NATURE

SATURDAY, JUNE 2, 1928.

CONTENTS.

Editorial and Publishing Offices :

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3057, Vol. 121]

Arctic Aviation.

THE development of aviation, which may already be regarded as a safe means of transport for even comparatively long distances, promises before long to bring the realisation of the sixteenth-century dreams of the north-west and north-east passages and the transpolar routes between Europe and Pacific lands. For three centuries the polar ice has baffled man, but at length the aeroplane and airship have shown him how to avoid it. In 1919, Dr. W. Bruns suggested a series of transpolar commercial routes for airships, and a few years later Mr. V. Stefansson pointed out the advantages that the Arctic offered for flying. Plans for Arctic exploration by air were further discussed at a representative meeting in Berlin in November 1926, which led to the formation of the Internationale Studiengesellschaft zur Erforschung der Arktis mit dem Luftschiff, under the presidency of Dr. F. Nansen. The second general meeting of the society is to be held at Leningrad on June 18-23, when a long programme of papers on Arctic problems will be discussed.

Polar exploration by ship and sledge has made slow advances in recent years. A new method of attack on the inaccessible inner regions of the Arctic Sea is desirable if the remaining problems of the Arctic are to be solved. It was Dr. Nansen who, in defiance of all the accepted canons of polar exploration of the day, introduced the novel idea of a drifting ship in his journey in the *Fram* in 1892–95. At Berlin he dwelt on the value of the airship as an improvement on other means of transport. The new international organisation, of which several well-known British meteorologists are members, aims at raising funds for systematic polar exploration by air, and incidental to that work, the institution of meteorological and magnetic observations in high latitudes. In furtherance of the Association's aims, a quarterly journal entitled *Arktis* (Gotha : Justus Perthes) is being published. The first number, containing several valuable articles on polar work in German, French, and English, has just appeared. It contains also the constitution and membership of the Association, which, for convenience sake, is known as Aeroarctic.

International co-operation in polar exploration is not a new idea. So long ago as 1882–83 eleven States co-operated in a scheme for thirteen Arctic and two Antarctic observatories. The results of that one year's work was the basis of much of our knowledge of Arctic meteorology. To-day there are permanent observatories in west and east

Greenland, Jan Mayen, Spitsbergen, Novaya Zemlya, Siberia, Alaska, and Arctic Canada, but more are needed, and the task of founding and maintaining stations should not prove so arduous as it was forty-six years ago. Northern Greenland, Ellesmere Island, Wrangel Island, the New Siberian Islands, and Nicholas (Northern) Land are among the obvious sites. They could also serve as biological stations, since many of the biological problems of polar regions can be studied only on the spot. At present the Danish station at Disko in Greenland is the only Arctic biological laboratory. Some of the stations might serve as air bases for exploration of the surrounding area. It is important that such stations should be permanent. The intermittency of observations lessens their value. Since the whole of the Arctic regions is now within the nominal political jurisdiction of Denmark, Norway, Russia, the United States, and Canada, it is to be hoped that these States will regard exploration as one of the obligations of sovereignty. To a great extent this has been done already. Arctic sovereignty is no idle claim in Alaska, Arctic Canada, Greenland, Spitsbergen, and Novaya Zemlya.

At the meeting in 1926, when Aeroarctic was founded, discussion favoured the airship rather than the aeroplane in polar exploration. Capt. Amundsen had already used both, and been successful with the airship. The advantages of the airship lie in its great cruising radius and carrying capacity. General Nobile believes that an airship could be constructed to make a non-stop flight of ten days at a speed of 50 to 60 miles an hour; that is to say, it could explore a zone 15,000 miles in length. When he flew with Capt. Amundsen across the Pole, the distance was only 2300 miles, which were covered in 72 hours. Such an airship would obviously be valuable in carrying the materials for establishing a scientific station in regions otherwise poorly accessible. Furthermore, the airship has the advantage over the aeroplane in its powers of going at a low speed or even standing in the air provided the atmosphere is calm. It is said to be possible to land and pick up personnel from an airship. This greatly increases its value in exploration. On the other hand, there is the danger of ice incrustation during fog. However, Capt. Amundsen and Gen. Nobile found this to be less serious than they had anticipated, except when falling pieces of ice were hurled by the propeller against the envelope. The flight of the airship *Norge* in 1926 and *Italia* this year have shown that strong winds can safely be weathered, but it is doubtful if similar craft could face the sudden and incredibly fierce blasts of the Antarctic blizzards.

The aeroplane has been used successfully in the Arctic by Capt. G. H. Wilkins and Com. R. E. Byrd, following on some experimental flights by Mr. G. Binney and others in Spitsbergen and a daring but unsuccessful attempt by Capt. R. Amundsen to reach the Pole in 1925. Compared with the airship, it has the advantage of speed and is less influenced by weather conditions, but its cruising radius is limited by its comparatively small carrying capacity. It has value, however, in reconnaissance work, and might be used for survey of rugged inaccessible country near a convenient base, as in eastern Greenland.

Opinion differs among Arctic airmen as to the use of pack-ice for landing. Capt. Wilkins, from his wide experience, believes that ninety per cent of pack-ice is too rough, but that the remainder is smooth enough to afford frequent landing-places. North of Bering Strait, in 1927, he landed safely on the pack and rose again, and in his long flight across the Arctic Sea this year he saw numerous landing-places, although he had no occasion to use them. Com. Byrd suggests water surfaces as being more useful than ice, but Capt. Amundsen in 1926 nearly lost his hydroplanes in a lead in the pack, and, after extricating one with great difficulty, had to abandon the other. Antarctic pack certainly offers little likelihood of landing-places, while the low air temperatures in the south, even in the height of summer, would increase the danger of alighting on water by ice forming and adding to the weight of the machine. A better knowledge of Arctic meteorology may increase the flying season, but owing to the prevalence of fog in summer, April and May are now regarded as the best months. The disadvantage of that season is that the winter snow still lies and obscures underlying surface features.

All countries will benefit from the work proposed. A fuller knowledge of Arctic meteorology and magnetism will have universal value. There can be no national boundaries in scientific research. The Arctic flights that have so far been made have contributed little to our knowledge of the Arctic, although they have shown the skill and daring of the navigators and pilots. They discovered no new land where none was expected. Capt. Wilkins had fog in the one area where land might have been found. That is no reason, however, why other flights should not have important results. For example, a course from Spitsbergen eastward to Nicholas Land and the New Siberian Islands, which Gen. Nobile has followed, will have interesting

results even if they are negative in the discovery of land. In a few hours of flying instead of weeks or even months of laborious sledge travelling, the limits of Northern Land will be defined and the mystery of Sannikov Land solved. Apart from weather, success depends on mechanical efficiency, but the risk is no greater than that of failure of human endurance in the old methods of travelling. The full value of polar flying, however, will not be reached until the problem of voluntary descent and ascent is solved. Ground observations are essential. Without them the work is incomplete; but this difficulty will no doubt be overcome. The Internationale Studiengesellschaft zur Erforschung der Arktis deserves encouragement in its endeavour to make use of new scientific applications in the solution of old problems.

A Frazer Anthology.

Man, God, and Immortality: Thoughts on Human Progress. Passages chosen from the Writings of Sir James George Frazer. Revised and edited by the Author. Pp. xvi+437. (London: Macmillan and Co., Ltd., 1927.) 15*s*. net.

"ALL that I have attempted in the present volume is to crystallise, as it were, the results of my studies into an optic glass which may afford the reader some momentary glimpses of the long march of humanity on the upward road from savagery to civilisation." So with characteristic modesty, but not unfairly, Sir James Frazer defines the scope and object of this last published of his books. It is an anthology which is virtually a statement of his position as a philosopher and a student of certain phases of human evolution. It brings together within the compass of one volume the more general conclusions of his published works. Except for the slightest of revision, the change of a word here and there to fit the new setting, the original wording of the passages chosen remains unchanged. For their selection and the order in which they appear, M. Pierre Sayn has been responsible; but the compilation has been made under the direction of the author.

The contents have been classified into sections. The first deals with "The Study of Man," in which are embodied the author's pronouncements upon certain of the more general methodological problems of anthropological science. Part II. deals with "Man in Society"; Part III. with "Man and the Supernatural"; and the final section with "Man and Immortality." Few of the passages exceed three pages in length and each is complete in itself, except that in so far as it is the conclusion of an argument, or an inference from previously recited data, the evidence upon which it is based has been omitted. In a book of this character that is not to be imputed as a fault, but is merely an essential part of the general scheme. The reference to the source from which each extract is taken guards against any misunderstanding on the head of dogmatism or the nature of the premisses upon which the argument depends.

In publishing abridged editions of "The Golden Bough" and "The Folklore of the Old Testament," Sir James Frazer conferred a great boon upon his public. For while the complete works will always be indispensable to students and for use in reference, the abridged form, contrary to the general rule, conveys the greater pleasure to his readers. It contains proportionately more of Sir James Frazer. But this can be said even more emphatically of the present book. Here we have the author entirely to himself in extracts from the whole of his works and not from two only, and unadulterated with quotation from the work of others. For we venture to differ from the author when he expressed the opinion that if his work survives to posterity, it will be on account of his record of quaint and savage customs which will then have long passed away. If for no other reason, it will endure as a monument of pure, lucid, and flexible English of never-failing charm.

There is, however, little danger that Sir James Frazer's work will survive only as a storehouse of anthropological facts, or as a model of scholarly and graceful writing. In the course of his extensive studies there is scarcely a problem in social anthropology, in the comparative study of religion, in fact, in the whole range of the evolution of the mind of man, upon which he has not touched, and, it must be admitted, whether we agree with his conclusions or not, which he has not illuminated. In fact, so comprehensive in its scope is the present volume, and so versatile is the mind of which it is the offspring, that it might well serve as a guide, if not as a text-book, for the student in the mazes of what is admittedly one of the most difficult subjects of study.

It is not unfair to say that Sir James Frazer has sometimes been represented by those who do not accept his position, as if he wrote in the spirit of a partisan incapable of appreciating the force of an argument contrary to his own views. Nothing could be further from the truth, yet this imputation may have been made perhaps for the very reason of his essential fairness, and his aversion from anything that is controversial in tone. Yet if readers will turn to those passages in this volume which

deal with evolution and diffusion in culture, we venture to think they will find no clearer grasp of the problem, no more concise and well-balanced discussion of it, and no more logical conclusion free from prejudice in the whole of anthropological literature. It would be possible to cite instance after instance in the passages included here in which highly controversial problems are discussed in the same philosophical spirit, even if the conclusions are not always equally convincing.

It may be inferred from what has been said that this is a book that is of interest only to the anthropologist and the student. On the contrary, and perhaps even more than the works from which its material is drawn, it is essentially a book for the intelligent public, especially at the present moment. Questions relating to totemism, marriage, and the organisation of early forms of society may be passed over as more highly technical in interest. When Sir James Frazer deals with the form and history of religious beliefs, and the survival of primitive modes of thought in civilised communities, he is handling topics of vital interest to modern society. A study of his penetrating and logical examination of the development of man's attitude of mind in the past is a valuable preparation for clarity of thought in dealing with the problems of to-day.

This is not the occasion to enter upon a detailed and critical study of Frazer's work, although the issue of this compendious volume might seem a challenge. From the present writer, after reading and re-reading, it calls for nothing but respectful homage to a great work and a great thinker.

The Polychæta.

(1) *British Museum (Natural History). British Antarctic (Terra Nova) Expedition, 1910.* Natural History Report. Zoology, Vol. 7, No. 2: *Polychæta.* By Prof. William B. Benham. Pp. 47-182 + 6 plates. (London: British Museum (Natural History), 1927.) 12*s.* 6*d.*

(2) *Faune de France. 16: Polychètes sédentaires; addenda aux errantes, Archiannélides, Myzostomaires.* Par Prof. Pierre Fauvel. (Fédération française des Sociétés de Sciences naturelles: Office central de Faunistique.) Pp. 494. (Paris: Paul Lechevalier, 1927.) 75 francs.

(1) PROF. BENHAM'S memoir of the Polychæta of the Antarctic (*Terra Nova*) Expedition, and on those of New Zealand, is important not only for the number of species (88), but also from the novelty of many and the able treatment by the experienced author. As shown in a former paper, the most numerous species are Terebellids, closely followed by the Syllids, then the Phyllodocids, Aphroditids, Sabellids, and Ampharetids. Of the total number of species, 33 were obtained off the northern coast of the North Island of New Zealand during the work of the *Terra Nova* there.

Amongst the Antarctic Syllids, the author was fortunate in procuring the epigamous condition of the large band-like *Trypanosyllis gigantea*, and he combats Fauvel's view that this species is either *T. tæniæformis*, Haswell, or the *T. richardi* of Gravier. He adds the genus Eurysyllis to the fauna, with the 'polybostrichous' condition of *Autolytus maclearanus*. Of the Aphroditids, *Lætmonice producta*, Grube, a widely distributed species, is the only one met with; whilst amongst the Polynoids a new form, *Lepidasthenia antipathicola*, merits special mention, since it inhabits a latticed tunnel formed by the serrated branches of an antipatharian (*Parantipathes tenuispina*), the living tissues of which accommodate themselves to the tubular home of the annelid. The Polynoids and Phyllodocids are well represented; whilst the Lopadorhynchids embrace *Pelagobia viguieri* of Gravier, and *Maupasia cæca*, Viguier. The Nereids include the curious *Cheilonereis peristomialis* of the author, with the hood or collar. The Onuphids have a new sub-family, Aotearinæ, a group with the general facies of *Lumbriconereis*; but whilst the upper jaw-plates are of unequal number as in Eunice, the anterior series are in line as in Lumbriconereis. The Terebellids include the fine *Pista mirabilis* of the *Challenger* Expedition, which stretches from Valparaiso to Graham and Adelie Lands, Gravier's *Lanicides vayssierei*, *Lanice flabellum*, *Amphitrite kerguelensis* and various other members of the group. The author discusses at length his reasons for uniting the *Leæna wandelensis* of Gravier and the *L. arenilega* of Ehlers described two years later. The striking *Hauchiella tribullata* has a distribution ranging from European waters to New Zealand.

The author founds a new genus, Melinnoides, for a species—*M. nelsoni*—from McMurdo Sound. It has only two pairs of gills in a transverse row, and there are neither dorsal crest nor post-branchial hooks. He differs from Augener as regards the relationships of *Travisia oleus*, Ehlers, and *T. kerguelensis*, McIntosh, which the first-mentioned author united. Prof. Benham finds, after a careful survey of many examples, that these forms essentially differ.

The addition of a species of Euchone (*E. pallida*, Ehlers) to Antarctic waters is noteworthy, since

the genus is characteristically Arctic and northern. The finding of the tubes of the ubiquitous *Sepula vermicularis* L., broken into lengths of 1 in. to 2 in. 30 ft. above sea-level on the Drygalski glacier at Evans Cove, Victoria Land, is an interesting observation. Two new species of Vermilia, a new Zopyrus, and a new genus, Chitinopomoides, are described, the species *C. wilsoni* having an operculum approaching that of Mercierella and allied forms, and probably presenting similar blood-spaces on section. The author rightly groups the various varieties of Filograna under the single species, *F. implexa* of Berkeley—from *Protula Dysteri*, Huxley, to the Salmacinas of subsequent authors; and it may interest some to know that Prof. Huxley in July 1865 spontaneously admitted to the writer that his species was only *F. implexa*, a form which stretches over a wide area. The author met with an interesting case of a tube of this species budding at the tip into two tubes which he figures. Species of Protula and Apomatus from New Zealand complete the series.

Besides the intrinsic value of the memoir as an able contribution to the polychæts—to which it adds three new genera and sixteen new species—it affords another example of the extensive distribution of many of the group almost from pole to pole and from the Atlantic to the Pacific Ocean. It is illustrated by six quarto plates of carefully drawn figures by the author, which bring out striking features like the structure of the bristles and hooks, as well as such unique formations as the spiral ridges of sand-grains bristling with sponge-spicules on the tubes of *Lecæna wandelensis*.

(2) Prof. Pierre Fauvel, whose wide experience of the group ranges over both European and distant waters, continues his task in this volume with the "Polychètes Sédentaires" of the shores of France, though under this head are included those of the Mediterranean, North Africa, and one or two other regions. Unlike Prof. Benham, who follows his own classification, he for the most part stands by that of Malmgren.

Each species is defined and its important parts figured with great care by the author or others, so that his successors will reap the benefit of his unwearied labours. The method of illustration adopted (apparently lithographic ink) is prone to make the long bristles somewhat uneven, but on the whole they are helpful outlines. Occasionally inferior figures, as in Magelona, have been selected instead of more accurate representations, but generally the author has given his own figures or those of competent workers. He has a table of the families and of the genera and species in each case, and as there are, for example, in Polydora no less than a dozen species, the author's task has been no light one.

Under the family of the Cirratulidæ are the curious *Ctenodrilus serratus* of O. Schmidt, so common in aquaria, Zeppelinia, which reproduces by scissiparity, and Raphidrilus. Prof. Ashworth's Ascleirochilus is mentioned under the Scalibregmidæ, and Ardwisson's work under the Maldanidæ. Under the Arenicolidæ he gives *Arenicola Claparedii*, an Atlantic and Pacific form, notwithstanding Prof. Ashworth's proof in the British Museum Catalogue that it is *A. pusilla*, De Quatref. Again, he adheres to Claparède's species *A. Grubei*, which, after careful study, Prof. Ashworth and the writer consider to be *A. branchialis*, Aud. and Ed. The Sabellariidæ are followed by the Sternaspididæ, a group formerly placed under the Gephyrea, and still open to controversy as to its place amongst the polychæts. Under the great family of the Terebellidæ, Prof. Fauvel follows the reviewer in considering that the proposal of Hessle to classify them chiefly on their nephridia is more or less impracticable, and he prefers the arrangement of Malmgren—giving six sub-families. Notwithstanding his objections, *Amphitrite gigantea*, Mont., stands, as also does the union of the two forms *Nicolea venustula* and *N. zostericola*, as well as the distinctions between *Chone Fauveli*, *C. Duneri*, and *C. Rayi* in the Ray Society's monograph.

The author gives a useful classification of the Serpulidæ, under which *Serpula concharum* Langerhans, and various species of Hydroides seem to be in want of further investigation. Moreover, he adheres to the old view in regard to Filograna and Salmacina, even citing Prof. Huxley's *S. Dysteri* as a species. An appendix contains a few additions to the errant group, besides the Archiannelids and the Myzostomes.

This volume forms an important contribution, by an able investigator of the polychæts, to the fauna of the shores of France, and will be welcomed elsewhere by all students of the subject. W. C. M.

Modern Organic Chemistry.

Lehrbuch der organischen Chemie. Von Prof. Dr. Paul Karrer. Pp. xxi + 884. (Leipzig: Georg Thieme, 1928.) 34 gold marks.

THIS is a comprehensive text-book planned on a somewhat rigid classificatory basis. The historical introduction is limited to three pages, and except for an equally brief note on the evolution

of organic chemical formulæ, most of the remaining historical allusions are confined to a bare mention, usually undated, of names of leading investigators in the various fields which come successively under review. The treatment of aliphatic compounds (including methods of molecular diagnosis) occupies the first 361 pages; of carbocyclic compounds (including pyrones, indigotin derivatives, and certain other heterocyclic types), 342 pages; and of heterocyclic compounds, 137 pages. In a series of tables, filling the final 17 pages, a good deal of information of statistical and scientific interest is summarised. Useful bibliographies are appended as footnotes to leading sections of the book.

The general plan has necessarily entailed a dispersion of matter which in British text-books is usually assembled under special headings. Thus, the student of stereochemistry, tautomeric change, or valency, will need to collect his information from divers sections of the book, which may often suggest themselves only to the sophisticated reader. His task will be rendered still more difficult by the nature of the index, which is essentially an alphabetical list of names of compounds; the absence of an index of authors is an additional handicap.

These are inconveniencies; but the work may be commended to teachers and advanced students of organic chemistry as affording an excellent and up-to-date German text, dealing with the subject from the viewpoint of molecular constitution. Questions of structure, synthesis, and interrelationships of structural types are handled in a clear and workmanlike manner, and due regard has been paid to the current biochemical trend of organic chemistry. On the whole, recent developments have been well covered, but in a book of this size one is surprised not to find adequate references to modern ideas and investigations on such important subjects as the genesis and transmission of orienting effects in the benzene ring, applications of electronics to organic chemistry, tautomerism, glutaconic acids, the constitution of urea, the menthone chemistry, carene, hydroxymethylenecamphor, squalene, insulin, the production of acetic acid from cellulose by anaerobic fermentation, lead tetraethyl, dichlorodiethyl sulphide and phenarsazine. However, a text-book of organic chemistry offers a broad target to the arrows of detailed criticism, and it is unnecessary to empty the quiver. Suffice it to say, in conclusion, that both author and publisher are to be congratulated on a useful and well-printed addition to the literature of this flourishing branch of science. J. R.

Our Bookshelf.

The Flora of Oxfordshire: a Topographical and Historical Account of the Flowering Plants and Ferns found in the County; with Biographical Notices of the Botanists who have contributed to Oxfordshire Botany during the last Four Centuries. By George Claridge Druce. Second edition (rewritten). Pp. cxxxi + 538. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 30*s.* net.

WE congratulate Dr. Druce on this, the latest addition to the series of county floras to the preparation of which he has devoted so much time, study, and investigation in the intervals of a busy life, for more than forty years.

Compared with the original edition of 1886, the book has much increased in size. Both the form and number of pages are larger. The 'botanologia,' or biographical notices of botanists who have contributed to our knowledge of the flora, has more than doubled in extent, while the flora proper, now limited to the seed plants, ferns, and Characeæ, occupies 533 pages as compared with 366 in the 1886 edition. The appendix on mosses and Hepaticæ, supplied by Henry Boswell in 1886, and the lists of fungi and lichens, have been omitted.

The extensive introduction deals briefly with the topography, soils, elevation, and geology of the county, followed by a more detailed account of the characteristics of the botanical districts, of which seven are recognised based on river drainage (by some oversight, a map included in the former edition has been omitted), and a short section on meteorology (by F. A. Bellamy); the second half of the introduction is taken up mainly by the botanologia. The plan of the systematic portion is similar to that of other county floras by the same author,—references are given to the "Flora of Berkshire" for additional synonymy and bibliography.

From the summary we learn that the flora comprises 1061 species, including denizens and colonists, as compared with 1091 in Berkshire and 1027 in Buckinghamshire. Adventives (450), hybrids (79), and varieties and forms (781) bring the total up to 2371, and there are also eight species now regarded as extinct. Two species, *Orchis Simia* and *Stachys germanica*, appear now to be confined to the county. More than thirty species are mentioned as remarkable absences for which special search should be made. A. B. R.

The Bread of our Forefathers: an Inquiry in Economic History. By Sir William Ashley. Pp. xii + 206 + 4 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 12*s.* 6*d.* net.

ALTHOUGH at first sight of purely antiquarian interest, the question of the kinds of grain our forefathers used for breadmaking proves on examination, to be "intimately bound up with some of the most fundamental problems of our economic

and social history." By the end of the eighteenth century, wheat was firmly established as the universal bread grain in England, at a time when the commoners of other northern races still ate rye.

The main transition to wheat took place during the eighteenth century, and though in earlier times, wheat, rye, barley, and oats were all used as bread corn to some extent, the chief competition always lay between the two former. It is clear from the old records, both civil and ecclesiastical, that wheat and rye bread early became the symbols of social position, rye being the staple food of the commoners, wheat that of the aristocracy or overlords. In some cases bread of different grades was used as currency in payment for services rendered, wheaten bread being given only in very special circumstances.

In England the change in the balance from rye to wheat was much influenced by the interest in the land taken by the lords of the manors. This led to such improvements in agricultural practices as marling and liming, which needed capital expenditure, and steadily improved the land and rendered it more fit for wheat growing. It took centuries, however, for wheat to become the ordinary food of the whole nation. In northern continental countries where the land remained largely in the hands of peasant proprietors, rye growing held its own, and even at the present day forms a staple part of the food of the community.

The rivalry between wheat and rye has always been entirely a question of supply rather than one of cost, because in the early days the price of bread did not affect the bulk of the nation to the degree it now does, as most bread was baked at home. With short supplies, wheat early became a mark of social distinction, and with increasing ambition among the populace, and increasing supplies, it gradually attained the position it now holds as the staple bread corn of Great Britain.

The Soils of Cuba. By H. H. Bennett and R. V. Allison. Pp. 409. (Washington, D.C.: Tropical Plant Research Foundation, 1928.) 6.25 dollars.

