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The Museums of the British Isles.[1]

SCATTERED throughout Great Britain and Northern Ireland there are 530 museums, all at the service, in greater or less degree, of the public. They represent a great heritage of historical, educational, and intrinsic worth, and, like any other heritage, they impose obligations upon their trustees and beneficiaries alike. That, in the main, these obligations have not been satisfactorily met, is the burden of the report of Sir Henry Miers, made at the instance of the Carnegie United Kingdom Trustees. This outstanding monograph, which bears evidence of careful investigation and constructive thought, ought to mark a stage in the development of British museums, from which definite and rational progress should be made, and for this reason it ought to be in the hands of everyone associated with the control of museums.

The inefficiency of the majority of local museums arises from three sources. In the first place, it may be imbedded in their history, for many began as odd and nondescript collections made by 'collectors,' and many have continued the tradition of their foundation. In the second place, it may arise from indefiniteness of ideas as to the purposes and capabilities of museums in general or of some particular museum. This weakness is especially centred in governing or controlling bodies which, with the best will in the world, may be able to give no useful guidance in the development of the collections of which they are trustees, and at the worst may regard the museum as a home for derelicts, requiring no attention, demanding no progress, a place set aside for moths and dust. The last inefficiency lies in the museum curator himself, who, through lack of knowledge, lack of training, or lack of ideas, may be unable to guide either his collections or his trustees.

With these and the many subsidiary shortcomings of provincial museums, Sir Henry Miers attempts to deal in his report. It is impossible to state in any fullness the many suggestions he makes, but broadly his ideas run towards a great centralising and local decentralising of museum effort. He thinks there should be more museums, since many large towns and populous areas show extraordinary museum deficiency, but he is equally positive that the small, ill-assorted and heterogeneous collections which compose the stock-in-trade of perhaps the majority of little local museums, must give place to

[1] A Report on the Public Museums of the British Isles (other than the National Museums), by Sir Henry Miers, to the Carnegie United Kingdom Trustees. Pp. ii+213+8 plates. (Dunfermline: Carnegie United Kingdom Trust, 1928.)

something better devised to meet the needs of their district.

At the centre of this scheme would stand the great government and national museums, places of rich collections, where the pick of the nation's treasures are to be found, with highly expert staffs and superabundant specimens ready to supplement the efforts and collections of lesser institutions. Next in grade would be central county museums, under the care of "the only body which can hope to provide adequately for the needs of the rural population," the county council. An already existing museum might be selected or a new museum created as the 'county museum,' but the essence of its place in the scheme is that it should become the centre of the county's museum efforts, housing the general collections, directing the scope, and aiding the development of the rural museums in its area, so that wasteful duplication should be avoided and the resources in skill and material of the less populous places be fittingly supplemented.

Last in the series, and providing perhaps the greatest problem of all, are the rural museums. The muddled assortment of bric-à-brac must go, and its place be taken by restricted and discriminate collections selected from a local viewpoint to serve in the best possible way the needs of the immediate district. Each local museum would thus become in the main, if not in entirety, a specialised institution with collections of a specific nature depending upon the idiosyncrasy, scientific, industrial or artistic, of its own limited region. Here we have foreshadowed a development in the museum world of that 'regionalism' which, introduced by Prof. Patrick Geddes, has given a new stimulus to the study of geographical and human relationships.

The scheme is a bold and a fine conception. The question which will arise in the mind of anyone familiar with the museums of Great Britain is, "Is it practical politics?" The difficulties are enormous. At the bottom lies the need of money; money to erect suitable buildings, to purchase and keep first-rate collections, and, most of all, to pay for the services of skilled curators; for no scheme can ever come into being based upon the degraded notions that are too prevalent regarding the qualifications required for the proper conduct of a museum.

There are also other difficulties, of which one of the greatest may be local patriotism. The American museums, some of the best in the world, depend very largely upon charity, and charity must be encouraged, but it has frequently a local flavour. A successful man collects during his residence abroad a fine, perhaps unique, collection of a specific kind, which he offers to the museum of his native town. The museum trustees recognise that it lies without their usual field, but are they to refuse a gift of great scientific and intrinsic value? Still more, are they to set about quenching the smoking flax of interest in their charge?

County councils cannot burden the public rates on behalf of museums to the extent that would be necessary until such time as they have a solid backing of public opinion, and public interest in local museums cannot be aroused until museums offer the people collections and arrangements of collections more instructive and more entertaining than the dry-as-dust medley with which they are too familiar. It is a vicious circle: improve the museum, public interest will be stimulated, and public money will be forthcoming to improve the museum.

There is only one way out, and this is that the first step in the cycle, the bettering of the museum, so that it may be established on an up-grade which will ultimately land it at its due place in the educative and beneficent activities of the State, should be made through the application of funds from an outside source, independent of the public and the rates.

The Medicine of an Aboriginal Tribe.

Memoirs of the Asiatic Society of Bengal. Vol. 10, No. 2: *Studies in Santal Medicine and connected Folklore.* By Rev. P. O. Bodding. Part 2: *Santal Medicine.* Pp. 131-426. (Calcutta: The Asiatic Society of Bengal, 1927.) 10.11 rupees.

THE Sántáls are one of several aboriginal tribes of India whose home is in the hills of Bihar and Chota Nagpur. Before 1855, when, infuriated by the subtle extortions of the Hindu moneylender, they rose in rebellion (and are said to have shown their valour by standing up fairly with axe and bow to a charge of suppressive cavalry), they were little seen or heard of outside their own jungles. Brave and self-reliant as they are, they live in terror of devils. Though their homesteads in their characteristic villages are well spaced in a long row on either side of a single street, without any cross-streets or unhealthy alleys, they are not exempt from the diseases generally endemic in India or from the common epidemics of the country; and their untutored minds think of disease as caused by devils, which they call *bongas*, and auxiliary witches.

The author of this memoir has lived among the

Sántáls for thirty-seven years and has made a close study of their ideas of the nature and origin of disease and of their ways of treating it. In an earlier memoir (see NATURE, April 3, 1926, p. 499) he explained their views of its supernatural causation, and described in much detail all the rites and breathéd spells by which, in the individual case of illness and as the appointed prelude to any mere medical interference with it, a sort of sorcerers called *ojhas* and *jáns* set about to discover and appease the causative *bonga* and outwit the obstructive witch. In the memoir now under notice, he describes in like detail their more mundane medical methods and apparatus, apart from the incantations of the pale-eyed priest, at the same time leading us to understand that the *ojha* mysteries are an exotic (probably Hindu) imposition, overshadowing this healing art, which—seeing that most Sántáls have some knowledge of it, and that some of its regular practitioners are not *ojhas*—may be regarded as in the main truly indigenous. The author has collected this subsidiary medical lore, and has here arranged it in three hundred and five what he calls 'prescriptions,' each 'prescription' referring to a particular deviation from health recognised by Sántáls as a disease, and giving the symptoms of that disease and the directions for its treatment, including the composition of the various medical recipes and, so far as is possible, the scientific names of the ingredients—the whole forming a remarkably interesting compendium of nosology, materia medica, and pharmacy.

The prevalent diseases among the Sántáls are those of all India, namely, malarial fevers, above everything, and the concurrent enlargement of the spleen, parasitic infections of the skin, dysentery and diarrhœa, and cataract and various other affections of the eye: stone is not mentioned, though the multitude of recipes for treating hæmaturia and gravel must surely mean that it is as common there as elsewhere in India. The multiplicity of recipes for 'madness,' epilepsy, and a host of paroxysmal seizures (tiger-convulsions, deer-convulsions, caterpillar-convulsions, etc.), quaintly named after familiar postures of animals, and suggestive of chorea, hysteria, tetany, and catalepsy, point to derangements of the nervous system, the frequency of which must be something peculiar to Sántáls. Syphilis, which is "fairly common," pulmonary tuberculosis, which is "fearfully prevalent," and leprosy, which is "alarmingly" on the increase, all three are said to have been brought in at the time of the rebellion—a convenient date for marking the entrance of some of the Sántáls upon the larger industrial stage of India. Epidemics of small-pox, chicken-pox, measles, and cholera are familiar.

The Sántáls have great faith in their medicines, although directions for diet and injunctions to continence occur in some of their 'prescriptions.' They get a few common drugs in the bazaar, but most of their materia medica comes from their own villages and jungles—from common trees and herbs, with a promiscuous assortment of animal products, liquid and solid, and sometimes nasty, contributed by a multitude of beasts, birds, reptiles, frogs, fishes, and a wide variety of creeping things. In all this stuff there is much that is of medicinal value and much that forms the airy basis of a very lively and inventive superstition. Their herbal remedies of most frequent and most diversified use, as judged by continual recurrence in the 'prescriptions,' are trees and plants, many of which are herbs of grace all over India; it is unlikely that the medicinal properties of all of them have been discovered quite independently by the Sántáls.

The superstitious adjuncts of this genuine material, however, illustrate so ingeniously those tricks of strong imagination, those soaring flights of devil-stricken frenzy and fine poetic fancy, that go with a tendency to nervous derangement, that they well may be native to a land where 'eagle-convulsions' is one of the many forms of nervous disorders that afflict the population. A few of the more instructive of these artistic creations of phantasy are the conical prickles of the silk-cotton tree and the warts on the leaves of *Ficus glomerata*, prescribed for small-pox; the juice of the red water-lily for hæmoptysis; the twisted pods of *Helicteres* for colic; the ointment of cicada and mole-cricket for screaming-fits; the scales of a barbel for the crusts of chronic itch; the hair and excrement of the hare for perforated palate; the placenta of the cat for night-blindness; the mud with which the male hornbill blocks the mouth of the cavity wherein his mate is brooding, for a cancerous growth; the dirt scraped from a bow for the long-drawn opisthotonic spasms of tetanus; and the tiny egg of the diminutive honeysucker for the marasmus of infants.

The magic touch is obvious in the use of medicinal roots as amulets; and the frequency of prescribing medicines that have to be smeared over the whole body must surely imply the idea of making the patient repulsive or resistant to the *bonga*: many of the medicaments for malarial fevers are applied in these two ways. The shadow of the supernatural is also evident in many medical

customs. We may note the obligatory use of the left hand in medical operations; the special tool for digging the root, regarded always as the most precious part of the herb; the occult influence of a virgin's touch; the virtue of the dew and of the melted hail (even in bottle) as particular solvents; the studied disregard of the apothecary's proverbial *jucunde*, shown in the use of putrid rice-water for making-up the sick man's healing draught; and the augury of the fixed day and the brand-new pot for administering a remedy.

In their adroit search for good medicine, however, the Sántáls are not entirely blinded by a superstitious imagination. They are observant and inquisitive. They turn their poetic eye on the sick and wounded animal and consider its ways —what herb it may eat or rub itself against, and live; and they question one another purposefully about a recovery from illness or an ancient scar, and thus acquire knowledge, somewhat after the manner of the ancient Babylonians described by Herodotus.

From the author's account it is plain that, apart from most of the formulated superstition of the *ojha* and the *ján*, pretending to familiarity with the supernatural—which appears to be a Hindu accretion—this aboriginal medicine has some logic and philosophy in it. For albeit that the Sántáls regard evil spirits as the cause of disease, they do not make the sad mistake of thinking of diseases as entities, but look upon them as deviations from health—as a sort of accident—for which their great and good god Cando has provided, most unquestionably, divers natural means of recovery. Although in the quest, as in the usage, of these means his children have stuck pretty firmly to the idea of finding things and ways wherewith to mystify and distract the *bonga*, they have yet managed to discover some things that are really physic to the sick man. So that save in the matter of 'clothes' there is not such a very wide gulf between a Sántál doctor who is deaf to the *ojha* and can retain even the *bonga*, as Mr. Blotton reserved the term 'humbug,' for convenient use in a Pickwickian sense, and medical practitioners of greater pomp and circumstance in countries of more brilliant polish.

The author is much to be congratulated on this diligent research into the medical science and art of a discriminative tribe who in their stories of the creation are said to have placed the English second only to themselves. His memoir will be appreciated by the anthropologist and by the medical man who is curious about the evolution of his calling and is sensible of his ties with the practitioner of a generation not so very far back, who

> "Kepte his pacient a ful great del
> In houres by his magik naturel";

although for his brother whose imagination ranges among hormones and seeks the uttermost parts of biochemistry, it may not have much interest.

Radio Communication.

Wireless Principles and Practice. By Dr. L. S. Palmer. Pp. xi+504. (London: Longmans, Green and Co., Ltd., 1928.) 18*s*. net.

LITTLE more than ten years ago it was possible for an industrious plodder to declare that he was acquainted with all the literature of radio communication and that he had studied all the known methods and apparatus thoroughly. To-day, such a claim would be thought to be too ambitious; for the science and practice of radio engineering has been enriched by so many new discoveries and inventions, has found expression in so wide and diverse a literature, that no one mind can possibly now grasp the subject as a whole and in all its details. To point this remark one need only notice that the flow of invention in high-frequency engineering and its related subjects has been so copious since the War that the relevant patent specifications of any one progressive country would make a dozen large tomes. This flood of invention has been accompanied by a corresponding spate of scientific investigation and discussion; and thus, by the way, the recent history of wireless telegraphy affords a large-scale example of the intimate and rapid mutual reactions of science and practice. The largeness of the scale can be seen from the encyclopædic nature of some of the books on radiotelegraphy that have appeared recently.

As a consequence of this expansion in the use and study of high-frequency currents, it has become a heavy task to prepare a treatise which aims, as Dr. Palmer's book does, at making a complete survey of the abstract and applied aspects of the subject of radio communication. In attempting this high task, Dr. Palmer has divided his subject into the divisions which occur naturally to the mathematically minded; and he has built into this theoretical framework as much of the engineering practice as will fit in snugly. The structure thus given to the treatise puts it definitely into the class of college text-books; it is a book for leading the student, rather than for informing the practi-

tioner—for those who wish to enter the temple than for those already in it. Inevitably the book ministers to those who desire to understand the inner laws of plant and apparatus, rather than to those who wish to learn the forms and capabilities of existing constructions. In the opinion of the reviewer, this mode of treatment is the only sound one for training youthful minds for entry into a rapidly developing branch of technology. In other words, the mere description of forms of existing plant is rightly minimised in the present treatise, since most of the existing plant will have become obsolete before the student has developed into the practising engineer. Besides which, and quite apart from this educational aspect, this mode of surveying such a subject, which borrows and adapts a variety of principles from older branches of science, is more compendious than the descriptive method ; it has allowed the present text-book to embrace a very wide range of radio communication problems.

When, as is here the case, the subject is too extensive for all of it to be included, the value of a technical treatise, as measured by its utility to the general reader, depends greatly upon the author's discrimination in making his selection of material. The selection ought to be such as to outline and explain all that is truly important in present practice, and as much as possible of what is going to be important in the future. To some extent this is a matter of taste, or, rather, opinion, and demands some slight gift of prophecy. In this latter respect it seems to us that the book is not perfect. For example, there is too little about the merits and demerits of modern developments, such as picture and facsimile transmission, and about the apparatus for carrying it out ; again, too little attention is paid to the theory and methods of controlling very short waves in practical circuits and antennæ ; and the various methods of rendering a high-frequency amplifier free from self-oscillation are discussed so tersely as to be really useful only to those already competent. Further, the immensely important new methods of frequency control obtained by linking electrical with mechanical oscillators are treated lightly, and their probable influence upon future practice is completely missed ; in fact, the subject of piezo-electricity, surely an important practical matter, is almost ignored. It would have been wiser, in our opinion, to have devoted to these important branches of the subject some of the space actually occupied by rather barren algebraic exercises on, for example, oscillating triode circuits.

Leaving aside this question of the selection of the matter and the stress each part deserves, we can very cordially affirm that the book treats in a scholarly, accurate, and lucid manner many branches of wireless telegraphic science, and can be strongly recommended to the student, old or young, who seeks competent guidance into the deeper portions of radiotelegraphic technology.

Birds of Malaya.

The Birds of the Malay Peninsula : a General Account of the Birds inhabiting the Region from the Isthmus of Kra to Singapore, with the adjacent Islands. By Herbert C. Robinson. (Issued by Authority of the Federated Malay States Government.) Vol. 1 : *The Commoner Birds.* Pp. 1+329 + 25 plates. (London : H. F. and G. Witherby, 1927.)

THE present work is one of five volumes, in which Mr. Robinson proposes to deal with the birds of the Malaysian region. In the volume under review he describes what he calls "The Commoner Birds," whilst the succeeding volumes will contain respectively : Vol. 2, the birds of the hill stations ; Vol. 3, sporting birds, birds of the shore and estuaries ; Vol. 4, the birds of the low-country jungle and scrub ; Vol. 5, open-country and rice-field birds, migratory birds, and species not included in the above volumes, 'keys' to all the forms from the Peninsula, and a general index to all the volumes.

The average ornithologist, whether he be a museum or a field worker, will probably regret that the birds could not be dealt with in one consecutive whole, as in other books on ornithology. We understand, however, that the format adopted is not as devised by the author, but is written according to the instructions of the Government of the Federated Malay States. The classification employed by Mr. Robinson is that of Sharpe's "Hand-List" (1899–1912), with a certain number of variations according to the author's personal ideas. Unlike most modern systematists, he refuses to accept the Pico-Passeres as an order, with two sub-orders of Scansores and Passeres. The author of this work raises the Owls and Parrots to the rank of orders, and again later on in his work gives the Broadbills, Eurylæmidæ, the same rank. Curiously enough, the whole of the intermediate families of Rollers, Kingfishers, Bee-eaters, etc., he simply places as separate families under no particular order, a convenient and easy method to adopt, but surely not very scientific. The Pittas he includes in the

Passeres, though when commenting on the Broadbills, he remarks that, anatomically, the Pittas and the Broadbills are practically the same, though superficially very different. We cannot quite follow the author in his classification of the various families usually collected in an order often termed the Coracii or Coraciiformes by those who object to a Pico-Passeres group.

Amongst the Passeres there are but few points calling for remark in the author's classification, though we observe that he raises a group of little birds trivially called Ioras, Ægithina, and Green Bulbuls, Chloropsis, to the rank of a family, as had already been done by Stuart Baker forty years ago, when discussing these birds in a journal of the Bombay Natural History Society; this will be probably accepted by most systematists. We are doubtful, however, if some of the names employed by Mr. Robinson are really acceptable. Thus, Gmelin described *Trachycomus zeylanicus* for a bird said to be found in Ceylon, but gives a very indifferent description. This, however, Robinson accepts as sufficient identification for a bird the type locality of which he fixes in Java. Again, Bonaparte described *Ixos erythrotis* as Javan, undoubtedly some form of Bulbul. This, again, Mr. Robinson accepts as sufficient identification for the Burmese form of Otocompsa. It appears to us that these very doubtful specific names should not be accepted.

Before coming to the birds themselves, Mr. Robinson gives us an excellent geographical preamble, describing in considerable detail the various portions of the country included in his work, and there can be very few people who will not be able to learn a great deal from this. He then gives a brief history of the local ornithology and, finally, several paragraphs on nomenclature and orthography, in which he very clearly states his views on the subject.

The book as a whole is well worthy of the great reputation the author already enjoys and, indeed, it would have been impossible for anyone else successfully to have brought out a work of this magnitude on the birds of Malaya. Each bird is dealt with methodically and fully. The descriptions are good without being too long, albeit in dealing with minor points, such as range, nidification and habits, each species is treated in the same way, and the letterpress is accordingly very easy to follow.

In closing this volume, one feels that though so much admirable work has been carried out by Mr. Robinson and his fellow-workers in museums, an enormous amount of work still remains to be done by field workers. For the most part, except for records of the field work done by Messrs. Robinson and Kloss, the volume is a record of skins. Mr. Robinson himself refers to this, and we join with him in the hope that the present volume will stimulate others to fill in the many gaps in the biological history of the birds of Malaya.

Every work written is merely the basis for further work, but we feel that in the present volume the nomenclature will be found to be, on the whole, extraordinarily accurate, whilst the field worker of the future will not be distracted by constantly having to alter names of the birds the habits and nidification of which he is trying to learn. We congratulate Mr. Robinson on having been completely successful in bringing out a work which is very badly needed and one which will undoubtedly, for many years to come, be the standard work of the birds of the Malay region.

A New Dictionary for the Technical Translator.

Pitman's Technical Dictionary of Engineering and Industrial Science. In seven Languages—English, French, Spanish, Italian, Portuguese, Russian and German. Compiled by Ernest Slater. Complete in about 36 fortnightly Parts. Part 1. Pp. x+70. Part 2. Pp. 71-134. (London: Sir Isaac Pitman and Sons, Ltd., 1928.) 2*s.* 6*d.* net each Part.

THE translator of technical literature, whether he be a specialist in his own branch of science or technology, or merely attempts to be an interpreter of other people's endeavours in the world of science and industry, feels the need of a comprehensive technical dictionary in which he will be sure of finding the word he wants. This new dictionary sets out to cover that want, by giving in one set of volumes (when complete) all the important technical terms used in a wide range of arts and sciences. It is arranged on an English basis, that is to say, the English terms are given first, in alphabetical order, followed by the equivalents in the six other languages. Here, we think, the publishers have made a grave mistake and considerably curtailed the scope of the work, because most of the translator's work consists in translations from the foreign idiom into his own language. Unless the publishers include an index at the end, giving all the words listed in every language, then the dictionary will be confined in its utility to translations made by Englishmen into the foreign language, or similar translations made by the foreigner into his particular language.

It is difficult, from a perusal of the first two parts, to criticise a work of this kind fairly; but, as a whole, the dictionary includes most of the words one is likely to want. There are, however, a few mistakes and lacunæ, to which we should like to direct attention. Under the heading "air," or "airless," one would naturally expect to find the modern expressions "airless injection oil engine"; "air, blast" (that is, the blast air used in large Diesel engines); or to find the term usually employed in German for "(ventilation) air duct," namely, *Lutte*; but one is disappointed. Again "air capacity, free," that is, the free-air capacity—the usual rating for a compressor—might have been given under *air* as well as under *free*. Then there is a tendency to use the Latinised equivalent, instead of the purely Teutonic word in German; for example, "amplitude of swing" is given as *Schwingungsamplitüde*, where the more common forms *Schwingungsweite* or *Schwingungshöhe* are preferable. In their endeavours to use the native word, the Germans are now even using *Vomhundertzahl* or *Vomhundertsatz* in place of the Latin-German *Prozentsatz*. Similarly with the motor expression *Fussakzelerator* for accelerator, instead of the less clumsy *Beschleunigungspedal*. *Schraubenbefestigung* for "screwed-on attachment" is scarcely correct, the appropriate word being *angeschraubter Anschluss*.

In an introduction dealing with the technical translator's art, some valuable hints are given for the user of the dictionary and some of the pitfalls explained. When, however, the compiler states that the "velocity of a falling body" cannot be translated literally into French with pleasing effect, and he suggests instead *vitesse de chute d'un grave*, he departs from the strictly scientific. Physicists in their text-books actually do use *vitesse d'un corps tombant* or *qui tombe*. Referring to the difficulties attending the translation of the word "standard," it should be noted that the Germans use the prefix *Normal-*. . . . (*Normalmasstabe*—standard rule, *Normallehre*—standard gauge; *Normalelement*—standard cell), and that *standards* in German are *Normen* (cf. *Normenausschuss für die deutsche Industrie* = German Engineering Standards Committee).

These few criticisms apart, the work covers extremely well the ground it sets out to cover, and the inclusion of the Portuguese equivalents will be of real value to those who have occasion to make technical translations for Portugal, Brazil, or Portuguese East Africa.

E. S. HODGSON.

Our Bookshelf.

Die Bahnbestimmung der Himmelskörper. Von Julius Bauschinger. Zweite Auflage. Pp. xv + 671. (Leipzig: Wilhelm Engelmann, 1928.) 59 gold marks.

THE outstanding literature of a comprehensive and practical nature on the subject of the determination of orbits of celestial bodies is contained in five books—Gauss's "Theoria Motus" (1809), translated from Latin into English by Admiral Davis in 1857, Watson's "Theoretical Astronomy" (1868), Oppolzer's celebrated "Lehrbuch" in two volumes (1870 and 1880), Klinkerfues's "Theoretische Astronomie" (1871), and finally, the first edition, in 1906, of the volume now before us. All of these were out-of-print, but it is gratifying to note that the most recent has reached a second edition.

Bauschinger's treatment of the subject is a model of simplicity and orderly design, the needs of the practical computer being kept constantly in view. In the early chapters a thorough foundation of spherical and dynamical astronomy is laid. A third of the book is devoted to the laying down of the principles that are to be employed in the actual determination of orbits. The development of the principal subject is clear, concise, and well illustrated by examples. The determination of definitive orbits and of special perturbations also finds a place.

What is perhaps most disappointing is to find so little revision in a work that has enjoyed a deservedly high reputation as the most up-to-date on its subject. Developments of the past twenty years have been dismissed in a few lines each, and some not even mentioned. We should have expected a description of the perturbation method of Cowell and Crommelin, which was used so successfully for the prediction of the return of Halley's Comet, and earned the award of the Astronomische Gesellschaft prize; it is not even mentioned, although that of Noumerov, which is merely a modification of Cowell's, is quoted as a "méthode nouvelle." The work of the American school under Leuschner is merely cited in a reference. No attempt has been made to describe the simplifications that are rendered possible by the use of calculating machines. The author, in his preface, states that this course has been adopted deliberately, and is careful to point out that it is not due to ignorance of the new methods that have been so summarily excluded.

In view of the non-existence in the English language of any suitable text-book on this subject, translation of the work would be most welcome.

L. J. COMRIE.

Science and Ethics: Conway Memorial Lecture delivered at Essex Hall, Essex Street, Strand, W.C., on April 18, 1928. By J. B. S. Haldane. Pp. 46. (London: Watts and Co., 1928.) 2*s*. net.

THE number of professional scientific men who realise vividly the importance for ethics of the work they are doing is probably not large; we

may therefore be grateful to Mr. J. B. S. Haldane for dealing with the subject in his Conway Memorial Lecture. He holds that science impinges upon ethics in at least five different ways: (1) It creates new ethical situations; (2) it may create new duties by pointing out previously unexpected consequences of our actions; (3) it affects our whole ethical outlook by influencing our views as to the nature of the world; (4) scientific anthropology is bound to have a profound effect on ethics by showing that any given ethical code is only one of a number; (5) it will evidently favour ethical principles and practices which transcend the limits of nation, colour, and class.

Mr. Haldane holds that the greatest danger to which our ethical system is exposed from science is the deliberate exploitation of scientific ideas in the interests of unscientific prejudice. In this connexion he regards with particular misgiving the application of ill-understood principles of genetics by eugenist amateurs. We do not yet know enough about the inheritance of mental ability to say that a few generations of selection against it would have appreciable results; and "the dictates of biology are on the whole in line with those of humanitarian ethics." Eugenics certainly has "a very great future as an ethical principle," as has hygiene, but the successful application of a principle demands exact and complete knowledge, and this we cannot be said, as yet, to possess. J. C. H.

Introduction to Theoretical Physics. By Prof. Arthur Haas. Vol. 1. Translated from the third and fourth editions by Dr. T. Verschoyle. Second edition. Pp. xiv + 333. (London: Constable and Co., Ltd., 1928.) 21*s.* net.

