, they made a reputation by the construction of the hydraulic jacks by means of which Brunel launched the *Great Eastern*, and they afterwards became known all over the world as the makers of steam engines and pumping machinery.

E. C. S.

## Societies and Academies.

### SWANSEA.

**Institute of Metals**, September 21.—J. E. **Clennell**: Experiments on the oxide method of determining aluminium (Report to the Aluminium Corrosion Research Sub-Committee of the Corrosion Research Committee of the Institute). It was desired to find a direct method of determining aluminium in presence of iron and other impurities. Precipitating aluminium as hydroxide by alkali thiosulphates was fairly satisfactory, but the weight of precipitate generally exceeded the theoretical amount calculated from the aluminium known to be present. This excess was traced to small quantities of absorbed substances, notably salts of iron and sulphates, probably of aluminium. A better method is as follows: Pass sulphur dioxide through the slightly ammoniacal solution, precipitating in dilute, faintly acid, boiling solution with sodium thiosulphate with addition of dilute acetic acid, washing by decantation with hot 1 per cent. ammonium chloride, filtering and washing with hot water. Iron, zinc, manganese, and magnesium in ordinary amounts do not interfere, but when the first two are present in large quantity a double precipitation is necessary.—Marie L. V. **Gayler**: The constitution and age-hardening of alloys of aluminium with copper, magnesium, and silicon in the solid state. *Constitution.*—These alloys have been regarded as a ternary system since magnesium and silicon are added in the proportions of the compound magnesium silicide, which is very stable at all temperatures. Microscopic examination shows that the solubility of copper is reduced from 4·5 per cent. to 2 per cent. at 500° C. by the presence of 0·7 per cent. magnesium silicide; while 2 per cent. of copper reduces the solubility of magnesium silicide from 1·2 per cent. to 0·7 per cent. at 500° C. At 250° C. both constituents are turned out of solution when only 0·5 per cent. of each are present. *Age-Hardening.*—Brinell hardness measurements were made on alloys in which the percentage content of one constituent only was varied; they were quenched from 500° C. and allowed to age-harden at room temperature. Age-hardening is due to the difference in solubility at high and low temperatures of both copper and magnesium silicide, and the solubility in aluminium of both in the presence of each other. Heat treatment of age-hardened alloys caused a preliminary softening before an increase in hardness; this is probably due to the process by which both compounds tend to come out of solution. Derived differential curves of alloys which had been quenched, but not aged, show three critical points; the lowest is at a constant temperature; the temperature of the two upper critical points is lowered with increasing copper content; the intensity of the uppermost varies with the copper content. Probably this point is due to the precipitation of the copper compound and the second to the precipitation of magnesium silicide.—D. **Stockdale**: The copper-rich aluminium-copper alloys. Alloys of copper with aluminium up to 20 per cent. of aluminium have been investigated. Thermal data from the cooling-curves and from quenching experiments in conjunction with microscopic examination were used to obtain equilibrium diagrams. The minimum in the liquidus curve at 1031° C. with 8·3 per cent. of aluminium is a true eutectic point; a small arrest point at 1017° with alloys containing between 16·5 and 18 per cent. of aluminium has been discovered. Copper at 1000° C. can hold only 7·4 per cent. of aluminium in solid solution; at 500° C. and at lower temperatures, 9·8 per cent., although to obtain such an alloy a long annealing is required.—R. **Seligman** and P. **Williams**: Cleaning aluminium utensils. Aluminium is not attacked by water-glass solutions or by hot soda solution containing a little sodium silicate. Attack by a 5 per cent. soda solution is immediately arrested by the addition of an amount of sodium silicate equal to 1/100 of the soda. Satisfactory detergents consisting of a mixture of soda and sodium silicate are articles of commerce; among them are "Carbosil," "Pearl Dust," and "Aquamol."—W. **Rosenhain** and J. D. **Grogan**: The effects of over-heating and melting on aluminium. Exposure to an unduly high temperature during melting, and re-peated re-melting even at ordinary melting temperatures, are thought to cause deterioration approximating to the condition generally described as "burnt" aluminium. High-grade aluminium was poured at temperatures up to 1000° C. and also at the usual pouring temperature after heating for some hours at 1000° C. The castings rolled and tested in the annealed state showed no deterioration. High-grade aluminium and also aluminium containing ½ per cent. each of iron and silicon were cast to ½-in. slabs and rolled to 0·01 in. sheet; the sheet was re-melted and the process repeated ten times. Test pieces from each melt showed no systematic change.

SYDNEY.

**Linnean Society of New South Wales**, July 26.—Mr. G. A. Waterhouse, president, in the chair.—A. E. **Shaw**: Description of new Australasian Blattidae, with a note on the blattid coxa. Nine cockroaches are described as new, three belonging to Platyzosteria, five to Cutilia, and one doubtfully to Zonioploca.—H. H. **Karny**: A remarkable new gall-thrips from Australia. These thrips infest the branchlets of the "Belah" (*Casuarina Cambagei*) and cause rounded galls of aborted tissue to form, in which large colonies of thrips develop.—G. F. **Hill**: A new Australian termite. The new species of Calotermes from near Condon, W.A., is distinct from any described Australian species and easily distinguished in the soldier caste by the long narrow head, large mandibles, dentition, third joint of antennæ, and enlarged femora.—E. W. **Ferguson** and G. F. **Hill**: Notes on Australian Tabanidæ, part ii. Eight new species, including 1 species of Silvius and 7 of Tabanus, and two varieties of species of Tabanus are described.—J. **McLuckie**: Studies in symbiosis, part ii. The apogeotropic roots of *Macrozamia spiralis* and their physiological significance. Root-tubercles occur upon many of the seedlings and older plants of *Macrozamia spiralis*, particularly about the soil-level. They are seldom present on the more deeply situated secondary roots, but may be induced to develop by artificial inoculation. The root-tubercles are due to infection by soil bacteria, the presence of which stimulates the development of the cortex and sheath, so that the tubercles are more massive than ordinary roots.