A COMPREHENSIVE survey of the soils of Cuba has been undertaken by H. H. Bennett and R. V. Allison, and the results published in book form. Cuba is still the greatest sugar-producing country of the world, and every effort is necessary to maintain this supremacy. The point of the survey was to investigate the possibility of lowering the cost of production of the raw material in the fields by the use of more modern agricultural methods and the better adaptation of the varieties to the soils on which they are grown.

A general description is given of the various soil series found throughout the island, with complete chemical analyses and physical measurements of some of the more representative types, followed by a detailed survey of middle, eastern, and western Cuba and the Isle of Pines. Some areas are handicapped by the presence of large amounts of soluble salt in the soil, which is so detrimental to sugar cane that the mortality and retarded growth is in some cases severe enough to cause the fields to be completely abandoned. Furthermore, the cane juices obtained from salty areas are of inferior quality for milling purposes. The opinion is expressed that better results would accrue from more intensive cultivation of sugar cane on smaller areas, the poorer and less suitable soils being put down to grass or timber.

The influence of soil is of paramount importance in the Cuba cane fields, and emphasis is laid on the importance of cultivators understanding their soils and learning how to treat them to get the best results, as the behaviour of the soil and subsoil has definite peculiarities in many cases. A large-scale annotated soil map is appended, with brief descriptions of the quality of the soil, the best methods of cultivation and treatment, together with the most suitable crops. W. E. B.

Die europäischen Schlangen: Kupferdrucktafeln nach Photographien der lebenden Tiere. Von Dr. Fritz Steinheil. Siebentes Heft. Herausgegeben von Prof. Lorenz Müller. Tafel 31: *Vipera berus berus* (L.); Tafel 32: *Vipera berus berus* (L.); Tafel 33: *Vipera berus berus* (L.); Tafel 34: *Vipera ursinii ursinii* (Bonap.); Tafel 35: *Vipera ursinii macrops* (Mehely). Pp. 17 + 5 Tafeln. (Jena: Gustav Fischer, 1927.) 6 gold marks.

AFTER an interval of more than twelve years, a further part of Dr. Steinheil's beautiful photographs of European snakes, with the appropriate letterpress, has been published. The issue of the work was interrupted, after the appearance of the sixth part, by the outbreak of the War, and favourable conditions for the continuance of publication did not present themselves until 1926. In the spring of that year, Dr. Steinheil resumed his work, but a return of an old malady necessitated an immediate operation, from which he died in April 1926. His friend, Prof. Lorenz Müller, has undertaken the completion of the work as an act of duty and esteem, and, in a foreword to the present part, pays an eloquent tribute to the memory of Dr. Steinheil and to the value of his work. Dr. Steinheil left behind all the photographs necessary for the completion of his book, and Prof. Müller will write the descriptive text. The seventh part, which is now published, deals with *Vipera berus berus*, *Vipera ursinii ursinii*, and *Vipera ursinii macrops*, and is accompanied by five beautiful copper-plate reproductions of excellent photographs of these forms. This part maintains the very high standard of its pre-War predecessors and, now that publication has been resumed, we shall look for a speedy completion of this valuable work, which Prof. Müller has undertaken as a memorial to his friend.

Introduction to the Calculus. By Prof. William F. Osgood. Pp. xi + 449. (New York: The Macmillan Co., 1926.) 12*s.* net.

IN this revision of the author's "First Course," the sets of examples have been improved by the addition of more difficult examples. Even these should be well within the reach of most serious students. The tendency in England in the past

has been to include too many examples of the problem type in the introductory course. Nowadays it is recognised that this is a mistake. Nevertheless, it may be doubted whether this course contains enough to extend the abler readers of it. One reason why many teachers are slow to introduce modern text-books is that the older books, however unsatisfactory they may be in some respects, usually have the merit of containing excellent collections of problems for the better students. This is the more necessary in small schools, where it is not possible to grade the real mathematicians into sets by themselves.

In this volume the emphasis is on the applications of the subject, and there is much material which does not usually occur in an English text-book on the calculus. Whether this material is really required depends on what other text-books are being used concurrently, but the book would certainly be suitable for certain classes of British students, for example, those whose main subject is not mathematics, but who wish to acquire some knowledge of the ideas and applications of the subject. A. R.

Manuel du tapissier décorateur. Par Prof. Lucien Coussirat. (Bibliothèque professionnelle.) Pp. 440. (Paris: J.-B. Baillière et fils, 1927.) 25 francs.

IT is always a satisfaction to encounter a work giving evidence, not alone of the pleasure experienced in its preparation, but also of a thoroughness of knowledge and a completeness in execution, such as are too often absent. In writing about 'completeness' it is, of course, not suggested that the whole art and science of decorative upholstery can be embodied between the covers of a book (16mo) of 440 pages with the encroachment caused by 239 illustrations and diagrams. It is rather the completeness that takes a survey of all the *varia* that may be comprehended by the subject matter.

M. Coussirat might have done better to enter more into the class of upholstery that would suit the average purse of to-day; whereas, in fact, his attention is mainly devoted to 'period' furniture and furnishing; this is peculiarly noticeable in Chapter ix. A curious chronological *mélange* occurs early in the book (p. 19) concerning Catherine de Medici, upon which there is no need to enlarge. The chapter on colour is worthy of attention by the student, though there is some confusion created between spectrum colours and pigments. The chapters dealing specifically with upholstering and the cutting-out of fabrics are the most valuable in an interesting work. P. L. M.

The Story of the Roads. By Cyril Hughes Hartmann. With an Introduction by Lieut.-Col. Alfred Hacking. Pp. xx + 194 + 12 plates. (London: George Routledge and Sons, Ltd., 1927.) 7*s.* 6*d.* net.

RECENTLY there appeared in these columns an article upon road formation, the *raison d'être* being two books, dealing in one case with the scientific aspect of roads, and in the other with the management and methods of concrete highway construction. A passing reference to Mr. Hartmann's "Story of the Roads" will form a fitting corollary. The lively style of diction, in which he displays the history of the island roads of Great Britain from Roman days onwards to the days of gyratory traffic, together with the quaint illustrations, provide a couple of hundred pages of very attractive material. Regarding highway bridges, one might deplore the loss of the original Blackfriars bridge in stone, when viewing the present iron structure.

Apparently the author differs from Mr. Macadam, by lauding the Scotch roads of the eighteenth century to the detriment of those in England. He properly stresses the fact that "the roads must be made to suit the traffic, and not the traffic to suit the roads." It is, of course, a case of pendulum-swinging respecting the former hegemony of the roads being restored after a period of eclipse by the railways. Has the final swing taken place?

P. L. M.

Romance of the Sun. By Mary Proctor. Pp. xii + 266 + 13 plates. (New York and London: Harper and Bros., 1927.) 7*s.* 6*d.* net.

THE contents of Miss Proctor's book are not quite so comprehensive as the title would suggest. The first few chapters include an account of the transit of Venus expeditions and Gill's observations of Mars made for the purpose of measuring the sun's distance. Chapters v.-viii. touch upon the sun itself, but almost exclusively on those phenomena—prominences and corona—which are seen at total eclipses of the sun. Chapter ix. gives the author's personal experiences at the eclipses of 1896, 1900, and 1905, whilst the final chapter describes the recent eclipse of June 29, 1927.

Miss Proctor quotes largely from her authorities; indeed, one-quarter of the text is made up of excerpts. Whether so excessive a use of quoted passages is wise in a book of this description is very questionable. But however that may be, an entertaining account is provided of astronomers and their friends in quest of observations which are only possible at rare intervals.

A Manual of Field Astronomy. By Prof. Andrew H. Holt. Second edition. Pp. xiv + 126. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 10*s.* net.

PROF. HOLT'S little book is intended for the instruction of those doing field work with theodolites. It contains a theoretical explanation of the heavenly motions sufficiently full to enable the student to follow the formulæ with intelligence. The practical directions are clear and explicit. There is a useful table of formulæ for solving spherical triangles, and some explanation of the solar attachments, which when used in conjunction with a theodolite enable the meridian to be found mechanically. There are tables at the end for the conversion of sidereal to mean time, refraction, azimuth of Polaris at elongation, etc. These tables indicate that the order of accuracy aimed at is the nearest second of arc. An error has been noticed on p. 82. In the equation just above (10) for cos z read cot z.

A. C. D. C.

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.*]

Geological Features of the Sites of the Sligo Implements.

AT intervals from August 1927 to March 1928 there appeared in NATURE a series of letters relating to the discovery of chipped fragments of limestone by Mr. J. P. T. Burchell in the neighbourhood of Sligo. These were claimed by him to be evidence of Palæolithic man in Ireland. Apart from the arguable question of the human character of the flaking of the limestone, Mr. Burchell's statements regarding the geology were disputed by Prof. R. A. S. Macalister, Prof. J. K. Charlesworth, Dr. Lloyd Praeger, and Mr. A. W. Stelfox.

We were therefore requested to assess the geological evidence furnished by the sites, and for this purpose visited the Sligo district at the end of March. We were much assisted in finding the exact sites by the photographs in Messrs. Burchell and Moir's book, "The Early Mousterian Implements of Sligo, Ireland." We have to report as follows:

Photo] [*R. J. Welch*

FIG. 1.—Boulder clay at Ballyconnell, showing angular fragments of limestone.

At Ballyconnell, about ten miles north-west of Sligo, is a small bay with two horns, at each of which boulder clay rests upon limestone. There is a place on each of these horns where the boulder clay reaches about the height recorded by Mr. Burchell and where it can be seen lying upon limestone. The 'implements' were obtained from an 'implementiferous layer' a few inches above the base of the section. The boulder clay of the two promontories contains an astonishing number of angular limestone fragments of all shapes and sizes, and near the base the limestone beds can be traced breaking down into angular pieces, similar to those incorporated in the boulder clay (Fig. 1). The edges of the limestone visible just beneath the boulder clay have been flaked and shattered. We understand that Mr. Burchell devoted some weeks to seeking the 'implements' in this section, and we understand also that he found two or more 'implements,' of which the human workmanship is not so enthusiastically and generally accepted as in the case of the Rosses Point finds. Among such myriads of angular limestone fragments, it would be surprising if in the course of some weeks, two or even more pieces simulating human workmanship could not be found. If the 'implements' are *beyond question* of human origin, there is certainly a case for the existence of man before the boulder clay of the region was formed. If, however, there is any doubt about the workmanship, the 'implements' from Ballyconnell are of no value as evidence of Palæolithic man in Ireland.

At Rosses Point, Mr. Burchell claims to have discovered a rock-shelter of high antiquity, the roof of which was formerly in place but was broken down, as he suggests, under the load of the advancing ice which deposited the boulder clay. At the most, the rock-shelf (the 'shelter') was not higher than a table, and at present there is very little overhang of the 'roof' (Fig. 2). One would expect that if a rock-shelter collapsed under these conditions, the collapsed fragments would consist of roof-blocks, whereas in point of fact we counted 26 (out of a total of 36) large slabs, having an aggregate area of about 180 square feet lying above H.W.M. of ordinary summer tides, which were unmistakably derived from the 'floor,' being of limestone of different character from that of the 'roof,' and easily distinguished from it. These 26 blocks have been lifted to a height of at least 5 ft. above the level of the floor by the waves during storms. Whatever, therefore, may be the position as regards the human origin of the flakes found beneath the loose blocks, it is improbable that a 'shelter' could have existed there in Palæolithic times. It might even not have been there a hundred years ago.

The supposed raised beach is neither more nor less than sand and shells which have been blown up and plastered against the face of the boulder clay cliff behind. That boulder clay also is crammed full of angular fragments of limestone, which seems to be a feature of the boulder clay of the district. Mr. Burchell refers in one of his letters to the fact that he hurled blocks of rock about on the site "in the way in which some people imagine the sea to have done." It is easier to contrast than to compare the hurling of blocks by a human being and the action of the sea during winter storms on the Atlantic coasts. The fact that limestone blocks from the floor of the supposed shelter are now found in abundance above the level of that floor, and that one of them was, in fact, imbedded in the soil and grass well above H.W.M., proves conclusively that the storms on the very exposed coast near Sligo are capable of lifting and hurling at each other very large blocks of limestone.

Some of the transported slabs we measured were 4 ft. in length by 3 ft. in width. This piling-up of blocks is a feature of the whole coast-line where low-dipping limestones run out to sea. It is particularly well seen on the western side of Coney Island, where there are rows of blocks, fringing the low coast-line, the source of which can be traced to two or three ledges below H.W.M. which have been stripped to provide the blocks piled up above H.W.M.

At the western end of the northern side of Coney Island, Mr. Burchell has described another rock-shelter or cave, out of which he supposes 'implements' to have been washed. This part of the coast again bears obvious traces of rapid erosion, due in that case partly to the exposed position, partly to the existence of well-bedded rocks with shaly limestone underlying more massive beds, and partly to the exceedingly well-marked joints, which run roughly parallel to that part of the coast. The cave which Mr. Burchell describes is interesting, because not long ago (? fifty years) a beacon was erected near the edge of the cliff (Fig. 3). The concrete base of the beacon has now been undermined by the collapse of the cliff over the cave, and the whole bed which formerly supported it has come away in one piece to a width of about 7 ft. and length of at least 30 ft. Since the beacon would certainly not be built on an unsupported overhanging concrete base, we may say that since it was erected the coast has receded not less than 7 ft. by erosion.

Such low sea-caves, about 3 to 4 ft. in height and due to the undercutting action of the sea, in no way resemble inland shelters and caves in limestone districts, which are usually solution-phenomena.

Photo [*R. J. Welch*

FIG. 2.—The so-called 'shelter' at Rosses Point. The black cross marks the 'floor' of limestone and the white crosses blocks of the same rock which have been thrown up by wave-action.

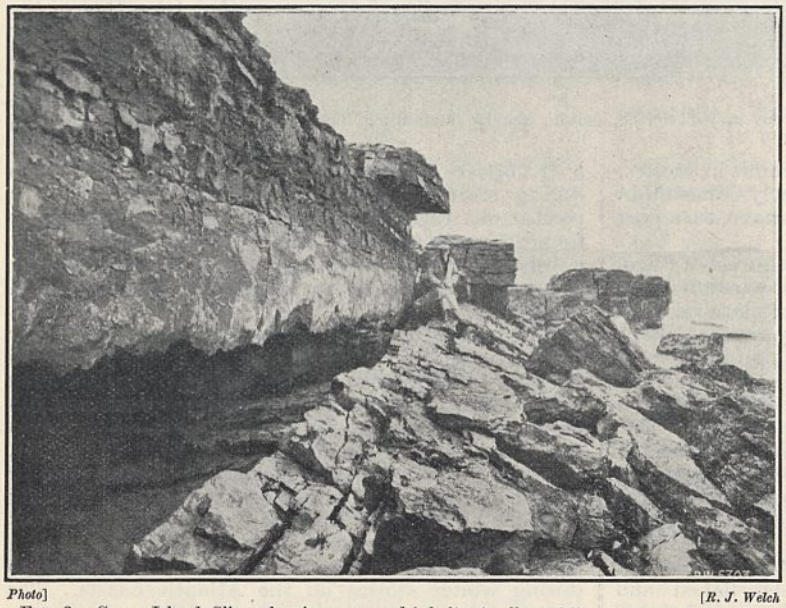

Photo [*R. J. Welch*

FIG. 3.—Coney Island, Sligo, showing supposed 'shelter,' collapsed limestone and, above the figure, the old masonry foundation of the beacon.

Finally, we may perhaps be permitted to say that we went to Sligo unprejudiced and prepared to find that there was a real case to be considered. We are convinced that there is absolutely no case whatever for supposing that the sites concerned are of any antiquity, with the exception of Ballyconnell, the 'implements' from which, as we have said, are not enthusiastically accepted. Not having seen any of the 'implements' which were exhibited in London, we offer no opinion on them.

O. T. JONES.
University of Manchester.
P. G. H. BOSWELL.
University of Liverpool.
May 8.

Nova Pictoris.

THE article entitled "Nova Pictoris as a Double Star," in NATURE of April 7, attributes to me views which I do not hold. This is doubtless due to an incompletely cabled report of an interview which I gave to a reporter of the *Cape Times*, after the announcement from Johannesburg of the duplicity of the star, which was announced in the local press as a splitting of the star. In this interview I mentioned various theories which have been advanced as possible explanations of the outburst of a nova, including the theory of a grazing impact of two stars. I referred to the inherent improbability of the latter occurring, but added that as Nova Pictoris had behaved in such an exceptional manner from the time of its first discovery, it should not be left out of consideration in seeking an explanation of the star's behaviour, and that subsequent observation of the

star would doubtless throw further light on the matter. I do not, however, adopt the view that the outburst was definitely due to such a collision.

There has also been some misunderstanding in regard to the separation of the stars. The figure of one-fifth of a second was merely a hypothetical figure which I adopted for the sake of argument to show that if the companion was in reality a background star, previously hidden by the nova but afterwards uncovered, the proper motion required to render it visible in a large telescope was not excessive. I adopted the figure of one-fifth of a second as the minimum separation at which the duplicity would be certainly detected with the 26½-in. refractor at Johannesburg, as at that time I was not aware of the separation observed at Johannesburg. It is unfortunate that it has been interpreted as a measure of the separation made at this observatory. With the 18-in. visual refractor here, the duplicity has not been conclusively seen, though suspected. The most prominent feature of the star is the very strong nebulous envelope.

The Johannesburg observers are satisfied that there are three components, and suspect a fourth, thus still further adding to the mystery of this extraordinary star. The star is surrounded by rings which are probably due to matter ejected with high velocity at the outburst. The diameter of these rings suggests that the star is relatively near, much nearer than indicated by the spectroscopic parallax derived by Mr. Davidovich, and that the parallax should be easily measurable by direct methods. The star has therefore been placed upon the parallax observing list of the Cape Observatory.

H. SPENCER JONES.
(H.M. Astronomer.)

Royal Observatory,
Cape of Good Hope,
May 3.

Mechanical Production of Short Flashes of Light.

IN the study of phenomena which occur in a very short interval of time, it is usually necessary to have some kind of 'light shutter' that operates with extreme rapidity. An electro-optical shutter which lets through very short flashes of light has been previously described (Beams, *J.O.S.A. and R.S.I.*, **13**, 597; 1926; Lawrence and Beams, *Proc. N.A.S.*, **13**, 207; 1927), but in some experiments it is highly desirable that the shutter operate as many times per second as possible in order that enough intensity can be obtained to observe the phenomena accurately.

If one sends monochromatic light into an interferometer, say of the Michelson type, and projects approximately straight fringes upon a slit or slit system parallel to the fringes, and then changes the optical path in one arm of the interferometer with respect to the other, the fringes move perpendicular to their length. The slit then becomes a source of light flashes the duration of which depends upon the time required for a bright fringe to cross the slit. If, then, the optical path in one arm of the interferometer is changed rapidly enough with respect to the other, very short flashes of light can be produced. Thus, if light of 5000 A. is used, and the optical path changed at the rate of 1 cm./sec., then 2×10^4 flashes are produced per second, each flash lasting not longer than 5×10^{-5} sec.

There are, of course, several ways of changing the optical path with considerable rapidity, but the following device has been adopted because of its simplicity and the tremendous rate of change of optical path which it effects: two right angle prisms of identical material and dimensions are placed in one arm of the interferometer so that their hypotenuses are parallel, and so oriented that if the hypotenuses were in contact, the two prisms will form a rectangular block.

Light incident perpendicular to one of the sides is then undeviated as it passes through the prisms. If the two prisms are moved with respect to each other horizontally and parallel to the side upon which the light is incident, the optical path is changed and the fringes in the interferometer move. The rate of change in optical path depends upon the index of refraction of the glass, the angles of the prisms and the speed with which the prisms move, while the total difference in optical path at any time is limited only by the coherence length of the monochromatic light used.

In my preliminary experiments a single glass prism with a small vertical angle was mounted on a balanced steel arm, which was fastened to the shaft of an electric motor so that the prism moved approximately parallel to an identical fixed prism in the optical path. On the same shaft an opaque disc with a small slit in its edge revolved in front of a mercury arc source, so that light passed through the interferometer only while the optical path was being changed. A filter which permitted only the mercury green line to pass was used in front of the arc. The duration of each light flash was slightly less than 10^{-7} sec. These light flashes when sent back through the interferometer form two sets of fringe systems. These fringes are viewed by means of a mirror placed in front of the mercury arc in such a way as to avoid undesirable reflected light. One of these fringe systems is approximately stationary and serves to indicate when the apparatus is working properly. Although not used in this preliminary work, the instrument can be calibrated if desired in terms of the velocity of light by letting the light flashes pass over a measured distance before sending them back through the interferometer and observing the relative shift of this stationary fringe system. In fact, it is even possible to make this calibration with the slit removed.

One of the applications of this apparatus might be mentioned. If light flashes of the proper wave-length are focused on a bulb containing metallic vapour, and the resonance light from the bulb sent back through the interferometer, the resulting fringes will appear stationary, due to a sort of stroboscopic effect when the length of light flashes are constant, but will move or change their character when the flashes are shortened, depending upon the average time between excitation and emission for the vapour.

The present arrangement is not very satisfactory, because the two prisms twist slightly, and hence a very narrow slit in the opaque disc must be used, thereby sacrificing light intensity. However, a new apparatus is to be constructed in the near future that should eliminate these difficulties as well as give shorter light flashes. It should be easy to produce flashes of 10^{-8} sec. and possibly 10^{-9} sec. duration.

The writer desires to express his appreciation of the valuable suggestions made by Mr. Donald Cooksey with regard to the design of the mechanical parts of the apparatus.

J. W. BEAMS.

Yale University,
April 19.

The Band Spectrum of Mercury excited by a High Frequency Discharge.

A METHOD of exciting spectra by a high frequency discharge has been described by Wood and Loomis (NATURE, **120**, 510; 1927), Clarke (NATURE, **120**, 727; 1927), and others. The method consists of sending a high frequency current through a wire coiled around the tube in which the discharge is excited. While

experimenting with a low voltage Tesla coil in which the primary circuit power was supplied from a 110-volt buzzer, it was observed that when contact was made between one side of the secondary and a metal support on a diffusion pump, a brilliant green discharge was produced in the mercury circulating through the pump at a pressure of about 5 cm. The spectrum of this discharge showed a very intense emission of the green fluorescence band of mercury.

This observation suggested an experiment to study the conditions of excitation of the mercury bands. Accordingly, a quartz tube, 0·7 cm. in diameter and 15 cm. long, having a small bulb near each end, was evacuated and sealed off containing about 1 c.c. of mercury. A piece of wire was wrapped around one end to serve as a single external electrode, and the tube was supported by this wire in a vertical position. One side of the secondary of the Tesla coil was connected to this wire and the other earthed through the primary circuit.

When the mercury in the tube was heated to boiling by a Bunsen burner, the Tesla coil produced a bright discharge in the tube. The spectrum of this discharge showed the mercury arc lines and the mercury bands, the maxima of which come at λλ4850, 3300, 2540, and 2345. No trace of a band at 2650, observed by Houtermans (*Zeit. f. Phys.*, **41**, 140; 1927) and Rayleigh (*Proc. Roy. Soc. Lon.*, **114**, 620; 1927), was found. Light from the middle of the quartz tube was focused on the slit of the spectrograph. If the middle of the tube was heated by a blow torch, the spectrum showed that the 4850 band had disappeared, the 2345 band had been weakened, but the 3300 and 2540 bands were unchanged in intensity. As soon as the middle of the tube cooled to the same temperature as the upper part, the 4850 band appeared again, and the spectrum was the same as before heating. If the mercury is vigorously boiled, the 3300 band is weakened with respect to the 4850, 2540, and 2345 bands.

In order to find the effect of distillation of the mercury on these bands, the tube was suspended in a furnace so that stagnant vapour resulted, and the discharge studied at various pressures from that at room temperature to that at which the discharge ceased. The arc lines appeared at all pressures, and at the higher pressures there was a faint trace of the 2540 band, but there was no observable emission at any pressure of the other mercury bands.

This experiment shows that distilling vapour is necessary for the excitation of the mercury bands 4850, 3300, and 2345 in a high frequency discharge. It is well known that distilling is necessary in many cases for the excitation of the 4850 band in fluorescence. Wood (*Jour. Frank. Inst.*, **205**, 488; 1928) and Pringsheim and Terenin (*Zeit. f. Phys.*, **47**, 342; 1928) have explained this as due to the sweeping away of impurities by the vapour stream. The same explanation probably applies here. These impurities in stagnant vapour are supposed to destroy the excited molecules of mercury through collisions of the second kind before they have a chance to emit the mercury bands.