THE first English edition of the treatise by Prof. Haas received commendation in our issue of Aug. 22, 1925, and the fact that a second edition has already been called for is sufficient testimony to the value of his work. A comparison between the two editions shows that the revision has been carefully carried out. The most important alteration is the addition of part of a section on the Hamiltonian function and the canonical equations of motion. It is a striking tribute to the almost superhuman genius of Hamilton that his work is continually finding fresh applications; his powers of generalisation were such that even to-day his methods are being used in developing the new quantum mechanics and the wave theory of matter. Some twenty years ago Lord Rayleigh commented on the long-continued neglect of Hamilton's work on optics, and remarked that he "allowed his love of generality and of analytical developments to run away with him." Certain it is that much loss has ensued from ignorance and neglect of work already done.

The English student will welcome the new edition of the "Introduction to Theoretical Physics," because it gives him in convenient form such a lucid account of those branches of mathematical physics which are of outstanding importance at the present time. H. S. A.

Plant Ecology. By Prof. W. B. McDougall. Pp. 326. (London: Henry Kimpton, 1927.) 14*s.* net.

THIS text-book is designed to serve as an introduction to the ecology of plants. It treats the subject of plant life comprehensively rather than intensively, and the term 'ecology,' defined as "the science of the interrelations of living things and their environments," is given a wide connotation. Chapters ii.-ix. deal mainly with the structure and autecological relationships of plants. They form a good introduction to general botany from the ecological viewpoint. The physical factors of the environment are dealt with in the succeeding five chapters, and the last third of the book summarises various aspects of synecology. A useful, but too brief, appendix contains suggestions for the teacher concerning laboratory and field work. An index is provided and the text is illustrated by 114 figures. References to selected literature (in English only) are given at the ends of most of the chapters. The book can be heartily recommended to teachers in Great Britain, though it has one drawback: that many of the examples quoted, both of individual species and of plant communities, are endemic to North America, and are therefore probably unfamiliar to the English student. W. B. T.

Röntgenstrahlen (*Physik, Technik, und Anwendungen*). Von Dr. Richard Herz. (Sammlung Göschen, Nr. 950.) Pp. 136 + 16 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1927.) 1·50 gold marks.

THIS volume fully maintains the standard set by earlier members of the series, and provides the usual mine of condensed but accurate and eminently readable information. Almost one-half of the book is devoted to the physics of the subject, and the remainder to the technique of the production of X-rays, and to their medical and technical applications. The ground covered is approximately that of the Cambridge Diploma in Medical Radiology, but the sixteen pages of excellent plates, mostly of tubes and installations, will make it of particular value to readers who have not the opportunity to see or use elaborate apparatus of this type. One wishes that there existed an equally good and inexpensive treatment of the subject in English.

The Great Physicists. By Dr. Ivor B. Hart. Pp. vi + 138. (London: Methuen and Co., Ltd., 1927.) 3*s.* 6*d.* net.

THIS book, from an experienced writer, is the first of a series, now in preparation, entitled "The Great Scientists," which is to survey in requisite departments the main achievements of scientific progress from early to modern times. The historic sense in Dr. Hart's narrative is well preserved. We notice (p. 64) that 1660 instead of (correctly) 1662 is given as the date of incorporation of the Royal Society. Also (p. 112) the name Tyndal should read Tyndall. The book is handy in size and well printed.

Letters to the Editor.

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

Influence of Forest Formation upon Soil Moisture.

IN the discussion upon Dr. C. E. P. Brooks's interesting paper, "The Influence of Forests on Rainfall and Run-off" (*Quart. Jour. Roy. Met. Soc.*, **54**; 225), Mr. W. Vaux Graham (p. 16) states that three springs near Tosson, Rothbury, clearly shown on the 1863 edition of the 6-inch Ordnance map, were not marked upon that of 1896, and now had almost ceased flowing. He suggested that the formation of a large spruce plantation on the hillside just above the springs was responsible for the diminution in flow. Dr. Brooks replied that there may well be isolated instances in which the planting of trees would affect the flow of springs adversely, and this would naturally result if they were planted in ground formerly bare or occupied by xerophytic vegetation. Numerous examples could be cited, however, in which it had been claimed that the *cutting down* of trees had had the effect attributed by Mr. Vaux Graham to the planting of trees, that is, the cessation of springs.

In view of this discussion, the following data relating to the influence of various species of trees upon the soil moisture may be of interest.

In my experience the moisture content of soil of one and the same general physical type will either increase or decrease according to the original nature of the substratum—that is, whether it was a free water surface, a sandy waste, a bare rock surface—and the plant succession. Lithoseral and psammoseral successions—those beginning on bare rock surfaces and on pure sand, respectively—react physically and chemically upon the substratum stage by stage, the principal feature being the addition of soil moisture; such addition continues until the climax community is developed. On the other hand, hydroseral successions—those taking place in free water, or on very moist soils—bring about the gradual drying of the soil: until the development of the climax stage limits this reaction. Thus the planting with trees of a hydroseral site—that is, the hastening of the succession to a climax either artificial or natural—brings about a certain loss in soil moisture, whereas the planting of lithoseral and psammoseral sites increases the moisture content, unless the species employed be foreign to the normal succession. Water-voracious indigenous plants not natural to the particular sere, and demanding exotics, draw strongly upon the soil moisture no matter what the successional history of the site.

The degree of moisture absorption by the roots of trees has to be taken into account in the study of the reactions of all forests, natural and artificial. Although this was realised to some extent so early as 1856 by Cotta, and remarked upon by Borggreve in 1891, it was not until Fricke (1904), Albert (1915), Barrington-Moore (1917), Hans Burger (1923), Aaltonen (1923), and myself (1922–27) had investigated the matter experimentally, that the potent draining effects of certain tree stands were brought to light. No details can be given here, but the following mean moisture content data for adjacent sites bearing different types of vegetation—the soil being of the same general nature throughout—are instructive in demonstrating the reactions of different tree communities:

Vegetation.	Mean Moisture Content (per cent).	
	At 6 inches.	At 24 inches.
Macchia ('fijnbos') shrubs to 10 ft.; the medial stage of the sere	35	26
Primeval forest of medium moist type: the climax for the sere .	42	35
Plantation of *Pinus insignis* Doug. (*P. radiata* Don.): about 14 years old; planted 6 ft. × 6 ft., and much thinned . .	34	24
Plantation of *Pinus pinaster*: about 14 years old; planted 6 ft. × 6 ft., thinned once . .	33	24
Plantation of *Eucalyptus globulus*: about 14 years old; thinned thrice	25	20
Plantation of *Acacia melanoxylon*: about 14 years; thinned twice. (For a full account of the behaviour of this species, see J. F. V. Phillips, *Trans. Roy. Soc. S.A.*, **16**, 31-43; 1928.)	18	16

From the foregoing it is clear that planting of *Eucalyptus globulus* and *A. melanoxylon* would very seriously decrease the soil moisture, whereas the planting of the pines would affect this but slightly.

Furthermore, I have been able to collect information regarding the drying of numerous small streams in the George-Knysna-Humansdorp coastal region, as the outcome of the planting of various species of *Eucalyptus*, and the planting of *A. melanoxylon*; on the other hand, appreciable diminution of flow due to the formation of blocks of *Pinus insignis* and *P. pinaster* has not been detected—during periods of normal rainfall. In dry periods, however, a minor drying influence is demonstrable.

Clear or selective fellings in natural and artificial forest often produce appreciable increase in soil moisture at depths greater than 6-9 inches—provided strong weed-growth or rapidly developing coppice shoots do not appear; this increase is due to decreased absorption by the roots. The following examples must suffice:

Vegetation.	Mean Moisture Content of Soil at 12 Inches (per cent).		
	Before Felling (: x : 1).	2 Months after Felling (: x : 1).	2 Years after Felling (: x : 2).
Primeval forest of medium-moist type .	38	50	42
Acacia melanoxylon . .	17	25	19

(: x : 1) mean values from numerous determinations over 1 month.

(: x : 2) dense weed-growth and vigorous coppice produced on both sites.

As pointed out by Mr. Vaux Graham, the loss of moisture by interception of rainfall by trees is worthy of consideration; observations at Deepwalls, Knysna, have shown that from 10 to 25 per cent of the fall fails to reach the ground, being spread over the surface of the foliage, the twigs, the branches, and the boles of the trees.

The losses due to absorption and interception at

Deepwalls are all the more interesting because at least 15 inches of precipitation are added to the ordinary rainfall as the result of condensation by the forest canopy of hydrometeoric mists.

JOHN PHILLIPS.

Tsetse Research, Kondoa Irangi,
Tanganyika Territory,
(Formerly Forest Research Station,
Deepwalls, Knysna, S.A.),
May 21.

The Complex Structure of the Copper–Tin Intermetallic Compounds.

THE equilibrium diagram of the copper–tin system is one that shows a bewildering complexity of phases. The great majority of these exist only at high temperatures or form solid solutions of variable composition, but there exist at ordinary temperatures three phases which show a very limited range of composition. These have been usually considered by metallurgists, following the classical work of Heycock and Neville, as the intermetallic compounds: δ bronze Cu_4Sn; η bronze Cu_3Sn; and ϵ bronze CuSn.

Recent studies of these compounds by the method of X-ray analysis of single crystals have been carried out partly at the Davy Faraday Laboratory and partly in the Department of Mineralogy at Cambridge with the invaluable assistance of the Department of Metallurgy. It has been shown conclusively that definite intermetallic compounds exist, but that their compositions and structures are much more complex than those usually assigned to them. The complexity is such that the complete structural analysis will take some considerable time, so that it has seemed of interest to give the following preliminary results.

The compound δ bronze has been most carefully studied from some minute single crystals without faces prepared by Dr. Weiss; it is found to have a cubic structure with a face centred lattice of side 17·92 A., thus confirming the powder photograph observations of Westgren and Phragmen (*Ark. f. Mat. Ast. u Fys.; K. Sven. Vet. Akad.*, **19** B, No. 12; 1926). With a cell of this large size it is difficult to be certain of the number of atoms in the cell. However, its close relation to the structure of γ brass worked out by Bradley and Thewlis (*Proc. Roy. Soc.*, A, **112**, 678; 1926), which has a cell of almost exactly half the dimensions, 8·87 A., and gives intensities of reflections for the 50 corresponding planes of almost identical values, makes it almost certain that the total number of atoms in the cell is $8 \times 52 = 416$. Such a number cannot be made up from molecules of Cu_4Sn, and the most probable values to fit with the density 8·95 are 328 atoms Cu and 88 atoms Sn, which makes the simplest formula $Cu_{41}Sn_{11}$. In order to check this, Mr. J. Stockdale has kindly carried out a micrographic analysis of a set of specimens of composition ranging from 19 to 22 atomic per cent tin at 0·2 atomic per cent intervals, and annealed for three weeks. He has found clear evidence of a two-phase structure, except in the case of the specimen containing 20·6 atomic per cent tin, which agrees very closely with the value found by X-rays. In any event, it is clear that the formula Cu_4Sn must be abandoned; its retention up to the present being due on one hand to insufficient annealing, and on the other to the desire for a simple formula. The positions of the atoms in δ bronze are very similar to those in γ brass. They have been found with sufficient accuracy to give a reasonable account of the 700 observed plane intensities. The space group is T^2_d.

The compounds η bronze and ϵ bronze were examined in the shape of single crystals prepared by Mr. Heycock by dissolving alloys of appropriate composition with concentrated hydrochloric acid.

η bronze grows in lath-shaped crystals with corroded faces sufficiently good, however, to show that the symmetry is orthorhombic. This is confirmed by X-ray analysis, which shows a cell unique outside organic crystals, $a = 4·33$, $b = 5·55$, $c = 38·1$ A. There is, however, a pseudo cell with the same a and b axes, but with the c axis 4·76 A., one eighth of the true value, the dimensions of which resemble nearly a close-packed hexagonal arrangement. This is the structure found by Evans and Jones (*Phil. Mag.*, **4**, 1302; 1927) by the powder method, which is of course powerless to deal fully with a structure of such complexity. In this case the accepted composition is probably correct, analysis of the actual crystals giving 25·2 atomic per cent tin, which gives 16 molecules of Cu_3Sn per cell. Micrographical analysis, however, gives 24·3 per cent, which agrees better with the formula $Cu_{50}Sn_{16}$. The lattice is bc face centred Γ^1_o, and the space group probably Q^{17}_h.

ϵ bronze grows in beautiful needles, which, measured optically, show hexagonal symmetry. Its structure is the most curious of all the compounds. The lattice is hexagonal Γ_h, $a = 20·85$, $c = 25·1$ A., very closely simulating one of one fifth of these dimensions. Such a cell would contain two molecules of CuSn with a nickel arsenide structure. The composition in this case, however, differs widely from CuSn. Analysis of the crystals gives 45 atomic per cent tin, while micrographic analysis leads to the value 46 atomic per cent. With a density of 8·27 the cell has from 230 to 250 atoms of tin and 280 to 300 of copper, the simplest formula being 50 Cu_6Sn_5, but further study will be required to arrive at the exact numbers.

From these studies two things appear; there is first the extreme regularity of the internal structure of compounds that repeats exactly with cells of such magnitude and of such complex composition, and secondly, there is a distinct tendency to mimic much simpler cells: cubic close packing in the case of 'Cu_4Sn,' hexagonal close packing in the case of 'Cu_3Sn,' and a nickel arsenic structure for 'CuSn.' The second property is plainly the same as exists in the more usual metals and compounds such as the silicates, in this case connected with the ratio of the free electrons of the atoms of tin and copper as suggested by Bradley and Gregory (*Proc. Manch. Phil. Soc.*, **72**, 91; 1928). The extreme complexity is in the author's opinion due to some incommensurability in the atomic diameters which cannot adjust themselves in less than a certain number of atomic steps.

J. D. BERNAL.

The Mineralogical Laboratory,
University of Cambridge.

Quality of Soil in Relation to Food and Timber Supply.

THE statement made by the "Writer of the Article" in NATURE of June 2, to the effect that no land should be planted which is capable of providing food, is surely a very sweeping one if applied literally to the British Isles. The "Writer" doubtless knows that a mild and humid climate enables ground to be utilised for grazing in Ireland which would be practically worthless under more arid conditions. This means that food production is not confined to good land, and sheep in particular can and do produce large quantities of meat on land which is even too poor and exposed for timber production. The relative advantages of food and timber production

for land utilisation are not, therefore, determined merely by the quality of the soil, as is suggested by the "Writer of the Article," but by other considerations, some of which are referred to by Mr. Hiley.

Over and above these points, the remark raises the question whether timber-growing on poor soil is necessarily accompanied by any economic advantage. For the best part of a century economists and foresters have adopted a theory that land considered too poor for agriculture can be advantageously devoted to afforestation. The economist argues, of course, that food is a more essential production than timber, but a similar argument might be used in connexion with hundreds of articles or industries now considered necessary to civilisation, which take up or occupy land capable of food production. Why should timber alone be prohibited from occupying land of a class which is equally difficult to prove suitable for one particular purpose to the exclusion of others? From the forester's viewpoint the theory referred to has been advanced chiefly to justify his existence, and rests on no firmer foundation than that provided by the economist.

The precise qualities which render certain soils more productive under timber crops than when devoted to tillage or grazing are not easily defined, and the question is so extremely complex that its discussion here would be quite impossible. But a great advance could be made in the broader issues of rural economy if a general agreement could be arrived at on one particular aspect of the question. This is the scientific principle which should be recognised in all forms of land utilisation, so far as this affects land control. Why, for example, does the State persistently ignore the most important asset the country possesses by disregarding all forms of control over land, and leave the disposal or utilisation of this asset entirely to the individual? The correct answer is probably that the matter is too big for our statesmen to tackle. The argument is always forthcoming that the pressure of necessity or supply and demand will invariably settle the problem on general lines in the long run, and the individual occupier must decide for himself whether corn, grass, forest, fruit, or garden produce is giving the best return to the country at large, as well as to himself. The mere fact that this is the only practical solution of the problem is, however, no proof that it is the correct one. It merely proves that land utilisation is still governed by self-interest, tradition, or empiricism rather than science, and that force of circumstances, negligence, or some other factor is responsible for a certain percentage of the natural fertility of the soil remaining unutilised.

If the covering of the soil with a tree crop is the objective, irrespective of profit, quality, or size of timber, or the production of commercial material, the problem is narrowed down to selecting a species which is capable of normal existence on the particular land being dealt with. An objective of this kind may be connected with the prevention of soil erosion, regulation of water supply, climate, or landscape effect, etc., and soil fertility is then a subsidiary question. If, on the other hand, the production of commercial timber is aimed at, soil fertility in relation to the particular crop or species is of considerable importance, taking, of course, elevation, aspect, etc., into consideration. Every timber tree requires certain conditions for its normal development, in the same way as any other plant, but there is no evidence, so far as I am aware, that timber trees are less exacting as regards soil fertility than the majority of farm crops, due allowance being made for the fact that the latter can only utilise the first few inches of surface soil, and must, therefore, maintain themselves from a layer in which soil nutrients are concentrated rather than diffused, while the former have a deeper rooting range. Different species of trees differ, of course, in their requirements, but if the total amount of nutrient material extracted from the soil could be compared with the dry weight of vegetable matter it produces, the probability is that timber trees would be found to make similar demands upon soil as is the case with farm crops. Young trees growing in nurseries afford an illustration of this, for the average tree nursery requires cultivation and manuring to as great an extent as oats or potatoes, otherwise the crops fail.

Those who favour the theory that soil fertility is less important for trees than for farm crops, overlook the fact that the bulk of the commercial timber in Europe is growing on soils which are by no means poor, and that the assumed poverty of much forest land is based on appearances rather than facts. Rocks, boulders, uneven ground, steep slopes, etc., which obstruct or prevent ordinary cultivation, do not necessarily imply poor soil. Many of the forests pointed to as examples worthy of imitation grow on land equally as good as agricultural land in their vicinity, and the preservation of the forest has been due to causes quite distinct from soil conditions.

The theory that forest should occupy poor land only is merely sound so far as it is required as a surface covering for various purposes, irrespective of timber production. Where the latter is the main object in view, the tree crop should occupy land capable of meeting, but not exceeding, its requirements for normal growth. No economic advantage is gained by planting land below the standard of quality required to produce a satisfactory crop, and a country cannot both have its cake and eat it. Either the commercial forest must disappear, or land of suitable quality must be set aside for its use, and in the majority of cases this land will have a not inconsiderable agricultural value, and is consequently capable of food production if cleared or left unplanted.

Nature does not recognise these sharp divisions between agricultural and forestry land, but too often scrub or worthless timber is regarded by the layman as satisfactory forest, and the distinction between commercial and non-commercial timber ignored or unrecognised.

A. C. FORBES.

Dublin.

Silver Bubbles and Films.

IT may be of interest to record a phenomenon observed in the course of an experiment on the properties of 'sputtered' silver films. On the passage of a discharge through the sputtering tube, it was noticed that numerous 'globules' of varying sizes—some transparent, others iridescent—made their appearance on the walls of the vessel.

A casual glance suggested the presence of a condensed liquid, but a more detailed examination revealed the supposed globules as very thin films of metal which had entrapped a finite volume of gas. Many of these 'metallic skins' showed brilliant interference colours by reflection, whilst others were so thin as to appear almost transparent when viewed by transmitted light. The shape of the deposited films varied, the majority being circular, while some were elongated, giving an appearance similar to that of blistered paint. This characteristic formation is shown in the accompanying photograph (Fig. 1).

The average diameter of the deposits was found to be 6·0 mm., the largest oval formation being

13·0 mm. long by 6·0 mm. wide. The fact that a continuum of metal having so large an area can be spontaneously deposited on the glass walls is of great interest, since it points to a perfectly homogeneous film structure.

The films were kept under observation for several hours, and were found to undergo a progressive transformation due apparently to gas diffusion through the metal, the skins slowly shrinking, and finally puckering. On passing a further discharge at this stage, the flaccid films became electrified, and consequently disrupted by contact with the walls of the tube. The continuous formation of minute gas bubbles upon the surface of the 'envelopes' confirmed the supposition of a gas diffusion through the film.

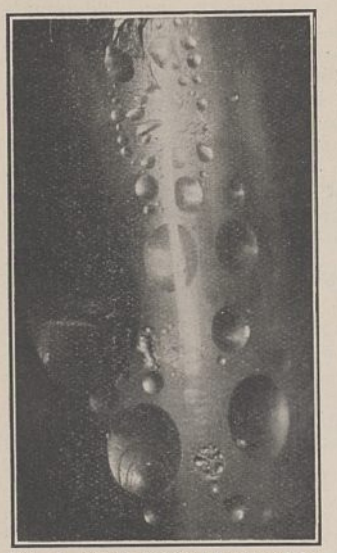

FIG. 1.—Silver bubbles produced by discharge through a 'sputtered' tube. Twice natural size.

Evidence of a granular structure in the metal deposit was sought, but was not confirmed by observation with a high-power microscope. An attempted measurement of the thickness of the films by observing the interference colours produced was rendered abortive, owing to a general 'browning' of the glass walls, but since a thickness of approximately 0·3 μ is requisite for visible interference phenomena, it is apparent that the observed deposits approximated to molecular thickness.

The discharge was maintained at a pressure of 5×10^{-3} mm. of Hg, using a 10 in. coil, with mechanical 'make and break,' to excite the tube.

D. R. BARBER.

University College, Exeter,
June 16.

A Century of Inventions.

PERUSAL of Sir Alfred Ewing's masterly review of "A Century of Inventions" (NATURE, June 16) brings to mind the singular accuracy with which Erasmus Darwin (1731–1802) foretold some of them. The forecast lies buried in his poem, "The Botanic Garden, or the Lover of the Plants," which incurred Canning's merciless parody, "The Loves of the Triangles," and was pronounced by Byron to be "pompous rhyme."

"The Botanic Garden" was published in 1789, fifteen years before Trevithick first made a steam carriage to run upon rails. Darwin did not live to see that, nor did he foresee the internal combustion engine; but his prophecy was of remarkable range.

"Soon shall thine arm, Unconquered Steam, afar
Drag the slow barge and drive the rapid car;
Or on wide-waving wings expanded bear
The flying chariot through the fields of air.
Fair crews, triumphant, leaning from above,
Shall wave their flutt'ring kerchiefs as they move;
Or warrior bands alarm the gaping crowd,
And armies cower beneath the shadowy cloud."

HERBERT MAXWELL.

Monreith.

IN the thirty-fourth James Forrest Lecture, delivered by him before the Institution of Civil Engineers on June 4, Sir Alfred Ewing omits to mention the source from which he has borrowed his title. The historian of science is not likely to forget that remarkable memoir, "A Century of Inventions" (1663), in which the steam-engine is first described. It has been often reprinted, and under this name, an abbreviation of the original has been translated into several European languages. The author, Edward Somerset, second Marquess of Worcester (1601–1667), was eldest son of Henry, the first marquess, by Anne, second daughter of John Lord Russell and of Elizabeth, third daughter of Sir Anthony Cooke, Knight of the Bath. By virtue of their common descent from the last-named statesman, he was a cousin once removed of Francis Bacon, Viscount St. Alban. His only son, Henry Somerset, first Duke of Beaufort, was a maternal ancestor of Augustus Fitzroy, third Duke of Grafton, grandfather of Admiral Fitzroy, the eminent meteorologist. THURKILL COOKE.

5 Cavendish Square, W.1.

MR. THURKILL COOKE is of course right in saying that I borrowed the title of my recent James Forrest Lecture from the Marquis of Worcester's well-known book. The title is so familiar in that connexion to students of engineering history that I imagined my audience did not need to be reminded of its origin. Mr. Cooke will find a reference to the original "Century of Inventions" in my book on "The Steam-Engine and other Heat Engines" (p. 4), where a brief sketch is attempted of early stages in the evolution of the steam-engine. J. A. EWING.

Valence and the Rule of Eight.

F. LONDON, in an interesting article (*Zeit. f. Physik*, **46**, 455; 1928), attempts to account for the difference in valence behaviour between nitrogen, oxygen, and fluorine on one hand, and phosphorus, sulphur, and chlorine on the other, in terms of absolute quantum restrictions. The chemist has been inclined to account for the limited valence of nitrogen, oxygen, and fluorine on the grounds of energy relations; that is, many compounds do not occur because they are 'unstable.' Such an explanation is admittedly unsatisfactory.

London's main premise is that the 'homopolar' bond between two atoms consists of a pair of electrons, one of which is contributed by each atom. If two electrons belong to the same atom and are 'paired,' that is, neutralise each other magnetically, they are not available as a bonding pair to form a link with another atom. This is, of course, quite a different postulate from the one made by G. N. Lewis, who assumed that the pair of electrons in the bond might both belong to one atom. London's postulate works well in that he can show that fluorine has only one 'free' electron, while chlorine may share as many as seven pairs of electrons in perchloric acid. This latter assumption, however, abrogates the rule of eight, which has its physical basis in the stability of the electron structure of the noble gases and is, after all, one of the main principles of the Lewis theory.

Apparently London naïvely accepts the old valence theory, which assumes that an element will show a different valence toward oxygen than toward hydrogen, without realising that this behaviour calls for some explanation. If $HClO_4$ exists, why not H_2Cl? The Lewis theory accounts for all this very nicely by the rule of eight.

Furthermore, oxygen and fluorine form compounds

with valences greater than two and one respectively. These cases would be disposed of by London, perhaps, as not being all 'homopolar' in type. Nitrogen, however, according to London, should have but three electrons to share, and nitric acid and the amine oxides appear to offer difficulties.

By giving up the rule of eight a few facts can be accounted for on grounds more definite than those of energy relations. But it may be expected that when a rule which has been found applicable to hundreds of thousands of compounds is given up, new explanations must be invented for the existence or non-existence of various chemical structures, and some of these explanations will probably involve *ad hoc* assumptions.

WORTH H. RODEBUSH.

Laboratory of Physical Chemistry,
University of Illinois, Urbana, Illinois,
May 29.

The Raman Effect and the Spectrum of the Zodiacal Light.

IN a recent address (*Indian Journal of Physics*, vol. 2, part 3, p. 387) Prof. C. V. Raman announced the interesting discovery that when monochromatic light is diffused by the molecules of a liquid, the spectrum of the scattered light contains, besides the incident lines, also other new lines of increased wave-length. The Raman effect, as it may be called, is less easily observed in the case of scattering by gases and vapours. Nevertheless, I have succeeded in photographing a satisfactory spectrum of the light scattered by the vapour of ether showing the effect. For this purpose, a specially constructed spectrograph of small dispersion and very large light-gathering power was used. With a 3000 c.p. mercury vapour lamp as the source, an exposure of 186 hours on the light scattered by a flask of ether vapour brought out the most prominent line of increased wave-length very clearly. The intensity of this line in relation to the incident line which excites it is considerably less in the case of the vapour than in the case of the liquid.