## Official Publications Received.

Proceedings of the South London Entomological and Natural History Society 1921-22. Pp. xvii+83. (London: Hibernia Chambers, London Bridge.) 5*s*.

Merchant Venturers' Technical College. Calendar for the 67th Session, 1922-23. Pp. 54. (Bristol.) 6*d*.

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Boletim Meteorologico: Anno de 1912. Pp. 110. Boletim Meteorologico: Anno de 1913. Pp. 130. (Rio de Janeiro.)

Papers of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. 8, No. 3: The Turner Group of Earthworks, Hamilton County, Ohio. By Charles C. Willoughby; with Notes on the Skeletal Remains, by Earnest A. Hooton. Pp. viii+132+27 plates. (Cambridge, Mass.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 23, Part 2: Trees and Shrubs of Mexico (Fagaceæ-Fabaceæ). By Paul C. Standley. Pp. xxxvii+171-515. (Washington: Government Printing Office.)

Memoirs of the Department of Agriculture in India. Entomological Series, Vol. 7, No. 7: New and Rare Indian Odonata in the Pusa Collection. By Major F. C. Fraser. Pp. 39-81. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 1.4 rupees; 1*s*. 9*d*.

Annual Report of the Meteorological Observatory of the Government-General of Chosen for the Year 1918. (Results of Observations.) Pp. iv+134. For the Year 1919. (Results of Observations. Pp. iv+143. (Jinsen.)

Sixth Annual Report of the National Research Council. Pp. 72. (Washington: Government Printing Office.)

## Diary of Societies.

*MONDAY*, OCTOBER 9.

INSTITUTE OF BREWING.—S. K. Thorpe, and others: Discussion on the Expenses incurred in connection with the Shipment of Foreign Barleys.

ROYAL SOCIETY OF MEDICINE (War Section) (at Royal Army Medical College, Millbank), at 5.—Lt.-Gen. Sir John Goodwin: Presidential Address.

*TUESDAY*, OCTOBER 10.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 4.30.—Dr. W. Langdon Brown: The Problems of Asthma (Presidential Address).—Dr. T. Izod Bennett: The Modification of Gastric Function by means of Drugs.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Chemical Society), at 5.30.—Dr. A. E. Dunstan: The Work of the Standardization Committee.

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—A. Keenes: Conditions to get High Economy from Oil Fuel.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—F. Martin Duncan: Crustacea.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—Dr. R. S. Clay: The Development of the Photographic Lens from the Historical Point of View (the Twenty-fifth Annual Traill-Taylor Memorial Lecture).

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, INC. (at Caxton Hall), at 8.15.—R. Fortune: Some Points in the Law of Heating Engineers' Contracts.

*WEDNESDAY*, OCTOBER 11.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS, INC. (at Caxton Hall), at 3.—J. L. Musgrave: Heating and Ventilating of Passenger Ships.

ROYAL MICROSCOPICAL SOCIETY (at Examination Hall, 8-11 Queen Square, W.C.1), at 7.30.—A Conversazione.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Automobile Club), at 8.—Lt.-Col. D. J. Smith: Presidential Address.

*THURSDAY*, OCTOBER 12.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Dr. L. C. Martin: A Physical Study of Coma.—F. W. Preston: The Structure of Sand-blasted and Ground Glass Surfaces.

INSTITUTE OF METALS (London Section) (at Institute of Marine Engineers), at 8.—Dr. D. Hanson: Chairman's Address.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Dr. W. Harris: Toxic Polyneuritis (Presidential Address).

*FRIDAY*, OCTOBER 13.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science), at 2.30.—Dr. E. J. Butler: Virus Diseases in Plants.—Dr. J. A. Arkwright: Virus Diseases in Animals and Man.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

—— (Ophthalmology Section), at 8.30.—N. Bishop Harman: A Visual Standard for School Teachers.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—E. C. West: Artificial Ice Making.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—Dr. C. A. Swan: Carcassonne and the Pyrenees.

### PUBLIC LECTURES.

*MONDAY*, OCTOBER 9.

UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Beginnings of Science.

KING'S COLLEGE, at 5.30.—Prof. G. B. Jeffery: Einstein's Theory of Relativity.

*TUESDAY*, OCTOBER 10.

UNIVERSITY COLLEGE, at 5.—Prof. C. Spearman: The Nature of Intelligence.

*WEDNESDAY*, OCTOBER 11.

UNIVERSITY COLLEGE, at 5.30.—Miss A. S. Cooke, Col. J. M. Mitchell, and Capt. R. Wright: Discussion on Recent Developments in Rural Library Work.—Miss Lilias Armstrong: The Use of Phonetics in the Class Room. (As applied to the teaching of French.)

BEDFORD COLLEGE FOR WOMEN, at 5.30.—Prof. E. A. Gardner: Delphi and Delos.

UNIVERSITY COLLEGE, at 7.—A. H. Barker: Standard Ratings for Radiators, Boilers, and Complete Heating Installations.

*THURSDAY*, OCTOBER 12.

CITY OF LONDON Y.M.C.A. (186 Aldersgate Street), at 6.—Sir Arthur E. Shipley: Fleas, Flies, and Mosquitoes.

*SATURDAY*, OCTOBER 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Shaw: Flight in all Ages.