The destruction of *only* the 4850 band through local heating is hard to explain. The local heating prevented the formation of extra fresh vapour through condensation and evaporation at the point of observation, but there was still a stream of mercury vapour past this point. It may be that the excited molecules which emit the 4850 band have an energy which very nearly coincides with that which the impurities may absorb, and it is, therefore, more probable that collisions with impurities will be of the second kind. This may also account for the non-appearance of the 2650 band.

This experiment, and those of Houtermans and Rayleigh (*loc. cit.*), show that the 3300 and 4850 bands originate in different initial excited states. This experiment shows in addition that the initial excited state for the 4850 band is also different from that for the 2345 and 2540 bands. This disagrees with the association of the 2540 and 4850 bands made by Houtermans. The final states for the 2345 and 2540 bands must be the same, since both are obtained in absorption. The results of this experiment also indicate that the 3300, 2540, and 2345 bands are emitted from separate initial states.

J. G. WINANS.
(National Research Fellow.)
Princeton University,
New Jersey.

Active Nitrogen.

I REGRET having to request valuable space in NATURE, but it seems necessary to answer a criticism by E. J. B. Willey in the issue of Mar. 10. Quoting a single sentence from one's publication is generally unsatisfactory unless the correct meaning is carried with it. To one who reads my article in the *Journal of the American Chemical Society* (**50**, 27; 1928), it is evident that the statement does not, as Dr. Willey suggests, stultify a good deal of the work under consideration. It is meant merely to indicate that, besides the reactions studied by Willey, there are actions initiated by active nitrogen which require more than two volts, of which he is aware. One need only direct attention to the vast amount of literature on the excitation of spectra requiring up to 10 volts.

Aside from strictly spectroscopic data, which are themselves sufficient evidence for my original statement, I may point out that iodine is ionised by active nitrogen (Constantinides, *Phys. Rev.*, **30**, 95; 1927); 9·4 volts are required for this reaction. $Cu\,Cl \longrightarrow Cu + Cl$ requires 3·3 volts. The Cu lines are also strongly excited (Mulliken, *Phys. Rev.*, **26**, 1-32; 1925), and should this occur simultaneously, the total energy requirement is more than 8 volts. Other energetic reactions occur in active nitrogen, but one hesitates to insist on the exact energy requirement since we are not sure of what is happening, that is, whether the nitrogen molecule or atom is effective. Admission of oxygen or water to active nitrogen gives nitric oxide spectra. Admission of carbon monoxide or carbon dioxide gives cyanogen and nitric oxide spectra. If a single atom does the work, as, for example, $CO + N = NO + C$, this requires about 8 volts. Although direct proof is lacking, it is not inconceivable that metastable nitrogen molecules in level *A* can actually dissociate oxygen (7·02 volts). The criterion for water formation by $H_2 + O = H_2O$ is considered ill-chosen, as it is problematical whether this reaction as given will take place (see "Photochemical Clustering," NATURE, May 19, p. 792). It is worthy of note that J. Kaplan has observed a green and red line in oxygen excited by active nitrogen (abstract in *Bull. Amer. Phys. Soc.*, April 7). In the case of hydrogen, it is well known that the molecule can possess electronic energy greatly in excess of that necessary for dissociation and can lose this energy in band spectrum emission. Dissociation also cannot be expected with carbon monoxide, as indeed Willey and others have found, since the energy required is larger than is available from the metastable nitrogen molecule in level *A*. (Heat of dissociation of carbon monoxide is 10·8 volts. Birge and Sponer, *Phys. Rev.*, **28**, 283; 1926.)

I regret the unfortunate wording which drew Dr. Willey's next criticism. I meant to convey that 2-volt nitrogen molecules do not issue only from the

discharge, but that spectroscopic data make it appear very probable that they may also be created outside the discharge by collisions of the second kind. I am well aware of Willey's work with an uncondensed discharge, where certain chemical actions occur in the absence of the afterglow. In this connexion it would be especially interesting to see whether there is sufficient energy in active nitrogen from an uncondensed discharge to bring out the band spectrum in cuprous iodide and the arc spectrum of copper.

As to the experiments with active hydrogen and ordinary nitrogen, my results are not extraordinary or new. The experiments are simple and were perfectly and easily reproducible. My negative results are, moreover, supported by several other investigators, including Bonhoeffer, who employed the same method (for literature see *J. Amer. Chem. Soc., loc. cit.*). It still remains, I believe, for Dr. Willey to explain the kind of active hydrogen with which he was dealing, for (1) at 10 mm. pressure and 150 cm. (corrected in private communication) from the discharge no atomic hydrogen can exist (Kaplan, *Phys. Rev.*, **30**, 639; 1927); (2) electronically excited atoms or ionised species are out of the question; (3) there is no real evidence for the existence of H_3, in fact, there is much evidence against it (see Urey and Smallwood's exhaustive attempts to prepare it with negative results, *J. Amer. Chem. Soc.*, **50**, 620; 1928; also Paneth and others, p. 29 of my paper).

The criticism is meaningless that since ammonia extinguishes the glow of active nitrogen (of which I am aware), that this constitutes a grave objection to my theory of ammonia formation—which by the way is not mine, since it has been expressed by Olsen (for reference see my paper, p. 33). My experimental procedure indicates that the pressures of nitrogen and hydrogen were low, down to 0·04 mm., and that a liquid air trap condensed out the ammonia immediately following the mixing chamber. It is certain that some of the ammonia formed, which would have otherwise reached the trap, was again decomposed. It is quite beyond the human eye to detect changes in the afterglow intensity at these low pressures, and it is rendered even more difficult due to stray light from the discharges. The results published in Table I. are only a few of the numerous runs made.

I feel that private communication in controversial matters, once experimental data have been presented, is a far more satisfactory means of discussion.

BERNARD LEWIS.
(National Research Fellow.)
University of Minnesota,
Minneapolis, Minn., U.S.A.

The Mechanism of Formation of the Latent Photographic Image.[1]

IN a communication to NATURE of Sept. 24, 1927 (vol. 120, p. 441), the preliminary results were described of experiments made in an attempt to correlate the mechanism of the latent image formation with that responsible for producing changes of conductivity on illumination. It was shown that the apparent absence of the photo-conductivity effect in the ultra-violet was due to two things: (1) the small penetration of that light, and (2) the use of thick layers of the silver halide. With thinner layers, of the order of 70μ, the ultra-violet (λ3650) effect in silver bromide was found to be about twice as great as that produced by the blue (λ4358), thus supporting the original prediction that in very thin layers of the order of 1-5μ the effect at λ3650 would rise to nearer ten times that at λ4358, which is the ratio of *photographic* effects in very thin layers of slow, pure silver bromide emulsions. It was further predicted that in very thin layers the 'hump' of maximum sensitivity at λ4600 in the photo-conductivity–wave-length curve would disappear. How completely these conclusions have now been verified can be seen from the accompanying graph (Fig. 1). The inference is that in very thin layers of silver bromide the three curves representing

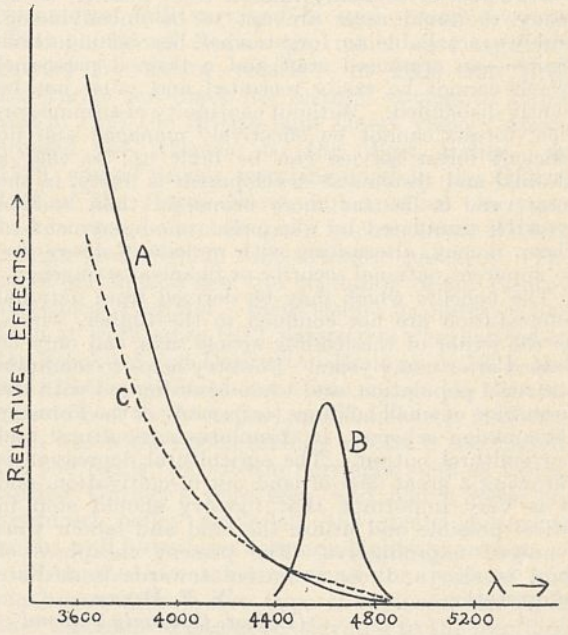

FIG. 1.—Curve *A* represents the relative photographic effects in 'single layer' emulsions of silver bromide. It also closely represents the absorption curve of this halide. The relative effects at λ3650 and λ4358 are as 10:1.

Curve *B* represents the relative photo-conductivity effects in layers of silver bromide of the order of 0·7 mm. and upwards. As the thickness is decreased, this curve gradually changes and approaches the form of Curve *A*. The closest approach yet obtained experimentally is given in Curve *C*, where the ratio of effects at λ3650 and λ4358 has risen to 7:1. The thickness of layer in this case was roughly of the order of 20μ.

(1) the relative photo-conductivity effects, (2) the relative photographic effects, and (3) the relative light absorptions, each plotted against the wave-length for equal incident intensity, are closely the same, indicating that in all probability the primary stage of the photographic mechanism is intimately connected with that which produces conductivity changes on illumination.

It is hoped that these results will be presented in detail and discussed at the forthcoming International Congress of Photography to be held in London on July 9-14.

F. C. TOY.
Physics Department,
British Photographic Research Association.

Forestry and Agriculture in Great Britain.

ALL forest economists will agree with the writer of the leading article in NATURE of May 5 that national poverty greatly increases the difficulties of a scheme of State afforestation, and that periods when money can be borrowed cheaply are most suitable for afforestation development. Only those, however, who take a superficial view of our national forest problem are likely to be greatly influenced by this consideration.

For many decades those who were alive to the facts of the case have advocated a policy of national

[1] Communication No. 67 from the British Photographic Research Association Laboratories.

afforestation, and various Commissions have recommended in favour of it. It took a great war and the imminent danger of an alarming timber shortage, when we were cut off from foreign supplies, to rouse the public to action. The Forestry Commission was constituted immediately after the War, and now, at the end of its first ten-year period, there is a danger that national lassitude will allow the Commission to languish from lack of adequate funds.

Statistics of so many million trees planted on so many thousand acres are apt to be unconvincing, and we are liable to forget what lies behind these figures—an organised staff and a trained personnel which cannot be easily recruited and must not be lightly disbanded. Without continuity of administration, forests cannot be effectively managed and no efficient forest service can be built up, so that a gradual and systematic development is likely, in the long run, to be far more economic than sudden growths stimulated by war panic, unemployment, or cheap money, alternating with periods of decay due to apparent national security or financial stringency.

The benefits which may be derived from national afforestation are not confined to the timber, which, as the writer of the leading article says, can only be reaped after many years. Forestry helps to maintain the rural population, and when co-ordinated with the formation of small holdings, as in many of the Forestry Commission schemes, it stimulates agricultural and horticultural output. The agricultural depression is throwing a great deal of land out of cultivation, and it is very important that forestry should step in where possible and utilise the land and labour thus rendered unproductive. The present cheapness of land is also a direct incentive towards immediate afforestation.

W. E. HILEY.
(Editor, *Quarterly Journal of Forestry*.)
Imperial Forestry Institute,
University of Oxford,
May 9.

MR. HILEY misses the point of the article on "Forestry and Agriculture in Great Britain." No suggestion was put forward that the afforestation work now being undertaken should be discontinued. The view was expressed, however, that the Government should perhaps consider whether some of the heavy overhead charges which have little bearing on the actual planting of trees, that is, the afforestation work proper, could not be curtailed. The plea that forestry should step in and plant up land, which, owing to agricultural depression is being thrown out of cultivation, is surely unsound. The first axiom of scientific forestry is that no land which can be made to produce food should come under the ægis of the forester. The money Mr. Hiley would devote to afforesting such land would be more justifiably employed in assisting the agriculturist to bring it once more under crops or stock.

THE WRITER OF THE ARTICLE.

Salt Crystals as Nuclei of Sea Fog Particles.

I HAVE received from Dr. J. S. Owens a note of observations of a fog drifting from westward which he experienced recently on the Bay of Biscay. I cannot recall any observations exactly similar, so I append a copy of the note. It will interest readers of NATURE, and at the same time revive an old question as to the real meaning of an observation of the wet bulb in a sea fog, of which there are many thousands on record.

NAPIER SHAW.
May 17.

"On Sunday, April 29, 1928 (R.M.S.P. *Demerara*), we were a little south of Ushant, about 49 degrees north and 6 degrees west, when after a bright sunny morning a fog came on about 12·30 P.M. and remained till about 7 P.M. The sea was very smooth, no white caps or spray. A light breeze from west. The fog could be seen blowing in wisps across the ship. My cabin being on the west, the breeze was blowing into the port, and I placed a well-polished tumbler in the port hole so that fog particles blown in might hit it and stick. After about an hour visible spots were on the tumbler, and at about 5·30 P.M. the side facing the west was well covered with minute drops obviously liquid, when magnified. I removed the tumbler and filled it with hot water, when all drops disappeared, and in their place were whitish spots, such as one would expect if the droplets contained a soluble salt. On emptying the glass and allowing it to cool again, after about 10 minutes the whitish spots became converted into drops of liquid, evidently the soluble salt deliquescing. It seems, therefore, evident that the fog particles were formed round salt crystals, and that for such a fog to form the relative humidity need not rise much above 75 per cent, assuming, as is fairly certain, the salt present was sea salt, which deliquesces at 74 per cent or 75 per cent relative humidity.

J. S. OWENS."

Correlation.

FOR the determination of a linear function of X approximating to Y for a range of corresponding values (X, Y), a graphic method is desirable.

If the plotted values are divided into two classes by the median of X, in each class, the same number

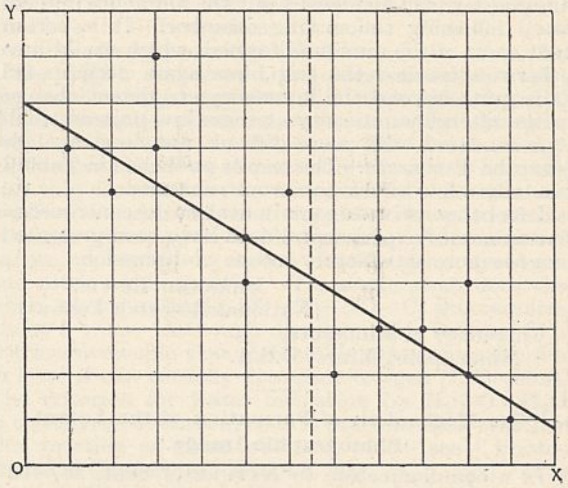

FIG. 1.

of points should lie on each side of the required line, which is thus found by inspection.

The method is much more expeditious than that of least squares. It appears, moreover, to be free from undue bias by outlying values.

For the values plotted in Fig. 1, the straight line is $Y = (40 - 3X)/5$, with a mean deviation of 1·00. The method of least squares gives $Y = (1940 - 137X)/236$, with a mean deviation of 1·05.

A. F. DUFTON.
Barns Green,
Horsham,
May 5.

The Centenary of the Institution of Civil Engineers.

By Engr.-Capt. EDGAR C. SMITH, O.B.E., R.N.

FOUNDED through the action of six young engineers, the first formal meeting together of whom took place at the Kendal Coffee House in Fleet Street on Jan. 2, 1818, the Institution of Civil Engineers on June 3-7 is celebrating the centenary of its incorporation by Royal Charter. It was in January 1820 that Telford was asked to become the first president of the new society, and it was largely through him its charter was obtained eight years later. The celebrations are to commence with a memorial service in Westminster Abbey at 3 P.M. on Sunday, June 3; on Monday, June 4, the president, Mr. E. F. C. Trench, and the council will receive the delegates, and Sir Alfred Ewing will deliver the thirty-fourth James Forrest Lecture on "A Century of Inventions"; during the three succeeding days there will be a conversazione, a banquet, a conference at which some thirty different problems in engineering will be discussed, and a series of visits to important engineering works and undertakings.

In the petition of a hundred years ago to the Attorney-General for the grant of a charter, it was laid down that "Civil Engineering is the art of directing the great sources of power in Nature for the use and convenience of man," an all-embracing phrase which covers almost all the manifold activities of the engineer, and it is not without interest to find that practically all the subjects to be dealt with at the conference—docks, harbours, shipbuilding, railways, fuels, gas, boilers, domestic lighting and heating, road traffic, tidal power, mining, water supply, and sewage—were all matters of vital interest to the engineer a hundred years ago, while even at the time of the incorporation of the Institution, the internal combustion engine was a subject of practical debate, and in the laboratory of Faraday was being laid the foundation of our electric power and lighting.

The birth of the Institution and its incorporation by charter are but two of many landmarks in the material progress of Great Britain. It was not the first society of its kind, neither did it mark the beginning of any new branch of engineering. Docks, harbours, bridges, viaducts, and aqueducts had been constructed for centuries; France many years before had founded a School and Corps of Civil Engineers, while in Great Britain we see the rise of the Smeatonian Society and the short-lived Society for the Improvement of Naval Architecture. These, however, were but the forerunners of the great modern engineering institutions of Great Britain which really had their foundations in the vast extension of the work of the engineer due to the widespread application of mechanical invention to manufacture and to transport during the eighteenth and the early part of the nineteenth century.

When the Institution was incorporated, Brindley, Smeaton, Arkwright, and Watt had long since passed away, but the movements they inaugurated gained in volume day by day. No one had added more to the roads of McAdam and the canals of Brindley than Telford himself, while as a bridge-builder he will always be remembered for that most graceful bridge which spans the Menai Straits. In 1828 the steamboat was a recognised factor in overseas transport, though both Bell and Symington still survived in undeserved poverty. Through David Napier the mails were regularly carried by steam vessels: in 1825 the little *Enterprize* had made her historic voyage to India, and in 1827 the British-built Dutch vessel *Curocoa* crossed the Atlantic to the West Indies. In 1828, steam vessels were included in the Official List of the Royal Navy, but another ten years had to pass before Brunel's famous *Great Western* inaugurated regular trans-Atlantic passages. The same period also saw the beginning of the railway systems of England. Blenkinsop's locomotives had been at work since 1812, passengers were carried on the Stockton and Darlington Railway in 1825, and in 1828 George Stephenson was engaged in the construction of the Liverpool and Manchester Railway, with which the epoch-making *Rocket* is associated. On the roads, too, steam carriages such as Goldsworthy Gurney's were seen, and had a more enlightened policy prevailed, the steam motor-car might well have been common eighty years ago.

With the increasing demand for engines and machinery arose a new type of engineer, known as the 'mechanical engineer,' devoted to the founding and fashioning of iron. Not only was he called upon to make steam engines in great numbers for factories, ships, and railways, but it was he who built the iron bridges and the iron ships. Thanks to the work of Cort, the iron masters of Great Britain were able to meet all demands, and the country came to boast of some thousands of puddling furnaces. With these things came the rise of the machine tool makers. From the shops of Boulton and Watt at Soho, the Butterley Iron Works, and Maudslay's shops at Lambeth, came a long line of successful pioneers, such as Roberts, Muir, Whitworth, and Nasmyth, who gave us the planing machine, the true plane surface, the standard screw thread, and the steam hammer.

Among the first members of the Institution of Civil Engineers were to be found men engaged in all the various branches of engineering, and the *Proceedings* of the Institution contain a progressive review of the great achievements of the engineering profession. In the early days of the Institution, however, engineering work was carried out mainly by practical men trained in the hard school of experience. Of scientific education for the engineer, in England at least, there was none, and scientific research was in its infancy. If there is one thing more than another which separates the present from the past, it is the attitude towards scientific discovery, but for many years now in matters of education and investigation the Institution of Civil Engineers has taken a leading part. In connexion with this it is perhaps worth recalling that when William Anderson inaugurated the

annual lectures which keep alive the memory of the most famous of the Secretaries of the Institution, James Forrest, he took for his subject "The Interdependence of Abstract Science and Engineering." That was in 1893. Since then many men famous both as engineers and as men of science have delivered the James Forrest Lecture, but the happy choice of the Council in selecting Sir Alfred Ewing to give the lecture which will mark the centenary of the incorporation of the Institution will not fail to gain general approval; his lecture on "A Century of Inventions" will be awaited with more than usual interest. In the voluminous publications of the Institution, which in themselves form a veritable engineering library, it may be there are few, if any, more valuable records than these James Forrest lectures, which have often rivalled in interest the famous presidential addresses of Sir John Rennie, Robert Stephenson, Sir William White, and others.

The Accuracy of Shortt Free Pendulum Clocks.

By Dr. J. JACKSON and W. BOWYER.

THE period of vibration of a simple pendulum, swinging in a vacuum through the small semi-arc α is given by $2\pi\sqrt{\frac{l}{g}}\left(1+\frac{1}{16}\alpha^2\right)$.

Variations in the rate of a pendulum clock are produced by variation in (1) the length of the pendulum; (2) the arc of vibration; and variation in several factors which produce a departure from the above formula; namely: (3) air resistance; (4) elasticity of the spring; (5) interference with the free motion of the pendulum by the escapement and impulsing mechanism.

We will consider these in turn.

(1) The principal cause of variation in the length of the pendulum is change of temperature. This can be overcome by keeping the pendulum at constant temperature. Attempts have also been made with more or less success to compensate the effect by the use of metals of different coefficients of expansion so as to make the effective length of the pendulum practically independent of the temperature. But the parts of such compound pendulums may not take up changes of temperature at the same rate, and those of the grid-iron type are apt to roll. The discovery of invar has greatly simplified the temperature question. But invar is a rather unstable substance and its growth produces slow secular change in the clock rate.

(2) If the bob moves in a cycloid instead of a circle the period is independent of the amplitude. Clocks have been constructed with 'cycloidal cheeks' to guide the pendulum, but these have not proved of value. When the semi-arc of vibration is 1° a change of 1′ in the amplitude affects the daily rate of a simple pendulum by only 0·05*s*. The change of arc in precision clocks is not great, and, moreover, as a result of the action of the suspension spring, the effect of change of arc in such clocks may easily be less than the theoretical amount given, so that this source of irregularity is not very serious.

(3) A change of 1 per cent. in the air pressure under ordinary conditions changes the daily rate of a standard type of pendulum by about 0·1*s*. This can be fairly accurately compensated in various ways, but for the most accurate clocks it is best to keep the pressure constant. For Riefler clocks this is usually about 600 mm. of mercury, but for the Shortt clocks it is of the order of 30 mm.

(4) The effect of the suspension spring does not appear to be very great, although various methods of supporting the pendulum have been invented. Change of elasticity with temperature and fatigue of the material from continuous bending, may produce variations of arc and so affect the rate of the clock.

(5) The most difficult problem in clock making has been in the escapement. In the usual type of clock the escapement serves a double purpose. It enables the number of vibrations to be counted, and through it the impulse is given which maintains the vibrations of the pendulum. The pendulum is in more or less continuous contact with the escape wheel, and although this is generally situated fairly near the point of suspension, it is clear that frictional forces and continuous interference by the escape wheel may easily produce considerable irregularity in the clock rate.

At the end of 1924 the clock Shortt 3, made by the Synchronome Co., Ltd., was installed at the Royal Observatory, Greenwich, and it proved so reliable that it was introduced as standard on Jan. 1, 1925. It consists of a 'free pendulum' and a 'slave clock.' The free pendulum is made of invar swinging in an air-tight case at a pressure of about 1 inch of mercury. The free pendulum has no escapement. On a bar about one-fifth of the way from the top it carries a very light wheel about 6 mm. in diameter. At every fifteenth swing to the left (30 seconds) a gravity lever carrying a weight of $\frac{1}{3}$ gm. and released by the slave clock, falls on the wheel, giving it an impulse. As this lever gets clear of the wheel a tail-piece releases mechanism which resets the impulse lever and also causes an electric contact to be made which synchronises the slave clock. An action of the synchroniser on the slave clock advances its phase by approximately 0·004*s*. The slave clock is rated to lose about 5*s*. a day, or 0·002*s*. per 30*s*. Under these conditions the synchronising action on the slave pendulum occurs at alternate half minutes with considerable regularity. The slave clock does all the work of counting the vibrations and releasing the impulse lever. Consequently, the only interference with the free pendulum is the impulsing during a fraction of a second every thirty seconds. The great advantage which the Shortt clock has shown over all other types of clock is undoubtedly due to the relative freedom of the pendulum from mechanical interference.

This clock was started at a practically zero rate

at the beginning of 1925, but it acquired a losing rate at about 0·04*s*. per day per month. By the autumn of that year the rate of change of rate had fallen to about 0·012*s*. per day per month. It remained at approximately this value until June 1926, when the clock stopped as a result of the failure of the release of the lever which resets the impulse arm of the free pendulum. This failure was caused by two steel surfaces jamming, and to avoid a recurrence of the fault a jewel was introduced at the locking surface.