The spectrograph constructed for the research mentioned above proved itself equal to the task of photographing the spectrum of the zodiacal light with less than an hour's exposure, fast plates sensitised with erythrosine being used. The plate showed a continuous spectrum, with the calcium absorption line at 4227 A. prominently appearing in it. The spectrum showed no trace of light of wave-lengths longer than about 5000 A., though the plates were sensitive up to the *D* lines. The complete absence of the longer wave-lengths makes it difficult to accept the suggestion of Dufay that the particles to which the zodiacal light is due are larger than the wave-length of light in size. It is more reasonable to assume that the scattering material is diffused in atomic or molecular condition. Since the radiation incident on the diffusing molecules includes very short wave-lengths, the scattered radiation from them penetrating through the earth's atmosphere must include not only the incident frequencies, but also radiations of modified frequencies which are less perfectly polarised. The weakness of polarisation of the zodiacal light can be reasonably accounted for in this way. It appears not improbable, therefore, that the Raman effect is of significance in relation to the spectral character and polarisation of the zodiacal light.

L. A. RAMDAS.

20 Kutcheri Road,
Karachi, May 29.

Imperishable Labels for Preserved Organisms.

WHEN paper labels are used for describing the contents of a bottle containing animals, especially those obtained on expeditions and not examined until many years after the material is preserved, it is not infrequently difficult to read the labels with certainty. Valuable material is sometimes lost from this cause. Moreover, the writing of paper labels out-of-doors in wet weather under pressure of time and material is irksome and inefficient. No doubt there are many ways of overcoming a minor difficulty of this kind, but it is probably not superfluous to record a successful method which may not be known generally and has been extended in this laboratory to more valuable uses. A satisfactory label can be made of pieces of opal glass of a suitable size and thickness. Opal glass sheets or slips can be obtained easily commercially with one side polished and the other rough and unpolished. There is no difficulty in writing with a graphite pencil on the unpolished surface, and the writing is permanent in ordinary preservatives and fixatives.

In overlooking recently a quantity of labels I made in this way in 1912 and 1913, I find they are as clear to-day as when written. I have also used labels of this kind during many years for experiments in the sea, but growths may render them undecipherable after about a year's immersion. No doubt other workers have used similar labels, but if so, the fact merely serves to show that convergence is common in the realm of ideas as it is in organic evolution.

J. H. ORTON.

Marine Biological Laboratory,
Plymouth,
June 15.

The Reflecting Power and Colour Sequences shown by Metals on Activation.

THE brightening of the colour sequences shown by copper on continued oxidation and reduction has been observed to occur simultaneously with the increase in catalytic activity (cf. Hinshelwood, *Proc. Roy. Soc.*, A, vol. 102, p. 318; 1923). Direct spectrophotometric observations have shown (*Proc. Roy. Soc.*, A. vol. 117, p. 377; 1928) that the reflecting power of the metals, iron, nickel, and copper reduced from the granular oxide increases with the number of oxidations and reductions until a limiting reflecting power is reached, and that the brightening of the colour sequence is a consequence of the increased reflecting power of the underlying metal. The limiting reflecting power of activated reduced nickel and copper is, however, much less than that of the burnished metals. Thus a burnished metal surface becomes duller on activation, and the accompanying colour phenomena are less pronounced. This has now been verified experimentally.

It is usual for a metal to produce colour sequences on oxidation which increase in brightness on alternate oxidation and reduction, because the original metallic surface reduced from the coarsely granular oxide becomes finer in structure, but this brightening is not always associated with activation.

A burnished surface becomes duller and coarser on alternate oxidation and reduction, and the associated colour sequences become less bright.

F. HURN CONSTABLE.

St. John's College,
Cambridge.

The Freshwater Medusa *Limnocodium sowerbyi* in the Royal Botanic Society's Gardens, Regent's Park.

IT may be of interest to record the reappearance of the freshwater jellyfish, *Limnocodium* (*Craspedacusta*) *sowerbyi*, in the *Victoria Regia* tank of the Royal Botanic Society's Gardens, Regent's Park. The medusæ were found by us in large numbers on June 30, and some persisted over the week-end. The specimens are mostly fully grown, with an umbrella diameter up to about 13 mm. They resemble in every way the specimens first described by Allman and Lankester. These remarkable freshwater medusæ were first discovered in Regent's Park in 1880, and are reported to have reappeared there for four or five years; they have apparently not been noticed in the tank in recent years. Since its original discovery in 1880, the jellyfish has, however, been recorded from tanks in botanical gardens in other towns in England, in France, Germany, and the United States.

The most recent appearance of *Limnocodium* in England that we can trace, was in the *Victoria Regia* tank in the Botanical Gardens in Birmingham, where they were collected by Prof. Boulenger in 1912. Apparently the same species was found by Prof. Carman in a creek near Frankfort, Kentucky, in 1916, whilst an allied species, *L. kawaii*, has been recorded from a river in China.

W. U. FLOWER.
S. LOCKYER.

Bedford College,
London, N.W.1,
July 2.

The Complementary Nature of the Quantum Theory.

PROF. BOHR has kindly informed me that in the last chapter of my recently published book on quantum mechanics, the reference to his work on the complementary nature of the quantum theory (described in the supplement to NATURE of April 14, pp. 579-590) may perhaps give rise to misunderstanding. When I was last in Copenhagen, in September of the past year, Prof. Bohr was away at the congress in Como, and the views which had been recently developed by Heisenberg and himself were elucidated to me at the Institute for the purpose of this last chapter. In the discussions, use was frequently made of a mode of probability calculation similar to that used in earlier work on the statistical formulation of quantum mechanics, but which appeared to me to be more simple and direct. Prof. Bohr points out that the wording of the chapter may create the impression that these calculations were *primarily* developed in connexion with the new ideas, whereas they may be said to be characteristic of the whole recent development of the quantum theory. When Prof. Bohr was in Cambridge in November, I happened to have neither the manuscript (then in the press) nor the proof of this chapter (then not yet printed), otherwise this impression would doubtless have been noticed and removed.

G. BIRTWISTLE.

Pembroke College,
Cambridge, June 20.

A Tetraploid *Saxifraga* of known Origin.

THE results of genetical studies, completed up to the F_2 generation this year, and of preliminary cytological investigations, enable us to add another to the increasing list of known tetraploids amongst plants. Crossing *Saxifraga rosacea* with *S. granulata*, a small F_1 generation was raised the plants of which were uniform, except that one showed abnormal development of the petals in most of the flowers. The general balance of characters was towards the male parent (*S. granulata*). One of the F_1 plants with normal flowers was selfed and a large F_2 generation (436 individuals) raised. The plants of this generation were remarkably uniform, except that petal abnormalities appeared in a few or majority of flowers in five plants. No trace of segregation towards the distinct habit and flower characters of the two parents could be traced.

Chromosome counts have been made by Mr. R. O. Whyte, of Cambridge, who reports that the F_2 material has 32 chromosomes in the anthers, the number in this generation being double that in its predecessors. The reduction divisions in the F_1 are most irregular and, at present, difficult to interpret completely. A full account of the work is being prepared for publication.

E. M. MARSDEN-JONES.
W. B. TURRILL.

Kew, June 20.

The Colour of the Peacock's 'Eye.'

WITH reference to Lord Rayleigh's observations on the colour of the peacock's 'eye' in NATURE of May 26, it may be of interest to note the remarkable change in the colour of the filamentous groundwork of the train effected by wet—a peacock living in the open appears in rainy weather to have this part of the train copper-red instead of green, though the 'eyes' remain of the usual colour. This observation applies only to the ordinary peacock; the black-winged mutant has a coppery train when dry, while the very distinct Burmese peacock and its hybrid with the common bird generally show much pinkish-red in the train; both of these, by the way, show a large amount of black in the wing. What the trains of peacocks of these three kinds look like when wet I do not know, having observed them chiefly in the Zoological Gardens, where they are kept in aviaries with shelter always available, and so do not get wet.

Ordinary daylight would also appear in some cases to effect a considerable change in the colour of the train of stuffed peafowl, the specimens in the peacock case at the Natural History Museum being abnormally blue, except the bird shown in display, which is a new one. Yet a peacock in the Horniman Museum, exposed to a far stronger light, has kept its normal coloration for years; but it has not been exposed nearly so long.

F. FINN.

Spectrographic Detection of 'Traces.'

IN the May issue of the *Journal of the Chemical Society* Dr. J. A. N. Friend, in a paper entitled "Experiments on Transmutation" (pp. 1321-1324), announces negative results of examinations by spectral means for 'traces' possibly formed in specimens of barium sulphate, silver foil, and gold foil by bombardment from a source of radium-*D*, -*E*, and -*F*, and also by the action of radium emanation.

He states: "If any kind of transmutation had taken place, its quantity was too minute to admit of detection spectroscopically."

It is desirable to point out that as only spark, and not D.C. arc, spectra were used, this statement is open to question: arc spectra are so much more powerful in revealing 'traces' that they should always be employed if possible for this purpose. Further, if spectral examination is contemplated as the final stage of an investigation, the latter should be so planned that arc spectra can be used.

J. R. GREEN.

Batchelor, Robinson and Co., Ltd.,
Llanelly.

The Bicentenary of Joseph Black.

THOUGH the event has apparently passed unnoticed, on April 16 last occurred the bicentenary of the birth of Joseph Black, whose name is rendered immortal by his epoch-making chemical discovery of the nature of 'fixed air,' or carbon dioxide, and by his enunciation of the doctrine of latent heat. These two important additions to knowledge were made by Black in early manhood, but though he lived to the age of seventy years, history records no further contribution to scientific discovery by him, while of all men of science his writings are of the scantiest. His fame, however, was world-wide. His great contemporaries in England were Priestley and Cavendish; in France, Lavoisier, Berthollet, and Fourcroy, and it was the last who once referred to Black as "the Nestor of the chemistry of the eighteenth century." Proust, also on Black's name being mentioned, exclaimed: "Ah! c'est le Patriarche de la Chimie." Of Black's career and work, practically all that will probably be known is contained in "The Life and Letters of Joseph Black, M.D.," the last published work of the late Sir William Ramsay. From a scrap of autobiography given in this we learn that Black was born at Bordeaux on April 16, 1728, his father and mother both being of Scotch descent. He was one of a family of eight boys and five girls, and was taught English by his mother. At the age of twelve years he was sent to school at Belfast. At sixteen he entered the University of Glasgow, at twenty-one he removed to Edinburgh, and in 1754, at the age of twenty-six, took his degree of M.D. with the thesis, "De Humere Acido a Cibis Orto, et Magnesia Alba," which, developed and perfected, was read two years later to the Medical Society of Edinburgh with the title "Experiments upon Magnesia Alba, Quicklime, and other Substances."

At Glasgow, Black had come under the influence of Cullen, who saw that chemistry was not merely a curious and useful art, but a "vast department of the science of nature, which must be founded on principles as immutable as the laws of mechanism, and which may be one day formed into a great system of doctrines, of various degrees of subordination and dependence." Black probably began studying under Cullen in 1749, but his experiments for his thesis were begun in 1752. Black in 1754, in a letter to his father at Edinburgh, said, "Medicine is allowed on all hands to be in a very flourishing condition. It is practised in the most rational and simple manner," but the cause which led to his famous research was a curious one. A medicine invented by a Mrs. Joanna Stephens had apparently relieved both Sir Robert Walpole and his brother, who were troubled with the stone. Through them she received no less than £5000 to reveal the secret, which was published in the *London Gazette* of June 19, 1739. It ran as follows: "My medicines are a Powder, a Decoction, and Pills. The Powder consists of Egg-shells and Snails, both calcined. The decoction is made by boiling some Herbs (together with a Ball, which consists of Soap, Swines'-Cresses, burnt to a Blackness, and Honey) in water. The Pills consist of Snails calcined, Wild Carrot seeds, Burdock seeds, Ashen Keys, Hips and Hawes, all burnt to a Blackness, Soap and Honey." Cullen and his colleagues held opposing views as to such remedies, and it was with the object of discovering a 'milder alkali' that Black began his experiments on magnesia which led to the discovery of 'fixed air.'

After the publication of his thesis, Black practised medicine in Edinburgh for two years, and then, on Cullen's transference to that University, Black succeeded him at Glasgow, where he remained from 1756 until 1766. It was during these years that he enunciated and first taught the doctrine of latent heat, of which he read an account to a society in Glasgow on April 23, 1762. In his lecture notes occur the sentences: "To ascertain what I mean by the word Heat" to "ascertain the real difference between heat and cold" and "to mention some of the attempts which have been made to discover the nature of heat." He argued that heat is the positive thing and not cold, and goes on to say, "But our knowledge of heat is not brought to that state of perfection that might enable us to propose with confidence a theory of heat," but "when we have at last attained it, I presume that the discovery will not be chemical, but mechanical."

One or two of Black's experiments may be recalled. In the first he hung two globes 18 inches apart in a large hall; one contained 5 oz. of water the other 5 oz. of ice. The water in half an hour had increased in temperature from 33° to 40° F., whereas 10½ hours elapsed before the ice had melted and attained the same temperature, from which he argued that 139 or 140 "degrees had been absorbed by the melting ice, and were concealed in the water into which it had changed." He next tried adding equal weights of ice and water at 32° to equal quantities of warm water, and deduced the figure 143° F. In the third experiment he proved that a lump of ice placed in an equal weight of water at 176° F. lowered the temperature to 32°. Somewhat similar experiments were made by Black on the latent heat of steam, in which he compared the time required for a known weight of water to rise through a definite interval of temperature when exposed to a constant supply of heat with that required to dissipate the water into steam, and it was the results of these experiments which Black communicated to Watt just at the time the latter was pondering over the problems raised by the irregular working of the model Newcomen steam engine in the University of Glasgow.

Few scientific discoveries have had a greater influence on the work of engineers than those made in the effects and properties of heat, of which Black's was one of the most important. Up to the seventeenth century all had been conjecture. The first real step in progress was the invention

and improvement of the thermometer. This first appeared in Italy about the same time as the barometer, and the conception of the steam engine may be traced directly to the introduction of those philosophical instruments and the enlargement of human knowledge they brought in their train. Fahrenheit, the German instrument maker of Amsterdam, was the first to make thermometers with adequate skill, and he also fixed, first the freezing point, then the blood heat, thirdly the extreme cold of a mixture of ice, water, and sal-ammoniac, and then the boiling point of water. Writing a hundred years later, Sir John Leslie, himself a great experimenter, said: "The Doctrine of Heat has in the course of the eighteenth century been advanced to the rank of a science. Its transfusion through the mechanical arts has communicated a grand movement to society and wonderfully augmented our natural wealth and resources." Leslie then went on to recall some of the most important discoveries: Fahrenheit's thermometric scale; Cullen's observation of the lowering of the boiling point under a decrease of pressure; Black's theory of latent heat and sensible heat; the introduction of the terms 'capacity for heat' and 'specific heat'; Lavoisier's and Laplace's experiments on calorimetry; Wedgwood's pyrometers; the registering thermometers of Six, and the production of artificial cold; but like Black he felt that the true theory of heat had yet to be discovered, remarking, "What seems wanted at present to complete our knowledge of heat, is not the vague repetition of experiments already carefully performed, but a nice investigation of several unexplored properties, directed with scrupulous accuracy on a large scale." Had Leslie but known it, even at the time he wrote, the famous essay of Carnot had already been published, while Joule, Rankine, Kelvin, Mayer, Clausius, Tyndall, and others were just beginning the careers during which they were to demonstrate by means of "nice investigations," "directed with scrupulous accuracy," that, as suggested by Black, the true theory of heat is not "chemical, but mechanical."

With Black's work on latent heat his course of discovery came to a close. In 1766 he removed to Edinburgh as professor of chemistry, and there for more than thirty years lectured on his favourite subjects. The friend of Watt, Adam Smith, Robison, Hume, Playfair, and Hutton, he passed his life in the quiet performance of his congenial duties, somewhat indifferent to honours, but cheerful and courteous to all alike. His death took place suddenly as he sat in his chair, on Dec. 6, 1799. Robison, who wrote a sketch of him and published his lectures, gave the date of his death as Nov. 10, and Ferguson gave it as Nov. 26, another mistake. It was Muirhead who first pointed out the discrepancy; the date Dec. 6 being confirmed from the newspapers of the time.

Life's Unsuspected Partnerships.[1]

By Prof. DORIS L. MACKINNON.

SYMBIOSIS is the word used by biologists to describe the state of affairs in which two or more different kinds of organisms are closely, and in some cases inseparably, associated for the greater part of their lives in a partnership from which both, in some degree, probably draw benefit. Within the last few years, many unsuspected interdependences have been revealed, and a vast field has been opened up for further research.

It has recently been claimed by Pierantoni and other workers that the luminescence of surface-living cuttle-fishes, pelagic tunicates, and certain reef-inhabiting fishes is produced by bacteria that are in constant symbiosis with them. Saprophytic light-giving bacteria are abundant in the sea, and are inevitably swallowed by feeding animals, in the dead bodies of which they multiply exceedingly, and, still glowing, produce the disconcerting phenomenon of phosphorescence which may be noticed, for example, in rotting fish.

Among the little sand-hoppers of the genus *Talitrus*, which are normally not luminescent, one is occasionally found glowing with a mysterious inward light. Such individuals are always diseased, and if their infected blood be injected into the bodies of other like crustaceans, these also begin to glow and soon die. It would look therefore as though, for some animals, the incursion of luminescent bacteria is directly harmful. But others have acquired immunity against the invaders, and have even turned the invasion to account. Such are the pelagic tunicates and the cuttle-fishes. The best-known example of tunicate phosphorescence is that of the creatures known as *Pyrosoma*, which form transparent, gelatinous, tube-shaped colonies floating on the surface of the warmer seas. The walls of the tube are composed of numerous individuals seated in a common gelatinous envelope and adding to their number by budding. The mouth of each person is directed outwards, and close behind it is a patch of tissue which is the light-organ. It has been discovered that the cells composing this organ contain luminescent bacteria, and it is the glowing of these that gives the animals their phosphorescence. It is not easy to imagine what advantage the *Pyrosoma* colony derives from this; the animals have no eyes, they are hermaphrodite, and they lie in close association; but some important advantage there must be, for the eggs that will give rise to new colonies are always furnished with a certain quantity of the bacteria, handed on from the parent.

When the *Pyrosoma* individual is sexually mature, some of the bacteria in its light-organ begin to form spores, which then leave the shelter of the cells in which they have developed and are carried by the blood-stream to the little sac in which the single egg is developing. Invading the cells of this sac, they seem to induce these to divide, and one of the

[1] From a Friday evening discourse delivered at the Royal Institution on May 11.

daughter cells at each division moves into the space between the sac and the egg. This invasion continues and the infected cells continue to multiply and move in towards the egg until there are about four hundred of them. The egg itself has meanwhile begun to divide, and the infected follicle cells, glowing all the time, take up their position between the blastomeres. Each egg gives rise to four *Pyrosoma* individuals, which will be the founders of a new colony, and between these four the invading luminescent cells are scrupulously divided, taking up their definitive position, as time goes on, in the light-organs. In this way, from generation to generation, the sacred flame is handed on.

In the cuttle-fishes, the eyes are in their way as perfect optical apparatus as those of a vertebrate, the sexes are separate, and in the majority of species the luminescence is shown by the female only. The eggs of the cuttle-fish are enveloped in a shell which is secreted around them on their passage to the exterior by structures known as the nidamental glands. In front of the nidamental glands lies another, usually called the accessory nidamental gland; and it was always supposed that this furnished some contribution to the egg-shell. But now we know that it does no such thing; it is a phosphorescent organ, composed of tubes of three kinds and colours, white, yellow, and orange, each of which is crammed with bacteria of a different sort: it is those in the yellow tubes that are luminescent. The luminescent gland opens to the sea and the bacteria can pass out. The cuttle-fish, then, may glow with a more or less steady internal light, or it may eject streams of fire. In some cuttle-fish, the apparatus is further complicated by the development of a reflector behind the gland, backed by a pigment screen, and there is actually a lens in front, so that the animal has a veritable bull's-eye lantern. The opening of the light-organ is so arranged with relation to the genital duct that the eggs as they pass along get smeared by the expressed bacteria, and so the new generation is safely infected. We find the bacteria glowing inside the egg-shell, though how the embryo actually incorporates them we do not yet know.

The presence of three different kinds of bacteria is paralleled by the condition of things in certain insects. It is known that many bacteria are mutually interdependent, and will not flourish when isolated from their fellows; possibly we have here a second degree of symbiosis within the first. In these cases, then, the light would seem to be the product of captured and tamed bacteria; and we speak of a symbiosis, though we are very far from understanding yet the special advantages that accrue to the microbe partner.

Now, while the symbiosis productive of luminescence may give protective advantages or facilitate mating, the other and far commoner examples with which I propose to deal are concerned with nutrition. The primary concern of all living organisms is with food, the getting of it and the dealing with it when it has been secured; and we cannot even begin to understand the majority of symbiotic partnerships until we know something about the feeding habits of the organisms concerned. In the more intimate associations, as of green plant with fungus or bacteria, of animal and green plant, of animal and fungi and bacteria or protozoa, the microscopic partner has been called in to perform some function that the larger partner cannot perform for itself. Let us bear in mind that the green plant, the fungus, the bacterium, and the animal have each very different capacities of dealing with the material that composes what we call their food.

It must be admitted that, seen from our point of view, many of these associations appear very one-sided in their benefit and border closely on true parasitism, between which and symbiosis there is no hard-and-fast line to be drawn. Strictly speaking, we should use symbiosis to describe a condition where equilibrium is established between the partners, but we still use the term when one organism seems to derive more benefit than the other: true parasitism may be said to occur when the benefiting organism gets the upper hand so far that it lives actively upon its host's tissues or diverts so much of the available food that the host dies of starvation. Obviously, it is seldom to the advantage, even of a parasite, to kill the goose that lays such golden eggs; and where such a thing occurs, we may assume that perfect equilibrium has not yet been achieved. In the course of ages many harmful parasites, as we see them to-day, may become innocuous; and as their hosts develop an immunity, they may even become useful symbiotes.

It is well known that the leaf-cutting ants of the genus *Atta* do not feed directly on the leaves they cut up, but use these as manure for their fungus-gardens, and it is on the white mycelial nodules of the fungus that they depend chiefly for food. The greatest care is taken of the fungus-gardens, and we may say that the same sort of symbiotic relationship exists between the ants and their fungi as betweeen the ants and their green-fly 'cattle.' It has for a long time been a puzzle as to how the precious plant is transferred to the new nest when the young queen leaves the old colony; now it is known that the queen carries with her, in a little pocket under her chin, a sample of the necessary mycelium, and in the new nest she deposits this and cares for it as diligently as for the eggs she lays, until such time as the workers hatch out and are ready to take over these menial duties.

Strange to say, this same habit of fungus-culture is also found in one of the families of termites, and it occurs again among certain beetles, such as *Hylecoetus dermestoides*, the larvæ of which live in tunnels that they make in fresh wood. These larvæ, when they hatch out, feed upon the mycelial nodules, rich in protein, which line their tunnels. It has recently been shown by Buchner, that the adult female *Hylecoetus* has on her ventral side two elongated pockets filled with thick-walled fungal spores, and between these pockets lies a gutter also filled with spores. All these structures end just where the oviduct opens to the exterior, and the eggs as they are laid get smeared with the spores

squeezed out on them by the muscles of the abdomen. The eggs are deposited on the bark of a tree, and the larva, in eating its way out of the egg-shell, devours with that the spores and so gets infected. The larva burrows into the wood, and the spores, passing through its body uninjured, are deposited in the excrement, germinate, and, even in the poor soil of the powdered wood in the tunnel, produce a flourishing supply of rich fungal food.

The wood-wasps of the genus *Sirex* do something of the same kind. Here the infecting apparatus consists of two syringes filled with the ooidia of a fungus, and between the syringes is a gland, the sticky secretion from which mingles with the fungal material as it is squeezed out when the eggs are laid. The mycelial growth that appears within the larval tunnels is never so rich as with *Hylecoetus*, and here it may be that the grub merely makes use of the fungus as an aid to the digestion of the gnawed wood, about 50 per cent of which is pure cellulose.

Cellulose does not occur in animal tissues, if we except the group of the tunicates, and there are very few animals that produce enzymes capable of splitting it up and putting it in a more assimilable condition. So far as we know, no vertebrate can digest cellulose unaided, and among the invertebrates the only established examples are those of certain snails, the shipworm, the crayfish, the earwig, and a butterfly. Innumerable insects live on vegetable matter containing a high percentage of this indigestible material; although they seem able to make use of it, they secrete no cellulose-splitting enzyme that we can discover. The suggestion is that they call in the aid of fungi and bacteria that have this peculiar power. We assume, then, that the fungus-gardens of the ants and termites and of other insects with wood-eating larvæ, furnish not only direct nutriment but also substances that will split up the cellulose for the animals that ingest these.

From the external fungus-garden in the nest or the burrow, it is only a step to an internal symbiosis. Why not carry one's garden around with one all the time?

We find, in fact, that the majority of insects living on plant tissues or plant juices have outgrowths from the gut in which swarms of yeasts or of bacteria have their permanent abode. Sometimes, as in *Dacus oleæ*, the olive-fly, the symbiotes live free in the cavity of the reservoir. More often, perhaps, they are contained within the cells of which it is composed. How the micro-organisms are prevented from multiplying to excess we do not know; but that is what we should expect in a true symbiosis—that the host should have developed some power to keep its guests in useful check.

Here, as in *Hylecoetus* and *Sirex*, we find the most elaborate precautions for ensuring that the next generation shall be furnished with the necessary supply of the symbiote of the species. When the female insect is sexually mature, numbers of the bacteria or of the yeasts migrate to the hinder end of its body and take up their position in outgrowths from the gut opening just by the aperture from the oviducts. The yeasts are squeezed out on the shells of the passing eggs, and are presumably swallowed by the larvæ as they emerge; the still smaller bacteria frequently pass through the micropyle of the egg or through tiny pores alongside this, and the emerging larva is already safely infected.

It has also been observed that blood-sucking invertebrates habitually harbour micro-organisms, which may possibly help them to digest blood. Lice, bed-bugs, tsetse flies, culicine mosquitoes and leeches all have in their guts micro-organisms comparable with those we meet with in insects depending on a plant diet rich in cellulose. In some instances here also the transfer of the symbiote to the young of the host has been demonstrated.

It is not only in connexion with luminescence or with their immediate digestive activities that animals have called in the aid of symbiotes. Certain snails of the families Cyclostomatiidæ and Annulariidæ have long been known to have curious branched, concretion-containing 'glands' lying on the dorsal side of the intestine and in close proximity to the kidney. The concretions are spherical in form and are composed mainly of uric acid deposited in an organic matrix arranged in concentric lamellæ. They lie in special cells known as purinocytes, and alongside them within these cells there are almost always quantities of a bacillus. The purinocytes are undoubtedly excretory in function. The work of Meyer and others has shown that they remove from the snail's tissues and store the excess of nitrogenous waste in the form of the concretions. Then, according to Meyer, the bacilli invade the purinocytes and do their work, which seems to be the breaking up of the uric acid.

The tissues of the snail itself do not produce any uriolytic ferment, and the animal seems to depend on bacterial assistance at this point. A number of free-living bacteria are known to have this power of splitting up uric acid, and in the soil, among the decaying leaves on which the snail feeds, are found bacteria indistinguishable from those in its purinocytes. They also occur in the snail's gut, where they have come with the ingested food, and there seems every reason to suppose that they make their way thence to the excretory cells—though why they should show this special affinity for the purinocytes remains a mystery. (The same might be said of the yeasts in the 'mycetomes' of insects.) Presently certain cells in the neighbourhood of the purinocytes become actively amœboid and devour the purinocytes with their contents—the organic basis of the partially dissolved concretions, that is, *and* the bacterial symbiotes whose work is now over. Presumably the phagocytic cells then hand over to the snail's tissues the broken-down products, and presumably these are anabolised by the mollusc, especially during the periods of inertness which we call hibernation.

I say 'presumably.' It will be noticed that in nearly all these recently investigated examples of suspected symbiosis, we must still qualify our

assertion. The inference is strong that the micro-organism is a true symbiote—its constant presence in the special situations, its unvarying character, its scrupulous distribution to the offspring, its powers of producing chemical changes of which the host is known to be incapable, but can, in its presence, effect. There is much circumstantial evidence. But we cannot say with certainty that the partnership exists, in however one-sided a degree, until we have proved by experiment that the containing animal suffers irreparably through removal of the guest, and is benefited by its return.

An experiment of this kind has been undertaken and carried through with success in the case of certain wood-eating termites. Some termites habitually cultivate fungus-gardens, and such species live on rotting wood and other vegetable matter plus the assisting fungus. The true wood-eating termites, and these form the majority of families, cut up and eat wood that is quite fresh ; and termites of these families do not cultivate fungus-gardens. The wood on which they depend for subsistence contains at least 50 per cent cellulose, and the experiments of Cleveland have proved that such termites, kept in the laboratory, can live for at least three years—perhaps indefinitely—on a diet of pure cellulose. In these experiments of Cleveland's, the cellulose was given in the form either of pure filter-paper or of specially prepared ligno-cellulose.

The cellulose-fed termites in the laboratory behaved in exactly the same way, and flourished just as well as the controls living on a more normal-seeming wood diet. That is to say, the workers always fed directly on the pabulum, and so did the nymphs of all the other castes. The royal forms likewise fed themselves until the so-called post-adult stages, when they, together with the second and third form adults and the adult soldiers, became dependent on the workers for food-supply, the muscles of their own jaws atrophying, or, in the case of the soldiers, the mandibles becoming so large and unwieldy as to be useless for wood-gnawing. The dependent castes fed either on the semi-digested food passed from the hind-gut of the workers, or on the secretions poured out from their salivary glands. It was the soldiers who seemed to live most constantly on the semi-digested gut-contents of the workers ; the younger creatures—the nymphs and the royal and complementary forms in their later life depended on the salivary secretions.

Now cellulose is indigestible even by termites, which secrete no cellulose-splitting enzymes ; and these families have not even got fungus to aid them. But it has been known for a long time that the gut of the true wood-eating termite that does not cultivate fungus, harbours an extraordinary menagerie of protozoa not found anywhere else, if we except some small relatives from the hind-gut of the cockroach. Unless it has been seen, the writhing multitude of inter-sliding protozoan bodies that almost blocks the gut of a healthy termite worker and constitutes about half its total body-weight, is difficult to picture. In spite of their relatively large size and the vast numbers of motile threads covering their bodies, they are ranked by protozoologists among the flagellates, where they form a special and peculiar group, the Hypermastigina or trichonymphids. It seems that each genus of wood-eating termites has its own special association of trichonymphids. Now it is to be noted that the flagellates are found abundantly in all the castes at the stages when they do their own feeding. They disappear from the second and third forms in later life, and become less abundant in the soldiers after these have passed the nymph stage. Larvæ isolated from the time of hatching never have any ; but if they are placed with workers, they have protozoa in their guts within twenty-four hours. The soft protoplasmic bodies of the flagellates are generally crammed with tiny fragments of termite-masticated wood which they have picked up : they have no mouths, but probably take in the particles at the naked posterior end of the body.

It has long been suspected by protozoologists and by entomologists that these strange flagellates are not parasites of the termite, nor even mere commensals, but true symbiotes in the highest degree, conferring incalculable benefits on their hosts, and, richly compensated in return by food and shelter, become incapable of living a separate existence. It has been suspected that these protozoa, like certain fungi and bacteria, have the power of splitting up cellulose, living on the more assimilable products and handing over to their hosts a certain proportion thereof, adequate not only for the particular individuals they inhabit, but also for the dependent castes.

Cleveland's ingenious experiments have recently carried these suppositions into the realm of scientific fact. First he set about removing the protozoa from their termites without injury to the insects. This was difficult. He did it in three different ways—by starvation, by keeping the colonies at a temperature of 36° C., and thirdly, by subjecting them to oxygen under pressure. The first method, starvation, removes nearly all the protozoa in about fifteen days, but it is impossible to defaunate the insects completely before they themselves have begun to suffer in health. Incubation at 36° C. for twenty-four hours kills the protozoa without damaging more than a small percentage of their hosts. But an oxygen pressure of four atmospheres kills the flagellates in about half an hour without damaging their hosts at all, and this method has been found the most convenient for experiment. The various kinds of trichonymphids in one termite gut are variously susceptible to the effects of the poison. By varying the dose and the period over which it acts, Cleveland has found it possible to remove first one species and then another, thus altering the character of the particular intestinal fauna in which direction he will, for when one species dies out another there present multiplies rapidly and takes its place.

The termites defaunated by the oxygen poison are themselves perfectly healthy, but when they are supplied with wood to feed on, though they devour it greedily, they cannot digest it, and they

die of starvation in three to four weeks. Supply them, however, with predigested humus or with fungus-digested cellulose, and they can get on all right. But the crucial test is yet to come. Put them back with other termites of their own kind containing protozoa, they rapidly become re-infected, are then once more able to cope even with pure cellulose, and can live on that indefinitely. There seems, then, no question whatever that the protozoa split up the cellulose for them, and that, in the course of ages, they have become absolutely dependent on these secret sharers for their essential food. The flagellates, for their part, cannot live for more than ten days apart from their termites, and then only in a special blood-serum medium to which finely powdered ligno-cellulose is added. They have never been known to form protective cysts, and, so far as is known, they do not occur anywhere else in Nature. The exact method by which they are transferred from termite to termite is not fully understood—though probably they pass in the semi-fluid substance from the anus of the workers.

The association between these partners is undoubtedly of very long standing—it must have taken many ages to evolve the exact adjustment between them and the extraordinary specialisation that we find. But complete and successful the partnership undoubtedly is. Many minor details have yet to be worked out. We do not yet know in what form the broken-up cellulose is handed on to the insect. A great deal of glycogen (animal starch) is always found in the bodies of the trichonymphids, though none occurs in the intestinal cells of the termite. Even when the diet has been pure cellulose for as much as three months, the protozoa still contain glycogen. The suggestion is that they split the cellulose into the sugar glucose, which they then build up into glycogen. How they hand over the excess to their partners we do not know, or whether, as seems possible, their own bodies are sacrificed in the process. Nor do we know yet how the termite gets the nitrogen necessary for the formation of protein when it is fed on pure cellulose. Possibly the bodies of the junior partners afford the immediate supply: but whence have *they* got their nitrogen? Have they the power of fixing free nitrogen, as certain bacteria have? Or do the termites themselves perform this un-animal-like feat? Do not let us forget, however, that along with the flagellates in the termite's gut there are also myriads of other micro-organisms—spirochætes, bacilli, and what not. It may be that these are, in their degree, essential partners in the process.

Obituary.

SIR JOHN ISAAC THORNYCROFT, F.R.S.

SIR JOHN ISAAC THORNYCROFT, whose death on June 28 we much regret to announce, was born on Feb. 1, 1843, at Rome. He was eldest son of Thomas Thornycroft, a sculptor, who had married Mary, the daughter of John Francis, who had taught him his art. Sir William Hamo Thornycroft, the sculptor, was another son of Thomas Thornycroft. Educated first at private schools, Sir John Thornycroft became a student of the University of Glasgow, and there came under the influence of Rankine and Kelvin. After gaining some experience in shops in the north of England, in 1866, the same year that Sir Alfred Yarrow started at Poplar, he began boat building at Chiswick, and soon became known for his success with steam-boat machinery. The little *Miranda*, built in 1871, was only 45½ feet long, but created considerable stir by steaming at 16¼ knots.

It was the adoption of the spar torpedo, and then the automobile torpedo for naval warfare, that opened a new field to Thornycroft, and in 1873 he constructed his first torpedo-boat for the Norwegian government. In 1877 he built H.M.S. *Lightning* for the Royal Navy. He was probably the first to use a locomotive boiler in a boat, and when this type of boiler proved troublesome, he invented a water-tube boiler. He early employed forced draught in his boats, and was a pioneer in the construction of fast-running, lightly constructed steam engines. His first vessel fitted with a water-tube boiler was the mission boat *Peace*, for use on the Congo. In the two torpedo-boats for the British Navy, Nos. 99 and 100, he introduced the flat stern and the double rudders which became a conspicuous feature of his designs. The history of the torpedo-boat destroyer begins with the *Havock* and *Hornet*, ordered by the Admiralty from Yarrow, and the *Daring* and the *Decoy*, ordered from Thornycroft. The *Hornet*, with Yarrow boilers, attained a speed of 27·3 knots, and was the fastest craft afloat. She was soon beaten, however, by Thornycroft's *Daring*, which attained a speed of 27·9 knots. Both these records were surpassed by the Russian *Sokol*, built by Yarrow in 1895, and by the *Forban*, built by Normand the same year, which did 31 knots. Reciprocating engines were used in this type of craft up to 1906, and Thornycroft built and engined many of the so-called thirty-knotters. On the adoption of the Parsons' steam turbine he was given the contract for some of the coastal destroyers, and in 1907 built and engined the ocean-going destroyer H.M.S. *Tartar*, which with oil fuel and triple screws driven by turbine attained a speed of 35·6 knots.

Thornycroft had been joined by the late John Donaldson in 1872, and later on by the late S. W. Barnaby, while for many years Mr. C. H. Wingfield was the chief mechanical engineer of the firm. Motor building had been added to the firm's activities in 1896, and after Donaldson's death in 1899 the concern was turned into a company. In 1906 the work having outgrown the capacity of the premises at Chiswick, a site was secured at Woolston, near Southampton, and it was there that all the later destroyers were built. During the War the firm built and engined twenty-nine torpedo-boat destroyers and flotilla leaders, with a total tonnage of 37,210 tons and 957,000 horse-

power, besides some submarines and other vessels. Mention should also be made of the remarkable coastal motor boats which were used with success off the Belgian coast and in the attack of Cronstadt.

A frequent contributor to the *Transactions of the Institution of Naval Architects* and other technical societies, Sir John Thornycroft was elected a fellow of the Royal Society in 1893, and in 1902 received the honour of knighthood. For some years past he has resided at Bembridge, in the Isle of Wight, engaged in the study of the problems in naval architecture to which he has made so many notable contributions. He married in 1870, and had two sons and five daughters. His eldest son, Sir John Edward Thornycroft, the present managing director of the firm, was knighted in 1918.

A DISTINGUISHED naval architect has favoured us with the following appreciation of Sir John Isaac Thornycroft:

Sir John got most of his early technical training from his father, who was a keen amateur engineer with a sound knowledge of mechanical principles. Sir John spent some time at South Kensington and was a contemporary there of Sir Philip Watts. Unlike some of his famous contemporaries, he did not serve an ordinary apprenticeship. He was at the University of Glasgow in the engineering class under Prof. Rankine, and took the natural philosophy class under Lord Kelvin. The class of naval architecture and marine engineering was not then founded, but Prof. Rankine's lectures included much that was the foundation of the science of marine engineering, and young Thornycroft no doubt owed a great deal of his scientific knowledge to the lectures of Prof. Rankine.

Like his co-worker in the development of small high-speed vessels, Sir Alfred Yarrow, Thornycroft began to make high-speed vessels when scarcely out of his teens. He produced the *Miranda*, which attracted the attention of the Admiralty; he built for the Norwegian Government in 1873 a 14-knot boat. Other governments ordered vessels of 18 knots, and the British Government ordered from him in 1878 the first torpedo-boat built for the Navy, the *Lightning*, of 80 ft. length and 18 knots speed. He built this vessel in a small yard on the Thames at Chiswick, and there built many other torpedo-boats, and ultimately the *Speedy* in 1893, which was almost too large for the capacity of the works. Later, the development of the torpedo-boat destroyer, which gradually grew to be too large for the scope of the Chiswick works, caused the acquisition of the present Thornycroft yard at Southampton early in this century, where the traditions of the firm are maintained and where the latest destroyer for the British Navy still holds the high record which has been continuously maintained since Sir John I. Thornycroft first created it in his almost boyhood days.

Thornycroft's early work was associated with the locomotive boiler in ships, but the pressure for higher speed led him to develop the Thornycroft water-tube boiler, which is to-day the steam producer in all the destroyers built by his firm. He devoted himself also to high speed in smaller vessels, and developed the form of small high-speed vessel known as the 'hydroplane,' which by a series of two or more inclined planes in the form of the bottom of the vessel forces her out of the water, and so reduces the resistance and increases the speed. This principle was of great value in the War, and was applied by Thornycrofts in the building of 40-knot coastal motor boats which carried torpedoes and attacked successfully larger ships which their speed enabled them to evade.

Sir John I. Thornycroft had for many years given up the commercial management of the Thornycroft business, and had left it to his son, Sir John E. Thornycroft, devoting himself to the technical and scientific side of ship design and research. He will be remembered as one of the three pioneers in light high-speed vessels and machinery of the last half of the nineteenth century; of the other two, Normand has passed away, but Yarrow is with us still. Sir John I. Thornycroft himself appeared less in the public eye than the other two, preferring the rôle of the scientific worker to that of the commercial man, but his work for his time did not suffer thereby. He was taking a keen interest in engineering and scientific matters to the end.

PROF. LAUNCELOT HARRISON.

THROUGH the untimely and unexpected death of Prof. Launcelot Harrison on Feb. 20 last, at the early age of forty-eight years, Australian zoology has lost one of its most distinguished exponents, and the University of Sydney a brilliant and stimulating teacher, who had made his influence felt both inside and outside the university walls.

Harrison was born at Wellington, N.S.W., in 1880, and was educated at the King's School, Paramatta. Taking up a business career, it was not until 1911 that he found it possible to enter the University of Sydney as a science student. He was already imbued with that profound love of natural history which had been fostered by years of active membership of the Field Naturalist Club and remained with him to the end. After a distinguished undergraduate career, he took the B.Sc. degree in 1913 with first class honours and the University medal in zoology. In the following year he was awarded the John Coutts and the 1851 Exhibition Scholarships and proceeded to Cambridge, where he gained a research exhibition at Emmanuel College and the B.A. degree by research in 1916. In the same year he was selected as advisory entomologist to the Mesopotamian Expeditionary Force with the rank of lieutenant and later of captain, a position he was thoroughly well qualified to fill through his work in Prof. Nuttall's laboratory and by his own investigations on ectoparasitic insects. He did splendid work in the field, but unfortunately he himself fell a victim to both typhus and malaria, and he never fully recovered from their effects.

At the end of the War, Harrison returned to Sydney to the post of lecturer in zoology, and on the death of Prof. S. J. Johnston in 1920, became acting professor, and two years later succeeded to the Challis chair, so long occupied by his distinguished teacher, the late Prof. W. A. Haswell. At the time of his death he was president of the Linnean Society of New South Wales and a member of the Board of Trustees of the Australian Museum, in the affairs of both of which he took a very active interest.

Harrison's scientific work covers a wide field and is of great general interest. As an undergraduate he had already in 1911 read a paper before the Science Society on "The Taxonomic Value of Certain Parasites," in which he discussed the possible value of the parasites in question (the biting lice or Mallophaga which occur on birds and mammals) in the determination of the phylogenetic relationships of their hosts. This same thesis had been put forward by Kellogg in 1896, also in the case of the Mallophaga of birds, and by Zschokke when dealing with the cestodes of South American and Australian marsupials. It formed the mainspring of Harrison's best work, and he selected it under the title of "Host and Parasite" as the subject of his presidential address to the Linnean Society of New South Wales. This address, which he was destined not to deliver, is a most interesting and masterly survey of the whole field of host-parasite relations, in which his own observations (embodied in a series of scattered papers), as well as those of others, are summarised and discussed. His general conclusion is that parasites may quite justifiably be used to aid in the solution of phylogenetic and other problems affecting their hosts. The address (*Proc. Linn. Soc. N.S.W.*, vol. 53, part I.) is worthy the attention of all zoologists.

As the direct outcome of his work in this field, Harrison became keenly interested in the problems of geographical distribution, and in a series of papers dealing with the migration route of the Australian marsupials and the composition and origins of the Australian fauna, he supported the Antarctic radiation theory and contended that Wegener's hypothesis of the origin of continents is the only one which provides a satisfactory explanation of the facts of distribution (Pres. Address, Sect. D, A.A.A.Sci., Perth, 1926). In 1925, with Miss Claire Weekes, he gave an interesting account of the placentation of the lizard, *Lygosoma entrecasteauxi*, a field of investigation which is being worked by Miss Weekes with conspicuous success.

At the time of his death, Harrison had much unpublished work on hand, notably a taxonomic study of the Ischnoceran Mallophaga and a revision of the Australian frogs, and he had begun the study of a rich collection of developmental material of Ornithorhynchus, procured for the Department of Zoology at Sydney by Mr. Harry Burrell. We venture to express the hope that steps will be taken to ensure that his observations on this priceless material are completed for publication, with adequate illustrations.

Harrison was a man of distinctive and vigorous personality, wide in his outlook and interests. He had the capacity of inspiring his students with the research spirit, and not the least of his services to Australian zoology was his establishment of a vigorous research school in Sydney. Though often incapacitated by attacks of acute arthritis, he carried on his work with cheerful fortitude to the end, which came quite suddenly as the result of cerebral hæmorrhage. We tender our sympathy to his widow (Amy E. Mack), who shared so largely in his interests and in his life's work. J. P. H.

News and Views.

THE past week has witnessed the three-hundredth anniversary of the birth, on July 12, 1628, of Henry Howard, who, in 1677, became sixth Duke of Norfolk, on the death of his brother Thomas. The Royal Society recalls him as the donor of a great library of rare books and manuscripts; the University of Oxford for the bestowal of the Arundel marbles. Originally the library was at Arundel House, in the Strand; afterwards at Gresham College. Howard was elected a fellow of the Royal Society on Nov. 28, 1666, through his acquaintance with John Evelyn. Many important influences were in fact established by means of the friendship. Evelyn himself tells us that it was at his instigation that Mr. Howard granted the Society use of rooms in Arundel House, whilst Pepys writes, under date Jan. 9, 1667, "To Arundel House, when first the Royal Society meet by the favour of Mr. Henry Howard, who was there. And here was a great meeting of worthy noble persons; but my Lord Brouncker, who pretended to make a congratulatory speech upon their coming hither, and great thanks to Mr. Howard, did do it in the worst manner in the world."

HOWARD had travelled much before the Restoration, and in the year 1645 had met Evelyn at Venice. Finally, in 1655, he settled at Albury, Surrey, a home at which the diarist was a frequent visitor. In 1662—the year of incorporation of the Royal Society—Howard's first wife died, and for long he was subject to melancholia, and given to dissipation. The strictures of Evelyn as to Howard's neglect of notable and choice inherited possessions were doubtless well deserved, but in kindly extenuation we suggest that this indifference was the reflex of his unhappy moods and habits. In 1664, Howard left London for Constantinople. An entertaining account of his doings was published by one, John Burbury, in 1671, entitled "A Relation of a Journey of Lord Henry Howard (afterwards Duke of Norfolk) from London to Vienna, and thence to Constantinople," 12mo. In 1669, Howard went as ambassador-extraordinary to Morocco. In 1677, the year previous to a second marriage, he succeeded his brother Thomas as the sixth Duke of Norfolk. He died on Jan. 11, 1684, and was buried at Arundel. There is a portrait of Henry Howard, by Sir Peter Lely, in the National

Portrait Gallery, and an engraving from this portrait is also in existence.

DURING the past thirty years the centre of interest in zoology has moved from classical morphology to those studies concerned with function which are carried out on living animals. Experimental morphology, genetics and the cytological studies which are linked up with it, animal behaviour and the very varied investigations which may be called comparative physiology, now form the great bulk of the zoological work of the world. These investigations have to be carried out under controlled conditions, maintained by methods which have to a considerable extent been discovered by physiologists. The interpretation of their results demands a wide knowledge of other sciences; both physics and bio-chemistry are constantly involved, physiological conceptions form the foundation of many lines of research, and psychology and neurology have the most intimate association with the study of animal behaviour. Thus a modern zoological institute must make provision for keeping animals alive, in good health and under controlled conditions. Its staff must include men who have very varied interests and a familiarity with the methods and ideas of many other sciences. Its work will be made much easier if it be housed in the closest association with active schools of chemistry, physiology, anatomy, and psychology, so that first-hand information about these sciences is always available.

THE conditional gift of £120,000 to University College, London, which has recently been announced, is intended to enable that institution to carry out a scheme for the establishment and endowment of a modern department of zoology, comparable in size with the existing departments of physiology and anatomy. It is intended to erect a suitable new building directly continuing that in which anatomy is housed and to provide the necessary equipment. The staff of the department of zoology will be enlarged by the addition of professors of genetics and comparative physiology, and readers in cytology and animal behaviour, and full provision will be made for the necessary technicians and for the heavy expenses of modern zoological work.

THE attempts to rescue the Italian airmen stranded by the wreck of the *Italia* off North-East Land, Spitsbergen, continue, and search is also being made for the lost French aeroplane with Captain Amundsen on board. General Nobile, who was rescued by aeroplane from the pack-ice, has made a statement, published in the *Times*, about the probable cause of the disaster. Although he had a suspicion that one of the valves in the stern of the airship was leaking, he thinks that the wreck was due to a tear in the envelope. After the *Italia* struck the ice and several of the crew and a considerable weight of material were thrown out, it rose rapidly and disappeared among the clouds to the south-east. General Nobile does not think that the *Italia* could have remained in the air more than an hour longer or travelled more than twelve to eighteen miles. This indicates the area that should be searched for the missing men. Twenty minutes after the accident a column of dense black smoke was seen by several of the crew on the horizon to the east. If this was the burning airship, there is no hope for the men on board. It may, however, have been caused by burning oil and petrol if the tanks had been thrown overboard in order to act as a brake on the fall of the ship. General Nobile inclines to this view, and hopes that the wreck of the vessel may still be found with the men alive; but the hope is faint.

A BRIEF account is given in the *Times* of July 2 of the *Palio* festival held at Siena on the preceding day. This year the procession was particularly splendid. New 'properties' had been provided. Representatives of the seventeen streets marched in procession, on this occasion for the first time with representatives of the old military companies which existed before the fall of the old Republic. A new ox-drawn cart took the place of the old *carroccio*. It was decorated with allegorical banners, and bore the old standard of the commune and four biccharina, the magistrates who once presided over all festivals. Horses representing ten out of the seventeen streets competed for the silken banner and silver plate. The Sienese *Palio* is one of the best known of the summer processions of the Italian towns. The *Palio* from which it takes its name is a canopy which used to be presented by one of the lords of the town as the civil contribution, just as the *Ceri*, huge poles of wood, wax, or other material, to which a phallic origin has been attributed, were the contribution of the ecclesiastical authority. The *Palio* is thought to be the cloth with which the image of the god was covered when it was carried in procession around the commune in the pagan ceremony from which these processions are descended. The *Carroccio*, which is always the principal feature, was in early times the holy war chariot of the community, which, after being blessed by the Church, always headed the warlike expeditions of the State. It is usually regarded as a survival of the cart in which the Aryan-speaking peoples, we are told, carried their gods. It is not without significance that dolls were sometimes attached to the cardboard *Ceri* of Florence.

THE annual special issue of *The Chemist and Druggist*, published on June 30, contains, in addition to its usual items, a number of interesting articles relating to the history of medicine and pharmacology. Dr. Charles Singer contributes a paper on Celtic and Anglo-Saxon medicine and pharmaceutical practice from the ninth to the thirteenth centuries, in which he gives an account of the ancient leech books, sympathetic magic, and Anglo-Saxon medicine, including plant lore. Among the numerous excellent illustrations accompanying the article, special attention may be directed to two beautiful coloured plates, one showing the debt of Anglo-Saxon medicine to the classics and portraying Cheiron the Centaur receiving the Book of Wisdom for Plato in Saxon costume, and the other representing pharmaceutical processes in a MS. of the early thirteenth century. A short paper

by Mr. Howard Bayles on an Elizabethan chemist is illustrated by a transcript of the earliest known reference to a chemist in business contained in a letter dated 1596, by John Delabere, an Oxford physician. Mention may also be made of anonymous papers on Raleigh's chemical and galenical experiments with facsimiles of the recipes prepared by him during his imprisonment in the Tower of London, a sketch of the history and development of the drug trade in London from the time of the Roman Empire until the present day, accompanied by numerous contemporary prints, and notes on the history of Cheltenham, which is to be the seat of the British Pharmaceutical Conference on July 23.

THE Mexican earthquake of June 16, which all reports describe as very severe (NATURE, June 23, p. 994), originated, according to the U.S. Coast and Geodetic Survey, in a centre in 14° N. lat., 95·5° W. long. (*Daily Science News Bulletin*, No. 378 A, Science Service, Washington, D.C.). This point lies in the Pacific Ocean, about 125 miles south of the coast of the State of Oaxaca, not far from the isthmus of Tehuantepec, in which great damage is said to have occurred, and 460 miles from the city of Mexico, where some poorly built houses were injured. The Survey also reports a severe earthquake on Mar. 22 in a centre not far from the above, and two other shocks in the same region on April 13 and 17. One of the latter broke open a tomb in the city of Monte Alban, near Oaxaca, revealing valuable jewels, which it is believed will throw light on the prehistoric races of the country.

THE Nederlandsche Chemische Vereeniging is celebrating the twenty-fifth anniversary of its foundation on July 15–17, and we offer the Society our hearty congratulations and good wishes for a successful meeting. The festivities will take place at The Hague immediately before the meeting of the International Union of Pure and Applied Chemistry. The president of the Nederlandsche Chemische Vereeniging is Prof. S. C. J. Olivier (Wageningen), and the honorary secretary is Dr. A. D. Donk (Haarlem). Honorary membership is to be conferred at the anniversary meeting on several foreign chemists, including Prof. F. G. Donnan, professor of general chemistry in the University of London. It will be remembered that the activities of this important association include the publication of two valuable chemical journals, the *Chemisch Weekblad* and the *Recueil des Travaux chimiques des Pays-Bas*.

AN expedition to the Labrador coast and Davis Strait in connexion with the Ice Patrol of the U.S. Coast Guard is announced in a recent *Daily News Bulletin*, issued by Science Service of Washington, D.C. The steamer *Marion*, under Lieut.-Com. E. H. Smith, U.S.N., will carry this oceanographical expedition, which will be principally concerned with studying currents, in the hope of throwing more light on the drift of icebergs. It is also announced that the Danish Government steamer *Godthaab*, in command of Com. Riis-Cartensen, will be conducting oceanographical work this summer in West Greenland waters.