The clock was restarted in July 1926, since which time its performance has been remarkable. The rate showed the previous change of about 0·012*s*. per day per month, but apart from this the going appeared nearly uniform. During October and November 1926, when special time determinations were being made for longitude purposes, the temperature was subject to unusually large fluctuations, and it appeared that there might be a temperature term of the order of 0·003*s*. per day per 1° F. Consequently thermostatic control was introduced, and the clock rate became very steady. This continued until May 1927, when the clock error commenced to depart from the predicted value, but this was traced to an irregularity in sidereal time and not in the clock rate. For those not acquainted with the exact definition of sidereal time, we may state that sidereal time is defined by the hour angle of the first point of Aries measured westward from the meridian. The motion of the first point of Aries is for convenience divided into two parts, the uniform part called precession and the non-uniform part called nutation. The principal part of the latter is given by the formula

$$-1{\cdot}06s.\ \sin\Omega - 0{\cdot}08s.\ \sin 2L.$$

The period of the first of these terms is 18·6 years, and this term can with sufficient accuracy be expressed in the form $\alpha+\beta t+\gamma t^2$ for an interval of a year or two. The second term, though of much smaller amplitude, runs through its period in six months, and this term cannot be expressed in quadratic form for more than four or five months. The clock error was therefore analysed in the form $\alpha+\beta t+\gamma t^2+$nutation, and this satisfactorily explained all the observations while the temperature was approximately constant. The temperature of the clock room had been maintained near 55° F., but in the summer of 1927 it rose to about 62° F., and by comparison of the observed clock error with the formula, it was found that there was a temperature term of very nearly 0·0030*s*. per day per 1° F. When this effect was allowed for, a formula was obtained which fitted all the observations from March 1927 to December within 0·1*s*. The formula was extrapolated backwards and found to leave residuals of about three-quarters of a second in the autumn of 1926 and to fit the observations again in July 1926. Extrapolation forwards fits the observations to 0·1*s*. at the end of March 1928.

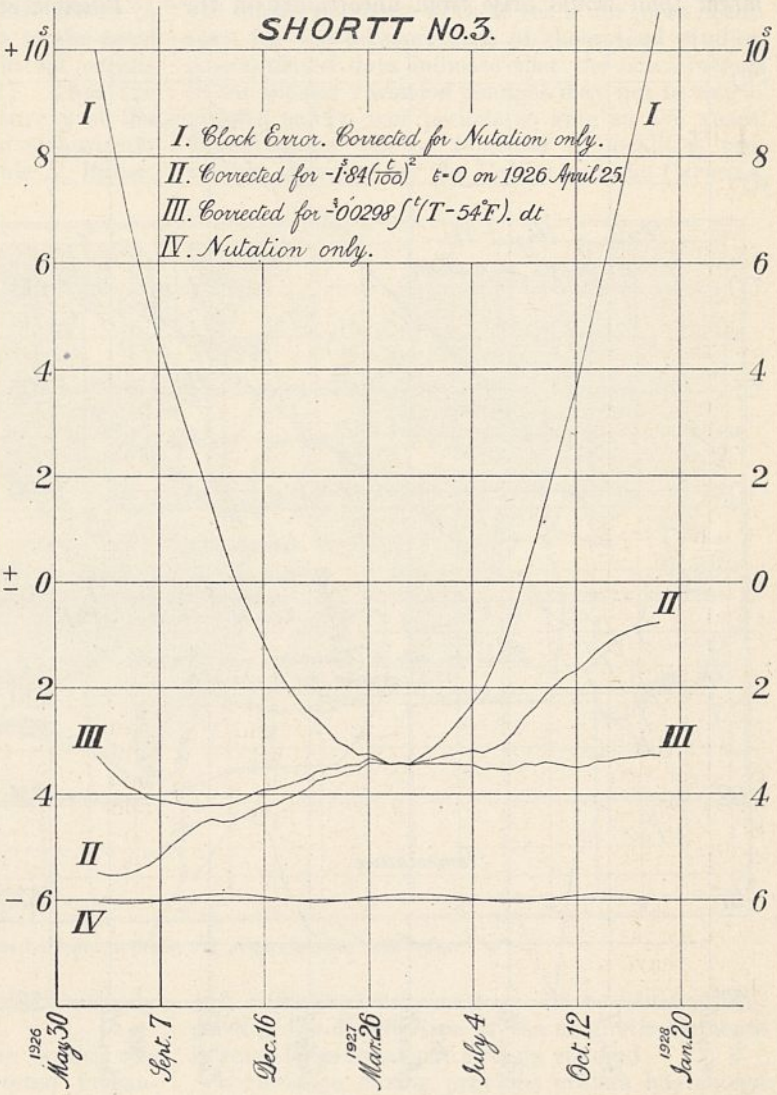

FIG. 1.

It should be stated that although the temperatures were not known with great accuracy in 1926, the residuals must be due to change in γ or some other irregularity.

The two diagrams (Figs. 1 and 2) show how closely the observed clock errors can be explained when the irregularities are allowed for. The points in the diagrams are based on curves drawn

through all the errors determined with the transit circle. A more detailed comparison of the observed and computed clock errors is given in the *Monthly Notices of the Royal Astronomical Society* for March 1928.

The temperature term of 0·0030*s*. per day per 1° F., or 1·1*s*. per year per 1° F., is much smaller than that for most high-grade clocks, but it was not expected to exist. It is said by the makers to be larger than would arise from uncertainty in the coefficients of expansion of the materials used in the construction of the pendulum. The second Shortt clock which was erected in the same clock room in May 1926 shows a temperature coefficient of similar amount.

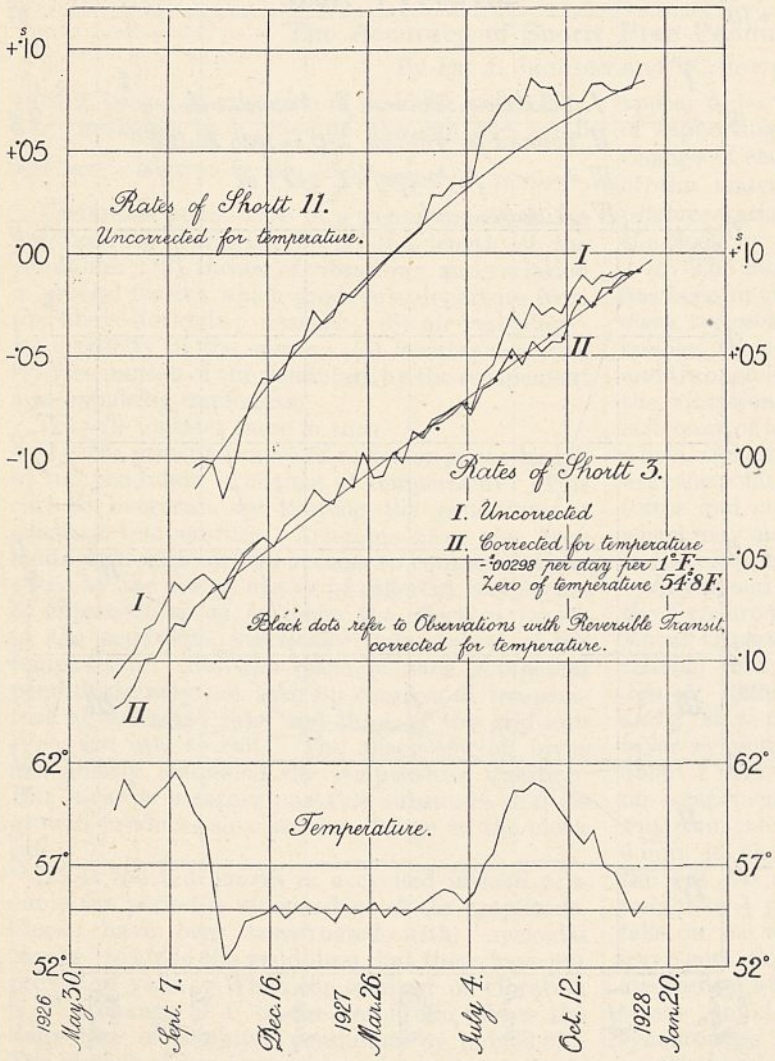

FIG. 2.

The temperature term in the clock error is, however, of comparatively small importance. The important term for long-distance forecasting of the clock error is γt^2, γ being 1·84*s*. when t is in units of 100 days. This term will amount to more than three minutes in 3 years. There can be little doubt that it is due to growth in the length of the pendulum. It is known that invar grows for years after its manufacture, and that the growth may be irregular. To explain the above coefficient the growth in the length of the pendulum (994 mm.) is 0·001 mm. in 118 days. Changes in the rate of growth of the pendulum do not affect the prediction of clock errors for a month or so, but may become serious when a formula fitting the observations for a year or more is considered.

Possible changes in the rate of rotation of the earth have recently attracted the attention of astronomers. Observations of the positions of the moon, supported fairly well by observations of more slowly moving bodies in the solar system, indicate that the rotation of the earth may be subject to variation amounting in extreme cases to about 1*s*. per year. One second a year is only 1 part in 30 millions, and if residuals of this order in the relative times shown by the earth and the free pendulum are demonstrated, the question will arise as to whether they are caused by:

(*a*) Residual secular change in the length of the pendulum.

(*b*) Variation of gravity.

(*c*) Variation in the actual rate of rotation of the earth.

(*d*) Seismic disturbances.

(*b*) and (*c*) may be inseparable, as changes in the earth's moment of inertia may be accompanied by changes in gravity as well as in the earth's angular velocity.

The real difficulty in the clocks is (*a*). It appears that the principle of their construction is such that they could be used to check the uniformity of the earth's rotation if only material stable for several years to 1 part in 100 millions could be obtained for the manufacture of the pendulums. At present the two sidereal Shortt clocks at Greenwich have been running continuously for 20 months, and a run of a few years would possibly suffice for errors of 1*s*. to accumulate in the earth's rotation, but a variation of 1 per cent. in the rate of growth of the pendulums would introduce greater irregularity in the clock error. It appears impossible to be certain that any piece of material has the required degree of stability, and until pendulums of different materials in different parts of the earth agree in supporting the motion of the moon and planets against the earth's rotation, clocks will not play an important part in checking the uniformity of the earth's rotation.

Cruise VII. of the *Carnegie*, 1928–1931.

By Dr. J. A. FLEMING and Capt. J. P. AULT,
Department of Terrestrial Magnetism, Carnegie Institution of Washington.

AFTER an interval of more than six years, the *Carnegie* began again on May 1, 1928, a world-wide cruise planned to continue to September 1931. This will be the seventh cruise of the vessel and, as indicated by the tentative route shown in Fig. 1, will add 110,000 statute miles to the total of nearly 290,000 miles traversed in all oceans during Cruises I. to VI. (1909–1921). Thus the plans for the magnetic and electric survey of the oceans envisioned in 1904, under the enthusiastic and energetic directorship of Dr. Louis A. Bauer, netic work already done on the *Carnegie* is attested by the principal hydrographic establishments of the world and by individual investigators. While magnetic data are needed for practical navigators, yet future magnetic work at sea is far more necessary for the advancement of theoretical studies. Accumulated data indicate that the accelerations in the secular variation changes may not be extrapolated safely over periods so long as five years. Observations will be repeated in localities previously surveyed by the *Galilee* and the *Carnegie*,

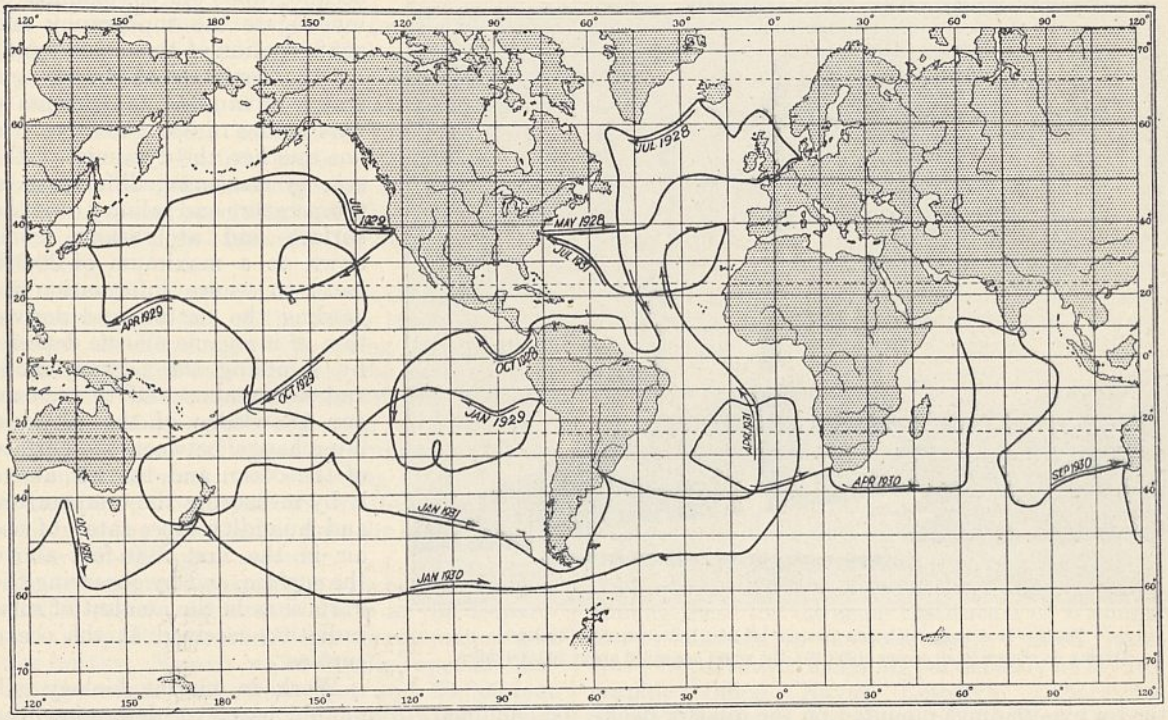

FIG. 1.—Tentative route for Cruise VII. of the *Carnegie*, 1928–1931.

will be further realised and the results already obtained will be greatly enhanced.

The survey of the oceans of the world was begun during 1905–8 on the chartered brigantine *Galilee* in the then magnetically unexplored Pacific under the command, respectively, of J. P. Pratt for the first cruise, and W. J. Peters for the second and third cruises. Upon completion of the specially designed yacht *Carnegie* in 1909, the survey was continued with greater efficiency, because of non-magnetic construction of the vessel and the steady evolution of suitable instruments and observational methods, in all oceans during 1909–21 under the command, respectively, of W. J. Peters for Cruises I. and II., of Capt. J. P. Ault for Cruises III., IV., and VI., and of H. M. W. Edmonds for Cruise V.

The practical and theoretical value of the mag- and additional information will be obtained regarding the distribution of the magnetic elements in some large areas not already covered.

Experience during previous cruises has shown that results with certain magnetic methods and instruments are more trustworthy than with others, so that the duplication of instruments and methods need not be continued. Thus the magnetic declination will be determined by use of the marine collimating-compass, omitting the deflector; the horizontal intensity will be determined by the deflector, omitting the dip circle method; the magnetic inclination will be determined with the earth inductor, omitting the dip circle. Some improvements have been made in the magnetic instruments, chief among which is the addition of a constant speed apparatus and drive for rotating the coil of the earth inductor, with amplifier and micro-

ammeter to determine inclination electromagnetically. Electromagnetic methods are also to be attempted with the earth inductor for the measurement of the horizontal intensity, thus replacing the more laborious deflector method by a more rapid and accurate electric method.

For the further investigations on the origin and maintenance of the earth's electric charge and of their relation to the earth's magnetic condition, determinations of changes in the values of the atmospheric electric elements with geographic position are needed in addition to those already made. A photographic recorder will be used to record variations in atmospheric potential gradient continuously; it will be mounted near the top of the mainmast and will be controlled by the apparatus for eye-readings mounted on the quarter-deck railing as heretofore. A motor has replaced the spring and clock-work mechanism in the ionic-content apparatus for drawing the air through the instrument.

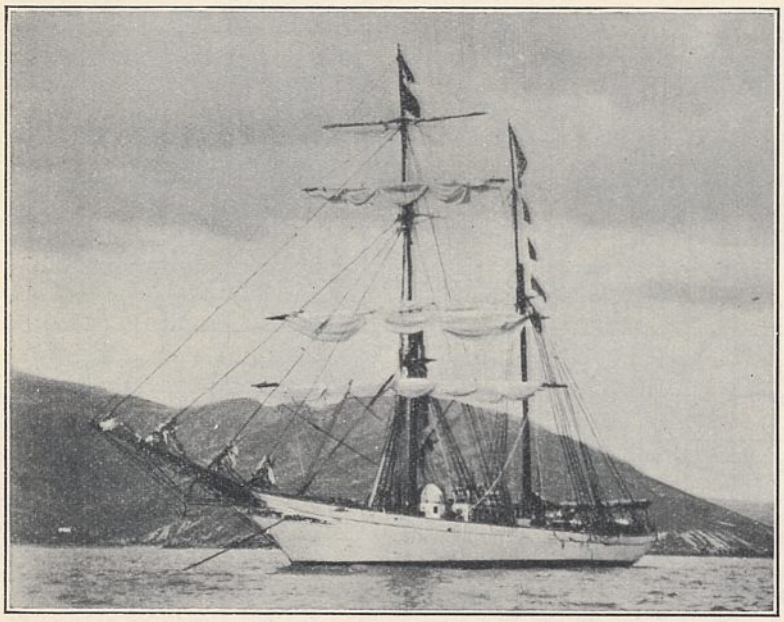

FIG. 2.—Non-magnetic yacht *Carnegie* off Port Lyttelton, New Zealand. During six cruises in all oceans (1909–21), the vessel has sailed about 290,000 miles.

Some improvements have been made in the instruments and methods used for measuring the penetrating radiation and the radioactive content, and more frequent series of observations extending over a period of twenty-four hours are planned. In addition to the programme previously followed for observations of the penetrating radiation, parallel observations will be made with a Kolhörster instrument which Dr. Kolhörster is testing thoroughly and comparing with his 'standard' instrument. It is planned to observe especially for variations with time, with geographical position, and with depth. Dust-count observations, using an Aitken dust-counter, will be made for correlative studies with atmospheric electricity. The measurement of marine electric currents will be attempted by trailing electrodes on cables from the stern of the vessel.

The important contributions to the study of various geophysical problems, which are being made by investigations of the Heaviside conducting layer and of radio transmission and variations with changing magnetic and electric conditions, greatly enhance the value of the atmospheric electric data already collected on the *Carnegie* over the ocean areas, and indicate co-operative investigations along similar lines for the coming cruise.

The omission of duplicate magnetic methods and instruments previously mentioned, and addition of two men to the scientific personnel, make possible a substantial programme in physical and biological oceanography. In physical oceanography it is planned to investigate the topography and configuration of the ocean depths by the sonic depth-finder; to study the causes of movements of vast bodies of water relatively to one another, the dynamics of the sea, by measuring differences in temperature and salinity over the surface and at various levels down to a maximum of 20,000 feet; to secure information regarding the nature and derivation of inorganic marine deposits by sampling the bottom muds and sediments; and to increase our knowledge of the physical interchange between the surface of the ocean and the air above it by measuring the temperature and humidity lapse-rates of the air in the first 100 feet above the surface, and by observing the variations in the amount of solar radiation received at the ocean surface.

Work in marine biology will be confined to microbiology, to determine the abundance and distribution of plankton and other small organisms. Most of the collecting will be done by tow-nets and dip-nets. A special boom-walk, similar to the one used by Beebe, has been installed on the starboard forward side of the vessel, where the collector may walk 30 feet out from the side of the ship on a plank suspended by a netting of rope from two boat-booms and about three feet below them. The booms are hinged at the rail and are suspended from the mast by a pendant with preventer stays both forward and aft. Shallow-water dredging will be undertaken to secure diatoms and foraminifera, and specimens of porpoises, dolphins, birds, and other creatures will be collected from special regions.

To carry out this programme of oceanographic investigations and to provide for new equipment required many changes in the *Carnegie*. The

structural changes were made during the summer of 1927, when the vessel was completely overhauled and reconditioned at Hoboken, New Jersey. The two lifeboats were removed from the quarter-deck to overhead platforms amidships, thus leaving the quarter-deck free for the operation of the winch, sounding wire, water-bottles, deep-sea reversing thermometers, tow-nets, bottom-samplers, and earth-current cables. Two new laboratories were constructed on the main-deck, one designed for oceanographic investigations, and one for radio and sound work. In the oceanographic laboratory are mounted the Wenner electric salinity apparatus, the Negretti and Zambra distant-recording surface temperature thermograph operating on a 24-hour rate, and the various equipment and apparatus for the study of plankton and of the chemistry of the air and of sea water.

In the radio and sound laboratory is mounted the depth-finder loaned by the United States Navy Department for measuring rapidly and accurately the depths of the sea. The short-wave transmitting and receiving radio equipment made after the design of the United States Naval Research Laboratory, for the investigation of variations in transmitting and receiving conditions and on skip distances and signal intensity, is installed in this laboratory.

In a new galvanometer house on the port side of the quarter-deck aft of the radio laboratory, are mounted the Einthoven type string galvanometer for the earth inductor and for the earth-current apparatus, the control portion of the constant speed apparatus, amplifying unit, microammeter, special inductance coils, and appurtenances for the earth inductor work, the recording apparatus for six resistance thermometers located at various places from the masthead to near the ocean surface, and the roll-and-pitch recorder.

The oceanographic equipment includes a Wenner electrical salinity apparatus made in the Department's shop, Richter and Wiese thermometers and water-bottles, Nansen water-bottles, special non-magnetic winch with 6800-foot and 20,000-foot aluminum-bronze cables for depth-work, sonic depth-finder loaned by the United States Navy Department, chemical and biological apparatus, silk metre and half-metre plankton nets, various types of bottom-samplers, and necessary appurtenances.

The meteorological instruments are in general of the recording type, and a special programme of observation and control has been arranged. At Plymouth and at Hamburg, additional recording wet- and dry-bulb thermograph and wet- and dry-bulb resistance thermometer equipment with recording galvanometer for three stations at masthead, cross-tree, and meteorological screen are to be installed. It is hoped that, despite the difficulties of such work on a sailing vessel, data on the general upper-air circulation may be obtained by pilot-balloon flights, for which equipment is provided.

The members of the scientific personnel and their special fields of activity are: Capt. J. P. Ault, commander and chief of scientific staff; Wilfred C. Parkinson, senior scientific officer, atmospheric electricity and photography; Oscar W. Torreson, navigator and executive officer, magnetism, navigation, and meteorology; F. M. Soule, observer and electrical expert, magnetism and physical oceanography; H. R. Seiwell, chemist and biologist, oceanography; J. H. Paul, surgeon and observer, medical work, meteorology, and oceanography; W. E. Scott, observer, navigation and commissary; Lawrence A. Jones, radio operator and observer, radio investigation and communication. The sailing staff will consist of 17 men, making the total number of men on board 25; of the sailing staff, A. Erickson, first watch-officer, C. E. Leyer, engineer, and F. Lyngdorf, steward, occupied similar positions during the entire two years of the *Carnegie's* last cruise.

The first leg of the cruise will be to Plymouth, England, where the vessel was due to arrive at the end of May. After a call at Hamburg, the next ports of call will be at Iceland, at Barbados, and at the Panama Canal Zone (about the end of October 1928). The remainder of the cruise (see Fig. 1) will cover the North Pacific, South Pacific, South Atlantic, Indian, and North Atlantic oceans. Among the ports of call will be Easter Island, Callao, Papeete, Apia, Guam, Yokohama, San Francisco, Honolulu, Lyttelton, South Georgia, St. Helena, Cape Town, Colombo, St. Paul, Fremantle, Rapa Island, Buenos Aires, Ponta Delgada, and Madeira.

The preparations for this cruise have had generous co-operation and expert advice on all sides from interested governmental and private organisations and individuals both in America and Europe, who have also either loaned or presented much of the special oceanographic equipment and many books for the reference library on board. Among these the Carnegie Institution of Washington is indebted to the following: United States Navy Department, including particularly its Hydrographic Office, Naval Research Laboratory, Signal Corps and Air Corps of the War Department, Coast Guard, National Museum, Bureau of Fisheries, Weather Bureau, and Coast and Geodetic Survey; Scripps Institution of Oceanography of the University of California; Museum of Comparative Zoology of Harvard University; School of Geography of Clark University; American Radio Relay League; Geophysical Institute, Bergen, Norway; Marine Biological Association of the United Kingdom, Plymouth, England; German Atlantic Expedition of the *Meteor*; Institut für Meereskunde, Berlin, Germany; British Admiralty, London; Carlsberg Laboratorium, Bureau International pour l'Exploration de la Mer, and Laboratoire Hydrographique, Copenhagen, Denmark; and many others. Dr. H. U. Sverdrup, of the Geophysical Institute at Bergen, Norway, research associate of the Carnegie Institution of Washington, is consulting oceanographer and physicist.