A MELANCHOLY interest attaches to the paper "On Some Biological Principles" (*Kgl. Danske Vidensk. Selskab.*, Biol. Meddel., **7**, 2; Copenhagen, 1928) by Dr. C. G. Joh. Petersen; it was his last work, and marks the end of a long and distinguished career. Since retiring a year or two ago from the directorship of the Danish Biological Station and from active participation in the fishery researches in which he was an acknowledged pioneer and master, Dr. Petersen paid close attention to the philosophical side of biology, and worked out for his own satisfaction a viewpoint which for the time being he felt to be adequate. This point of view is stated in his paper with that simplicity, clarity, and directness which was so characteristic of the man. Dr. Petersen was greatly impressed by the philosophy of Huxley: he held that the mechanistic method should be pushed as far as it would go, and that, as a method, it was more strictly 'scientific' than any other. He recognised, however, that it had severe limitations, and he urged that it must be supplemented by the 'principle of the whole,' which he understood much in the sense established by Kant. This principle could not, he considered, be used for explanation, but only for description and orientation. He held, nevertheless, that it was of great importance and wide application in descriptive biology. He admitted also a third point of view—the psychological—but considered this applicable only to the study of the behaviour of the higher animals, and even there to be used with caution. His paper is one which should be read by all who are interested in the question of biological method. It is the adventure in philosophy of a biologist of long experience and great breadth of view.

AN international illustrated fertiliser review, under the title *Superphosphate*, is being issued by the Superphosphate Manufacturers' Association as a monthly journal. Hitherto the Association's publications have not been available to the general public, its object having been to convey information to its members only. The present aim, however, is to provide a journal by means of which all agricultural scientific workers and practitioners may become acquainted with the work carried out at the Hamburg-Horn Experimental Station, and further to quote the more important information with regard to the utilisation of superphosphate and compound fertilisers from the official reports of the various chemical agricultural research stations of the world. In the first number, a detailed account is given of the comparative pot experiments carried out at Hamburg-Horn with superphosphate and various compound phosphatic fertilisers, barley and oats being the crops grown. The development of the plants is traced from germination to harvest, the superiority of those dressed with superphosphate being made clear throughout. A continuation of this report is to be given in the next number, where it is to be hoped that some form of tabulated summary will be appended, as the reader will find some difficulty in making a general review of the work as it is in diary form. Two lectures on the phosphoric acid question, delivered

at the 1928 meeting of the German Agricultural Society at Berlin, are reported, and notes of interest from other sources quoted. The journal is calculated to reach a cosmopolitan circle of readers, since it is published in columns of English, French, and German.

THE issue for June of *Antiquity* fully maintains the high standard in editing and in the interest and quality of its contributions, which so soon have gained for this periodical a place unique among magazines dealing with scientific subjects. It appeals to laymen without special knowledge, as well as to the scientific worker who wishes to keep abreast of recent developments outside his own special branch. In this issue Dr. D. Randall-MacIver continues his study of the early civilisations of Italy, a paper to which fuller reference is made elsewhere in this issue (p. 72), and Admiral Somerville describes two dolmens in the neighbourhood of Tours. Mr. Eric Thompson discusses the 'diffusionist' theory in relation to Central America, concluding that if extravagances are ignored, there is a case to be met, and that there are elements in late old empire times which have an Asiatic air when stripped of their purely Maya features. Mr. O. G. S. Crawford writes on 'Our Debt to Rome?' tracing the history of Cranborne Chase and Grovely Forest from early to Elizabethan times, in relation to the question of continuity through the hiatus between A.D. 400 and A.D. 600. Excavations at Cyprus are described by Dr. Einar Gjerstad, and at Beisan by Dr. Alan Rowe. Mr. George H. Bushnell contributes an article on the Alexandrian Library. Some excellent notes on current and recent events in the archæological world, and a number of reviews, complete a highly interesting number.

THE annual conference of the German Bunsen-Gesellschaft für angewandte physikalische Chemie was held in May at Munich under the presidency of Dr. A. Mittasch of Ludwigshafen. The retiring president, Prof. K. Fajans, opened the proceedings on May 17, and during the next two days more than forty papers were read on subjects which covered a very wide range. Useful abstracts of many of these communications will be found in the *Chemiker-Zeitung* for May 26 and June 2. Prof. Sommerfeld lectured upon the use of atomic models, whilst many of the papers dealt with the various types of chemical combination, viewed under widely different aspects. Thus Dr. N. V. Sidgwick lectured on co-ordination and the electronic theory of valency, whilst Dr. F. Hund discussed combination from the point of view of the quantum theory. Prof. Debye dealt with electric moments of molecules and intermolecular forces, and also with the conductivity of strong electrolytes. Prof. Scheibe examined the evidence obtained from light absorption, whilst X-ray spectra were dealt with by Dr. O. Stelling, electrical conductivity by Prof. v. Hevesy, and the deformation of ions and molecules as deduced from refractometric measurements by Prof. Fajans. Amongst the many other topics were papers by Prof. Hönigschmidt on the atomic weight of silver, by Dr. Noddack on the chemistry of rhenium, and by Prof. Paneth on the age of meteorites calculated from their content of helium. Prof. Bodenstein of Berlin was elected to preside at next year's annual conference to be held in Berlin.

IT was in September 1852 that Foucault first showed the Paris Academy of Sciences how the rotation of the earth affected a gyroscope, and for half a century afterwards the gyroscope remained nothing but a piece of scientific apparatus. Its practical development has taken place in the last twenty-five years, and it is to-day used for navigation, for gunnery, for torpedoes, and for stabilisers. Ships are nowadays actually maintained on their course by the gyro compass itself, and in a recent issue of the *Sperryscope* it is stated that the s.s. *Pulpit Point* was kept on her course, S. 38° W., from San Francisco to Auckland during a voyage of 21 days entirely by the gyro compass. In the same issue is a note on the world's largest motor yacht, *Savarona*, 294 feet long, 2200 tons displacement, which during its maiden trip from the Delaware River encountered a severe gale, during which the rolling of the vessel was reduced from 26° to about 6° by means of the gyro stabiliser. In this vessel a gyro compass is used for navigating, the gyro stabiliser reduces the rolling, a small gyroscope controls the stabiliser, and on the trial a gyro-roll recorder, designed about fifteen years ago, recorded the rolling.

IN 1875, Prof. W. C. McIntosh published a volume entitled "The Marine Invertebrates and Fishes of St. Andrews," which has been of much use to successive generations of Scottish marine zoologists. Now, after the lapse of more than half a century, the veteran author, with help from some of his pupils and other friends, has compiled a volume of "Additions to the Marine Fauna of St. Andrews since 1874" (London, 1927). Like its predecessor, this volume is largely reprinted from papers that have appeared in the *Annals and Magazine of Natural History*. The three coloured plates illustrate some of the more striking forms that have occurred in the plankton. Naturally, some groups have received more attention than others. Prof. McIntosh's notes on the annelids are, of course, especially valuable, Mr. E. T. Browne has assisted in compiling the list of Coelentera, and Dr. W. Nicoll contributes an important list of parasitic worms, with the names of their hosts.

IN commemoration of the gift of £200,000 by the late Mr. H. H. Wills for the erection of the new Physical Laboratory in the University of Bristol, the Council has decided to found a Henry Herbert Wills Memorial Lecture in Physics to be delivered annually in the University. Sir J. H. Jeans has consented to give the first lecture, for which the date, Oct. 30, has been provisionally fixed.

REFERRING to a remark in the review of Forel's "The Social World of the Ants compared with that of Man," published in NATURE of May 26, Mr. J. B. S. Haldane points out that the observation that the size of insects is limited by their respiratory system, which works by diffusion, which was attributed to him by Prof. J. S. Huxley, was due to Prof. August Krogh.

THE Hector Medal and Prize of the New Zealand Institute for 1928 has been awarded to Prof. D. M. Y. Sommerville, of Victoria University College, Wellington, for his general mathematical work and for his investigations in non-Euclidian geometry. The medal is given yearly for distinction in different branches of science in rotation, in memory of the late Sir James Hector. This year the subjects of award were astronomy, mathematics, and physics.

THE Council of the Institute of Metals has accepted an invitation from the Verein Deutschen Ingenieure and the Deutsche Gesellschaft für Metallkunde to hold next year's autumn meeting of the Institute at Düsseldorf, in Germany. Düsseldorf is so readily accessible, and so full of interest for metallurgists, that the meeting, the first to be held in Germany by the Institute of Metals, is certain to be well attended and successful, supported as it will be by powerful German technical societies and by a large and enthusiastic German membership.

AT a meeting held on July 3, the council of the Institution of Professional Civil Servants unanimously adopted the following resolution: "The Council of the Institution of Professional Civil Servants, realising that the construction and maintenance of the architectural and engineering works controlled by Government Departments calls for the employment of highly qualified and experienced quantity surveyors, is of opinion that the attempt of the Air Ministry to recruit Assistant Surveyors from candidates who are below the age of 25 and are not required to have obtained by examination the appropriate professional diploma in quantity surveying, is calculated to lower the status of the surveying profession in the Civil Service and is contrary to the public interest."

THE thirteenth International Physiological Congress will meet at the Medical School of Harvard University, Boston, Massachusetts, on Aug. 19–23, 1929. The Federation of American Societies for Experimental Biology, which comprises the American Physiological Society, the American Society of Biological Chemists, the American Society for Experimental Pathology, and the American Society for Pharmacology and Experimental Therapeutics, will be hosts to the Congress, and Prof. William H. Howell, of Johns Hopkins University, will be the president. The arrangements for the Congress are in the hands of Prof. Walter B. Cannon, of the Harvard Medical School, who is chairman of the Congress Bureau, and Prof. Edwin J. Cohn and Alfred C. Redfield, who are the secretaries.

THE second International Congress of Radiology is to be held during this present month at Stockholm. There is little doubt that this will prove to be a very important gathering of X-ray workers from all parts of the world. In conjunction with the Congress an exhibition of apparatus is to be held in the Parliament House at Stockholm, and an important feature will be an exhibit of British-made X-ray apparatus, which is being contributed by the leading firms in this industry. Considerable importance is attached to this exhibit, for it is the first occasion on which it has been possible for British manufacturers to show their products on a large scale at such a congress outside Great Britain. The X-ray apparatus industry was, up to 1914, mainly in the hands of other countries. Since that time it has become established in England, and the present occasion gives indication of its steady growth and of the hope that at no distant future, Great Britain and the British Empire will be self-supporting in this important branch of scientific investigation. Particulars of the Congress can be obtained from the British Institute of Radiology, 32 Welbeck Street, London, W.1.

A USEFUL survey and index of statistics appearing in official publications issued in 1927 is provided by volume 6 of the annual *Guide to Current Official Statistics* issued by H.M. Stationery Office. Statisticians, economists, social workers, and other investigators will find that the *Guide* saves much labour in hunting up statistical references in government publications.

MR. W. H. ROBINSON, 4 Nelson Street, Newcastle-on-Tyne, has sent us a copy of his catalogue (No. 21) of "Old and Modern Books," comprising more than 1000 volumes dealing with bibliography, English and foreign literature, voyages, and travels. Copies can be had upon application to the bookseller.

THE second annual report for 1927 of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W.15, gives an account of some of the activities of the Institute. These include propaganda work on malaria control, and researches in the laboratories by Dr. Menon on the effects of Paris green on the aquatic stage of mosquitoes, on fungi and fungal diseases by Sir Aldo Castellani, and on the changes in the blood and tissues in cancer with reference to diagnosis and treatment by Dr. Shaw-Mackenzie. During the year, 73 in-patients were treated in the hospital, and an extension of accommodation is much needed. The balance sheet shows that the annual subscriptions have increased by only £200, and additional subscriptions and donations are necessary to develop the work of the Institute.

MESSRS. Ogilvy and Co., 20 Mortimer Street, London, W.1, have for disposal at reduced prices a number of second-hand and shop-soiled microscopes and microscopical accessories, microtomes, hæmacytometers, cameras, and other instruments and apparatus by Messrs. Leitz and other well-known makers. Catalogues may be obtained on application to Messrs. Ogilvy and Co.

A FURTHER catalogue (No. 196) just received from the enterprising firm of Max Weg, of Leipzig, contains details of a very large stock of literature and maps relating to the geology of Germany. Its 10,058 items, which fill 296 pages, are classified geographically in 22 sections, and range from short 'separates' to long runs of periodicals. The prices appear very reasonable, and both this and the several other catalogues recently issued by the same firm should prove very

helpful to the student endeavouring to get together the literature of some particular branch of geology.

MESSRS. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, have just circulated an important catalogue (No. 417) of upwards of 1800 second-hand works on zoology and geology, classified as follows: general works, zoology (anatomy, anthropology, arachnida, conchology and mollusca, crustacea, entomology, ichthyology, mammalia, ornithology, reptilia, echinodermata, infusoria, polyzoa, zoophytes, microscopy, etc.), geology, palæontology, etc. The list includes the entomological library of G. T. Bethune-Baker and a selection from the library of W. de Selys Longchamps.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An honorary lecturer on tropical diseases at Westminster Hospital Medical School, S.W.1—The Dean, Westminster Hospital School of Medicine, 12 Caxton Street, S.W.1 (July 16). A research studentship at St. Mary's Hospital, Institute of Pathology and Research—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W.2 (July 17). A teacher of engineering and allied subjects at the Barnstaple and Bideford Technical Schools—The Secretary, County Education Office, Exeter (July 19). A head of the mechanical and civil engineering department, and a lecturer in the same department of the Sunderland Technical College—The Chief Education Officer, Education Offices, 15 John Street, Sunderland (July 20). An assistant lecturer and demonstrator in organic chemistry at East London College—The Registrar, East London College, Mile End Road, E.1 (July 31). A lecturer in economics in the United College of St. Salvator and St. Leonard, St. Andrews University—The Secretary and Registrar, The University, St. Andrews (Aug. 31). An assistant lecturer in geography in the University of Bristol—The Secretary, The University, Bristol (Sept. 10). An inspector under the Fertilisers and Feeding Stuffs Act, 1926, and assistant agricultural analyst, under the Devon County Council—The Clerk to the Devon County Council, The Castle, Exeter. A graduate in engineering subjects for the Dursley Secondary School and Evening Institute—The Headmaster, Secondary School and Evening Institute, Dursley, Gloucestershire. Part-time teachers in gas fitting (calculations and drawing), building construction, and science for builders at the Erith Technical College—The Principal, Erith Technical College, Belvedere, Kent. A full-time assistant master to teach engineering and workshop practice at the Kingston-upon-Thames Technical College—The Principal, Technical College, Kingston-upon-Thames.

Our Astronomical Column.

MIRA VARIABLES AND THE MILLIKAN RAYS.—Mr. Axel Corlin, of the Lund Observatory, suggested some time ago that the variation in intensity in the Millikan rays according to the R.A. of the meridian might be due to the rays coming, either wholly or partly, from Mira variables when near maximum. He found a theoretical curve from the maxima of known stars of this type, the date chosen being Sept. 12, 1926. This curve fell below the observed intensity of the rays in the region R.A. 16^h to 23^h. In reply to some objections raised, he returns to the subject in *Astr. Nach.*, No. 5566, using a larger list of Mira variables and including all that were within a quarter period of light maximum on the chosen day. He has thus secured a closer agreement with observation. He considers that the observed variation of intensity with sidereal time shows that the rays come from definite centres in the heavens; these centres may be either Mira stars or unknown cosmical clouds

FAMILIES OF ASTEROIDS.—Prof. K. Hirayama announced in 1922 his detection of five families among the asteroids, the members of each family having such closely related orbits that it was conjectured that each family might have arisen from the separation of a single body. He contributes another article on the subject to the *Japanese Journal of Astronomy and Geophysics*, vol. 5, No. 3. He uses later determinations of elements, and corrects his former values to a small extent, but the conclusions as regards the five families remain unchanged. He now adds five new families, of which one, named after Phocæa, has eleven members, but the others are very small. The Desiderata family has five, the Pallas family three, while the remaining families have two each. These last have small perihelion distances, and approach the earth fairly closely. Æthra and Ganymed are linked together, also Albert and Alinda; the resemblance between the orbits of the last two had been noted by others. Incidentally, a principle of asteroid nomenclature was violated here. It was agreed that asteroids with exceptional orbits should have masculine names. This principle was carried out in Albert's case but not in that of Alinda.

SOLAR HYDROGEN FILAMENTS.—The dark filaments of the sun's upper atmosphere are now regularly observed at several solar observatories by means of spectroheliographs working at a limited portion of the middle of the spectrum lines of calcium, *H* or *K*, or of the hydrogen line, *Hα*. In a recent publication, *Annales de l'Observatoire de Paris, Section de Meudon*, Tome 6, detailed charts of dark filaments, together with tables, are given for the period March 1919–January 1920. Each chart, which embodies the observations extending over one rotation of the sun, shows sunspots, calcium flocculi, and dark filaments, thus affording an instructive comparison between these different phenomena. The solar latitude and longitude of these objects, which are traced in outline, can be easily read off from the charts. By a suitable notation other details of the filaments are given concerning their growth, duration, and movement.

A glance through the charts shows very clearly the chief characteristics of the dark filaments: namely, (1) their much longer life as compared with sunspots; (2) their distribution in solar latitude, both within the spot zones (where, however, they frequently appear apart from the spots) and also in high latitudes; (3) their great extent in longitude; (4) their marked inclination to the sun's equator. It is generally accepted that prominences and filaments are one and the same thing, the former being seen in silhouette at the sun's limbs, the latter as dark markings projected, whilst in transit, against the more brilliant background of the disc. An extended series of these charts would be of great use to those who study the relationship between various solar phenomena and also to those interested in solar-terrestrial relationships.

Research Items.

FORERUNNERS OF THE ROMANS.—Under this title Dr. D. Randall-MacIver continues in *Antiquity* for June the study of the early civilisations of Italy, which he began in the issue of that periodical for June 1927. At about 1000 B.C., that is, about the beginning of the Iron Age and two centuries before the effective coming of the Etruscans, northern and central Italy may be partitioned into five distinct spheres. The north-west is occupied by the Comacines, part of Venetia by the Atestines, the Bolognese region by the northern Villanovans, Tuscany and a part of Latium by the southern Villanovans, east of the Apennines, from Rimini to Aufidena, the Adriatic coast, and the central Apennines are held by the Picenes, including some of the Samnites and some Umbrians. The first four are related and practise cremation; but the Picenes are of wholly different origin and practise inhumation. In several parts of the country these civilisations maintained an independent existence down to the fourth century B.C. The most important contribution to the early Iron Age culture of Italy was undoubtedly that of the two Villanovan nations, and in Etruria the Etruscans owed more to them than has been appreciated. They were the pioneers in metal-working, and it was to their coppersmiths that the Etruscans owed their supremacy in the metal trade of the Mediterranean. The highest point of the Atestine culture of Venetia is between the seventh and fifth centuries. They were probably the latest of the cremating nations to settle in Italy. Originally they were closely related to the Villanovans and kept in close touch with them. The Picenes, it is suggested, are the descendants of the original neolithic population, who above all were warriors—a reef against which Villanovan and Atestine migration beat in vain.

A MAORI FEEDING FUNNEL.—In the *Museum Journal* (Philadelphia) for March, Mr. R. U. Hall describes a feeding funnel now in the University Museum which was used for administering liquid food to persons who were undergoing the process of being tattooed. It is roughly in the form of an inverted cone, distorted so that the slope of one face was longer, or developed more gradually than that of the other. Each of these two faces led to a grotesque and distorted human figure on the rim of the funnel. Most of the published examples of such funnels are almost entirely covered with the characteristic Maori scroll and spiral ornament. The present example differs in that the ornament is confined to the two faces mentioned and the side and top of the rim. It is also more slender and graceful in form, while the rim is a shelf-like projection. It shows the tool marks of the stone implement with which it was carved, and is therefore of a considerable age. It is suggested that it is the work of a talented amateur rather than a professional wood carver. The figures are male and female, and differ in their method of representation. The head of the male figure is carved on the rim of the funnel, and its body and limbs appear on the tubular portion of the vessel, being built up of a number of spirals and concentric arcs of circles. The hip ornaments represent the *rape* or buttock pattern of the body-tattoo. The place occupied by the face, being too small for a realistic representation of the tattoo pattern, is filled in with concentric arcs. The female figure, in contrast, is carved wholly on the rim, the limbs and body being distorted to fit, mainly on an undercut downward extension of the rim, so that the whole figure is contained in a lozenge-shaped space. A second difference, one following the custom of real life, is that the face is undecorated except for the woman's tattoo confined to the lips and sides of the chin.

THE GESTALT THEORY.—The May issue of *Scientia* (vol. 43; 1928) contains a discussion on the *Gestalt* theory, in which Prof. E. Rignano and Prof. Köhler attempt to interpret one another's points of view. Prof. Köhler is one of the most enthusiastic workers in this field, and he includes under the word *Gestalt* "those structures which as wholes possess specific properties and therefore can with good right be regarded as unities." Some exponents are primarily concerned with the problems of the perception of 'shape,' but others have extended it to cover most of the operations of sensory perception. This results in a certain ambiguity of expression, and considerable divergence of opinion even among the supporters of the theory, who would seem to be agreed on but one thing, namely, to oppose the associationist school of psychology. Prof. Rignano supports the older view; he has difficulty in reconciling the different usages of the word *Gestalt*, and also finds the theoretical consequences confused. Prof. Köhler answers him with a very clear exposition of his point of view. The English reader who has been familiar with the discussion in somewhat modified form in Prof. Stout's writings, and later in Prof. Spearman's, cannot avoid the feeling that the disputants are dealing with different aspects of the problem, or at least seeing it in different perspectives. There is much experimental evidence in favour of the *Gestalt* hypothesis, but 'hypothesis' would still be logically more correct than 'theory' as a description of the system.

TRITRICHOMONAS FECALIS.—This was found by L. R. Cleveland (*Amer. Jour. Hygiene*, vol. 8, No. 2; 1928) in human fæces which had been in tap water from 15 to 25 days. It could not be demonstrated in the fæces before they were placed in water, but by heating one-half of a stool and placing it in water while the other half not heated was placed in sterile tap water in a sterile jar, it was shown that the organism was in the fæces, for in five experiments it was never obtained from the heated portion of the stools but invariably from the unheated portion. Heating of the fæces did not render them unsuitable for the growth of the Trichomonas, because it grew in them when added from other cultures. It has been maintained for three years in fæces placed in tap water, and will grow in any fluid which supports bacterial growth. It will ingest red blood cells, yeasts, and starch grains, but cannot live on red blood cells without bacteria. When grown anærobically in pure cultures of certain bacteria, the Trichomonas becomes exceedingly abundant. Multiple fission was constantly taking place, and it was found possible to induce this at will by crowding the organisms—this is the first record of multiple fission in a human trichomonad. Examples with from three to at least one hundred nuclei were observed. Trichomonads of many animals were placed in fæces diluted with tap-water, but none grew except *Tritrichomonas augusta* from the frog. *T. fecalis* is less than half the size of *T. augusta*, and differs from the latter in having no granules in the axostyle or in the cytoplasm.

PHOTOSYNTHESIS OF DIATOM CULTURES IN THE SEA.—Continuing their excellent work based in the Millport Marine Station, Miss S. M. Marshall and Mr. A. P. Orr report on experiments carried out with cultures of diatoms contained in glass bottles suspended in the sea (*Jour. Mar. Biol. Assoc.*, **15**, 1;

1928). A persistent culture of *Coscinosira polychorda* was used. The bottles containing the cultures were suspended at various depths, some exposed to light, others covered. The 'compensation point,' at which the amount of oxygen produced by photosynthesis is balanced by the amount used in respiration, was found to lie at a depth of 20-30 metres in summer. In winter it is close to the surface in coastal water. The optimum position for photosynthesis is never at the surface, even in winter, but some metres down. The experimental results are carefully considered in relation to the similar work of Gaarder and Gran and the authors' own researches in Loch Striven, and add much to our knowledge of this fundamental question.

NITRATE IN THE SEA.—H. W. Harvey continues (in *Jour. Mar. Biol. Assoc.*, **15**, 1; 1928) his interesting studies on the occurrence and seasonal variation in the English Channel of this important limiting factor in plant production in the sea. He confirms his previous conclusion that the nitrates are almost entirely utilised by phyto-plankton in the summer and are re-formed in early autumn. Regeneration takes place in the deeper layers, but the exact mechanism is not yet known. The interesting observation is made that the effect of land drainage on the quantity of nitrate is apparent for only a few miles from shore, and most of the nitrate entering Plymouth Sound in river and estuarine waters is used up by plants before it reaches open sea, at least in summer.

PLANT GENETICS.—Crosses have been studied by Dr. R. J. Chittenden (*Jour. of Genetics*, vol. 19, No. 3) of a number of *Primula* species, Vesicales section, including *P. Juliæ*, *P. acaulis*, *P. elatior*, and *P. officinalis*. All have as chromosome number $n=11$. Their hybrids are very fertile, with highly regular reduction divisions. The *Godetia* species studied fall into two groups: (A), including *G. amœna* and *G. Whitnegi* ($n=7$), intercross, but the hybrids are highly sterile; (B), containing *G. Bottæ* ($n=9$), *G. tenella* ($n=16$), and *G. lepida* ($n=26$). *G. Bottæ* will cross with *G. tenella* and the latter with *G. lepida*, but the hybrids are sterile. Groups (A) and (B) will not intercross. Six species of *Nemophila* ($n=9$) were also studied. Although four of the species are closely allied, they all refuse to intercross. Nevertheless, from a study of their variations, conclusions are reached regarding their probable genetic composition. In the genus *Phacelia* four species were examined ($n=11$). Two of the species were sterile with all the others, but the other two (*P. Parryi* and *P. Whitlavia*) may belong to the same species. Numerous parallel variations were found in the various genera. Thus in *Primula*, the pin and thrum types are present in all these species. Mauve and white flowers occur in two of the species of *Godetia*. Two species of *Nemophila* have a spotted and a uniform corolla colour, while in *Phacelia* two species have white and purple varieties. These variety characters show the same relations of dominance or recessiveness in different species of the same genus, for example, thrum being always dominant to pin, and the semi-glabrous condition of *P. Juliæ* dominant to the hairy condition in other species. A curious case is the occurrence of plants heterozygous for an inhibitor of a character which is not found in the species but is present in related species.

NEW SOURCE OF DIAMONDS IN SOUTH AFRICA.—In addition to the kimberlite pipes and derived gravels which constitute the source of most of the South African diamonds, the Witwatersrand bankets and the Upper Triassic Forest Sandstone are also known to be diamondiferous. A further occurrence in the chert beds of the Dolomite series (Transvaal System) has now been recorded by David Draper in the *Trans. Geol. Soc. S. Africa*, vol. 30, pp. 57-68; 1928. Following the marine transgression which led to the deposition of the great Dolomite series, a temporary regression of the sea made possible the formation of breccias and conglomerates from the newly exposed cherts and dolomites. At this time the diamonds were introduced from an adjoining elevated land surface, just as at the present time in Brazil and Borneo diamonds are being transported to lagoons and shore-lines where coral reefs are in process of formation. The productive fields are in the Lichtenburg and Ventersdorp districts in the south-western Transvaal, and their importance may be realised from the output for November 1926, which amounted to above 120,000 carats, valued at more than half a million sterling. Corundum occurs in the concentrates, suggesting that the ultimate source may have lain in the north-eastern Transvaal, where possibly it has been since obliterated by the intrusion of the great Bushveld complex.

THE UPPER ATMOSPHERE.—*Die Naturwissenschaften* for May 4 contains an interesting summary of our present knowledge of the upper layers of the earth's atmosphere, in an article (with brief bibliography) by J. Bartels. The sources of information touched on are very varied—meteors, luminous high clouds, auroræ, ozone, long-distance propagation of sound, terrestrial magnetic variations, and radio propagation; the extent to which the temperature, density, pressure, composition, and ionisation of the upper layers can be considered known is indicated.

THIN METALLIC FILMS.—In a recent issue (No. 8) of the *Annalen der Physik*, E. Rupp has described a neat method for preparing extremely thin foil. A small piece of metal is put in a tungsten boat in a vacuum furnace, and after preliminary purification *in situ*, part of it is distilled on to a highly polished rock salt plate. Heating is arrested when a sufficient quantity has been deposited, and the rock salt then transferred to a salt solution, where it dissolves and leaves the metal floating in the liquid, from which it can be lifted on a frame. Layers as thin as 10^{-6} cm., free from holes, can be prepared and handled in this way, and have been used for studying the diffraction of slow electrons by the Debye–Scherrer X-ray method, in a modified Ramsauer apparatus.

PHOSPHORESCENCE.—Prof. R. W. Pohl has given a valuable summary of some of the electrical and optical properties of phosphorescent crystals in the issue of *Die Naturwissenschaften* for June 15. The outstanding new result which he mentions is that their resistance for electron currents is proportional to the absolute temperature, a fact of particular significance since the same law holds for metals, where it has required the wave-mechanics for its explanation. One gathers from Prof. Pohl's article that the importance of these phosphors from the chemical and crystallographic point of view lies in their optical behaviour being that of a mixed crystal, and since the component responsible for the after-emission of radiation is present in vanishingly small quantity, its absorption spectrum and natural ultra-violet frequencies can thus be found with it in a dilute solid solution in an almost transparent matrix, instead of in a thin film of the pure substance that can only be prepared with some difficulty. It is an interesting point that measurement of the internal photoelectric current of a phosphor still provides the most direct proof of the rule that one electron is liberated for each radiant quantum absorbed.

ELECTRIC SPARKS.—The three experimental papers on the form and structure of electric sparks, by T.

Terada and U. Nakaya, published in volume 8 of the *Scientific Papers of the Institute of Physical and Chemical Research, Tokyo*, are instructive to scientific workers and will be useful to magneto manufacturers. The authors point out that our present knowledge of the form and structure of sparks is not much greater than in the days of Franklin and Lichtenberg. For example, the spark between the electrodes of a Wimshurst machine, instead of taking the shortest path, takes an irregular, bow-shaped curve with a right-angled bend on it. They give pictures of many zigzag sparks and point out the analogy with the 'discharge canal' in Lichtenberg's figures. Their most important results are in connexion with the straight and smooth type of spark sometimes observed. They found that this could always be secured by making a definite leak of electricity from the positive electrode. This was most readily secured by attaching a needle point to the positive electrode, from which a brush discharge takes place. This kind of spark they call a 'three-part' spark. Apparently the same spark is produced whether the needle is at a distance of 30 cm. or at a distance of 150 cm. from the spark. They conclude that the effect is neither directly due to the ions emitted from the point nor to any other kind of radiation which it may emit. If there is leakage on the negative lead, the three-part spark, or the 'fat spark' as it is called sometimes by magneto manufacturers, is not produced. It is advisable, therefore, to protect the negative lead with ebonite tubing. When an air blast is directed to the positive end of the three-part spark, its path makes a large curve at this end. When it is directed to the middle part of the spark nothing happens. When it is directed to the negative end, the number of sparks is greatly diminished and sometimes they stop altogether. If the voltage is increased, the air blast being applied to the negative end, the spark takes the zigzag form. Earthing the positive electrode produces the same effect as attaching a needle point to it.

EARLY MATHEMATICS IN SCOTLAND.—A paper of only forty pages naturally gives room for no more than a very rapid sketch of its subject; but within these limits Prof. G. A. Gibson, in a "Sketch of the History of Mathematics in Scotland to the end of the 18th Century" (*Proceedings of the Edinburgh Mathematical Society*, vol. 1, pts. 1 and 2, 1927–28), has given useful references to the work of men who are famous for original discoveries, or for their ability and success as teachers, or both. He deals with John Napier (1550–1617), James Gregory (1638–1675) and his nephew David Gregory (1661–1708), Robert Simson (1687–1768), James Stirling (1692–1720), Colin Maclaurin (1698–1746), Matthew Stewart (1717–1785), John Playfair (1748–1819), and Sir John Leslie (1766–1832). We are also given some interesting particulars of the state of mathematical studies in the schools and universities of Scotland at various dates. In Scotland, as in England, mathematics (arithmetic, geometry, and algebra) was not taken as a subject of education in schools until the latter half of the seventeenth century. In the universities, up to the time of the Reformation, the course included the "Sphere" (presumably the famous thirteenth-century work by Sacrobosco) and the "Physics," "De Caelo," "De Ortu et Interitu" and "Meteorologica" of Aristotle, but the mathematical subjects consisted of nothing more than arithmetic and very elementary geometry. Definite mention of arithmetic as a school subject begins in 1628. Only with the establishment from 1760 onwards of a new type of school more advanced than the grammar school and called by the name of "Academy" does a programme of higher mathematics appear in the curriculum extending, beyond plane and spherical geometry, to such things as the theory of equations, the differential calculus, statics, dynamics, hydrostatics, and optics, and it is not probable that this programme was at first carried out in the schools with any degree of thoroughness.

SPECIFIC HEATS OF SALT SOLUTIONS.—At room temperature, electrolytic solutions have an abnormally small heat capacity, and a mathematical theory to account for this has been advanced by Zwicky. He showed that in the vicinity of each ion a very high pressure could be set up due to the attraction exerted by the ionic field upon the dipoles of the water molecules. At room temperature, increase of pressure decreases the heat capacity of water, and hence an electrolytic solution should have a low specific heat. With rise of temperature, the heat capacity of compressed water increases, and therefore salt solutions should behave similarly. An attempt to test this theory experimentally is being made by F. T. Gucker, who describes some preliminary results in the *Journal of the American Chemical Society* for April. He employs an adiabatic twin calorimeter apparatus, with which, it is claimed, the specific heats of solutions may be found with an accuracy of 0·05 per cent. The results with potassium nitrate and chloride solutions do not uphold the above theory, although, as Zwicky has pointed out, the hydration of the ions may mask the effect of increase of pressure.

THE 'UNSATURATED HYDROCARBONS' IN THE GASES FROM THE CARBONISATION OF COAL.—In technical terminology the 'unsaturated hydrocarbons' in fuel gases are those which are absorbed by bromine or by concentrated sulphuric acid, and recent suggestions for their commercial utilisation has made it desirable to obtain a more detailed knowledge of the composition of these constituents. A convenient method for the determination of the unsaturated gaseous compounds present in coal gas is described by A. B. Manning, J. G. King, and F. S. Sinnatt in *Technical Paper No. 19* of the Fuel Research Section of the Department of Scientific and Industrial Research (London: H.M. Stationery Office). After the removal of the liquid constituents of the gas the unsaturated substances are separated as the bromine compounds, which are fractioned and the original hydrocarbons regenerated by the action of a zinc-copper couple. The resulting gas is analysed by treatment with strong sulphuric acid and combustion over copper oxide. The paper contains a detailed account of the apparatus used and some of the results obtained with gases from both low and high temperature carbonisation of coal.

CARBON MONOXIDE FROM GAS FIRES.—The Joint Research Committee of the Institution of Gas Engineers and the University of Leeds has issued its seventeenth Report, which records further study of the products of combustion of typical gas appliances, and in particular the evolution of carbon monoxide in the flue gases from gas fires. For this purpose a very refined modification of the iodine pentoxide method was employed, and indeed necessary, to detect and measure the small quantity of carbon monoxide passing from a modern gas fire. This reached 30 parts per 10,000 of gas burned in such a fire when properly regulated. The actual concentration in the flue gases is, however, much less—it may be so little as one two hundred and fiftieth of this owing to the dilution of the flue gases, which varies from case to case. Small as this is, in view of the volume of gas burned in such appliances, the usual practice of fixing them to efficient flues is considered to be advisable.

The Winnipeg Meeting of the Royal Society of Canada.

ON May 22–24, the Royal Society of Canada met west of Ottawa for the first time. Meetings were held in Winnipeg (the meeting place of the British Association in 1909, and the future meeting place of the British Medical Association in 1930) in the University of Manitoba and the Legislative Building.

Dr. A. H. R. Buller, professor of botany in the University of Manitoba, delivered the presidential address on "The Plants of Canada, Past and Present." He treated of Dawson's *Eozoon canadense*, the algæ obtained by Walcott from the Middle Cambrian shale of British Columbia, *Psilophyton* and the Devonian land flora, the Great Ice Age and the relic flora in Eastern Canada. The number of plant species in Canada, Canadian weeds, Canadian forests and their products, were described, and reference was made to the white pine blister rust disease, wheat in the West, the black stem rust disease of wheat, and to J. H. Craigie's investigations on sex in the rust fungi. Prof. Buller made a plea for a systematic botanical survey of Canada as a whole, and for the establishment of botanical gardens in various parts of the Dominion.

The annual popular address was given by Prof. J. J. R. MacLeod, of Toronto (now Regius professor of physiology of the University of Aberdeen), who took as his subject "The Air we breathe." He showed by a historical survey the close intertwining of chemical and physiological discoveries of the nature of atmospheric air and its utilisation by the organism.

The Government of Manitoba entertained the fellows of the Society at a reception and a luncheon while the final session of the meeting was held at the historic Lower Fort Garry, twenty miles north of the city, where the fellows were entertained by the Canadian Committee of the "Governor and Company of Adventurers of England trading into Hudson's Bay."

A number of papers on historical and literary topics were communicated in Sections I. and II. (French and English history and literature). Amongst the 179 papers communicated in the scientific sections, the following may be noted :

In Section III. (Physics, Mathematics, Astronomy, and Chemistry), Dr. H. M. Tory, in his sectional presidential address, dealt with comparative conditions of industrial research in various countries. In a paper entitled "The Gyromagnetic Electron and Wave Mechanics," Dr. L. V. King gave a mathematical discussion, in which from the classical dynamical theory he showed that equations of wave mechanics can be derived. Prof. J. C. McLennan and his associates gave a series of papers on various phases of spectral analysis, on the decomposition of ammonia by cathode rays, on the intensities of the light of the oxygen green line of the night sky, on the photo-electric effect at very low temperatures, etc. E. F. Burton ("A New Method of Measuring Electrical Conductivities of Materials by Use of an Oscillating Circuit") described an exceedingly sensitive quantitative procedure which will detect very small quantities of moisture. J. S. Foster and W. Rowles communicated "Further Observations on the Stark-Effect in Neon," in which the intensities are found to agree with those calculated by Schrödinger. In "A Method of Estimating Relative Conductivities of the Earth, using a Potential Method, either along Lines or over Areas," Prof. A. S. Eve dealt with the geophysical location of ore deposits. F. Allen and collaborators communicated papers on the correlation of colour blindness, anomalous vision, and normal colour vision, and the oscillatory effect in vision.

Other physical and mathematical papers included : J. F. Plaskett on the rotation of the galaxy ; R. W. Boyle and S. C. Morgan on some measurements of ultra-sonic velocities in liquids ; G. M. Shrum, C. G. Patten, and H. D. Smith on the change in the optical transparency of certain samples of ultra-violet glass after exposure to X-rays ; R. M. Stuart on the theory of an elastic tape ; D. Buchanan on the ellipsoidal pendulum ; S. Beatty on planar harmonic conjugacy ; and W. J. Webber on the Fourier series of a bounded function.

Amongst chemical papers presented were a series by G. S. Whitby and associates on problems related to rubber, several by T. Thorvaldson and associates dealing with the chemistry and physical chemistry of hydraulic cements, a paper by Miss E. V. Eastcott describing the isolation of crystals of Bios I., identified as inositol, "High Voltage Arcing and A. C. Electrolysis" by J. W. Shipley and C. F. Goodeve, the "Dielectric Constant of Pure Hydrogen Peroxide" by A. C. Cuthbertson and O. Maass, and "Correlations between the Total Nitrogen of the Bases and Arginine and Lysine Nitrogen of Various Proteins" by R. K. Larmour, the last paper yielding evidence supporting Kossel's hypothesis that arginine is the nucleus of the protein molecule.

The papers in Section IV. (Geological Sciences) had reference more particularly to phases of Western Canadian geology. W. A. Johnston dealt with the Lake Agassiz beaches, in their continuation northwards beyond the area mapped by Upham, with a critical discussion on adjustment of level since the time of the maximum extension of the lake. M. Y. Williams discussed the changes of level in Tertiary and post-Tertiary times in Southern Saskatchewan and Alberta. The petrographical character of the Whitemud and Ravenscrag beds was dealt with by F. H. McLearn, and the nature of the heavy minerals in the western sand horizons, particularly in Manitoba and Eastern Saskatchewan, by R. C. Wallace and his students. Further detail on the structural peculiarities of the dolomitised areas in the Manitoba Ordovician limestones was given by D. J. Birse. S. R. Kirk presented evidence to show that the conodonts of the Harding beds of Colorado are to be referred to ostracoderm plates. The historical data referring to the St. Lawrence earthquake of 1663 were assembled by E. A. Hodgson. T. C. Phemister discussed the genetic relationships of the Sudbury gabbro and Cobalt diastase. P. S. Warren described the Devonian and Carboniferous rocks of the Crowsnest Pass section, and in a second communication assembled the sedimentary record of the Rocky Mountain section at the 51st parallel. R. L. Rutherford presented evidence of considerable post-glacial uplift in Southwestern Alberta.

In the sectional presidential address to Section V. (Biological Sciences), Prof. J. J. R. MacLeod dealt with the present knowledge of carbohydrate metabolism and insulin action. F. E. Lloyd gave a kinematograph demonstration of the contractile vacuoles of *Paramecium*, and V. H. K. Moorhouse a similar demonstration of postural reflexes in spinal dogs, while Frère Marie-Victorin gave a series of papers dealing with eastern Canadian plants. W. P. Thompson presented papers on dwarfness and species-hybrids in wheat, Prof. A. H. R. Buller a paper on the blocking layer and the luminosity of the mycelium of *Armillaria mellea*. A. T. Cameron dealt with seasonal variations in the calcium content of the blood serum of the young rat, V. J. Harding with a comparison of the alkalinity of urine produced by sodium and potassium citrates, J. Miller with the muscular movements of the appendix

and their relation to appendicitis, and C. C. Macklin with the macrophages of the lung alveoli. C. M. Fraser discussed the ecology of the butter clam, F. C. Gilliatt the bionomics of the tortracid moth *Eulia mariana* (a new orchard pest which has developed in Nova Scotia), while S. Hadwen dealt with colour changes in animals, Miss H. I. Battle with the development of structural anomalies in the four-bearded rockling due to unfavourable temperatures and salinities during early stages, and J. M. D. Scott with pregnancy anæmia in rats.

Monseigneur Camille Roy, of Laval University, Quebec, was elected president, and Prof. A. S. Eve, of McGill University, vice-president, for 1928–29.

Kiln-Seasoning of Timber.

THE natural seasoning of timber by allowing it to remain stacked or otherwise for a varying period of time was well understood in Great Britain, and seasoned timber, especially for the better class of work, was in common use. During the progress of the War the stocks of seasoned timber were utilised, and kiln-seasoning, where seasoned material was indispensable, as, for example, for aircraft work, came to be relied on more and more. Experiments were also inaugurated in other parts of the British Empire with the object of endeavouring to place upon the market kiln-seasoned wood of some of the broad-leaved soft-wooded species from the tropical and sub-tropical forests which had previously been unmarketable. Kiln-seasoning thus began to assume an important position, where timber was in question, in commercial centres. So much so that repeated inquiries for advice have been addressed to the Director of the newly established Forest Products Research Laboratory at Princes Risborough. With the view of making public the research work being carried out in this direction, a report entitled "The Principles of Kiln-Seasoning of Timber" (*Special Report No. 2*) is being prepared, of which Part I., "Types of Commercial Kilns in Use," by Mr. S. T. C. Stillwell, has been issued.

In an introduction the troubles attendant on drying timber are discussed. A correct appreciation of these difficulties is necessary in order to estimate the value of the use of the kiln method. "If we consider a board of green timber," says the writer, "which is allowed to dry freely, the surface layers quickly lose their free moisture; this is followed by evaporation from the cell walls, and a corresponding shrinkage then takes place in the surface structure. In the meantime, though there is a tendency on the part of the moisture in the centre portion of the board to move towards the surface layers as soon as these become drier, the amount of moisture so moving is much smaller than the amount evaporated from the surface. It is inevitable, therefore, that the surface layers will tend to shrink before the centre portion is ready to do so, and, as a result, tension is set up in these layers." Regulation of the rate of drying from the surface is therefore essential and requires to be under control. This control involves the regulation of humidity, temperature, and the circulation of air, and that the latter should be changed regularly and frequently in the kiln.

Before dealing with the types of kilns, kiln treatment is briefly discussed. It may be mentioned that almost invariably the timber placed in the kiln is first warmed up by a circulation of saturated or nearly saturated air, driven through it by various devices, to a temperature slightly higher than that at which drying is to commence. This is said to be doubly advantageous since it both warms the timber in the centre, thus afterwards assisting in the transfusion of moisture from the centre to the surface, and also relieves any existing stresses in the surface layers.

Five different types of kiln are fully described and clearly illustrated in the report, these kilns being known as (1) natural circulation ventilated kiln, (2) tunnel or progressive kiln, (3) water-spray kiln, (4) external fan kiln, and (5) internal fan kiln. For their varied features and uses the report should be consulted.

The writer concludes with some brief notes upon lay-out, equipment, and kiln staff. A subsequent Part II. is promised, dealing with the field of kiln instruments, which is said to be both wide and important. Mr. Stillwell emphasises the importance of employing a good man, with scientific and engineering training, to supervise the seasoning operation. "Practically," he says, and the point is worth stressing, "all the prejudice which at present exists against kiln-seasoned timber can be attributed to the short-sighted policy of many commercial firms in putting their kiln plant in charge of men of little education and no experience as kiln operators."

The important work upon which this report is based can be safely recommended to all those in the British Empire who deal with timber in its many aspects.

Flowering Plant Hybrids.

THE Masters Lectures for 1927, delivered by Dr. C. H. Ostenfeld of Copenhagen on "The Present State of Knowledge on Hybrids between Species of Flowering Plants," have been published in the *Journal of the Royal Horticultural Society*, vol. 53, Part 1. Dr. Ostenfeld reviews past and present concepts of species, but finds it no more possible now than it was forty years ago to formulate a definition of a 'species' which possesses at the same time practical advantages and scientific accuracy. Any definitions which embody such modern concepts as 'microspecies,' 'ecospecies,' or 'genospecies' are for practical purpose useless. On the other hand, a practical definition which satisfies all minds and all ideas must necessarily possess a somewhat vague connotation.

In spite of the lack of a definition which is at once apt and generally applicable, species in Nature are rather well-defined, a characteristic which their ability to hybridise fails to modify. This is explained either by the sterility of the hybrids themselves, or by the ease of back-crossing with one or other of the parents as against 'selfing.' Any external sign of hybridity is thus quickly effaced.

Dr. Ostenfeld discusses some of the most recent work on the formation by hybridisation of new types which fail to segregate and are thus wholly or partially stable. Related species with the same number of chromosomes usually produce fertile hybrids, while sterile hybrids are usually produced when the parents have different chromosome numbers. The Japanese botanist Kihara has, however, succeeded in obtaining fertile hybrids in a cross between two species of *Triticum* with different chromosome numbers. The offspring with chromosome numbers the same as either of the parents were most fertile, while those with the intermediate number were very much less so. Thus a selective process goes on, resulting in the disappearance of intermediate forms.

The Danish geneticist, Winge, has advanced a theory that a new stable type could be produced by hybridisation of two species, if the chromosomes of

the hybrid were split longitudinally and thus doubled. This hypothesis explains many cases which cannot otherwise be understood, particularly the cases of some of our cultivated plants, which are obviously hybrids but yet breed true to type without showing any segregation in the offspring. Longley (1926) has advanced some definite data in the case of *Fragaria*, and in crossing two species with the same number of chromosomes, got in one case an individual with double that number of chromosomes which was morphologically distinct and bred constant.

University and Educational Intelligence.

ABERDEEN.—At the summer graduation the honorary degree of LL.D. was conferred on Emeritus Prof. J. D. MacWilliam, formerly Regius professor of physiology in the University. The degree of D.Sc. was conferred on Miss I. Gordon for a thesis entitled "Studies in the Development of the Skeleton in Echinoderms," and on Mr. E. V. Laing for a thesis entitled "Studies on Tree Roots: their Action and Development, with special reference to Mycorrhiza and Tree Growth on Peat Soils."

BRISTOL.—At a congregation held on June 30, the degree of D.Litt. was conferred upon Mr. E. J. Holmyard, head of the Science Department at Clifton College.

MANCHESTER.—Applications are invited for two Grisedale scholarships for biological research, tenable, respectively, in the botanical and zoological departments of the University. Each scholarship is of the yearly value of £100, and the award is open to graduates in botany and zoology, with some experience of research. Applications must reach the Registrar by July 29 at latest.

ST. ANDREWS.—Viscount Haldane of Cloan has been elected to the office of Chancellor of the University.

Prof. John McGibbon, professor of obstetrics in the University of the Witwatersrand, Johannesburg, has been appointed professor of midwifery and gynæcology in succession to Prof. Kynoch, who has recently resigned the chair.

MR. WASHINGTON SINGER, formerly of Paignton, has presented a sum of £25,000 to the University College of the South-West, Exeter, for the building of a chemistry laboratory. It had been decided to build a new physics laboratory on the recently acquired 100-acre site on the Streatham Estate, Exeter, and the cost of that building will be met with moneys raised by the general appeal. The welcome and generous gift of Mr. Washington Singer will enable the Council of the College to provide for the Departments of Chemistry and Physics in the same block. The building will be the first contribution to the University building scheme, and will be a considerable relief to the growing congestion in the present buildings.

THE Air Ministry announces that six hundred aircraft apprentices, between fifteen and seventeen years of age, are required by the Royal Air Force for entry into the Schools of Technical Training at Halton, Bucks, and at Flowerdown, near Winchester. They will be enlisted as the result of an open competition and of a limited competition held by the Civil Service Commissioners and the Air Ministry respectively. The apprentices are given a thorough training in their trade by qualified technical instructors, and their general education is also carried on simultaneously by a staff of graduate teachers. Full information can be obtained on application to the Royal Air Force, Gwydyr House, Whitehall, London, S.W.1.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to senior studentships and overseas science research scholarships for 1928:—*Senior Studentships*: Dr. T. E. Allibone, for research in pure and applied physics, and Mr. L. S. B. Leakey, for research in archæology and physical anthropology, on the recommendation of the University of Cambridge. Dr. G. F. J. Temple, for research in mathematics and mathematical physics, on the recommendation of the Imperial College of Science and Technology. Mr. B. Cavanagh, for research in physical and analytical chemistry, on the recommendation of the Victoria University of Manchester. Mr. C. E. Wynn-Williams, for research in experimental physics, on the recommendation of the University College of North Wales, Bangor. *Overseas Science Research Scholarships*: Canada, Mabel A. Borden (Dalhousie—zoology), D. R. McCullagh (Manitoba—biochemistry), and B. W. Sargent (Queen's, Ont.—physics); Australia, H. C. Webster (Melbourne—physics) and J. D. M'Gee (Sydney—physics); New Zealand, W. A. Macky (New Zealand—physics); South Africa, Evlyn Boyd (South Africa—zoology); Irish Free State, H. S. Boyd Barrett (National University — organic chemistry).

THE first Pan-Pacific Conference on Education, Reclamation, and Recreation, called by the President of the United States, was held at Honolulu on April 11–16, 1927. The United States Department of the Interior has now published a full report of the proceedings. In addition to the United States, represented by the Secretary of the Interior, the Commissioner of Education, and 25 other officials of various departments, the following countries were represented by official delegates: Australia (5), Fiji Islands and Western Pacific, Great Britain (British Consul at Honolulu), New Zealand, Chile, Peru (2), Colombia, Mexico (3), Nicaragua, France, Japan (9). There were no representatives of Canada, China, India, Siam, or the Dutch East Indies. Opportunities for the establishment of friendly personal relations were amply provided by giving up to excursions and social functions the week preceding and half of the week following the actual sessions of the conference. The addresses and discussions contain much of educational and scientific interest relating to the following, among other topics: the educational systems of the United States, Australia, Japan, Mexico, New Zealand, Peru, Hawaii, and American Samoa; exchange of lecturers, teachers, students, research workers, etc.; centres of educational information; evaluation of student credentials; vocational education; infant and child welfare; conservation and use of water; land-settlement; opportunities for scientific research and education presented by national parks; the uses of museums; wild life conservation; bird-migration. Resolutions adopted for submission to the various interested governments dealt with proposals for: introducing into the curricula of secondary schools courses in maternal and child hygiene, inviting the attention of government educational officials to the desirability of uniformity in educational terminology, and the appointment by the several governments of a pan-Pacific committee on co-operation between museums with special reference to the exchange of personnel, research students, publications and exhibits, and co-operation in exploration and scientific research. It was suggested that another conference should be held within two years.

Calendar of Customs and Festivals.

July 16.

ST. BRECCAN of Cluain-Catha (sixth and seventh centuries), of the race of Eoghan, son of Niall. Cluain-Catha is therefore identified with Cloncha or Clonca, Co. Donegal. The saint is said to have been the Abbot of Moville or Magh-bile, a foundation dating from St. Patrick's time, in Co. Donegal, and Bishop of Ardmore, Co. Meath. The obscurity and lack of precision of his legend suggest the survival of a pre-Christian cult, a suggestion which is supported by the pilgrimages to a pool in the rocks near Malin Head for the cure of various diseases, and prehistoric monuments near the ruined abbey—a curious stone circle, and what is known as Ossian's Grave. The name Magh-bile, which means "The Place of the Sacred Trees," shows that it was at one time the site of a sacred grove of the earlier faith.

July 17.

ST. KENELM'S DAY.—An annual fair was held on July 17 at Clent, in the parish of Hales Owen, in the field in which was situated the chapel of St. Kenelm. It arose out of a large concourse of people who were accustomed to assemble at the shrine on this day. The fair, at which the principal article of merchandise was cheese, was of considerable antiquity. It is probable, therefore, that, as in other cases, it perpetuated an assembly at a spot regarded as a place of sanctity long before it was associated with the saint. This view is supported by an annual custom, recorded by Brand, which was known as 'crabbing the parson.' On St. Kenelm's Wake, held on the Sunday after the fair, the clergyman of the parish on his way to conduct service was pelted with crabs as he went through the church field. According to another version, the inhabitants pelted one another with crabs, the pelting of the clergyman being incidental only while he was proceeding to the church.