Obituary.

DR. H. F. GADOW, F.R.S.

DR. HANS FRIEDRICH GADOW died suddenly on May 16, aged seventy-three years. He was born in Pomerania, the eldest son of the Inspector of the Prussian Royal Forests. He was a Wend by birth, and he was deeply interested in the languages and aspirations of all the peoples of East Prussia. He was being trained for a commission during the Franco-German war. Afterwards he was educated at Frankfurt, Berlin, Jena, and Heidelberg, and he regarded himself as a pupil both of Haeckel and of Gegenbaur. For the former he edited "The Last Link," and he suggested his striking and picturesque comparison of past evolution with the spectrum. In his morphological work he always remained a pupil of Gegenbaur, who suggested his employment by the British Museum in 1880. Here he remained until 1882, when he was appointed Strickland curator of birds at Cambridge, in 1884 becoming lecturer on the advanced morphology of vertebrates as well; he also became naturalised. He remained in these same posts until 1920, when his lectureship was changed into a readership. During all these years he was responsible for the advanced teaching in the comparative anatomy of vertebrates at Cambridge, but on becoming reader he undertook at his own desire for some years the elementary teaching as well. He also lectured at times on the history of zoology and on geographical distribution. He was elected a fellow of the Royal Society in 1892.

Dr. Gadow's early researches were largely concerned with the musculature of reptiles and birds, in much of which he broke a new field. His volume in Bronn's "Klassen und Ordnungen des Thier-Reichs" on the anatomy of birds, more than 1000 pages and 59 plates, 1884–91, will always remain classical, and this was followed by a systematic volume in 1893. He was also responsible for all the anatomical parts in Newton's "Dictionary of Birds." His two papers (1895–6) on the vertebral column were a great attempt to bring into line the anatomy of different groups. He established the existence in each vertebra of four pieces, but the whole question is still very involved. He examined his material directly and by sections cut at all sorts of angles, and above all he made pilgrimages, wherein he saw practically all the fossil material of Europe. His lectures on the cloaca, on ear ossicles, and on other organs, were largely founded on his own researches, and in all his work on the hard parts he treated fossil with living forms in a single story.

With further discoveries in palæontology and embryology much of this work has been superseded, but Gadow's method undoubtedly exercised a stimulating influence on all zoology. In 1898 he published his "Classification of Vertebrata," which most of the critics of that time judged severely for its division of suctorial and jawed forms and for the placings of many fossil groups, most of which are now accepted. The volume on amphibia and reptiles (1901) in the "Cambridge Natural History," next occupied his attention. He personally examined practically every beast that he mentioned, and he made himself acquainted with very many by keeping them alive, by studying them in Nature or in zoological gardens. He started *de novo*, and the result is seen in unquestionably one of the greatest works in zoological science.

Dr. Gadow's explorations led him to caves and mountains in northern Spain and in Mexico among other places. He visited the latter on several occasions, being always warmly welcomed by President Diaz. He camped when and where he liked and at all elevations in complete safety in that land of brigands, for he had the gift of friendship with such wild peoples. His results are seen in two travel books and many papers, of which perhaps the most remarkable were on the colorations of lizards, snakes, and birds. His presidential address to Section D of the British Association (1913) was on the necessity for the study of structure and function taken together.

In many respects the late Dr. Gadow was a man of strong personality. He was always ready to fight any- and everyone over any zoological research or teaching matter. He seemed to us to enjoy it, and for the time being it entirely dominated his life, his opponent for the moment in all his works and characteristics being a villain. Yet this never lasted long, and he made no enemies and many friends, for his very faults were all lovable. His ideas of research were Teutonic—a professor and an obedient school, a system unsuited to England—and consequently he had few direct pupils, though all zoologists appreciate his potent and excellent influence on the development of their science in the last fifty years. All Cambridge men in particular will deeply regret his death, but he has left a good name and a fine record. J. S. G.

PROF. J. V. DANEŠ.

THE Charles' University of Prague has lost one of its leading professors, Prof. Jiří Václav Daneš, who died on April 13 in Los Angeles in his forty-eighth year, having been run over by a motor-car. This disaster happened when he was on a scientific tour through the United States, where he had been invited by several universities to lecture on geographical problems.

Daneš was our professor of general geography at Prague, and his aim was to make his subject a truly scientific one. He studied under Palacký in Prague and under Penck in Berlin. In the year 1919 he was nominated ordinary professor of the Charles' University, but soon afterwards accepted the post of a general consul in Sydney. Daneš worked especially in the domain of geomorphology and anthropogeography in the Czechoslovak Republic, in Yugoslavia, together with its famous geographer, Cvijić, in the United States, Mexico, Jamaica, Java, Australia, and Oceania, where he spent some time in travelling with his colleague, Prof. Karel Domin, professor of botany, and after

his return to Australia he worked there and on some of the islands for the Australian Government. The results of these scientific travels were published, jointly with Domin, in a volume, "Through the Double Paradise," and his further work was "Three Years in the Pacific."

Daneš published a series of papers in the *Proceedings of the Bohemian Academy of Prague* (with summaries in English), and the following further papers: "Physiography of some Limestone Areas in Queensland" (*Proc. Roy. Soc. Queensl.*, 1910); "On the Physiography of North-eastern Australia (*Roy. Soc. Prague*, 1911); "Absence des traces glaciaires dans la Californie méridionale" (*La Géographie*); "La région des rivières Barrow et Russell (Queensland)" (*Annales de Géographie*, 1912); "Further Kars-Studies in Jamaica" (1914); "Glacial Studies in territory of Ljuma" (*Bull. Soc. Serbe de Géographie*, 1914); and many others. Daneš was in 1925–26 dean of the Faculty of Natural Sciences in the Charles' University; he was honorary, ordinary or corresponding member of many scientific societies, among them being—the Royal Society of Science and the Bohemian Academy of Science in Prague, the Royal Society of Queensland and the Royal Geographical Society of Australasia (Queensland branch, Brisbane), the Serbian Geographical Society in Beograd, the Royal Academy in Beograd, the Polish Geographical Society in Warszawa, and the Commission Internationale de l'Atlas photographique des Formes du Relief Terrestre. BOHUSLAV BRAUNER.

PROF. EDGAR F. SMITH.

BY the death of Prof. Edgar Fahs Smith on May 3, the United States loses a distinguished and versatile chemist who had many friends in England. Prof. Smith was born at York, Pennsylvania, on May 23, 1856. He graduated at Pennsylvania College in 1874 and proceeded to Germany, where he obtained his Ph.D. (Göttingen) in 1876. He was awarded the D.Sc. of Pennsylvania in 1899, and was afterwards honoured by many American universities and societies both in the United States and outside. He took up his duties as professor at Philadelphia in 1888 and continued there until his death.

Prof. Smith contributed to the advance of chemical knowledge in many fields, having carried out investigations in organic, inorganic, and physical chemistry. His earliest publications described the preparation and properties of the derivatives of certain aromatic acids and bases, and in this branch he claimed attention by translating Richter's "Chemistry of the Carbon Compounds," the first English edition appearing in 1886. Before this Smith had already turned his attention to the advantages to be gained by the application of electrical methods in analytical chemistry, and he worked out a number of procedures for separating and estimating metals by electro-deposition methods. So early as 1878 he published a book on "Electrochemical Analysis," which was favourably received and reached its sixth edition in 1917.

Most of Prof. Smith's researches, however, were concerned with tungsten and the tungstates, and although he carried out much painstaking work, this does not seem to have attracted the attention it merited. Indeed, Prof. Smith is best known as a biographer of American and other chemists and as a writer upon the history of science. His essays on the early American chemists, such as Martin Hans Boyé (1610–1686), Jacob Green (1790–1841), Robert Hare, J. Cutbush, Charles Baskerville (whose obituary he wrote for the *Journal of the Chemical Society*), and others, have done much to stimulate an interest in the achievements of these pioneers. In 1918 he published a "Life of James Woodhouse" (1770–1809), and last year there appeared his "Old Chemistries," in which he presented to "interested readers a hint of the vast stores of early literature relating to chemistry."

J. G. F. D.

THE issue of the *Physikalische Zeitschrift* for April 1 contains an obituary notice of Prof. Eilhard Weidemann from the pen of his former colleague and assistant, Dr. G. C. Smith. The son of the physicist Gustav Weidemann, he was born in Berlin on Aug. 1, 1852. He was educated at the high schools of various university towns, and at eighteen years of age entered the University of Heidelberg to study under Helmholtz, Bunsen, and Kirchhoff. He got his doctor's degree under his father at Leipzig in 1876 for a research on the elliptic polarisation of light. Two years later he received the title of extra-professor, and in 1886 was appointed professor of physics at Darmstadt, and a few months later at Erlangen. Here he spent the rest of his days and did his best work. In conjunction with his father he founded the *Beiblätter* to the *Annalen der Physik* and edited it for twenty-four years. He could speak with fluency several languages, and his studies in the history of science in Arabia are well known. He resigned his professorship in 1926 and died on Jan. 7 last. His principal researches dealt with specific heats and vacuum tube discharges. He was a fluent and clear lecturer.

WE regret to announce the following deaths:

Dr. Edward S. Burgess, for thirty years professor and head of the department of biological sciences at Hunter College, New York City, an authority on the asters of North America, on Feb. 23, aged seventy-three years.

Dr. Thomas Bruce Freas, professor of chemistry at Columbia University, to which he had been attached since 1911, who was known for his work on thermodynamics in chemistry, on Mar. 15, aged fifty-nine years.

Dr. F. M. Perkin, C.B.E., past-president of the Paint and Varnish Society and of the Oil and Colour Chemists' Association and one of the founders of the Faraday Society, on May 24.

Dr. C. G. J. Petersen, Director of the Danish Biological Station, Copenhagen, distinguished for his work on animal associations on the sea-bed.

Mr. W. E. Plummer, Director of the Liverpool Observatory at Bidston, Birkenhead, on May 22, aged seventy-nine years.

News and Views.

THE airship *Italia*, under the direction of General Nobile, has made two long flights from its base in King's Bay, Spitsbergen. The first was eastward past Franz Josef Land to Northern (Nicholas) Land. Details are awaited, but apparently no new land was discovered. The second flight was to the Pole, which was reached about midnight on May 23. Wireless messages report that it was impossible, as had been hoped, to lower anyone on to the pack-ice. Before returning, an attempt to reach the site of Peary's Crocker Land seems to have been made. A course was then set for Spitsbergen, against strong winds which reduced the speed of the *Italia* to 25 miles an hour. Fog was encountered, which led to ice accumulating on the envelope and added greatly to the weight. The airship was said to have ninety hours' fuel on board, and in case of forced descent a month's provisions. On Friday, May 25, the *Italia* was north-east of Spitsbergen, and apparently at no great distance from land. A north-westerly wind was blowing. On May 28 no further news had been received. Great anxiety as to the safety of the *Italia* and her crew was felt in Spitsbergen, and search parties had been sent out.

THE Friday evening discourse delivered by Mr. A. C. Egerton at the Royal Institution on May 25 dealt with engine knock and related problems. 'Knocking' is a sound which comes from the cylinder of an internal combustion engine during the abnormal explosion of the charge. It limits the compression of the charge and therefore the efficiency of the engine. The efficiency can be improved by suitable engine design, by the admixture with the petrol fuel of large percentages of non-knocking fuel, such as benzene, or by the addition to the petrol of small quantities of 'antiknocks,' such as lead tetra-ethyl or iron carbonyl. Thus the function of an antiknock is to make possible the use of higher compressions in the engine, thereby increasing the efficiency and preventing the unnecessary wastage of large quantities of petrol fuel. It was Sir Humphry Davy who, at the Royal Institution, first directed attention to the influence of small quantities of combustible substances on the combustion of other mixtures. The remarkable features of antiknocks, such as lead tetra-ethyl or iron carbonyl, are the small quantities needed to be effective—one part in 200,000 of the fuel and air mixture—and, secondly, the fact that although they deaden down explosion they themselves in the pure state are highly inflammable and explosive substances.

MR. EGERTON stated that antiknocks do not impede the progress of a detonating gaseous explosion, which makes their action in preventing 'knocking' still more obscure. They inhibit the processes of oxidation which occur prior to ignition of the gaseous mixtures. Metallic vapours—for example, of thallium, lead, and potassium—were found to be effective in delaying the ignition of petrol. A general theory of the combustion of hydrocarbons was set out, depending on the formation of chains of reacting molecules; centres of high energy are formed wherein ignition can be set up. Antiknocks act by interfering with these chains and delaying the setting up of ignition. 'Knocking' is accounted for by enhanced vibratory combustion in the neighbourhood of the walls towards the end of the travel of the explosion in the cylinder, favoured by regions of high energy; compression waves may thereby be set up which give rise to the 'knocking' sound.

THE Committee on Immigration and Naturalisation of the United States House of Representatives has published a statement, submitted by Dr. Harry H. Laughlin, dealing with the eugenical aspects of deportation, which embodies the results of a detailed investigation of the statistics and other data bearing upon the evidence of defects among immigrants and native-born Americans. One point upon which stress is laid is that of differential fecundity. While the upper levels tend to maintain themselves when there is racial contact owing to the purity of their women, there is a tendency for the lower race to breed up by the 'pure sire' method, the men of higher level mating, legitimately or illegitimately, with the women of the lower. On the other hand, the upper classes tend to have smaller families. While, therefore, controlled immigration could be used in promoting race conservation, a family standard, that is, an examination of the stock from which an individual sprang, might be made the basis of admission. In a large number of institutions from which particulars were obtained, the overwhelming proportion of defectives were native born, and very few were legally deportable. In dealing with distribution, defectives are low in number in agricultural areas, as they tend to gravitate to the commercial and industrial districts or to the poorer land of the hills. The so-called Ishmaels or American gypsies, of Indiana, who migrate north in summer and south in winter, are traceable historically through Kentucky back to Virginia. It is thought, though not proved, that they may be descended from exiles dumped from Great Britain in Virginia in the early days, as undesirables were dumped in Botany Bay. In these degenerate families increase is very rapid.

FOLLOWING the work of Whipple and his collaborators on the favourable influence of feeding with liver on blood regeneration in dogs made anæmic by repeated hæmorrhages, Minot and Murphy showed that the administration of at least half a pound daily to patients suffering from pernicious anæmia resulted in a marked amelioration of the symptoms, with permanent benefit in most cases provided that the diet was continued. This advance in the treatment of a disease of obscure etiology has been confirmed by other workers, and the dietetic treatment appears to have obtained a permanent place in therapeutics. The only drawback to it is the difficulty some patients have in consuming the necessary amount of liver daily; numerous recipes have been published with the aim of tempting the most fastidious palate. A

further step forward has, however, recently been made by Cohn, Minot, and Murphy and their co-workers, when they found that an extract of liver has the same effect as the liver itself. This work leads in the direction of the discovery of the actual substance which produces the beneficial effect and at the same time improves the treatment of the disease, since the extract is much less bulky and more palatable than the original liver. We have received from Messrs. The British Drug Houses, Ltd., a sample of their liver extract, B.D.H., which has been made by a process adapted from that described by Cohn. The results of clinical trials, already published, show that the extract exerts a marked effect in pernicious anæmia; a month's treatment may restore the number of red blood cells to normal. The extract is a dry powder, and is administered in the same manner as meat extract. It is put up in glass tubes, each containing one daily dose, the equivalent of half a pound of fresh raw liver.

IN *L'Europe Nouvelle* for Mar. 17, M. Genissieu, the transport engineer to the French Government, discusses the novel problems which will arise when electrical energy on a large scale is imported and exported between European countries. In 1923 the League of Nations suggested that transmission of electrical energy should take place freely between States, and in 1927 it recommended that all frontier dues in this connexion should be abolished. In Italy a law forbids the import and export of energy except when specially authorised. It also taxes this electrical energy at a rate which averages about $\frac{3}{4}d.$ per unit. Switzerland sells to other countries about a fifth of its power production, but permission for export must be obtained from the Federal Council. The difference between the transport of energy and the transport of goods is whether the former could have been produced in the country being traversed. When Westphalian coal wagons cross Switzerland, the Federal Railways find it profitable and do not grudge this foreign product passing. They would not regard with equanimity, however, a high voltage line crossing Switzerland and delivering energy produced in the Ruhr to Milan. The electric energy, whether flowing north or south, could have been produced from its own water power, and custom payments would not compensate for the loss. M. Genissieu thinks that with the possible exception of Denmark, every European country would oppose the transmission of electric power over it. He thinks that the evolution of technique will gradually solve the problems. Perhaps energy will be transmitted across seas and frontiers by Hertzian waves. Power lines of greater and greater length will continually be made. The prodigious power of the Congo cataracts may be transmitted to Europe, and then solutions to these international problems will have to be found.

EVERY teacher of electricity, when lecturing, attributes to Oersted the discovery that when a wire carrying an electric current produced by a battery is brought near to a poised electric needle, the needle is deflected. It generally happens that a few members of his class wonder who Oersted was, and some possibly think that no great credit is due to the discoverer of such an obvious phenomenon. Mr. Rollo Appleyard, in *Electrical Communication* for April, has done well to write a careful biography of this great physicist and show why great credit is rightly his due. H. C. Oersted was born in 1777 and was educated at the University of Copenhagen. His bent at first was towards literature and philosophy, and in his early writings it is easy to trace the influence of the great German metaphysicians. In 1800 he gained a money prize which enabled him to travel for a few years. He found that Germany was a realm of theory, but that Paris was the home of experimental philosophy. His great discovery was made in 1820, after he had been appointed a professor at Copenhagen. For some years he had a suspicion that just as an electric current can produce heat and light, so it might be able to exert magnetic influence. He was convinced by his experiments that every voltaic circuit had a magnetic field, and that the direction of the movement of the needle was determined by that field. He sent an account of his investigations to societies in all the capitals of Europe, and honours were bestowed on him by practically all of them. The Royal Society sent him a Copley medal and the Institut de France gave him a prize of 3000 francs. Faraday describes the discovery well. Oersted discovered "a fact of which not a single person beside himself had the slightest suspicion, but which, when once known, instantly drew the attention of all who were able to appreciate its importance and value." Mr. Appleyard gives many novel and interesting biographical details.

WE have received the fifth Annual Report of the Benzole Research Committee, issued by the National Benzole Association. Much useful and fundamental work has been done during the past year, particularly on the cause and prevention of resin formation in motor spirit of the benzole type derived from coal. The use of ultra-violet light in indicating tendency to resin formation was studied in the previous year and this work has been continued. The conclusion is drawn that the test, although useful, is not altogether satisfactory, since resin formation may occur in the test but not in actual storage. Another test, depending on an examination of oxidation whilst the benzole is refluxed under exposure to oxidising conditions, has been examined. The use of inhibitors, particularly aniline and tricresol, has been investigated. There is also an account of the comparative efficiency of wash oils for benzole recovery, one of the materials examined being tetralin. It will be seen that the report contains much valuable and interesting information, and is of importance at the moment, when the possibility of increasing the yields of motor fuel from coal is prominent in the minds of all users of internal combustion engines.

THE annual publication of the Edinburgh University Forestry Society, *Sylva*, is now in its eighth year. This Society comprises the students following the forestry courses within the University and their

predecessors, now serving in every part of the Empire where forest conservation is in progress. The major part of the articles in the magazine come from the pens of present students and their predecessors, now in the services. A yearly record is published of the names, appointments held, and addresses of all forestry graduates. In the present number this information has been summarised in an article, "The E. U. Forestry Department and the Empire," where it is shown that between 1919 and 1927 one hundred and seventy-seven men qualified and are now serving in almost every corner of the British Empire overseas, as well as in Great Britain and Ireland. Lord Clinton, chairman of the Forestry Commission, was the honorary president of the Society during the year 1926–27. In his presidential address he traced the history of British forestry from early times, and then dealt with the present position of afforestation work in the country and the various aspects of research work being undertaken under the auspices of the Commission. In the latter connexion an interesting paper deals with 'Powder Post Beetles,' based on investigation work initiated by an Edinburgh graduate at the Forests Products laboratory. The work carried out shows that serious damage is committed in timber yards by this type of beetle, and these species of *Lyctus* have been, and still are being, brought into the country in American oak and ash lumber of low grade. A far too brief paper of considerable interest deals with the low-level conifers of Sarawak, in which it is shown that two species, *Dacrydium elatum* and *Agathis alba*, which are found in Sarawak and elsewhere in the Malaya region on the higher hills, occur in the former country in utilisable stands practically at sea-level. *Dacrydium* occurs with a slight admixture of *Casuarina sumatrana* on low swampy lands in the north. The *Agathis* is found on light soils in mixture with various broad-leaved species. The timber of both has a commercial value.

THE publication by the Cambridge University Press of the second volume of abstracts of theses for the Ph.D., M.Sc., and M.Litt. degrees at Cambridge contains an interesting statement in the preface suggesting the establishment in the near future of a complete university research intelligence service. One gain that such a service might bring to workers in a subject would be the rendering accessible of degree theses which do not reappear in the pages of some generally accessible scientific (or literary) journal. As it is, something might perhaps be done if these summaries, and similar summaries from other universities, reappeared in such a publication as *Science Abstracts* or in specialised bibliographies, in cases where the main work of the paper is not published elsewhere.

As these special research degrees are still quite a modern feature in Cambridge, it is not without interest to examine some of the statistics of the present volume. Out of the 55 research degrees granted in the year 1926–27, no fewer than 41 were for scientific investigations. The large excess of scientific degrees may represent the fact that more emoluments are available for scientific than for literary research by young graduates, and that more encouragement is given by the teaching staff of scientific departments at Cambridge and elsewhere to young graduates to continue with research work after taking their degrees. It is perhaps significant that 12 of the 14 literary graduates came from other universities to do post-graduate work at Cambridge; while of the 41 science graduates, 26 came from outside and 15 were purely Cambridge students. The unequal distribution in subjects is reflected in an unequal distribution among the colleges. Trinity with 10, Caius and Emmanuel with 9 each, and St. John's with 7 account for two-thirds of the students, while six colleges are unrepresented in the list. Physics heads the list of subjects with 10 names, followed by mathematics, 6; biochemistry, 5; physiology and botany, 4 each. It may be mentioned that 6 of the 55 graduates are now fellows of colleges.

THE Report of the National Physical Laboratory for 1927 is a quarto volume of 264 pages, 200 of which are devoted to detailed accounts of the work done in the various departments of the Laboratory. These are well illustrated, and enable the reader to follow the advances which are being made towards the solution of the problems which at present confront science and industry. The staff consists of about 560, 72 of whom are engaged in administrative and clerical work. About 43,000 tests have been carried out during the year as against about 46,000 in the previous year, the decrease being mainly in the Metrology Department. A considerable amount of work is done for Government departments and for the numerous industrial research associations which have been formed under the auspices of the Department of Scientific and Industrial Research. The equipment of the high voltage research building is proceeding, but nothing has been done towards the new physics building which has been urgently needed for more than six years and for which funds were provided by Parliament in 1925 and then withdrawn. To meet the requirements of aeronautics a compressed air wind tunnel is under consideration. There have been few changes in the senior staff, but the Superintendent of the Engineering Department has been knighted for his long and distinguished services to the country.

THE Mining Institute of Scotland has issued a tastefully got up pamphlet to commemorate the jubilee of its foundation. This dates from Jan. 24, 1878, when a number of gentlemen interested in mining met in Hamilton and decided to form an Association called the West of Scotland Mining Institute. The direct cause of the formation of this Association may be said to have been a disastrous explosion which took place at Blantyre Colliery in 1877. Not long after its formation the title was changed to that which it holds at present, namely, the Mining Institute of Scotland; and not many years afterwards its headquarters were transferred from Hamilton to Glasgow. The pamphlet gives a full and interesting account of the work of the Insti-

tute, including a long list of special committees, amongst the objects of which the problems of increased safety in coal-mining operations take a prominent place. A list of the principal presidents of the Institute, together with their photographs, form an interesting feature of the pamphlet.