July 18.

ST. THENNA, THENOG, or THANAW, of Glasgow (fifth and sixth centuries). A saint of obscure history reputed to be the mother of St. Kentigern, founder and patron of Glasgow. The story of St. Kentigern is largely legendary, and in so far that saint is identified with a Celtic god. It is therefore not surprising to find, as in the story of Merlin, that he was the son of an unknown, or, possibly in the original form of the legend, of no human father. According to one version, his mother was subjected to violation. Another story is that on Thenna's refusal to marry Ewen, son of Urien Rheged, King of Cumbria, her father, King of Laudonia of Scotia, gave her to a herdsman, who, however, in secret was a Christian, and with whom she lived inviolate. Before the birth of Kentigern she was sentenced by her father to be cast down a steep rock called Kep Duff, said to be Lammermoor, a statement which may preserve a record of a form of sacrifice similar to that to which reference is made in stories of Buddhist women of India. She was miraculously preserved from death, however, and cast ashore on the coast of Fife. She was again put to sea in a boat by a chieftain and reached Culross, where she gave birth to her son in a cave, near the cave of St. Servan.

July 20.

ST. MARGARET'S DAY.—A virgin and martyr whose cult spread widely over England, France, and Germany in the eleventh century. Her shrine in Paris was much frequented by women who desired children, a vestige of a pagan cult associated also with other Christian saints. At Bassingbourne, in Cambridgeshire, a festival of some importance took place on this day. In 1511 the miracle play of the Holy Martyr St. George was acted on an open stage in a field, and the churchwardens' accounts show that other parishes and townships took part in providing the expenses. A minstrel and waits were hired from Cambridge, and the keep of the players was provided for several days.

A well of St. Margaret at Wereham Church, Norfolk, was at one time much frequented, when people regaled themselves with ale and cakes, music and dancing. "Alms were given and offerings and vows made."

Of St. Margaret herself, the legend runs that she was once swallowed whole by the Devil, but that on making the sign of the cross she issued sound and whole. On another occasion when the Devil appeared to her she overcame him, placing her foot upon his neck, whereupon he confessed that he was Veltis, one of the devils enclosed by Solomon in a brass bottle and released at Babylon.

July 21.

ST. VICTOR of Marseilles.—The Abbey of St. Victor, founded by St. Cassien, patriarch of Constantinople, in the fourth or fifth century, stood upon ground held specially sacred by the people of Marseilles, as there was situated the grotto to which St. Mary Magdalene was said to have retired on landing at Marseilles. A chapel was afterwards erected on this spot and named "Notre Dame de la Confession," but by a popular confusion the chapel was held sacred to the Virgin. It is evident that there must have been a number of these sacred grottoes in the neighbourhood of Marseilles, for St. Mary Magdalene is reputed to have withdrawn again a league from Marseilles to a spot where a monastery of Carmes was afterwards founded, and later to Sainte Beaume, a grotto in the mountain of St. Pilon, where she ended her days.

The association of deities, and especially female deities, with caves and grottoes is familiar in the European pagan religions and folklore. The relics of St. Victor himself, which were preserved in the monastery bearing his name, were associated with many miracles, but especially the cure of demoniacs. He is said, when armed *cap-à-pie* and mounted, to have conquered the dragon of the wood adjoining, and a sculpture bearing a close resemblance to the familiar effigy of St. George was carved over the porch of the church.

St. Victor's day was formerly celebrated at Marseilles by a procession known as 'La Triomphale,' when the relics of the saint were carried round the town by the prior of the monastery, attended by the whole community, the procession being headed by a cavalier completely armed.

That the district was of special sanctity in early times is shown by the number of beliefs and practices which long survived. No woman could enter the grotto shrine of St. Mary Magdalene without being struck blind. The notorious Queen Joan disregarded the prohibition, and suffered the penalty immediately on passing the portal. Her sight was restored only when she had placed a rail of solid silver around the image of the saint. No woman was ever allowed to enter the underground chambers or grottoes in which the rites of Mithra were performed. The marble tomb of Mary Magdalene bore witness to the memory of the varied traditions of the district of Marseilles. On it were many curious figures, and among them the wolf suckling two children. One of two small columns of granite at the well of St. Victor in the Abbey bore an imprint of the devil's claw—in reality a partially defaced acanthus leaf, dating from the previous use of the column.

Societies and Academies.

LONDON.

Royal Society, June 28.—**E. Jones**: Photographic study of detonation in solid explosives. Direct photography of a detonating cartridge possesses advantages over other methods for determining rates of detonation in that it is absolute and enables a continuous and permanent record of the progress of detonation to be obtained. Results are given to illustrate the two stable velocities of detonation peculiar to gelatinous explosives, and the effect of nitroglycerine content of a powder explosive on its velocity of detonation. Photographic records obtained with opaque explosives give the rate of propagation of detonation along the surface of the cartridge. The detonation front inside the cartridge is convex towards the undetonated portion, so that detonation is further advanced on the axis of the cartridge than on the surface. For one explosive, the stable form assumed by the detonation front inside the cartridge, and its effect on duration of detonation phenomenon over a plane transverse section of the cartridge, have been determined.

E. T. Whittaker: On the potential of the electromagnetic phenomena in a gravitational field. In classical electromagnetic theory, the electromagnetic field due to any number of electrons moving in any manner is determined by a theorem which expresses the scalar and vector potentials of the field in terms of the positions and velocities of the electrons. This theorem is extended to electromagnetic phenomena which take place in a gravitational field, so that the metric of space-time depends on the gravitating masses. The formula obtained is completely different from the well-known formula of classical electromagnetic theory, of which it is, nevertheless, the true generalisation.

B. Topley and **J. Hume**: The kinetics of the decomposition of calcium carbonate hexahydrate. Measurements have been made under controlled conditions of the rate of the reaction $CaCO_3 . 6H_2O = CaCO_3 + 6H_2O$, the substance being in contact with water in a dilatometer. The very large increase in velocity is due to a true temperature coefficient of reaction rate. The absolute rate of propagation of chemical change in the solid has been deduced, and the temperature coefficient has been measured over the range 0° to 15°. An attempt is made to relate together the absolute reaction rate and its temperature coefficient by means of a mechanism involving the vibration frequency of the ions in the interface between the two solid phases and the distribution of energy among the vibrating ions.

L. W. Nordheim: On the kinetic method in the new statistics and its application in the electron theory of conductivity. With proper definitions, the dynamical theory can be worked out both for the Einstein-Bose and the Fermi-Dirac statistics in just the same way as by Boltzmann for classical statistics. The modified form of the fundamental equation of the gas theory is given, and the equilibrium states and the H-theorem are deduced from it. In comparison with the classical theory some characteristic new terms occur, but in the case of the electron theory of conductivity, they just cancel out in the usual approximation owing to the large mass ratio of the electrons and the atoms. It is therefore justified in that special case to use the new distribution laws together with the old form of the fundamental equation.

R. W. Wood and **V. Voss**: The fluorescence of mercury vapour. The factors determining the fluorescence of mercury vapour excited by the aluminium spark have been determined. Very minute traces of water-vapour destroy the fluorescence. All the stronger atomic lines of mercury have been found in the fluorescence spectrum, in addition to bands due to the mercury molecule. The intensity of these lines is proportional to the square of the intensity of the exciting light (the 2536 line excepted). Bands due to mercury hydride have been observed in the spectrum, as well as the carbon line 2478.

E. Rudberg: The velocity distribution of photoelectrons by soft X-rays. By means of a special magnetic method, measurements are obtained of the velocity distribution in the photoelectric emission from targets of carbon, aluminium, copper, and silver produced by the soft X-radiation from a carbon anode. In all cases, the emission is constituted of a group of electrons of a few volts energy and a less prominent group with energy concentrated in the region 200-280 volts. Baking at 400° C. generally reduces the first group by about 50 per cent, but does not affect the second. The latter seems to consist of primary electrons directly produced by the incident radiation quanta, chiefly belonging to the carbon Kα-line (275 volts). The distribution in the first group is identical with that of the secondary emission produced by electron bombardment; it is inferred that this group results from the presence of fast primary electrons in the target. Preliminary experiments on gold-leaf indicate an absorption coefficient of about 3×10^5 cm.$^{-1}$.

P. Gôtz and **G. M. B. Dobson**: Observations on the height of the ozone in the upper atmosphere. Some fifty measurements have been made of the height of the ozone layer in the upper atmosphere over Arosa (Switzerland). It is greatest when the amount of ozone is large, and least when the amount is small, and there is also evidence of an increase of height from autumn to spring. The average height seems to be between 35 km. and 40 km.

T. M. Lowry and **M. A. Vernon**: An improved method of ultra-violet polarimetry: anomalous rotatory dispersion of sodium tartrate. Improved sensitiveness has been obtained by measuring with a densimeter the density of the photographic image of the middle and outer portions of a triple field. By plotting the ratio of the densities against the readings of the analyser scale, the setting which gives equal photographic densities can be read off within about 0·005°. In this way a curve of anomalous rotatory dispersion has been plotted for a 1 per cent solution of sodium tartrate, which gave a maximum dextrorotation of only 0·5°.

J. B. Cohen, **C. H. Browning**, **S. Ellingworth**, and **R. Gulbransen**: Antiseptic compounds: some further derivatives of anil-quinoline. Compounds of larger molecular weight have been prepared and tested. Owing to limitations of solubility, no great increase in mass of the quinoline portion of molecule was possible, but powerful antiseptics were obtained by condensation of various nitroso compounds with methochlorides of methyl and ethyl quinaldyl carbamates. Addition of further aromatic nuclei to the benzene portion of the molecule diminishes antiseptic potency, but where the additional nucleus is reduced, thus assuming an aliphatic nature, activity is greater. Particularly potent substances are obtained by condensation of nitroso derivatives of tetrahydro-quinoline and methyl tetrahydro-quinoline with quinaldine compounds. Products were also prepared from nitroso mono-methyl aniline, practically as active as the corresponding dimethylamino compounds, whereas primary amino derivatives are less potent. Thus in the anil-quinoline series, the distinction appears to lie between those substances containing, on one hand,

a primary basic group, and, on the other, a secondary or tertiary group, in the benzene nucleus.

R. J. Ludford: Vital staining of normal and malignant cells (1). Vital staining with trypan blue and the cytoplasmic inclusions of liver and kidney cells. By the cytological technique described it is possible to demonstrate in kidney and liver cells of animals stained intravitally with trypan blue: (*a*) Dye droplets and mitochondria; (*b*) dye droplets and Golgi apparatus. No definite relation can be established between dye droplets and mitochondria. The dye droplets make their appearance in relation to the Golgi, and when formed break away from it. The formation of the droplets resembles the formation of secretion granules in gland cells. The observations suggest a functional inter-relation between the Golgi apparatus and the mitochondria.

E. D. Denny-Brown: Inhibition as a reflex accompaniment of the tendon-jerk and of other forms of muscular response. Close examination of cessation of tonic posture action currents during a tendon jerk in the same muscle reveals that the cessation is an inhibition. The silence is found by analysis to be due in part to a refractory period of the motor units involved, combined with a proprioceptive reflex inhibition of all units of the centre, caused by stimulation of some end organ in the muscle by the motor excitation. There is reason to believe that this end organ is the muscle spindle, and that every reflex activation evokes a proprioceptive inhibitory effect upon the muscle.

Physical Society, June 8.—**L. F. Richardson** and students of Westminster Training College: Contact potential in the Dolezalek electrometer connected idiostatically. The deflection x was related to the voltage V by the formula $x = k\{\frac{1}{2}V^2 + \eta V\}$, k being constant from month to month, but η varying from 0·3 to 1·2 volts on different days. If it is desired to measure V, it is therefore essential to reverse the polarity in order to eliminate η.—**G. P. Barnard**: Some experiments on the light-sensitivity of commercial selenium cells. Part 1.—The relation connecting the change in conductivity of selenium cells with illumination. The change in conductivity C due to a given intensity of illumination I is proportional to some power of the illumination I—*i.e.* $C \propto I^x$. The index value x varies from cell to cell, and is probably dependent on the construction of the cell. Part 2.—The reaction of selenium to various spectral regions. The change in conductivity of selenium cells is dependent, not on the number of foot-candles incident on the cell, but rather on the amount of radiant energy received. For the same amount of energy received, the action of the infra-red is relatively much weaker than that of the shorter wave portion of the spectrum. Experiments on the decay of conductivity of selenium after exposure to radiation from various portions of the visible spectrum indicate that, throughout a large portion of the visible spectrum, the internal state of the selenium, as determined by the change in conductivity, is independent of the wave-length of the exciting radiation.—**J. R. I. Hepburn**: The vapour pressure of water over sulphuric acid–water mixtures at 25° C., and its measurement by an improved dew-point apparatus. A critical study has been made of data previously used by Wilson in the construction of a mean curve for the vapour pressure of water over sulphuric acid–water mixtures at 25° C. The observations of Sorel (employed by Wilson over the concentration range 44-82 per cent sulphuric acid) are shown to be probably inaccurate, by calculations based on thermodynamics, and by determinations at 25° C., using an improved dew-point apparatus.

Mineralogical Society, June 12.—**F. Slavík** and **L. J. Spencer**: Place-names of mineral localities in central Europe. Many important mining districts in the former Austro-Hungarian monarchy are now in other countries and the localities are now known officially by other names. Lists are given for each county and province, with equivalent place-names in the various languages (fifteen in all), together with a statement of the principal minerals from each locality. A key to the pronunciation of letters, with diacritical marks and also a glossary of geographical terms that enter into the construction of place-names are added.—**L. J. Spencer**: Eleventh list of new mineral names. The first list of this series was published in 1897 and gave all the names of minerals not in the sixth edition of Dana's "System of Mineralogy" (1892). Others have appeared every three years at the end of each volume of the *Mineralogical Magazine*. They are intended as dictionary lists of new names rather than lists of new minerals. About 170 names are now added.—**A. F. Hallimond**: On the atomic volume relations in certain isomorphous series (3). It has already been shown that the volume differences in isomorphous series derived from the same group of eutropic elements stand in a constant ratio in all series, and that this relation can be used to calculate atomic volumes for the elements in the combined state. It is now shown that compressibilities agreeing with those determined by Slater for eleven alkali halides can be calculated from the atomic volumes already assigned to the combined elements, by means of the relations $\beta = V/K$, $\beta' = V'/K'$, where β, V are the compressibilities and atomic volumes of the combined metals; β', V' those of the halogens. For all the metals, K has the value -4×10^{-6}; for the halogens K' is approximately $-2{\cdot}5 \times 10^{-6}$. The compressibilities of the free metals, as well as the atomic volume relations and the compressibilities in the combined state, are consistent with relations of the type $pv = K$, already indicated by Richards for the free metals; K, the constant for the eutropic group, assuming a new value in each isomorphous salt-series. The atoms thus behave as regions of a perfect gas under a high pressure.—**H. Collingridge**: On the determination of optic axial angles and crystal-forms from observations by the Becke method in thin sections. A suggested method of combining separate observations of different sections in one stereographic diagram and incidentally finding from the combined diagram the forms and axial ratios and optic axial angle of the crystal. The method is illustrated by an example of olivine in an olivine-basalt.—**S. I. Tomkeieff**: A contribution to the petrology of the Whin Sill. Certain rare varieties of the Whin Sill are described, such as the coarse gabbroidal rock, occurring in the form of bands within the mass of the normal dolerite, the coarse rock with red granophyric spots, the red felsitic veinlets, and spherical aplitic inclusions. A scheme of differentiation is applied to explain the origin of these varieties.

Geological Society, June 13.—**G. B. Barbour**: A re-excavated Cretaceous valley on the Mongolian border. The valley, originally cut in pre-Cretaceous lavas, was completely filled by the Nantienmen Beds, levelled off by erosion, and entirely covered by a heavy capping of plateau-basalts. During late Pliocene times a stream followed part of this old Mesozoic valley-axis. The valley bottom was again filled up by wind-blown loess in mid-Pleistocene times, again partly excavated in late Pleistocene, and once more filled with very late Pleistocene or early recent gravels. At present, the course is being opened for the fourth time. The

Cretaceous valley deposit (Nantienmen Beds) has been left clinging to the side-walls in many places.—S. I. Tomkeieff: The volcanic complex of Calton Hill (Derbyshire): a petrological study. There are two phases of vulcanicity:—(i) Effusive phase—represented by, besides the agglomerate and tuff of the old volcanic cone, a highly decomposed lava. Petrologically and chemically it is comparable with the other contemporaneous Lower Carboniferous lavas of the district. The vesicles are filled up with a chlorite of delessite type. (ii) Intrusive phase—represented by a fresh analcite-basalt, which has intruded into the old volcanic chimney and spread amœba-like in the volcanic cone, detaching large masses of vesicular lava.

CAMBRIDGE.

Philosophical Society, May 21.—A. G. Hutchison: The metamorphic history of the Dee-side limestone, Aberdeenshire. The metamorphic history can be divided into three episodes: (*a*) Regional (of the highest grade) characterised in the limestone by diopside-hornblende epidotezoisite and scapolite, and in the Older Granite intrusions by hornblende pegmatites. (*b*) Thermal by Newer Granites, characterised by wollastonite-grossularite-idocrase hornfelses, chiefly confined to the neighbourhood of the hochnager granite mass. (*c*) Post-thermal emanations from the Newer Granites, chiefly the hochnager and Birsemore, resulting mainly in a widespread development of prehnite and, to a less extent, in wollastonite, grossularite, idocrase, scapolite.—L. R. Wager: The mechanism of replacement as illustrated by metasomatic alteration of the Whin Sill. A steady change in composition, by diffusion through small openings in the rock, of the solution responsible for the metasomatism, is used to explain a gradual transition from altered to unaltered dolerite and to show that plagioclase, orthoclase, and other minerals are in equilibrium with aqueous solutions at the low temperature of the metasomatism.—W. A. Wooster: Demonstrations on piezo-electric effects. The alternating electric field which may be obtained from a suitable circuit containing a triode valve has been applied to the detection of piezo-electricity in crystal grains. When these are placed between the plates of a condenser included in the oscillatory circuit and the frequency of the latter continuously varied, large changes in the anode current occur at the resonance frequency of each crystal grain.—J. D. Bernal: An X-ray photogoniometer. The description of a new universal instrument for all forms of X-ray crystallographic and spectrometric work by photographic methods. The apparatus can be used (1) as an optical goniometer; (2) for rotating crystal photographs with (*a*) plane plate, (*b*) cylindrical camera; (3) for oscillating crystal photographs; (4) for Debye-Scherrer powder photographs; (5) as an X-ray spectrometer.

DUBLIN.

Royal Irish Academy, June 11.—J. K. Charlesworth: Glacial geology of North Mayo and West Sligo. During the Glacial period, North Mayo and West Sligo were completely overwhelmed by extraneous ice which proceeded north-westerly from the ice-centres in Leitrim and Connemara. This is shown by the striæ, dispersal of erratics, and the distribution of the moraines. The ice, on its retreat, uncovered the higher mountains, as the Ox Mountains and the Nephin Beg range, and with the steady enlargement of these nunataks dissolved into valley glaciers. The various phases in the break-up of the ice and its complete withdrawal from the area can be readily followed by the well-developed and abundant moraines and the marginal drainage features. Local glaciers associated with the highest corries came into existence at an early phase of the recession; they cover an area of but a few square miles, and correspond to a snowline of about 1000 feet on north and east slopes.

EDINBURGH.

Royal Society, June 4.—G. Leslie Purser: *Calamoichthys calabaricus*, J. A. Smith (Part 1): The alimentary and respiratory systems, concluded. The histology of the mucous membrane of the alimentary tract is extremely uniform, and, though their size and proportions vary in the different organs, the cells are only of three kinds, (*a*) cells forming digestive granules (scarcely to be found in œsophagus), (*b*), goblet cells secreting various mucoid substances, and (*c*), the ordinary columnar ciliated cells. These latter lose their cilia in the cul-de-sac, in the fundus of the œsogaster, which is much more muscular than any other part of the tract other than the pyloric region. In fact there appears to be an inverse relation between the ciliation and the musculature along most of the canal. There is a well-developed spiral valve in the first two-thirds of the intestine, but the histology is so similar throughout that no subdivision other than a purely topographical one is justifiable.—P. R. C. Macfarlane: Salmon (*Salmo salar*) of the River Moisie (E. Canada), 1926 and 1927. This report, the third of a series dealing with Moisie salmon, is based on a collection of 900 scale samples taken during the months of June and July in 1926 and 1927. As in the two previous investigations, the outstanding features are the large proportion of 'spring' fish, the high percentage of fish on their second or subsequent return to the river for spawning purposes, and the absence of grilse. Smolt ages vary from two to five years; the two- and three-years-old smolts, in practically equal proportions, together form 97 per cent of each year's collection, the remainder being four-years-old smolts, with one exception, which had spent five years of river life before migrating to the sea. The average weight and length of each age group, except in the case of the two+ winters fish, are very similar to those found in Scottish collections. It is possible, however, that the main run of summer fish in the Moisie occurs after the sampling ceased in July. The figures obtained for 'condition,' the relationship between weight and length, corroborate the findings of the former investigations in that spring fish are in better condition than summer fish, the reverse of that found in the Rivers Dee and Spey in Scotland.—R. A. Sampson: The present-day performance of clocks. A study of the actual performance of two of the clocks at the Royal Observatory, Edinburgh, Shortt No. 0 and Shortt No. 4, during 1927. The clocks are at constant temperature as well as constant pressure, the arc is read daily to 2″, and besides transit circle determinations the two clocks are compared with one another by an oscillograph daily to $\frac{1}{1000}$ sec. Shortt No. 4 showed an increase in the pendulum of 0·012μ per day. Allowing for this, the rate was reasonably constant, showing only fluctuations in accumulated error which reached 0·1 sec. five times and once exceeded this. Reason is given to attribute this to residual escapement error.

PARIS.

Academy of Sciences, June 4.—E. Goursat: A problem of Monge with several independent variables.—A. Mesnager: A rectangular specimen undergoing normal pressures on its bases.—A. Cotton: Remarks concerning the note of MM. Cabannes and Daure on molecular diffusion.—Ch. Gravier and J. L. Dantan: Some points of the biology of the polychætal annelids of the *Nereis* family.—Gabriel Bertrand and Hirosi

Nakamura: The importance of manganese for animals. Description of feeding experiments with mice. Manganese would appear to take part in the whole of the nutritive exchanges in animals.—P. Helbronner: Deviations from the vertical in the French Alps. Figures for the astronomical latitude minus the geodesic latitude and astronomical longitude minus the geodesic longitude are given for eight stations between the Lake of Geneva and the Mediterranean.—André Blondel: The measurement of the brightness of diffusing surfaces.—Georges Claude and Paul Boucherot: The utilisation of the thermal energy of the sea. A description, with diagram, of the experimental installation at Ougrée.—H. Le Chatelier: Remarks on the preceding communication. The 50 kilowatt machine was worked by a heat engine with a temperature range of 10° C. only, an achievement hitherto regarded as impossible.—Jean Baptiste Senderens and Jean Aboulenc: The action of sulphuric acid on the aromatic acids: the sulpho-aromatic acids.—E. Mathias: Magnetic measurements in Creuse, Dordogne and Haute-Vienne.—G. Rempp: The comparison of meteorological results and the effects of chance. A development of results obtained by L. Besson and proof of their generality.—J. Popken: The arithmetical nature of the number *e*.—V. Hlavatý: The second fundamental form relative to the torsion factor. Rèmes: The solutions of differential equations, considered as functions of the initial point.—J. Delsarte: A group of functional rotations with one parameter and the connected functional differential equations.—Maurice Thomas: A new arrangement utilising, without a fall, liquid or gaseous currents, as well as waves.—Louis Breguet: Landing of aeroplanes and brake power. A discussion of the effects of various types of brake with special reference to safety of landing.—Carl A. Garabedian: Circular and rectangular thick plates loaded at the centre.—P. Swings: The relations between the Riemann potentials and differential quadratic forms of stationary fields with spherical symmetry.—Seth B. Nicholson and Nicolas G. Perrakis: The spectroscopic proof of the presence of boron in the sun. A direct comparison was made of the region λ4645-5137 of the arc spectrum of boric acid with the same region of the sunspot spectrum, the latter obtained with the 75-feet spectrograph of the large telescope of Mount Wilson Observatory. 81 strong lines were measured, but 55 of these could not be used, either because of the neighbourhood of a strong line showing the Zeeman effect or of other strong lines. Of the remaining 26 lines, 25 were identified.—A. Danjon: A visual stellar photometer.—Frédéric Joliot: The resistivity of thin metallic layers obtained by cathodic pulverisation.—Soulié: An arrangement permitting the maintenance of a constant potential feeding a receiver branched on an alternating current network.—S. Pieńkowski: The fluorescence of mercury vapour excited electrically.—J. Cabannes and P. Daure: Spectroscopic analysis of the light obtained by molecular diffusion of a monochromatic radiation in the middle of a fluid.—Jean J. Trillat: Spectrographic researches on beating out thin sheet metal. X-ray spectrography has been applied to the study of the changes produced in the structure.—L. Andrieux: The preparation by electrolysis of the borides of calcium, strontium, and barium. These borides can be obtained by the electrolysis at 1000° C. of a mixture of calcium (strontium or barium) borate with the corresponding fluoride. Analysis showed them to be of the composition $Ca(Sr,Ba)B_6$.—Paul Bary: The formation of filaments of ferric oxide by drying colloidal solutions.—Maurice Auméras: The solubility of cadmium sulphide in hydrochloric acid. The experimental results were in agreement with the formula deduced from the application of the ionic hypothesis and the law of mass action, assuming that hydrogen sulphide dissociates into HS^- and H^+.—Paul Riou and Léon Lortie: The influence of some colloidal substances on the velocity of absorption of carbon dioxide by solutions of neutral sodium carbonate.—P. Job: Application of the spectrographic method and the spectrophotometric method to the study of the hydrolysis of some alkaline salts.—Mlle. Choucroun: The selective permeability of membranes. The influence of the mobility of the ions on the polarisation.—Robert F. Le Guyon and Roger F. Auriol: The microtitration of lead cations and chromic ions by the centrifugal volumetric method. This method, described in an earlier communication, gives exact results in the titration of lead by a chromate. It may be useful for the estimation of lead in biological chemistry and in blood and urine.—P. Brenans and Ch. Girod: Chloriodophenols obtained from 5-chloro- and 3, 5-dichlorosalicylic acids.—A. Wahl and J. P. Sisley: Improvements in the method of elementary organic analysis. By reducing the quantity of material taken for combustion to 80-100 milligrams, a shorter combustion tube may be employed and the operation can be completed in 25-45 minutes.—André Léauté and Georges Dupont: A method for the partial dehydrogenation of certain hydrocarbons to render them more suitable for use in briquetting coal. It is possible partially to remove hydrogen from tar or oil by heating to a moderate temperature with sulphur. The viscosity and agglutinating power of the oil are increased, and the amount of sulphur remaining in the oil is not high enough to interfere with its application to briquetting.—Jacques de Lapparent: Mineralogical knowledge of the Pays de Fenouillet bauxites.—Mihaïlovitch Jélénko: The great earthquakes in Bulgaria in 1928.—L. Aufrère: The relations between the cold currents, oceanic absence of rain, insular deserts, and coast deserts in tropical and subtropical regions.—C. Dauzère and J. Bouget: The influence of the geological constitution of the soil and the points struck by lightning. The position of places liable to be struck by lightning is partly determined by the geological constitution of the soil. Some examples are given.—G. Nadson and G. Philippov: The formation of new stable races in the lower fungi under the influence of the X-rays.—Roger Heim: Preliminary observations on the genus *Inocybe*.—Georges Nichita: The pseudobranchia of *Girardinus Guppyi*.—Béhague, Garsaux, and Ch. Richet, Jr.: The minimum oxygen pressure compatible with life. The absolute pressure of the oxygen is not the only element which governs the respiratory life of animals.—Mlle. Andrée Courtois: Variations in the proportion of amino-acids of some Lepidoptera during nymphosis.—P. Bourcet and A. Fourton: The chemical nature of digitalic acid. The various substances described under this name are merely succinic acid containing more or less impurities.—Mlle. Suzanne Ancel: The action of various gases on the egg of the fowl. Assimilation of carbon monoxide as an inert gas. Eggs kept for eight days in an inert atmosphere of nitrogen or of hydrogen afterwards develop in the normal manner. Abnormal development occurs after exposure to sulphur dioxide, ammonia, hydrogen chloride, chlorine, acetylene, carbon dioxide, or coal gas. After eight days in carbon monoxide the eggs develop normally. Hence carbon monoxide behaves as an inert and not as a toxic gas.—R. Coquoin: The method of determination of the respiratory elimination of acetone in man.—A. Philibert and J. Risler: The bactericidal action of colouring matters.—C. Levaditi and Mlle. R. Schoen: The penetration and multiplication of protozoa in the nerve cell.

Official Publications Received.

BRITISH.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, Nos. 21 and 22. 21: The Rejuvenation of the Champion Potato, by W. D. Davidson; 22: A Review of Literature dealing with the Degeneration of Varieties of the Potato, by W. D. Davidson. Pp. 319-389. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 4s.

Journal of the Indian Institute of Science. Vol. 11A, Part 5: The Dielectric Constants of Ammonia, Phosphine and Arsine. By H. E. Watson. Pp. 41-61. 1 rupee. Vol. 11A, Part 6: The Fermentation of Toddy and an Account of the Micro-Organisms producing It. By M. Damodaran. Pp. 63-74. 12 annas. (Bangalore.)

Worthing Archæological Society. Sixth Annual Report. Pp. 16. (Worthing: The Museum.)

Mines Department. Sixth Annual Report of the Safety in Mines Research Board, including a Report of matters dealt with by the Health Advisory Committee, 1927. Pp. 55. (London: H.M. Stationery Office.) 9d. net.

Review of Agricultural Operations in India, 1926-27. By Dr. D. Clouston. Pp. vi+158+7 plates. (Calcutta: Government of India Central Publication Branch.) 2 rupees; 3s. 6d.

Memoirs of the Department of Agriculture in India. Veterinary Series, Vol. 4, No. 1: The Chemotherapy of Surra (*Trypanosoma evansi* Infections) of Horses and Cattle in India. By Dr. J. T. Edwards. Pp. iii+100+26 plates. 4.2 rupees; 7s. Veterinary Series, Vol. 4, No. 3: Trypanblue and certain Dithio-aniline Derivatives; their Efficacy in the Treatment of Piroplasmosis and other Affections in the Central Provinces. By Major R. F. Stirling. Pp. ii+129-137. 3 annas; 4d. (Calcutta: Government of India Central Publication Branch.)

The Agricultural Department, Madras. Bulletin No. 90: The Manurial Problem and its Solution. By Rudolph D. Anstead. Pp. 30. (Madras: Government Press.) 2 annas.

The Physical Society. Proceedings, Vol. 40, Part 4, June 15. Pp. 159-228. (London: Fleetway Press, Ltd.) 7s. net.

Papers from the Geological Department, Glasgow University. Vol. 12 (Octavo Papers of 1927). Pp. viii+17 papers. (Glasgow: Jackson, Wylie and Co.)

FOREIGN.

Proceedings of the United States National Museum. Vol. 71, Art. 24: Catalogue of Human Crania in the United States National Museum Collections; Australians, Tasmanians, South African Bushmen, Hottentots and Negro. By Aleš Hrdlička. (No. 2696.) Pp. 140. Vol. 72, Art. 14: Fossil and Recent Bryozoa of the Gulf of Mexico Region. By Ferdinand Canu and Ray S. Bassler. (No. 2710.) Pp. 199+34 plates. Vol. 72, Art. 18: Millipeds of the Order Colobognatha, with Descriptions of Six New Genera and Type Species, from Arizona and California. By O. F. Cook and H. F. Loomis. (No. 2714.) Pp. 26+2 plates. Vol. 72, Art. 24: Description of a New Species of Gecko from Tanganyika Territory, Africa. By Arthur Loveridge. (No. 2720.) Pp. 2+1 plate. (Washington, D.C.: Government Printing Office.)

A Series of Seven Radio Talks on Science in Industry (with Select Bibliographies). Delivered by Dr. Edward R. Weidlein, Prof. Stephen L. Goodale, Dr. James B. Garner, Frederick W. Sperr, Dr. Warren Fred Faragher, Dr. E. Ward Tillotson, Macdonald C. Booze, William A. Hamor. (Radio Publication No. 9.) Pp. 40. (Pittsburgh, Pa.: University of Pittsburgh.) 60 cents.

A Series of Eleven Radio Talks on Science in the Home. By W. A. Hamor, E. R. Harding, R. R. Irvin, Dr. Donald K. Tressler, Dr. H. M. Johnson, R. H. Heilman, George H. Johnson, L. E. Jackson, Dr. O. F. Hedenburg, Dr. F. F. Rupert, Carl H. Geister, Edgar S. Ross. (Radio Publication No. 23.) Pp. 83. (Pittsburgh, Pa.: University of Pittsburgh.) 75 cents.

A Series of Six Radio Talks on Automobile Engines: their Operation and Care. By Dr. Philip K. Porter, Dr. Donald R. Stevens, Samuel P. Marley, Dr. B. L. Souther, C. J. Livingstone. (Radio Publication No. 28.) Pp. 51. (Pittsburgh, Pa.: University of Pittsburgh.) 60 cents.

A Series of Seven Radio Talks on Wearing Apparel: its Manufacture, Utility, Selection and Care. By Edgar R. Clark, C. F. Goldthwait, Lloyd E. Jackson, George H. Johnson, Dr. Rob Roy McGregor, Helen E. Wassell. (Radio Publication No. 37.) Pp. 62. (Pittsburgh, Pa.: University of Pittsburgh.) 50 cents.

Methods and Problems of Medical Education. (Ninth Series.) Pp. iv+386. (New York City: The Rockefeller Foundation.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 80. The Alpine Algal Vegetation of the Mountains of British Columbia. By Wm. Randolph Taylor. Pp. 45-114+plates 9-13. (Philadelphia, Pa.)

CATALOGUES.

A Selection from the Catalogue of Medical Works. Pp. 8. Eighty-Four Years, 1844–1928. Pp. 8. (London: H. K. Lewis and Co., Ltd.)

Mathematik, Physik, Chemie. Pp. 96. (Berlin: Verlag Julius Springer.)

The Cambridge Bulletin. No. 60, June. Pp. 28+8 plates. (Cambridge: At the University Press.)

Diary of Societies.

SATURDAY, JULY 14.

PHYSIOLOGICAL SOCIETY (in Department of Physiology, University Oxford), at 3.15.—J. R. Marrach and L. F. Hewitt: Osmotic Pressure of Egg Albumin.—H. M. Vernon, T. Bedford, and C. G. Warner: The Influence of Various Systems of Artificial Heating on Skin Temperature.—W. L. Dulière and H. V. Horton: Non-irritable Muscles.—M. Hirst and C. G. Imrie: The Influence of Thyroid in certain Types of Creatinuria.—C. G. Imrie: Blood Sugar and Hypernœa.—D. Denny Brown: Isometric Records of Contraction from the External Ocular Muscles.—D. Denny Brown and Sir C. S. Sherrington: Facilitation in the Flexion-Reflex.—S. Cooper: Arrangement of Fractional Contractions in Muscle.—J. F. Fulton: Changes in the Vascularity of the Human Occipital Cortex during Visual Effort.—J. Argyll Campbell: The Effects of Breathing Carbon Dioxide and Oxygen Mixtures upon the Carbon Dioxide and Oxygen Tensions in the Tissues.—J. Mellanby: The Action of Secretin on Plain Muscle.—W. Burridge: Note on Sweating.—J. B. S. Haldane: Pituitrin and the Chloride-Concentrating Power of the Kidneys.—P. M. T. Kerridge and F. R. Winton: The Hydrogen Ion Activity of the Isolated Uterus.—Demonstrations:—W. H. Wilson and M. Hammonda: Method of Investigating the Effects of Inflation and Deflation of the Lungs on the Respiratory Rhythm in Animals.—Dr. A. S. Parkes and G. F. Marrian: The Induction of Complete Growth of the Mammary Gland in the Non-pregnant Rabbit.—H. M. Carleton: Histological Changes in the Heart following Removal of the Fibrous Pericardium.—H. M. Carleton and D. T. Barnes: Radiographs of Cat's Heart after Removal of the Fibrous Pericardium.—S. Cooper and R. S. Creed: Extensor Reflexes in a Decerebrate Preparation.—D. Denny Brown and E. G. T. Liddell: The Tendon-Reflex.—D. Denny Brown: The Nerve-Endings in Striped Muscle.—J. F. Fulton and Sir C. S. Sherrington: Spinal Flexion-Reflex.—G. Ekehorn: A Method of Microtitration.

MONDAY, JULY 16.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (Annual General Meeting) (at Royal Society of Arts), at 5.30.—Addresses by The Earl of Balfour, Sir Robert S. Horne, Sir Martin Conway, and Prof. L. T. Hobhouse.

SATURDAY, JULY 21.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Ilfracombe), at 12.

CONFERENCES.

JULY 13, 14, AND 15.

MIND ASSOCIATION: ANNUAL MEETING AND JOINT SESSION WITH THE ARISTOTELIAN SOCIETY.

July 13.

At 5.—Mind Association (Annual Meeting) (at Clifton Hill House, Bristol), followed by a Joint Session with the Aristotelian Society, for which the following arrangements have been made:—

Friday, July 13.

At 8.—Chairman: Prof. J. A. Smith.—Address by Prof. G. C. Field.

Saturday, July 14.

At 10.—Chairman: Prof. Beatrice Edgell.—Symposium: The Nature of the Self and of Self-consciousness. Prof. G. Dawes Hicks, Prof. J. Laird, A. Dorward.

At 2.—Chairman: Prof. J. H. Muirhead.—Symposium: Bosanquet's Account of the General Will. A. D. Lindsay, Prof. H. J. Laski.

At 8.—Chairman: Prof. H. Wildon Carr.—Symposium: Time and Change. J. MacMurray, R. B. Braithwaite, Dr. C. D. Broad.

Sunday, July 15.

At 2.—Chairman: Prof. G. E. Moore.—Symposium: Is there a Moral End? Prof. J. L. Stocks, Prof. W. G. De Burgh, W. D. Ross.

At 8.—Chairman: Prof. T. P. Nunn.—Symposium: Materialism in the Light of Modern Scientific Thought. Prof. L. J. Russell, Miss L. S. Stebbing, Prof. A. E. Heath.

JULY 14-17.

INTERNATIONAL GEOGRAPHICAL CONGRESS (at London).

JULY 16-21.

ROYAL SANITARY INSTITUTE (at Plymouth).

JULY 17-20.

BRITISH EMPIRE CANCER CAMPAIGN.—International Conference.

Tuesday, July 17.

At 9.45 A.M. (at the Royal Society of Medicine).—Sir John Bland-Sutton: Address of Welcome.

At 10 A.M. (at Royal Society of Medicine).—The Relative Values of Surgery and Radiation in the Treatment of Cancer of the Cervix Uteri, Rectum, Breast and Buccal Cavity. Chairman: Sir John Bland-Sutton. General Opener: Prof. Regaud.—Cancer of the Cervix. Opener: Dr. M. Donaldson. Papers: Dr. Lacassagne, Sir Gilbert Barling, Bt.; Dr. Healey, Dr. Cheval, Dr. Zweifel, Dr. J. Muir, C. Berkeley.—Cancer of the Rectum. Opener: Sir Charles Gordon-Watson. Papers: Prof. Hartmann, W. E. Miles, J. P. Lockhart-Mummery, Dr. D. Quick, Dr. Neumann.

At 10 A.M. (at College of Nursing).—The Etiology of Cancer. Chairman: Lord Dawson of Penn. Opener: Prof. J. Ewing. Papers: Prof. Roussy; Prof. Blumenthal, Prof. Leitch, Prof. Borrel, Prof. Deelman, Dr. Murphy, Prof. Maisin, Prof. Rhoda Erdmann, Prof. J. McIntosh, Miss Maude Slye, Prof. Teutschlaender, Prof. Blair Bell, Prof. Leo Loeb.

Wednesday, July 18.

At 9.30 A.M. (at Royal Society of Medicine).—The Classification and Treatment of Bone Sarcoma. Chairman: Sir Charles Gordon-Watson. Opener: Prof. Ewing. Papers: W. S. Handley, Dr. W. B. Coley, J. Taylor, Dr. C. Simmons, Prof. Fichera, Dr. F. Martin, R. C. Elmslie, Prof. M. J. Stewart, T. W. P. Lawrence.—Some Present Day Medical Aspects of Cancer. Chairman: Sir William Willcox.—Short Papers:—A Consideration of Cancer Cachexia, by Sir Thomas Horder. The alleged increased frequency of Primary Carcinoma of the Lung,

by Dr. R. Hutchison, followed by Dr. L. S. T. Burrell, Prof. T. Shennan, Prof. J. S. Dunn, W. G. Barnard, and others.—Biological Effects of Radium and X-Rays, with Special Reference to the Factors of Wave-Length, Intensity of Radiation and Duration of Exposure. Chairman: Prof. Russ. Openers: Prof. Regaud, Prof. Holthusen, Dr. D. Quick.

(At College of Nursing).—Occupational Cancer. Chairman: Prof. W. S. L. Barlow. Openers: Prof. A. Leitch, D. J. C. Bridge and Dr. S. A. Henry, Dr. T. H. C. Stevenson. Papers: Prof. Schmorl, Dr. Rostoski, Dr. A. Scott, A. H. Southam, Dr. L. Carozzi, Dr. A. F. S. Sladden, Prof. Teutschlaender, Dr. W. J. O'Donovan, Dr. L. D. Savatard, Prof. W. M. de Vries, Dr. F. L. Hoffman, Dr. E. L. Kennaway, Prof. E. L. Collis.

Thursday, July 19.

9.30 A.M. (at Royal Society of Medicine).—The Relative Values of Surgery and Radiation in the Treatment of Cancer of the Cervix Uteri, Rectum, Breast and Buccal Cavity. Chairman: J. P. Lockhart-Mummery.—Cancer of the Breast. Opener: Prof. B. Lee. Papers: Prof. Jüngling, W. S. Handley, Dr. F. Martin, Dr. R. Knox, G. Keynes.—Cancer of the Buccal Cavity. Opener: Dr. D. Quick. Papers: S. Cade, Prof. Pfahler, D. Harmer, B. T. Rose.—Evaluation of Statistics relating to Effectiveness of Treatment. Opener: Dr. Janet E. Lane-Claypon. Papers: Dr. C. Wood, Prof. G. Winter.

(At College of Nursing).—Methods of Treatment by Chemo-Therapy, with special Reference to Lead. Chairman: Sir Thomas Horder. Opener: Prof. Blair Bell. Papers: Prof. C. Wood, Dr. B. Simpson, Prof. Dilling, Mr. Hume, Dr. Wyard, Dr. Loewy, Dr. A. P. Thomson, Dr. M. Copeman, Dr. Lumsden, Mr. Pybus, Prof. Caspari, Dr. Hocking, Dr. H. J. B. Fry.

Friday, July 20.

9.30 A.M. (at Royal Society of Medicine).—The Early Recognition and Treatment of Cancer of the Stomach. Chairman: Sir Charles Gordon-Watson. Opener: Sir Berkeley Moynihan. Papers: Dr. E. Spriggs, Dr. A. F. Hurst, Prof. Stewart, Prof. Finsterer, Prof. D. Wilkie, Prof. Bastianelli, A. J. Walton, G. Taylor.—Diagnostic Methods in Relation to Cancer. Chairman: Sir William Hale-White. Opener: Sir Thomas Horder. Papers: Dr. T. Bennett, Dr. J. A. Ryle, Dr. MacCarty, Prof. Dudgeon, Prof. Ascoli, Dr. H. J. B. Fry, Dr. G. A. B. Hicks, Prof. W. C. M. Lewis, Dr. S. Melville, Prof. Dodds, Sir William Willcox.—The Effects of Radium and X-Rays on the Blood Vascular and Lymphatic Systems, with Special Reference to Malignant Growths. Chairman: Dr. R. Knox. Openers: Dr. F. C. Wood, Dr. A. Lacassagne, Prof. Holfelder.

(At College of Nursing).—Geographical and Racial Prevalence of Cancer. Chairman: Lt.-Col. F. E. Fremantle. Opener: Prof. Major Greenwood. Papers: Prof A. Niceforo, Dr. Sourasky, Dr. P. Stocks, Prof. Pittard, Dr. M. Young.—Public Action in Regard to Cancer. Opener: Sir George Buchanan. Papers: Prof. J. Maisin, Dr. G. A. Soper, Dr. S. Reimann, Sir John Robertson, Prof. F. Blumenthal, Dr. R. V. Clark, Dr. C. K. Millard, Dr. W. A. Daley, A. Cooke.

JULY 18-25.

INTERNATIONAL GEOGRAPHICAL CONGRESS (at Cambridge).

JULY 23-26.

BRITISH PHARMACEUTICAL CONFERENCE (at Cheltenham).

Monday, July 23.

Reception by the Mayor of Cheltenham.

Tuesday, July 24.

Welcome by the Mayor of Cheltenham.
Address by the Chairman of the Conference.
Science Meetings.
Delegates Meetings.

Wednesday, July 25.

Science Meetings.
Delegates Meeting.

Thursday, July 26.

Visit to Malvern.

JULY 24-27.

BRITISH MEDICAL ASSOCIATION (Annual Meeting, at Cardiff).

Provisional Programme.

Tuesday, July 24.

At 8 P.M.—Sir Ewen Maclean: Presidential Address.

Wednesday, July 25.

At 10 A.M.—Discussion: Diseases of the Coronary Arteries. Dr. G. A. Allan, Dr. A. G. Gibson, Dr. C. F. Coombs, Prof. G. Hadfield, Dr. C. B. Perry, Dr. I. J. Davies, Dr. D. E. Bedford, and Sir John Campbell.

Discussion: The Diagnosis and Treatment of Spinal Cord Tumours. D. J. Armour, Dr. G. Riddoch, Sir Percy Sargent, and G. Jefferson.

Discussion: Unsuccessful Forceps Cases. Prof. W. F. Shaw, Prof. J. Hendry, and Dr. D. A. Miller.—Paper: Prof. R. Vaudescal: Myomectomy during Pregnancy.

Discussion: Autotoxæmia as a Factor in the Causation of the Psychoses. Prof. W. Weygandt, Dr. E. Mapother, Dr. J. Porter-Phillips, Dr. Mary R. Barkas, Dr. A. Helen Boyle, Dr. D. F. Rambaut, Dr. F. A. Pickworth, and Dr. I. S. Wile.

Discussion: The Pathology of Encephalo-myelitis occurring in the course of Virus Disease and Exanthemata. Prof. H. M. Turnbull, Prof. J. McIntosh, Prof. J. C. G. Ledingham, Dr. M. H. Gordon, Dr. J. G. Greenfield, Dr. J. E. McCartney, Dr. S. P. Bedson, and Prof. G. Hadfield.

Discussion: Low Backache and Sciatica. W. A. Cochrane and P. J. Verrall.

Discussion: Chronic Splenomegaly in Childhood. Dr. R. Hutchison, L. E. Barrington-Ward, Dr. L. Findlay, and Dr. C. P. Lapage.

Discussion: Visual Efficiency and Working Ability. Dr. A. F. Fergus, Sir J. H. Parsons, and N. B. Harman.

Paper: Dr. T. H. Whittington: The Examination of the Eyes and Eyesight in Young Children.

Discussion: Chronic Ethmoiditis. Dr. R. Skillern and W. G. Howarth.

Papers: Dr. P. Watson-Williams: Case of Optic Neuritis due to Sphenoidal Sinusitis treated by Differential Exploration.—R. A. R. Wallace: The Ideal Treatment of Quinsy—Immediate Enucleation.

Discussion: The Relation between Trauma and Tuberculosis, especially from the point of view of Compensation and Accident Insurance. Dr. N. Tattersall, R. Milne, and Dr. O. May.

Papers on Factors in the Biochemistry of Tuberculosis: Dr. L. S. T. Burrell: The Therapeutic Value of the Heavy Metals.—Dr. J. C. Hoyle: The Serum Calcium in Experimental Tuberculosis.—Dr. W. H. Tytler: The Tuberculin-active Fraction of the Tubercle Bacillus.

Discussion: Ultra-violet Ray, and the General Public. Prof. W. E. Dixon and Dr. C. B. Heald.

Discussion: The Value of the Present Methods of Control of Infectious Diseases—(*a*) The Control of Small-pox. Dr. L. J. Rajchmann, Dr. J. M. Martin, Dr. T. E. Hill, Dr. R. P. Garrow, Dr. R. B. Low, and Dr. C. K. Millard. (*b*) The Control of Scarlet Fever and Diphtheria. Dr. R. A. O'Brien, Dr. J. G. Forbes, Dr. B. A. I. Peters, and Dr. E. H. R. Harries.

Discussions: (1) Recent Advances in Diagnosis and Treatment of Human Helminthiasis. Lieut.-Colonel Clayton Lane. (2) Transmission of Kala-azar. Dr. C. M. Wenyon.

Discussion: Historical Aspects of Ideas regarding the Nature and Treatment of Dropsy. Dr. J. D. Comrie.

Papers: Dr. E. R. Williams: Welsh Physicians and the Renaissance.—Dr. J. D. Rolleston: The History of Scarlet Fever.—Dr. P. Diverres: The Welsh Physician in the Middle Ages.—C. J. S. Thompson: The History and Lore of Cinchona Bark.

Discussion: Recent Advances in the Medical Treatment of Gastric Diseases. Dr. A. F. Hurst and Dr. T. I. Bennett: Treatment by Diet and Drugs.

Thursday, July 26.

At 10 A.M.—Discussion: The Prevention and Treatment of Diphtheria. Dr. J. D. Rolleston, Dr. J. G. Forbes, Dr. E. W. Goodall, and Dr. J. McGarrity.

Discussion: The Diagnosis and Treatment of Sterility. Dr. A. E. Giles, Dr. S. Forsdike, and K. M. Walker.

Discussion: The Differential Diagnosis and Treatment of Cerebral States consequent upon Head Injuries. Dr. C. P. Symonds, Dr. C. Worster-Drought, W. Trotter, Dr. R. D. Gillespie, Dr. D. McAlpine, and Dr. G. Riddoch.

Discussion: Variations in the Intestinal Flora in Health and Chronic Disease. Prof. J. Cruickshank, Sir Thomas Horder, Bt., Sir Thomas Houston, Prof. J. H. Dible, Dr. A. F. S. Sladden, Dr. L. P. Garrod, and Dr. C. E. Dukes.

Discussion: Volkmann's Ischæmic Contracture, with special reference to Treatment. Sir Robert Jones, Bt., S. Middleton, and A. H. Todd.

Discussion: Chronic Nephritis in Childhood. Dr. J. C. Spence, Dr. H. T. Ashby, and Dr. N. B. Capon.

Discussion: The Etiology of Glaucoma. W. S. Duke-Elder, T. Henderson, and N. B. Harman.

Paper: A. H. Levy: Telescopic Spectacles.

Discussion: Drainage of Brain Abscess. Sir Percy Sargent and S. R. Scott.

Paper: E. D. Davis: Injuries of the Ear arising from Fractures of the Skull.

Discussions: After-effects of Surgical Procedures on Cases of Pulmonary Tuberculosis. A. T. Edwards and Dr. F. G. Chandler. Tuberculosis as seen by the General Practitioner. Dr. R. Cameron and Dr. A. E. Kennedy.

Discussion: The Teaching of Hygiene. Dr. W. W. Jameson and Dr. H. B. Brackenbury.

At 10 A.M. to 12 NOON.—Discussion: The Fallacy of X-rays in Abdominal Diagnosis. H. J. Paterson, Dr. F. Hernaman-Johnson, and Dr. A. F. Hurst.

At 12 NOON.—Discussion: The Treatment of Gangrene. W. S. Handley, P. Turner, and E. G. Slesinger.

Friday, July 27.

At 10 A.M.—Discussion: Acute Nephritis. Prof. T. G. Moorhead, Dr. H. L. Tidy, Dr. T. I. Bennett, Dr. H. Gainsborough, and Dr. R. L. McKenzie Wallace.

Discussion: Pancreatitis. J. W. G. Grant and Dr. A. F. Hurst.

Papers: Prof. W. W. Chipman: Acute Conditions in the Lower Abdomen of the Female.—E. Williams: The Acute Pelvis.—Dr. G. G. Ward: Radium Therapy in Carcinoma of the Cervix Uteri; an Analysis of the Results obtained at the Women's Hospital in New York.—Dr. E. F. Murray: Radium in the Treatment of Carcinoma Cervicis and Intractable Menorrhagia.—Dr. J. Young, Prognosis and Treatment of the Albuminuria of Pregnancy.

Discussion: The Early Treatment of the Psychoses and Psychoneuroses. Dr. A. Helen Boyle, Dr. E. Mapother, Dr. R. D. Gillespie, Dr. Mary R. Barkas, Dr. R. G. Gordon, Dr. J. R. Rees, and Dr. I. S. Wile.

Discussion: The Falling Birth Rate in its Various Aspects—(*a*) The Biological Aspect, Prof. F. A. E. Crew. (*b*) The Economic Aspect, Prof. W. J. Roberts. (*c*) The Medical Aspect, Sir Thomas Horder, Bt., and Lady Barrett.

Discussion: Urticaria. Dr. A. R. Hallam and Dr. H. W. Barber.

Papers: Dr. H. C. G. Semon: Souttar's Steam Cautery in Dermatology.—Dr. J. E. M. Wigley: Thallium Epilation in the Treatment of Ringworm.—Dr. W. J. O'Donovan: Salvarsan Ill-effects and Fatalities.

12 NOON.—Discussion: The Diagnosis of Ureteric Calculi. Prof. A. Fullerton, Dr. E. B. C. Mayrs, K. M. Walker, J. S. Joly, and H. Wade.