THE following prize awards have recently been announced by the Belgian Royal Academy of Sciences: Maurice Nuyens (1500 francs), for his memoir on the resolution of problems with axial symmetry in general relativity; A. Monoyer (1500 francs), for anatomical and ethological researches on one or more plant species interesting through their mode of life; Théophile Gluge Prize (1300 francs), to L. Dautrebande for his work on the study of gaseous metabolism in man in health and disease; P. J. and Ed. van Bereden Prize (3400 francs), to Hans de Winiwarter for his work published during 1924–26; Adjutant H. Lefévre Prize (1500 francs), to Hélène Massart for her researches on the phenomena of secretion in plants; Ad. Wetrems Prize (7500 francs), to Louis Verlaine for; his studies on instinct and intelligence in Hymenoptera Agathon de Potter Foundation. The following grants have been made: W. Conrad (2000 francs), for the continuation of his researches on the lower organisms, particularly on the Belgian fresh-water flagellates; J. Pasteels (500 francs), to continue at Wimereux his researches on the cyto-physiological action of the dilution of sea water on the eggs of lamellibranchs; the Jean Mascart experimental garden (5000 francs), to continue a series of experiments on plant physiology commenced by the late Jean Mascart; E. Zunz (6000 francs), for the purchase of instruments necessary to the continuation of his researches on glycæmia; Th. De Donder (7500 francs), for the publication of his "Théorie des invariants intégraux"; Gilta (1000 francs), for the publication of plates of chemical crystallography; E. De Wildemann (3000 francs), for assisting the publication of parts of vol. 4 of "Plantæ Bequærtianæ"; Comité national de Géodésie (5000 francs), to enable it to print the reports of 1920–25 and 1926, on the geodesic work done by the Institute cartographique militaire since the War; Beeli (500 francs), for the execution of plates relating to the mycological flora of the Congo. Jean Servais Stas Prizes to Lucie De Brouckère, Léon Navez, Louis Henry; the Decennial Prize of the mineralogical sciences to Armand Renier.

Two exhibitions of special interest to students of South African archæology and ethnology will be held at the rooms of the Royal Anthropological Institute early in the month of June. A collection of copies of Bushman drawings will be on view on June 4–12. The collection is of exceptional interest, as some of the drawings are said to be of a type not hitherto recorded. Col. S. P. Impey, the author of a recently published work on the origin of the Bushman drawings and paintings, by whom this collection is exhibited, will give a demonstration of the drawings on Tuesday, June 5, at 4 P.M. Tickets of admission to the demonstration may be obtained from the Secretary of the Institute, 52 Upper Bedford Place; admission to the exhibition only on presentation of a visiting card. On June 11-19 a collection of stone implements from South Africa, belonging to Col. W. E. Hardy, will be on view at the Institute preparatory to the reading of communications on the South African Stone Age by the Rev. Neville Jones and Col. Hardy, on Tuesday, June 19, at 8.30 P.M., when specimens of South African stone implements of special interest and exceptional type, collected by the Rev. Neville Jones, will also be exhibited. The collection to be shown by Col. Hardy is noteworthy for the examples showing affinities with Sahara types which it includes. Admission to the exhibition and evening lecture may be obtained on presentation of a visiting card.

THE Huxley Memorial Lecture next year will be delivered by Prof. F. O. Bower in the Royal College of Science, London, on Friday May 3, at 5.30 P.M.

THE President of the French Republic has conferred the Cross of Officier de la Légion d'Honneur on Dr. George H. F. Nuttall, Quick professor of biology in the University of Cambridge.

PROF. D'ARCY W. THOMPSON, professor of natural history, University of St. Andrews, has been elected a foreign honorary member of the American Academy of Arts and Sciences, Boston, Massachusetts. The list of honorary foreign members of the Academy is limited to seventy-five, and among the distinguished zoologists in the section of zoology and physiology are Sir E. Ray Lankester and Prof. G. H. F. Nuttall.

ONE of the houses occupied by Newton when living in London stood on the corner site between St. Martin's Street and Orange Street, where the Westminster City Council is now erecting a new public library. The Council has decided to commemorate Newton's connexion with the site by cutting an inscription on the stone face of the building to read as follows: "Sir Isaac Newton lived in a house on this site, 1710–1727."

THE May meeting of the Royal Society of Canada was held at Winnipeg on May 21–24, under the presidency of Prof. A. H. Reginald Buller, professor of botany in the University of Manitoba, who delivered an address on "The Plants of Canada, Past and Present." A popular lecture on "The Air we breathe" was delivered by Prof. J. J. R. Macleod. The programme of the meeting includes abstracts of a very large number of papers contributed to the sections. Most of the meetings were thrown open to the public.

AT the anniversary meeting of the Linnean Society of London, held on Thursday, May 24, the following were elected officers for the year 1928–29: *President*, Sir Sidney F. Harmer; *Vice-Presidents*, Dr. W. T. Calman, Mr. H. N. Dixon, Mr. Horace W. Monckton, Dr. E. J. Salisbury; *Treasurer*, Mr. Horace W. Monckton; *Secretaries*, Dr. G. P. Bidder (Zoology) and Mr. John Ramsbottom (Botany).

THE following have been elected officers of the British Institute of Radiology for the session 1928–29:

President, Dr. G. W. C. Kaye; *Vice-Presidents*, Sir William Bragg, Dr. Robert Knox, Mr. L. A. Rowden; *Honorary Treasurer*, Mr. Geoffrey Pearce; *Honorary Secretaries*, Dr. Stanley Melville and Dr. G. Shearer; *Honorary Editors*, Dr. Robert Knox and Dr. G. W. C. Kaye.

THE annual general meeting of the Faraday Society was held on Wednesday, May 16, when the report of the Council was presented and the members of the Council for the session 1928-9 elected. The new president is Prof. T. M. Lowry. The retiring president, Prof. C. H. Desch, delivered an address entitled "Diffusion in Solids." During the past session the Faraday Society has held seven meetings, eighty-two papers being presented. Three of the meetings were general discussions on the following subjects: Atmospheric corosion; the theory of strong electrolytes; and cohesion and related problems. In future, the *Transactions* of the Society will be published in monthly, instead of bi-monthly, parts.

"NATIONAL Baby Week" is again being celebrated in Great Britain this year during the first week of July (July 1-7). Full particulars and suggestions for the celebration may be obtained from the secretary, National Baby Week Council, 117 Piccadilly, London, W.1. While all aspects of the maternity and child welfare problems are regarded as suitable subjects for propaganda, it is especially desired this year to focus attention on three subjects: (1) immunisation as a means of protecting young children against disease, (2) prevention of maternal mortality, and (3) new developments in child welfare work. A conference on infant welfare will also take place on July 4, 5, and 6, followed by an International Child Welfare Conference in Paris, July 8-12.

A RECENT *Daily Science News Bulletin*, issued by Science Service of Washington, D.C., reports the discovery by Mr. J. H. Sinclair, of the American Geographical Society's expedition, of a new volcano in eastern Ecuador in lat. 0° 8′ S., long. 77° 32′ W. It lies in a heavily forested uninhabited region and rises from a base elevation of about 4000 ft. to nearly 7000 ft. The crater appears to be very large. Activity of the volcano is reported to have begun in 1925 with a violent explosion that carried away the entire top of the mountain. Ash is said to have fallen in appreciable quantities as far away as a hundred miles. The expedition was surveying in that little-known region and made other important discoveries before its recent return to the United States.

THE second International Conference on Light and Heat in Medicine, Surgery, and Public Health, organised by the *British Journal of Actinotherapy* (17 Featherstone Buildings, London, W.C.1), will be held on Oct. 29–Nov. 1, at the University of London, South Kensington, S.W.7. There will be discussions on both therapeutic and scientific aspects, and it is hoped to arrange visits to representative clinics, where the most modern methods of utilising light and heat for therapeutic purposes will be seen. Simultaneously with the Conference, an exhibition of apparatus for ultra-violet, radiant heat, and allied forms of therapy, will be held in the Great Hall of the University, adjoining the conference hall. Reduced railway fares will be obtainable in England and Scotland for those attending the Conference.

AT the anniversary meeting of the Royal Society of South Africa, held on Mar. 21, Dr. W. A. Jolly, professor of physiology in the University of Cape Town, was elected president for the year 1928. Dr. A. Ogg, professor of physics in the University of Cape Town and retiring president of the Society, was elected honorary general secretary, and Dr. L. Crawford, professor of pure mathematics in the University of Cape Town, honorary treasurer. Dr. Ogg delivered his presidential address on "Some Aspects of Modern Physics," in which he discussed the origin of relativity and the quantum theory, passing on to Bohr's work on spectrum analysis and its modifications by Sommerfeld and others, and to Schrödinger's wave mechanics, and dealing in conclusion with Sir Ernest Rutherford's picture of the nuclear structure of radioactive elements.

THE Council of the Institute of Metals has issued a preliminary programme of the four-day annual autumn meeting of the Institute, which is to be held this year in Liverpool. This is the first time that the Institute has visited Liverpool. The proceedings will begin on Sept. 4 with a lecture on "Non-Ferrous Metals in the Shipping Industry," by Mr. F. G. Martin. The mornings of Sept. 5 and 6 will be devoted to the reading and discussion of papers, and the afternoons to visiting works of interest in the neighbourhood, the Gladstone Dock, and a large liner. In the evening of Sept. 6 there will be a reception at the Town Hall by the Lord Mayor (Miss Margaret Beavan). The meeting will conclude on Sept. 7 with an all-day motor trip to North Wales, during the course of which it is expected that an electric power station and aluminium works will be visited. Full particulars of the meeting can be obtained from the honorary local secretary, Mr. H. F. Richards, 42 Bedford Street, Liverpool, or from the secretary of the Institute of Metals, Mr. G. Shaw Scott, 36 Victoria Street, London, S.W.1.

UNDER the auspices of the National Association of Olive Growers of Spain (Alcalá 87, mod°. Madrid), a competition is being promoted with the object of simplifying and standardising the analytical and physico-chemical examination of olive oils and of mixtures in which they occur. It is hoped also to advance the olive-oil industry by gaining new information upon such fundamental problems as the mode of elaboration of the oil in the plant and the variations in its composition during the period of ripening. Moreover, an examination is required of the associated essential oils, colouring matters, and ferments, and of the products of enzymatic hydrolysis; while "as to the vitamins in olive oils, a brief study should be made to ascertain the quantities present, their class and their beneficial influence upon the human organism." In addition, competitors are asked to report upon the practicability of applying 'cracking' processes to

olive oils, with the aim of producing petrol and related materials from it. The details of the competition, which closes on July 30, are laid down in a circular issued by the Association through the Spanish Ambassador in London, and prizes of 20,000 pesetas (about £700) and 5000 pesetas are offered.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued a useful catalogue (No. 159) of a thousand works on geology, ornithology, and general natural history, including conchology, entomology, fishes, mammalia, etc. Many long runs of serials are included. The catalogue can be had free upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—Teachers of electrical engineering and of engineering drawing at the East Ham Technical College evening classes—The Secretary, Education Office, Town Hall, East Ham, E.6 (June 7). An assistant curator in the Royal Botanic Gardens, Kew, in charge of the Herbaceous and Alpine Department—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (June 9). A head of the mechanical and civil engineering department of the Sunderland Technical College—The Chief Education Officer, Education Offices, Sunderland (June 12). A full-time teacher of mining subjects in Rotherham and South Yorkshire—The Secretary for Education, Education Offices, Rotherham (June 15). A teacher in mechanical engineering at the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham (June 16). A full-time itinerant poultry instructor for the County of Essex—The Clerk of the Essex County Council, Shire Hall, Chelmsford (June 18). A demonstrator of chemistry at St. Bartholomew's Medical College—The Dean, St. Bartholomew's Hospital Medical College, E.C.1 (June 19). An assistant lecturer in agricultural economics in the department of agriculture, The University, Leeds—The Registrar, The University, Leeds (June 21). A leather research chemist for the New Zealand Tanners' Research Association—The High Commissioner for New Zealand, 415 Strand, W.C.2 (June 30). A full-time engineering workshop instructor at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. Instructor lieutenants in the Royal Navy with a university training and an honours degree in mathematics, science, or engineering—The Advisor on Education, Admiralty, S.W.1. A lecture assistant and laboratory steward for the chemistry department of the Royal Technical College, Salford—The Secretary for Education, Education Office, Salford. A head teacher in the electrical engineering and physics department of the Rochdale Technical School—J. E. Holden, Education Office, Rochdale. Two assistants in the department of geography of University College, London—The Secretary, University College, Gower Street, W.C.1. A lecturer in dairy accountancy and economics at University College, Cork—The Secretary, University College, Cork.

Our Astronomical Column.

A PROBABLE METEORIC DISPLAY.—Mr. Issei Yamamoto, of the Tokyo Observatory, has pointed out in the *Mon. Not. R.A.S.* that the orbit of Skjellerup's bright comet, seen last December, lies near the earth's orbit on about June 7 next, and that as the distance separating the orbits is only three millions of miles, there may probably ensue a meteoric shower. The radiant point has been computed as at 42°·3 + 41°·4. Dr. Crommelin has also calculated the place of radiation and gives the point a few degrees west of that given by Yamamoto.

It will be desirable to watch the heavens on June 7 in order to witness the shower should it occur. The distance of three millions of miles between the orbits need not negative the prospective display, for Halley's comet is responsible for a shower early in May though its orbital distance from us is greater than that separating us from Skjellerup's comet. There are a few other instances where meteors are seen from comets the orbital distance of which exceeds three millions of miles. At 10 P.M., the computed radiant will be unfavourably placed a few degrees above the northern horizon. The gibbous moon will rise on June 7 a few minutes before midnight.

THE SYSTEM OF PROCYON.—This is a difficult system to study owing to the extreme faintness of the companion, which was discovered by Schaeberle in 1896, but has not been satisfactorily observed since 1913. It is of interest owing to the fact that its mass seems to be too low for its bolometric magnitude according to the Eddington curve. Dr. Spencer Jones makes a very exhaustive study of the system in *Mon. Not. R.A.S.* for March, using meridian observations of the bright star from 1755 onwards, also micrometric observations of the companion, and spectroscopic determinations of the radial motion of the bright star made at the Cape between 1909 and 1924. The adopted orbit for the bright star about the centre of gravity is Periastron 1886·50, period 40·23 years, inclination 30°·6, omega 65°·7, node 307°·8, e 0·310, a 1″·020. For the faint star about the bright one a is 4″·26, node 127°·8, the other elements being the same as above. The bright star is taken as 3·18 times the mass of the faint one, the masses in terms of the sun being 1·24 and 0·39. The mass of the bright star according to Eddington's curve would be 1·46. This could be obtained by changing the adopted parallax from 0″·308 to 0″·292, but that is considered an improbably large reduction. In any case this research has made the discordance less than it was before.

COMETS.—*Lick Observ. Bull.*, No. 398, contains an investigation by N. T. Bobrovnikoff on the outward motion of matter in the tail of Morehouse's comet 1908 III. This comet was well situated for such examination, owing to its high north declination and the activity manifest in the tail. The repulsive force from the sun for three different condensations was found to be 154, 148 and 88 respectively in terms of gravitation at the same distance ; the probable error of each is about 8 units. The projected condensations travelled in hyperbolæ that were nearly parabolic, the average eccentricity being 1·01. The sun of course was outside the branch described. The acceleration was observed to diminish at a distance from the comet's head ; this is accounted for by dissipation of the cloudlike masses, and increase of resistance from slower-moving matter in the tail ; others have suggested the gradual leakage of electrical charges.

Research Items.

MUMMIES FROM COLOMBIA.—In *Man* for May, Mr. Warren R. Dawson publishes the results of a recent examination of two mummies now in the British Museum. Of these the first is that of an adult female in the sitting position, which is labelled as having been given by W. Turner, Esq., and found in a cave near Leiva, northern Grenada. The arms of the mummy are placed across the chest, the forearms nearly parallel. The head is slightly bent forward and inclined to the left. The knees are vertical, and the left foot over the right. All the nails of the toes are missing, and apparently those of the fingers as well, though this cannot be ascertained with certainty owing to the position of the hands. Part of the scalp is missing, and the condition of the sutures suggests middle age. Impressions of woven cloth show the body was wrapped up. Round the neck is a necklace of thirteen objects, and there are traces of red pigment on thighs, cheeks, knees, and elsewhere, which may be derived from the wrapping. The mouth is packed with wool which has distended the cheeks. The nose is broken away but the septum is intact, and there is no trace of a forced passage into the cranial cavity through the nose. The perineum is incised and the anus and vulva united into a single widely distended opening, probably due to the evisceration. The mummy was probably smoke dried. The second mummy is an adult male in poor condition from Gachansipa, northern Grenada. It is in the contracted posture with the head inclined forward. Wherever the integuments remain they are of a dark red colour, almost black in parts, suggesting the application of a resinous stain. The anterior part of the abdominal wall is broken away, exposing an empty cavity. There are no traces of the thoracic viscera, so the body was almost certainly eviscerated through an incision which appears in the left flank. The condition of this mummy suggests that it also has been smoke dried.

THE EXTINCTION OF THE PASSENGER PIGEON.—A letter written in March 1838 from Camp Gaugh, New Jersey, by J. T. Waterhouse to his parents in London, emphasises once again the former abundance of the passenger pigeon, and the great slaughter which took place during the migration (*Condor*, vol. 29, p. 273; 1927): "For the last fortnight the air has been almost black with wild pigeons emigrating from the Carolina swamps to more northerly latitudes, making their summer quarters in the lake countries. Within ten miles square during the last fortnight I suppose they have shot or netted twenty thousand. They fix up a kind of hut in a field made of the limbs of trees and buckwheat stubble. They have one or two fliers which they throw out every time a flock passes; the fliers are of the wild pigeon breed usually wintered over, or sometimes they take them direct from the flocks, tie their legs to a small piece of twine and throw them up." The writer then describes the operation of the fall net, and says that sometimes at one haul as many as three or four hundred pigeons were taken. "Whilst I am writing they are in the adjoining room picking seven pigeons for our breakfast. They were shot this morning at one fire of the gun."

UNUSUAL GESTATION OF ROE DEER.—The breeding of the roe deer is anomalous in respect of the period which elapses between the pairing season and the birth of the calf. Mating takes place during July and August and the young appear in the following May or June. This, however, does not represent the true gestation period, since there is evidence that germinal development does not actually begin until December, the probability being that fertilisation of the egg may then take place by sperms which have lain quiescent since the mating season six months earlier. The true gestation period—December to May or June—is therefore about six months. Dr. James Ritchie records and comments upon an interesting departure from this sequence (*Scottish Naturalist*, 1928, p. 49). In December 1927 an early roe calf was found with its mother on the hills near Kingussie. The calf apparently was born about six months after the pairing season, and the suggestion is made that the six-months dormant period was omitted from this life-cycle, and that fertilisation and development of the egg took place immediately upon pairing, "an abnormal reversion to a normal occurrence." The fact that the new-born calf had to face the rigours of winter and spring, suggests how valuable the normal staving off of the gestation period must have been for the survival of roe deer.

INSECT TYPES.—In his Report for 1926–27 on the Hunterian Collections, University of Glasgow, Prof. Graham Kerr refers to the completion by Mr. P. A. Staig of Part 1 of a monograph of the Fabrician types of insects contained in that museum. Dr. William Hunter afforded Fabricius ready facilities for studying the insects in his extensive collections and, as a result, Fabricius described many new species which he recorded in his classific works on systematic entomology. These 'antique' types constitute the standard by which it is possible to determine finally to what particular species a particular scientific name properly belongs. Fortunately, the Fabrician types contained in the Hunterian Collections are in a wonderful state of preservation, which has enabled Mr. Staig to prepare detailed descriptions, which should serve to assure entomologists as to which of the now well-known insects are rightfully assigned to the various Fabrician species. Part 1 of this monograph is now ready for publication, and deals with 55 out of a total of 250 of these early types.

RUSSIAN FISHERIES RESEARCH IN THE PACIFIC OCEAN.—The Pacific Ocean Scientific Fishery Research Station, recently established near Vladivostok (see NATURE, Aug. 6, 1927, p. 198), has issued the first volume of its *Bulletins*, of 328 pages, well produced with numerous illustrations. Apart from two papers by the Director of the Station, Prof. K. M. Derjugin, on the organisation and activities of the Station, the volume contains a number of papers based on original observations of its members. Of special interest is a description of the West Kamtchatkan fishing industry by J. T. Pravdin, containing detailed data on the economically most important species of fish, their bionomics, methods of rising, statistics of catches, labour problems in the industry, etc. Several papers deal with the chemical analyses of local fishes (*Oncorhynchus keta*, *O. gorbusha*, *Clupea melanosticta*), and of the sea-cabbage (*Laminaria*) and other sea-weeds of industrial value, of oysters (*Ostrea laperousi* Schrenk), meedies (*Mytilus dunkeri*), and of edible medusa (*Rhizostoma sp.*). G. U. Lindberg gives a description of the Kamtchatka grayling (*Thimallus arcticus pallasi* Val.), which was hitherto very imperfectly known. A detailed biometric study of Pacific herrings is presented by A. I. Rabinerson.

FRUIT-ROT OF CULTIVATED CUCURBITACEÆ.—For the past few years in Pusa, India, during the monsoon season, a fruit-rot disease of various members of the Cucurbitaceæ has been doing considerable damage to the fruit, both in the field and in storage. The etiology of the disease has been determined by Mitra

and Subramaniam (*Mem. Dept. of Agri. of India*, Bot. Series, vol. 15, No. 3). The causal organism is *Pythium aphanidermatum* (Eds.) Fitz., which has also been reported recently by Drechshler as doing considerable damage to cucumber and egg-plant fruits in the United States of America. This fungus forms a woolly mycelial weft over the surface of the affected fruits, and penetrating inside causes the interior to become soft and watery; decay rapidly follows. It is very common in the field during and after the rains, and most of the fruits lying on the soil or hanging near the ground are attacked. Microscopic examination reveals unseptate mycelium, both in the interior and on the surfaces of the fruits, with large numbers of oogonia, antheridia, and oospores. All the strains grow very well in cultures of different kinds, especially in oatmeal agar, in which sexual reproduction takes place freely. Sporangia and zoospores are not formed in any medium, but can be obtained within six hours, if a little of a culture is placed in a vessel containing water to which has been added some ants killed by boiling water.

DRYING SULTANA GRAPES.—The standard methods for drying sultana grapes are described by A. V. Lyon (Australian Council for Scientific and Industrial Research, Pamphlet No. 6). The fruit is treated by one of three processes prior to the drying, the method chosen depending chiefly on the class of fruit, local climatic conditions, and the capacity of the drying plant. In general, the cold dip and modified temperature caustic dip give the best results in early and mid-harvest periods with good quality fruit. The berries are picked directly on to perforated tins, which are immersed in the desired solution. Since the concentration of the liquid and the duration of the treatment are important factors, preliminary trials are made with the dip to ensure the correct conditions. Details for the adjustment of the concentration according to the condition of the fruit are given. The *boiling dip* consists of a caustic soda solution (approximately 3 lb. in 100 gallons) in which the berries are immersed for 1½ seconds, the bloom being thereby removed and the rate of drying increased. Only slight cracking of the berries results if the conditions are well managed. The *modified temperature caustic dip* closely resembles the boiling dip, except that it is used at 190°-196° F., and at a slightly higher concentration. It is imperative that the proper temperature should be maintained if the browning action of the soda is to be avoided. The *cold dip* consists of a solution of potassium carbonate (approximately 1 lb. in 2 gallons) to which an olive oil emulsion (1½ pints in 50 gallons) is added. The fruit must be immersed for 4 minutes in this case. After dipping, the fruit is drained and immediately spread thinly on drying racks; spraying with the cold dip solution, though not always essential, is recommended, as it hastens the drying and thereby increases the quality of the final product. Cold dipped fruit, in contrast to that treated with the caustic dips, retains its natural colour, and exposure to the sun after treatment is necessary to destroy the pigments. When bleached, a wash is given before the final drying. Care must be taken to avoid bundling partially dried fruit or thick spreading during drying, as uniformity in the sample is essential for good value.

BIOLOGICAL FUNCTIONS OF THE PROTEINS.—In a recent paper Dr. Dorothy Jordan Lloyd defines two biological functions of the proteins (*Biological Reviews*, vol. 3, No. 2). In the first place the amphoteric and colloidal properties of the proteins make them highly sensitive to changes in composition or condition of the cell fluids, thus establishing a relation between the proteins of different cells, and between those cells and the external environment. The inertia of the colloidal particles also gives stability to the system and protects its general equilibrium. Proteins play no part in the metabolic cycle of the living cell, but exist associated with chemically active groupings which play a direct part in the cycle of chemical change, whilst the physical condition of the proteins affects the chemical activity of the complex. A second function attributed to the proteins is that they form the chemical basis of differentiation of species. The various ratios in which the large numbers of amino-acid molecules condense to form protein molecules make possible a multiplicity of detailed structure combined with uniformity of fundamental structure. Dakin and Dale showed that albumins from the blood of hens and ducks, although closely similar in chemical composition, are actually different proteins in the two species. Working along similar lines, Dudley and Woodman pointed out that the casein from sheep's milk is not the same substance as the casein from cow's milk. This biologically specific character of the different proteins is sharply contrasted with the wide distribution of certain chemically active cell constituents such as glutathione, insulin, and cytochrome. Even in the cell nuclei the active chemical groupings seem to be non-specific in character. It is not suggested, however, that the same chemical cycles of metabolism are found universally in the animal and plant kingdoms, for there is plenty of evidence to show that different chemical cycles serving the same end have been produced in the course of evolution. In the animal world various respiratory pigments have been evolved independently and at different times. Proteins in the plant world are found only as intra-cellular substances or as food reserves in the seeds, the protective and supporting tissues being built up from carbohydrates. In animals, on the other hand, protein materials are also used for extra-cellular structures such as the keratins of the epidermis or the supporting fibres of connecting tissue.

THE PROBLEM OF CROCKER LAND.—The publication of the full report of the Crocker Land expedition, led by Dr. D. B. Macmillan in 1913–17 (*Bulletin of the American Museum of Natural History*, **56**, 6; 1928), throws interesting light on the possibility of non-existent lands being reported. In 1906, R. E. Peary reported Crocker Land to lie about a hundred and twenty miles north-west of his position on Cape Thomas Hubbard (Heiberg Island). As he sledged towards that site in 1914, Dr. Macmillan on two consecutive days saw 'land' to the west, a hilly, ice-capped land extending through 150°. Its appearance changed very slowly, and it gradually faded in the evening. On the site of Crocker Land in 82° 30′ N., 108° 22′ W., there was no sign of land within the range of view in any direction. But on his return, Dr. Macmillan, from Peary's view-point on Cape Thomas Hubbard, again saw extensive 'land' from south-west to north-north-east. These were obviously mirages, but their persistence in that area may indicate land farther west, though this is improbable. Yet the pack ice on the site showed a much broken appearance, indicating the existence of cross-currents which occur only in the vicinity of land. Recent transpolar flights have given no indication of land in that area. Low and snow-covered land might, however, be indistinguishable from pack ice.

MARSHALL ISLANDERS' CHARTS.—In a lecture before the Royal Geographical Society on May 14, Sir Henry Lyons directed attention to five examples of sailing

charts made by the Marshall Islanders, lent to the Science Museum by the Royal Colonial Institute. Only a few of these charts are known, and the present collection supplements the accounts of similar charts published in 1898 by Capt. Winkler and in 1902 by A. Schück. Narrow strips of the mid rib of a palm leaf are tied in certain positions by lengths of palm fibre. The relation of the strips to one another gives the information which the chart is designed to provide. The strips represent the wave front of the swell caused by prevalent winds. Curved rods indicate that the swell movement is checked in the neighbourhood of an island; where two swell fronts meet, rough water may be expected. Currents near islands are sometimes shown by short straight strips. Islands are marked, but only approximately, by small shells tied to the frame-work. Some of the simpler charts were made only for instructional purposes. The more complicated ones are not drawn to scale and are difficult to decipher with any degree of accuracy, but they are so frail that they can scarcely have been used on canoe voyages. The construction of these charts was kept a secret by the chiefs, and consequently it is difficult to be certain as to their full meaning and use.

ELECTRICAL CONDUCTIVITY.—The principles of the wave mechanics appear very clearly in an application of it by W. V. Houston to the problem of electrical conductivity. His work, which appears in the *Zeitschrift für Physik* of May 7, is an extension of Prof. Sommerfeld's revived electron theory of metals, already widely applied since its announcement last October. Each electron is treated as a system of waves occupying the whole of the metal, and its motion is supposed to be determined by the diffraction of the waves in the crystal lattice of the positive ions, conduction being thus referred to an interference phenomenon. The effect of increase in temperature is to make the thermal vibration of the positive ions more violent, and so permit of greater diffraction in the distorted lattice, most of the electrons being unaffected at low temperatures, because their wave-length exceeds the grating constant. Impurities in the metal are equivalent to a more or less periodic fault in the normal lattice, and the effect of this upon the motion of the electrons is the analogue of the production of 'ghosts' by errors in a ruled grating. The mathematical development of these ideas leads without further assumptions to a very satisfactory account of the temperature coefficient of resistance, except in the region of super-conductivity. The weak point of the theory appears to be that in other applications a definite form has to be assumed for the electric field of an ion, but even then the agreement with experiment is remarkably good.

PLATINUM ALLOYS IN THERMIONIC VALVES.—The American Telegraph and Telephone Company, which manages the long-distance communication arrangements of the United States, is very busy this year. It has to erect nearly a million poles, and the lengths of the underground and aerial systems to be installed amount to about three and a half million miles. It will soon complete a second cable route between New York and Chicago. For much of the success the company has achieved it is indebted to the thermionic valve repeater. In the *Bell Laboratories Record* for April, J. E. Harris describes the manufacture of the platinum alloys used in manufacturing the valves. It appears that a platinum alloy is used because there is no chemical action between it and the barium and strontium oxides with which it has to be coated. It is found that chemical reaction weakens the thermionic activity of the coating when metals such as tungsten are used. The platinum used in the alloy has a purity of not less than 99·98 per cent. The purity can be determined at once by the thermal electromotive force developed between the sample and a standard piece of metal. Frequent use is also made of the spectroscope to detect minute impurities. The platinum and alloying metals are melted in a high frequency induction furnace, the temperature attained being about 1750° C. The final diameter of the wires from which the wire ribbon required for the repeater is rolled vary from one to thirteen thousandths of an inch. Although platinum is twenty times heavier than water, an ounce of the metal can be drawn into a mile and three-quarters of the finest wire used in this work. Within recent years, improvements in the core and the coating and pumping processes have increased many fold the life of the thermionic repeaters. This enables the service to be improved and has effected considerable economies.

THE EQUILIBRIUM BETWEEN ALCOHOLS AND SALTS.—The *Journal of the Chemical Society* for March contains an account of an investigation by E. Lloyd, C. Brown, D. Bonnell, and W. J. Jones of the equilibrium between alcohols and salts. They have determined the solubilities of a large number of salts in methyl and ethyl alcohols, and of a few salts in higher alcohols. A number of alcoholates have been isolated and their dissociation pressures at various temperatures measured. This paper includes a discussion of the variation of alcohol vapour–air mixtures from the ideal gas equation, and the Van der Waals' equation. The authors also point out that in many cases of alcohols and salts, solvation, ionisation, and alcoholysis are not the only reactions which take place. Thus, above 50° C., ferric chloride solutions in methyl or ethyl alcohol evolve chloroform and deposit a red precipitate.

THE SYNTHESIS OF AMMONIA BY ALPHA RAYS.—The *Journal of the American Chemical Society* for March contains an account by S. C. Lind and D. C. Bardwell of the effect of the α-radiation of radon on a mixture of nitrogen and hydrogen in the proportion of 1 to 3 by volume. The gas flowed through a glass bulb at the centre of which was mounted a thin α-ray bulb and the ammonia formed was absorbed by water. The rate of synthesis of ammonia was determined by titration with acid and the yield was found to be 0·2 to 0·3 molecule of ammonia for every pair of ions produced in the gas. In comparison with other gas reactions taking place under α-radiation, the ionic efficiency is low and it is difficult to derive the mechanism of the reaction. The possibility that *ions* of both gases are involved is interesting, in view of the fact that B. Lewis has recently found that for the synthesis of ammonia both the nitrogen and the hydrogen require activation.

A NEW DEVICE FOR READING BURETTES.—We have received from Messrs. Andrew H. Baird, of Edinburgh, a simple device, named Hyman's burette-reader, which will be very serviceable to those who are constantly using burettes. A strip of transparent celluloid is firmly fixed by two pins upon a larger strip of opaque celluloid, which is divided into an upper white and a lower black portion by a sharp straight edge. The upper edge of the transparent slip is made to coincide exactly with this division, and the burette is pushed between the strips. The device, which costs ninepence, greatly facilitates the reading of the meniscus and, with the aid of a lens, the estimation of fractions of the intervals engraved on the burette. Since the edge of the transparent cover is viewed against the sharp dividing line there is no danger of any parallax error.

The Elements of Wave Mechanics.[1]

THE path of a material particle of mass m moving in a conservative field of force in which the potential energy V is a function of position (x, y, z) only is determined by Hamilton's Principle. If E is the constant total energy and A and B the points of departure and arrival, this may be expressed in the form

$$\delta\int_A^B \sqrt{2m(E-V)}ds = 0. \quad . \quad . \quad (1)$$

Consider a group of light waves emitted at A in a suitably dispersive medium. The path of the light which reaches B is determined by Fermat's Principle

$$\delta\int_A^B \frac{1}{u}ds = 0,$$

where u is the wave velocity. If in this relation we put $u = \frac{E}{\sqrt{2m(E-V)}}$, thereby determining the character of the medium, Fermat's Principle gives for the path of the light the condition

$$\delta\int_A^B \frac{\sqrt{2m(E-V)}}{E}ds = 0, \quad . \quad . \quad (2)$$

which is exactly equivalent to (1), and hence the path of the light given by (2) is in this case the same as the path of the particle given by (1). If we now determine the frequency ν of the light waves by the relation

$$\nu = \frac{E}{h}, \quad . \quad . \quad . \quad . \quad (3)$$

where h is Planck's constant, the *group* velocity g of the waves is given by

$$\frac{1}{g} = \frac{d}{d\nu}\left(\frac{\nu}{u}\right) = \frac{d}{dE}\left(\frac{E}{u}\right) = \frac{m}{\sqrt{2m(E-V)}},$$

so that g is equal to the velocity of the particle. It follows that under the above conditions the motion of a group of light waves not only follows the same path as the particle, but also that the group velocity is the same as that of the particle at each point of the path. It would therefore be possible to predict the velocity and position of the particle by considering the velocity and position of the corresponding group of light waves. This principle may be regarded as a method of inferring from a problem in geometrical optics the solution of a problem in dynamics.

Now the methods of geometrical optics suffice only when the wave-length is small compared with the obstacles encountered. If this condition is not fulfilled, the wave theory of light must be used. The question then naturally arises as to whether the solution of a small scale optical problem by means of the wave theory can be made to yield the solution of a corresponding small scale mechanical problem. In other words, does there exist a theory of 'wave mechanics' which should be applied to small mechanical systems in a way similar to the application of 'wave optics' to small optical systems? Schrödinger answers this question in the affirmative.

The equation of wave propagation is

$$\nabla^2\phi = \frac{1}{u^2}\frac{\partial^2\phi}{\partial t^2}.$$

To search for periodic solutions of frequency ν put $\phi = \psi(x, y, z)e^{2\pi i\nu t}$ and use the value of u given above,

$$u = \frac{E}{\sqrt{2m(E-V)}} = \frac{h\nu}{\sqrt{2m(E-V)}}.$$

The equation for ψ then becomes

$$\nabla^2\psi + \frac{8\pi^2 m}{h^2}(E-V)\psi = 0. \quad . \quad . \quad (4)$$

This is Schrödinger's Amplitude Equation, ψ being the amplitude of the periodic function $\psi e^{2\pi i\nu t}$. Solutions of this equation are sought which shall be (i) finite, (ii) single-valued. In the case of the hydrogen atom, the potential energy is $V_0 - \frac{e^2}{r}$, where V_0 is a constant chosen to make V positive and e is the charge on the electron. It may be shown[2] that solutions satisfying conditions (i) and (ii) only exist in two sets of cases:

(*a*) $E = E_n = V_0 - \frac{2\pi^2 me^4}{h^2 n^2}$, $n = 1, 2, 3 \ldots$

(*b*) $E > V_0$.

(*a*) corresponds to Bohr's elliptic orbits, each of which has its appropriate energy E_n. Transference from one orbit to another implies a definite quantum emitted or absorbed. The values E_n are called *eigen* values.

(*b*) corresponds to the hyperbolic orbits which are not quantised. The frequency in the nth elliptic orbit is given by $\nu_n = E_n/h$. If in the fundamental equation (4) we put $E = E_n$, we get n^2 independent values of ψ called *eigen* functions. The n^2 *eigen* functions appropriate to E_n correspond to the multiplicity of orbits in Bohr's model, the phenomenon known as degeneracy. If, however, as in the Stark effect, an electric field is applied, E_n is split up into n^2 slightly different *eigen* values to each of which corresponds a (now) definite *eigen* function. The combinations of the transitions between the n_1^2 energy levels corresponding to E_{n_1} and the n_2^2 energy levels corresponding to E_{n_2} give lines which are theoretically possible. Not all these lines are observed, but the theory accounts for this by yielding zero intensity for the absent lines. A magnetic field has an analogous effect and in this way the results of Stark and Zeeman are accounted for. Thus by the application of an electric or magnetic field the system is rendered non-degenerate and experimental control can be applied to numerical calculations.

If we suppose the system rendered non-degenerate in this way, to E_k there corresponds an *eigen* frequency $\nu_k = E_k/h$ and an *eigen* function ψ_k. It is possible to choose the ψ_k in such a way that they form a complete orthogonal system; *i.e.* so that

$$\iiint \psi_k\psi_l dxdydz = \delta_{kl},$$

where $\delta_{kl} = 1$ if $k = l$, $\delta_{kl} = 0$ if $k \neq l$.

Schrödinger considers the function

$$\psi = \sum_k c_k\psi_k e^{2\pi i(\nu_k t + \theta_k)}, \quad . \quad . \quad . \quad (5)$$

where $\Sigma c_k^2 = 1$ and interprets $|\psi|^2$ as the electric density ρ. With this assumption an atom in which the only vibrations excited correspond to elliptic orbits will emit like an infinitesimal dipole of moment (M_x, M_y, M_z), where

$$M_z = \iiint \rho z dxdydz = -\sum_k c_k^2 a_{kk} - 2\sum\sum_{k\,l} c_k c_l a_{kl}\cos(\nu_{kl}t + \theta_k - \theta_l),$$

$$a_{kl} = \iiint ez\psi_k\psi_l dxdydz, \quad \nu_{kl} = \nu_k - \nu_l.$$

It follows that a_{kl} depends only on the nature of the system and not on its state.

[1] Based on lectures delivered by Prof. Erwin Schrödinger at the Royal Institution of Great Britain on Mar. 5, 7, 12, and 14.

[2] Cf. A. S. Eddington, NATURE, July 23, 1927, p. 117.

Moreover, $\nu_{kl}=\nu_k-\nu_l$, so that the frequencies of the emitted radiation are the differences of the frequencies of the various orbits. This leads to Bohr's Selection Rule, for the lines not emitted are found by calculation to be just those for which $a_{kl}=b_{kl}=c_{kl}=0$. For linear polarisation parallel to z, say, $a_{kl}\neq 0$, $b_{kl}=c_{kl}=0$. For circular polarisation $a_{kl}=0$, $b_{kl}=c_{kl}$, and the phases differ by $\pi/2$. These results are obtainable by actual numerical computation.

Returning to the amplitude equation (4), we see that the value of ψ given by (5) is not a solution of the amplitude equation, but that it is the sum of solutions of the various amplitude equations obtained by giving E the values E_1, E_2, E_3 . . .

Since $$\frac{\partial}{\partial t}\left(\psi_k e^{\frac{2\pi i E_k t}{h}}\right)=\frac{2\pi i E_k}{h}\left(\psi_k e^{\frac{2\pi i E_k t}{h}}\right)$$

we can eliminate E_k between this and the equation of type (4) in which $E=E_k$. The resulting equation,

$$\nabla^2\psi-\frac{4\pi m i}{h}\frac{\partial\psi}{\partial t}-\frac{8\pi^2 m}{h^2}V\psi=0, \quad . \quad . \quad (6)$$

where ψ is now written for $\psi_k e^{\frac{2\pi i E_k t}{h}}$, is Schrödinger's Wave Equation and is satisfied by all the $\psi_k e^{\frac{2\pi i E_k t}{h}}$ and therefore by the function ψ of (5). Hitherto V has been considered as a function of x,y,z only. The further assumption is now made that V may also be a function of the time. This enables us to discuss the effect of an alternating field on the atom and leads to Schrödinger's theory of dispersion, that is, the alteration in a primary wave incident on a body of atoms, caused by the disturbance due to the secondary wavelets emitted by the atom under the excitation of the incident primary radiation.

Suppose then that an alternating field $F=A\cos 2\pi\nu t$ is applied in the z direction. We put

$$V=V_1+Aez\cos 2\pi\nu t,$$

where V_1 is the potential energy when $A=0$, the case which has just been discussed, the solution being given by (5). We take A to be small and suppose the c_k of (5) to be now slowly varying functions of the time. If we substitute from (5) in (6), multiply by ψ_l, and integrate throughout space we get, on account of the orthogonal property of the ψ_k,

$$\frac{dc_l}{dt}=\frac{\pi i A}{h}\sum_k a_{kl}c_k\left[e^{2\pi i(\nu_k-\nu_l+\nu)t}+e^{2\pi i(\nu_k-\nu_l-\nu)t}\right], \quad (7)$$

an infinite set of linear equations of the first order.

If $\nu_k-\nu_l\pm\nu$ is large compared with Aa_{kl}/h, resonance is excluded, the frequencies are large and we can suppose the c_k to remain approximately constant. If only the k level is excited, $c_k=1$, and all the others are zero. The z component of the electric moment is found to be

$$M_z=\iiint ez\rho\,dx\,dy\,dz=-a_{kk}+\frac{2}{h}A\cos 2\pi\nu t\sum_l\frac{(\nu_l-\nu_k)a^2_{kl}}{(\nu_l-\nu_k)^2-\nu^2}.$$

The first term is a spontaneous emission coefficient, the second shows that whether the vibrations are in or out of phase depends not only on the sign of $(\nu_l-\nu_k)^2-\nu^2$ but also[3] on that of $\nu_k-\nu_l$. It is also seen that the secondary waves have the same frequency as the incident waves. If two levels, say c_k and c_l, are excited, it is found that the secondary waves are not all of frequency ν, but that some of the secondary radiation is of frequency $\nu\pm(\nu_k-\nu_l)$.

The case of resonance is fundamental. If $\nu_k-\nu_l+\nu=\epsilon/2\pi$, where ϵ is infinitesimal, and if we retain only those terms which contain ϵ in the exponent, the system (7) reduces to

$$\dot{c}_l=i\sigma c_k e^{i\epsilon t}, \quad \dot{c}_k=i\sigma c_l e^{-i\epsilon t}, \quad \sigma=\pi A a_{kl}/h.$$

To solve these put

$$c_l=xe^{i\epsilon t/2}, \quad c_k=ye^{-i\epsilon t/2},$$

so that $$\dot{x}=i\sigma y-\frac{i\epsilon}{2}.x, \quad \dot{y}=\frac{i\epsilon}{2}.y+i\sigma x.$$

If the l level is initially unexcited, $x=0$ when $t=0$, and we obtain, denoting $\sigma^2+\epsilon^2/4$ by p^2,

$$|x|^2=4B^2\sin^2 pt, \quad |y|^2=4B^2\cos^2 pt+B^2\epsilon^2/\sigma^2.$$

Thus the total intensity is

$$|x|^2+|y|^2=4B^2+B^2\epsilon^2/\sigma^2,$$

and the total oscillating intensity is

$$4B^2\sin^2 pt+4B^2\cos^2 pt=4B^2.$$

Hence $$\frac{\text{Oscillating intensity}}{\text{Total intensity}}=\frac{\sigma^2}{\sigma^2+\epsilon^2/4}.$$

If then $\epsilon=0$, the resonance is complete and the total intensity oscillates continually between the k level and the l level. Thus Bohr's orbital jumps may be interpreted as a resonance phenomenon between the exciting frequency and the natural frequencies.

In generalised co-ordinates, the motion of a mass point can be represented by a trajectory AB in space of n dimensions, the co-ordinates of a point on AB being the n quantities required to specify the position and motion. By using a generalised Laplacian ∇^2 appropriate to these co-ordinates the amplitude equation (4) retains the same form. In this way the motion of the nucleus may be taken into account. In the case of the single electron problem, let m_1 be the mass of the electron (co-ordinates x_1, y_1, z_1) and m_2 be the mass of the nucleus (co-ordinates x_2, y_2, z_2). The generalised equation (4) is then

$$\frac{1}{m_1}\nabla_1^2\psi+\frac{1}{m_2}\nabla_2^2\psi+\frac{8\pi^2}{h^2}\left(E+\frac{e^2}{\sqrt{(x_1-x_2)^2+(y_1-y_2)^2+(z_1-z_2)^2}}-V_0\right)\psi=0.$$

Now in the Keplerian problem of two bodies, we may regard m_2, say, as fixed and m_1 moving about it, provided that we replace m_1 by the 'combined mass' μ given by $\frac{1}{\mu}=\frac{1}{m_1}+\frac{1}{m_2}$. In the previous discussion m_2 has been regarded as infinite. It has been found that certain hydrogen lines would coincide with certain He^+ lines if the Rydberg constant $R=2\pi^2 m_1 e^4/ch^3$ were replaced by $4R$ on the assumption that m_2 is infinite. Sommerfeld has shown, however, that a modified Rydberg constant must be used to obtain exact agreement, got by replacing m_1 by μ. To explain this put

$\psi=\phi$ (co-ordinates of G)
$\times\chi$ (relative co-ordinates with respect to G),

G being the mass centre of the system. The generalised amplitude equation above is now equivalent to the two equations

$$\frac{1}{m_1+m_2}\nabla^2\phi+\frac{8\pi^2}{h^2}E_T.\phi=0 \quad \text{(co-ordinates of } G\text{)}, \quad (8)$$

$$\frac{1}{\mu}\nabla^2\chi+\frac{8\pi^2}{h^2}(E-E_T-V)\chi=0 \quad \text{(relative co-ordinates)}, \quad (9)$$

E_T being the constant energy of translation of G.

(8) refers to the motion of G, while (9) shows that only the energy relative to G is quantised. Schrödinger's method gives *eigen* values for the relative energy $E-E_T$ in terms of the combined mass μ. Thus Sommerfeld's results are retained in the new theory.

L. M. MILNE-THOMSON.

[3] Cf. H. A. Kramers, NATURE, May 10, 1924, p. 673.

Fisheries of Madras.

RECENT work done by the Madras Fisheries Department is detailed in the administration report for the year 1925–26 by the Director, Dr. B. Sundara Raj (*Madras Fisheries Bulletin*, vol. 21, pp. 1-94. Madras. 2 rupees, 4 annas. 1927). This report deals mainly with the commercial development of the department as applied to fish, pearl, and chank (a gastropod, *Turbinella pyrum*) fisheries. The fish cannery at Chaliyam was not a success, but it is hoped that with the help of Sir F. A. Nicholson in the management of its experimental and manufacturing operations, the cannery will improve. At Tanur, researches were continued in the methods of curing fish for sale in the interior markets, of avoiding saline excrescences in semi-dried prawns, of manufacturing paint oil, and of refining sardine oil to take the place of cod-liver oil. Attempts in preparing fish-meal from sardines with a low fat content had to be abandoned for want of material. Investigations for improving the resources of edible fish in inland waters have been continued. It has been observed that the fish gourami (*Osphromenus sp.*) feeds voraciously on certain common garden shrubs, and that the tench and the English carp can be acclimatised.

In 1926, after a lapse of more than a quarter of a century, a pearl fishery was commenced on Feb. 17 at Tuticorin. The time-honoured method of fishing and of disposing of the oysters was in vogue, except for the fact that the lots for sale were not counted, but weighed out according to the average weight of 1000 oysters worked out every morning. Considerable success attended the fishery, yet the fishing operations had to be closed on Mar. 27 on account of an outbreak of cholera in the camp. In spite of the short period of fishing, the Government made a net profit of Rs. 136,417. The chank fishery was an improvement on the previous year, though the best chank diving season coincided with the pearl fishery.

The marine aquarium continued to be popular. It is proposed that if the suggested biological station at Krusadai Island is established, other aquaria at Rameswaram and at Vizagapatam should be established with facilities for conducting scientific research and for popularising natural history among the Indians. It is very gratifying to note that the Fisheries Department is endeavouring to introduce elementary education to the children of the fishing population, to organise and to spread the co-operative movement, and to promote temperance and the social and economic advancement of the country.

University and Educational Intelligence.

CAMBRIDGE.—Sir Archibald Denny, Bart., has offered to endow an annual prize of £15 for the student who does best in the theory of structures in the Mechanical Sciences Tripos.

LEEDS.—By the will of the late Mr. F. C. Clayton, a sum of £2000 has been provided to establish a scholarship of £100 a year, to be called the "Richard Reynolds Scholarship," tenable in the University by a student qualified to benefit by the same in the study of chemistry or pharmacy. Miss Florence Watts and her sister have presented a collection of photographs, scientific apparatus and specimens, in memory of their uncle, the late Sir Edward Thorpe.

With the object of assisting the further development of the research work of the Textile Industries Department, the Clothworkers' Company is making an additional grant to the University at the rate of £3000 a year for the next four years. Since the foundation of the Yorkshire College, donations and annual grants of more than a quarter of a million pounds have been received from the Company. The new building will be officially opened in October. It will allow of extension of the Textile Museum, improved laboratories for the Silk Research Association, and the extension of the mechanical and scientific equipment of the Textile Industries Department. The new grant of £3000 a year will allow of additions to the research staff, and of the award of a number of post-graduate fellowships or scholarships for research in both the Textile Industries and the Dyeing Departments.

THE following lectures in metallurgy have been arranged for by the Armourers and Brasiers' Company: At the Royal School of Mines, at 5.15, on June 4, 11, and 18, by Mr. G. Mortimer, "The Founding of Aluminium and its Light Alloys." At the Battersea Polytechnic, at 7, on June 5, 12, and 19, by Dr. J. M. Robertson, "The Heat Treatment of Steel." Admission will be free, and no tickets will be required.

APPLICATIONS are invited for the Dickinson Research Travelling Scholarship in Medicine, value £300, and tenable for one year. Candidates must be university graduates who have taken the full course of clinical instruction required by their examining bodies in the Manchester Royal Infirmary and the University of Manchester, and have earned distinction in so doing. Applications (in each case six in number) should be sent not later than June 14 to Mr. F. G. Hazell, Secretary to the Trustees, Manchester Royal Infirmary.

A COURSE of three advanced lectures in anthropology will be given at the London School of Economics on June 4, 5, and 6, at 5 P.M., when Dr. Marcel Mauss, Director of the École des Hautes Études (Sorbonne) and professor at the Institut d'Ethnologie of the University of Paris, will lecture on "The Theory of the Elementary Forms of Prayer (Australia)." The course will cover the definition of prayer, the general characteristics of prayer formulæ, the formulæ of religion, totemic and initiation cults, and dramatic, magic and negative ritual. The chair will be taken at the first lecture by Dr. E. Westermarck, Martin White professor of sociology in the University of London. Admission is free without ticket.

UNIVERSITY College, London, announces in its recently issued annual report that the total number of its students in 1926–27 was 3218, showing a decrease of ten. Excluding evening (456) and vacation-course students (290) the figures show an increase of 46. Students from parts of the Empire outside the British Isles numbered 287; those from other countries in Europe, 417 (including 212, chiefly vacation-course students, from Germany); and those from foreign countries outside Europe, 152, of whom 60 were from the United States of America. There were 1376 students in different stages of the degree course, and 534 post-graduate and research students. The College has for many years taken an active part in promoting adult education by providing public lectures open without fee. More than 8000 persons attended these lectures during 1926–27, the approximate aggregate number of attendances being 18,678. The report contains a record of the centenary celebrations, including the most important speeches and addresses. The centenary fund amounted, at the time the report was printed, to £173,445, and has since risen to above £200,000. The appeal was for £500,000.

Calendar of Customs and Festivals.

(Addendum to May) May 17.

In Morocco, the first day of summer, known as *Mūt l-arḍ*, "the death of the ground." No one may sleep on this day under penalty of losing his courage, while a wife is in danger of losing her husband's affections. Among the Tsūl, to avert evil influences everyone rises at daybreak and has a bath; this is said to strengthen the body, as the water this morning, coming from the well Zemzem, has special virtue. The magic of the death of the earth is used in various ways, especially in connexion with preparations of barley, for charms and magical purposes. But it is also the commencement of a new season. Therefore the women of the Aiṯ Sádděn fill their handmills with wheat and cover them up; the men of the Aṯ Ubáḥṯi buy new clothes for themselves and their women.

June 3.

TRINITY SUNDAY.—That Trinity Sunday, said to have been instituted by Beckett, was also a popular festival of older standing is suggested by the number of fairs held about this date, and also by the processions with garlands of flowers and ribbons which took place in many localities on this day. Aubrey, in his "Miscellanies," describes a garland ceremony at Newnton when, after prayers had been read, an exchange of a garland and a money gift took place between a maid and a bachelor of another parish.

In Carnarvonshire an offering was made of calves and lambs bearing the mark of St. Beuno, a natural mark on the ear, in the church of Clynnok Vaur. The beasts were sold and the proceeds used for the benefit of the poor or for repairs. At Paignton Fair, held at Exeter, as described in an account of 1809, an immense plum pudding decorated with ribbons and evergreens was drawn through the town by eight oxen, and then distributed among the people.

June 4.

TRINITY MONDAY.—An annual fair, lasting until Wednesday, was held at Southampton. This was declared open by the Mayor, who erected a pole on which was a glove. A bailiff held the jurisdiction of the fair, and no one might be arrested within its precincts. At the close of the fair the glove was shot down by the young men. A fair was also held at Deptford on this day, when the Master and Brethren paid their annual visit to Trinity House.

June 6.

EVE OF CORPUS CHRISTI.—In Wales this was specially regarded as a health-restoring time, when it was customary for those suffering from any ailment to kneel before the altar and pray for recovery. In North Wales, at Llanasaph, green herbs and flowers, and at Caerwis ferns, were strewn before the doors of the houses.

June 7.

CORPUS CHRISTI.—Instituted by Pope Urban in 1264 to celebrate the doctrine of Transubstantiation. In England it became in a special sense a community festival, in which the civic authorities took part, and the guilds were required to provide a pageant. Although the religious element declined in importance at the Reformation, the civil celebration continued for some time. Thus it is recorded that down to Queen Mary's day, the Skinners' Company went in procession on this day, with two hundred clerks, the officers of the Company, the Mayor and Aldermen in scarlet, and then the Skinners in their livery. At Norwich the crafts or companies, each with its banner, marched from the Common Hall around the market and back.

It is, however, on account of the performance of religious or 'mystery' plays, that the celebration of Corpus Christi is best known. A record at Newcastle-on-Tyne, dated 1426, mentions the Merchant Adventurers as concerned in the production of five plays, and no doubt other companies, drapers, mercers, etc., each one responsible for at least one. One of the most celebrated of the Corpus Christi performances was at York, but the Chester and Coventry plays were almost, if not quite, as important. Every trade in the city was obliged to furnish a pageant at its own expense—each individual had to personify some particular passage in the Old or New Testament. The part played by the miracle as well as the mystery in the development of the drama is too well known to call for comment; but here again it must be noted that the Church had adapted a popular custom to its own uses, as it had adopted the pagan dance, and had brought its performance, at least in the case of the miracle play, within the church walls.

The mystery play at Corpus Christi and the miracle play at Christmas, like the great classical drama of Greece, which itself was attached to a religious festival, grew out of, or was an adaptation of, a rustic performance which survived in Greece in the satyric drama, and in England in the folk-drama. This, as played by itinerant mummers, lasted in the north of England to within living memory, and has now been revived in a number of localities. That this popular English folk-drama was originally of a ritual character is shown by its uniformity in structure and motive—a combat in which one of the characters is slain and brought to life again by the 'doctor'; in other words, a dramatic representation of a ritual death and resuscitation.

June 8.

On the first Friday after Trinity, Coventry Fair opened, lasting for a week. It was one of the most famous of the English fairs, in which was represented the ride of Lady Godiva through the city, by which it was freed from the exactions of her husband Leofric.

June 9.

ST. COLUMBKILLE OR COLUMBA, Abbot of Iona and Apostle of Caledonia, A.D. 597, next to St. Patrick the most famous of Irish saints. He was of royal family, belonging to the Dal Ariadha, said to be of Pictish extraction. His birth was foretold long before Christian times in a vision to his royal ancestor, Fedhlimidh Reachtmhar, and also by the renowned Finn Mac Cumhaill.

St. Columbkille is associated both with holy wells and with holy stones. The stone on which he was born of his mother Ethnea from that time seemed marked with a cross, and to another reddish-coloured stone, called Cloch Ruadh, long preserved in a gold and silver case at Rathen, great efficacy was attributed when it was borne to houses in which were infirm persons in danger of death, and also in cases of difficult parturition. A flat slab is still said to be the bed of his birth, four indentations in the surface having been made at the time by his mother. It was once the object of the peasants' pilgrimage, and stations are still made there on the saint's festival.

At the parish of Clonmany, Co. Donegal, of which St. Columbkill is titular saint, it was the custom on his festival day to drive cattle down to the beach and swim them where the water of St. Columb's well runs into the sea.

Societies and Academies.

LONDON.

Geological Society, May 9.—**W. B. R. King**: The geology of the district around Meifod (Montgomeryshire). The general succession is summarised as Salopian, Valentian, (unconformity), Ashgillian, Caradocian. The Caradocian can be divided into six subdivisions, each characterised by a special fauna, probably controlled by the type of sedimentation and food-supply rather than by time. The evidence of marked unconformity at the base of the Silurian is striking at certain localities, and in conjunction with the ground on the east shows that the base of the Lower Valentian gradually transgresses the Ashgillian until some 1200 feet of strata are cut out. The fact that the whole of the Gala, from the zone of *Monograptus turriculatus* to that of *M. crenulatus* inclusive, is represented by some 300 feet of fine grey and maroon shales, is in striking contrast with the developments in Shropshire and central Wales.

EDINBURGH.

Royal Society, May 7.—**G. S. Carter**: A zoological expedition to Brazil and Paraguay in 1926–27 (Address). A year was spent on zoological investigations by the author and Mr. L. C. Beadle. On the way to the Paraguayan Chaco, where most of the work was done, six weeks were devoted to collecting zoological material along the line of the new railway from São Paulo to Porto Esperanza on the Paraguay. The aim of the expedition was (1) to collect and bring home young larvæ of Lepidosiren with the intention of breeding them to maturity at Glasgow; this was accomplished without difficulty; (2) to study the conditions of life in the swamps of the Chaco. As a result of investigations of several physical and chemical characteristics of the water of these swamps, it was found that, of the characteristics studied, the oxygen-content of the water was the condition of greatest bionomic importance. It was very low, and the fauna, especially the fishes and the oligochætes, showed adaptations to the satisfying of this need. The shortage of oxygen in these waters is due to several conditions which must occur in many other tropical waters, but not in those outside the tropics.—**D. A. Allan**: The geology of the Highland border from Tayside to Noranside. The rocks of the serpentine belt are of pre-Old Red Sandstone age, and are bounded to the south by the Highland Boundary Fault, the course of which has now been determined, and further evidence of its reversed nature found. A new exposure of Highland Boundary rocks has been found in the valley of the Prosen. A sequence of Lower Old Red Sandstone lava flows and sediments, the latter mainly conglomerates, has been proved throughout the area, an important new datum line being the Lintrathen porphyry, hitherto regarded as intrusive, but now demonstrated to be a dacite lava flow of wide extent and constant stratigraphical horizon. Contemporaneous erosion of considerable importance occurred during Lower Old Red Sandstone times. An interesting series of normal faults was mapped in the vicinity of the Highland Boundary reversed fault, and it is suggested that they correspond to the phase of relief of pressure immediately following upon the compression, fracture, and over-riding of the Lower Old Red Sandstone strata.—**F. Walker** and **J. Irving**: Igneous intrusions between St. Andrews and Loch Leven. The intrusions between St. Andrews and Loch Leven are mainly sills, and include olivine-dolerites, teschenites, nepheline-basanites, monchiquites, and quartz-dolerites, the first four types being probably consanguineous. The quartz-dolerites, which are very abundant, occasionally contain analcite. At several localities the published maps have been modified, the most important alteration being the inclusion of the twin Lomond peaks amongst the volcanic necks of the district. All the igneous rocks under consideration are probably of Carboniferous age.

PARIS.

Academy of Sciences, April 30.—The president announced the death of Félix Lagrange, *correspondant* for the Section of Medicine and Surgery. **Charles Moureu, Charles Dufraisse**, and **Louis Girard**: Researches on rubrene (7). The dissociation pressure of rubrene peroxide at the ordinary temperature. The peroxidation of rubrene in solution by free oxygen under the influence of light is a reversible phenomenon and the dissociation pressure of the peroxide is appreciable at the ordinary temperature (of the order of 5 mm. of mercury). Attention is directed to the analogy between the peroxidation of rubrene and of hæmoglobin.—**Pierre Termier** and **Eugène Maury**: New geological observations in eastern Corsica: the upper Jurassic: the primary strata prior to the granite.—**Gabriel Bertrand** and **Georges Nitzberg**: The ketonic function of α-glucoheptulose. From the colour reactions with orcinol and phloroglucinol in dilute hydrochloric acid, stability towards bromine water, and the reduction products with sodium amalgam, the new reducing sugar obtained by the action of the sorbose bacterium on α-glucoheptite was shown to be ketonic.—**H. Vincent**: Some non-colloidal substances with cryptotoxic properties. It has been proved in earlier publications that various colloidal substances, many of them soaps, possess the property of neutralising microbial toxins, such as the toxin of tetanus. It has now been found that other substances, not colloidal, possess a similar property, although generally to a less extent. Sodium salicylate has proved to possess the most marked activity in this respect. After the addition of 5 per cent or less of a saturated solution of sodium salicylate to a solution of tetanotoxin, a quantity representing from 200 to 400 fatal doses can be injected into a guinea-pig without inconvenience, and with further doses the animal can be immunised. Experiments with rabbits gave similar results.—**Léon Guillet**: The applications of the addition of nitrogen to certain special steels. The extreme hardness obtained by nitriding certain steels suggests interesting applications in motor-car construction.—**J. Favard**: Algebraic numbers.—**P. Vincensini**: Congruences of normals in their relations with certain rectilinear congruences.—**Bertrand Gambier**: Geodesic lines, lines of zero length, lines of constant total curvature.—**W. Břečka** and **J. Gueronimus**: The monotone polynomials deviating least from zero.—**Georges Valiron**: Circles of *remplissage* of meromorph functions.—**Arnaud Denjoy**: Series of rational fractions.—**J. Haag**: The calculation of certain elastic deformations, with application to the plane spiral.—**E. Carafoli**: The general movement round a contour.—**F. Wolfers**: Remarks on the theory of light. Energy, coherence, and supplementary fringes.—**J. Cabannes**: A new optical phenomenon. The beats which are produced when anisotropic molecules in rotation and vibration diffuse visible or ultra-violet light.—**F. Holweck**: The production and absorption of the *K*-rays of aluminium.—**Maurice François**: The preparation of mercurammonium iodide, $Hg_9N_4I_6$, in the crystallised state.—**Édouard Urbain** and **Victor Henri**: The formation of ammonia in the preparation of phosphorus. Charcoal impreg-

nated with phosphoric acid is heated to 900° C. in a quartz tube in a current of nitrogen. Under these conditions the nitrogen is converted into ammonia.—**Charles Prévost**: Erythrene and its dibromides.—**Bourguel**: The phenylpropines.—**André Meyer**: The products of condensation of homophthalimide with aromatic aldehydes.—**J. Bougault** and **L. Daniel**: The sulphoxytriazines.—**Maurice Nicloux**: The oxidation of glucose in alkaline solution by oxygen or by atmospheric air. The formation of carbon monoxide. The oxidation of glucose in alkaline solution by gaseous oxygen gives carbon monoxide, carbon dioxide, and other oxidation products. The optimum conditions as regards alkalinity and temperature for the maximum production of carbon monoxide have been worked out. —**J. F. Durand**: A synthesis of quinone (rectification). Correction of a note in the *Comptes rendus*, 192, 1927. The experiment described in the previous note cannot be repeated, and the author concludes that a mixture of acetylene and carbon monoxide acting on solutions of cuprous chloride in pyridine does not give quinone.—**Louis Barrabé**: The Callovian at Madagascar between Cape Saint-André and Betsiboka.—**J. Jung** and **P. Geoffroy**: The efficacity of the method of magnetic prospecting for the detection of faults in the Oligocene of Alsace. The instrument generally used for the determination in absolute measure of the horizontal component was used for this survey and was found to be very useful in detecting the directions of certain faults affecting the Oligocene. It may prove to be of use in prospecting for petroleum in Alsace.—**Léon Bertrand**: The general metamorphism of the secondary strata in certain parts of the Pyrenees.—**H. Besairie**: The existence of *Syringopora* limestones in the south-west of Madagascar.—**H. Buisson**: Measurements of the ozone in the upper atmosphere during the year 1927. The method used was based on the use of a spectrograph with quartz prisms and measurement of the ozone bands. There is a large annual variation with a maximum of about 400 in the spring and a minimum of 200 in the autumn. The results are in general agreement with those of Dobson and Harrison and of Gotz.—**L. Lutz**: The influence exerted by the support on the morphological characters of the birch *Polyporus*. Contribution to the study of the antioxygen rôle of tannin. Oak wood is normally invulnerable to this fungus, but the removal of the tannins by systematic washing with water renders it liable to attack.—**G. Ollivier**: The *bromuques* of certain Ceramiaceæ. *Bromuque* is the name given by C. Sauvageau to certain plant cells, which redden under the influence of fluorescin, a reaction attributed to free bromine. The application of Sauvageau's reaction to fresh specimens of *Ceramium* has proved the presence of these cells in seven species, *C. byssoideum* showing them in the greatest abundance.—**B. Ganossis**: The deflocculation and plasmolysis of soil coatings.—**E. Roubaud**: The maternal influence in the determinism of acyclic asthenobiosis.—**L. Léger** and **C. Motas**: Parasitism and the phenomenon of transport of a Hydrocarian in *Cricotopus biformis*. —**Maurice Piettre** and **André Chrétien**: Application of the acetone method to the study of the distribution of the antibodies in agglutinating sera in the course of immunisation.—**Y. Manouélian** and **J. Viala**: Lesions of the walls of the mouth and tongue in mad dogs.

CAPE TOWN.

Royal Society of South Africa, Mar. 21.—**A. Ogg**: Some aspects of modern physics (Presidential address). —**J. L. B. Smith** and **K. A. C. Elliott**: The essential oil of *Agathosma Microphylla*. *Agathosma Microphylla* or 'Stembok Buchu' is a short stunted shrub which grows in patches on the seaward side of the coastal hills, being found fairly extensively about Knysna and in neighbouring districts. It gives off a strong aniseed-like odour which is very noticeable in the still valleys where it flourishes. The oil content of the dried leaves appears to vary with the season, from 2 to 3 per cent of volatile oil when collected in summer, and as much as 5 per cent when collected in winter. Air-dried leaves yielded by distillation in steam a clear yellow oil of powerful odour, the chief constituent of which is methyl chavicol.—**Sir Thomas Muir**: Note on $(n-1)$-by-n arrays whose primary minors have a common factor.—**Theodora B. Auret**: Observations on the reproduction and fungal endophytism of *Lunularia Cruciata* (L) Dumortier. Female plants of this species are found in South Africa on slightly alkaline soil. Male plants and the sporophyte generation are not known. The gametophyte harbours a fungus which is confined to a definite zone below the assimilating tissue. The fungus has been identified as a species of Phoma. The association between the liverwort and the fungus is not a case of true symbiosis, but rather one of harmless parasitism.—**F. E. Fritsch** and **Florence Rich**: Contributions to our knowledge of the freshwater algæ of Africa. (7) Freshwater algæ (exclusive of diatoms) from Griqualand West. 183 species are recorded, 33 of which are new or represented by new varieties, and the total number of genera represented is 69, of which one is new (*Raphidiopsis*, a member of the Rivulariaceæ). Particular interest attaches to the discovery of two new species of *Sphæroplea*. There is another species of the hitherto monotypic genus *Centritractus*, and a highly peculiar new *Phacus*, *P. anomala*.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 3, March).—**W. L. Ayres**: On the separation of points of a continuous curve by arcs and simple closed curves. —**H. Hopf**: On some properties of one-valued transformations of manifolds.—**G. A. Miller**: Harmony as a principle of mathematical development. Throughout mathematics, progress has implied greater intellectual harmony and is seen, for example, in the way in which the equation has steadily displaced the proportion. Increase in accuracy of knowledge generally discloses new elements of discord; hence the principle of harmony is a source of inspiration and also a guide to the novelty of the results obtained.—**Einar Hille**: Note on the behaviour of certain power series on the circle of convergence with application to a problem of Carleman.—**H. S. Reed**: Intra-seasonal cycles of growth. Lemon shoots generally show three distinct cycles of growth during a single season. The growth curves suggest a series of autocatalytic actions due to the periodic activity of a growth-promoting substance.—**Sophia Satina** and **A. F. Blakeslee**: Studies on the biochemical differences between sexes in Mucors. (4) Enzymes which act upon carbohydrates and their derivatives. It has been suggested that sucrase is present in one sex and not in the other. Mucors of varying habit were grown in different nutrient media, each containing a carbohydrate attacked by a specific enzyme. No enzyme tested for was found to be limited to one sex. Trehalose, maltose, and salicin were found to be the best carbohydrates for growth.—**Dontcho Kostoff**: Induced immunity in plants.—**Selig Hecht**: On the binocular fusion of colours and its relation to theories of colour vision. With a red filter before one eye and a green filter transmitting light of about the same brightness before the other (for example, Wratten 29

and 58), a brightly illuminated white surface on a black background appears yellow; similarly, yellow and blue filters make a binocular white. Thus the red (or yellow) sensation in one retina and the green (or blue) sensation on the corresponding retinal area of the other eye results in a yellow (or white) sensation, which arises in the brain. No special receptors in the retina for yellow or white are therefore necessary and the uniqueness of yellow and white as sensations is not opposed to Young's three-receptor mechanism of colour vision.—**Willem J. Luyten**: On the motion of the Magellanic Clouds. Only a very speculative computation is possible, and this indicates that the path of the clouds with respect to the Galactic System may deviate appreciably from a straight line and that they are permanent members of our galaxy.—**Albert Titlebaum**: Artificial production of Janus embryos of *Chætopterus*. Double embryos were obtained by compressing the eggs between slide and coverslip; pressure applied shortly after the extrusion of the second polar body gives the best results. It appears to be correlated with the equal distribution of the 'polar lobe' substance between the two blastomeres in the first cleavage.—**Carl Barus**: Anode and cathode sparks differentiated by the mucronate electrode.—**R. C. Gibbs and C. V. Shapiro**: A spectroscopic criterion for the benzenoid structure in some types of triphenylmethane derivatives. The absorption spectra of compounds of benzenoid or lactoid structure in neutral alcoholic solution include a pair of bands with average separation of about 100 mm.$^{-1}$ in the region 3500–3700 mm.$^{-1}$; both are relatively weak but of the same intensity, and the average molecular absorption coefficient is always of the same order of magnitude.—**Boris Podolsky**: The dispersion by hydrogen-like atoms in undulatory mechanics. Terms of the order of relativistic correction are neglected.—**Joseph Kaplan**: The production of active nitrogen. The discharge tube contained air at 5 mm. pressure; the discharge was condensed and a spark gap connected in series with tube and condenser. The glow was blue, changing to yellow-green with continuous spectrum when the spark gap was excluded. Second and fourth positive bands of nitrogen were identified.—**J. R. Oppenheimer**: On the quantum theory of the Ramsauer effect.—**Norbert Wiener and D. J. Struik**: The fifth dimension in relativistic quantum theory. The fifth dimension is introduced to account for the phenomena of incoherency and the atomicity of electricity.—**Richard C. Tolman**: On the extension of thermodynamics to general relativity. Two principles expressed in equations true for all sets of co-ordinates, which are the analogues of the first and second laws of thermodynamics, are discussed.—**William Rule**: On the variation of the electromotive force in a photoactive cell, containing a fluorescent electrolyte, with the intensity of illumination. Two quartz 'boxes' containing fluorescein solution, connected by a quartz capillary and with central platinum wire electrodes, are used, enclosed in an air-tight case, and one cell is illuminated. This method is considered to eliminate diffusion effects. The electromotive force generated increases with increase of intensity of illumination for a given time, tending to a maximum, and its variation with intensity is roughly paralleled by the variation with exposure. The results support the view that photochemical changes take place in the fluorescent electrolyte.—**A. W. Simon**: A note on corona at high humidity. Parallel copper wires were hung parallel to and equidistant from two parallel steel plates near an open window. Ordinarily, on applying a high voltage (plates positive), heavy visual corona appeared and persisted until an arc struck. On very wet days no corona was visible, the current to the plates was much reduced, and intermittent sparking occurred, possibly due to reduced mobility of the negative ions.—**H. N. Russell, K. T. Compton, and J. C. Boyce**: The spark spectrum of neon (*v.* NATURE, Mar. 10, p. 357).—**Edwin B. Wilson**: On hierarchical correlation systems.

Official Publications Received.

BRITISH.

The Journal of the Imperial College Chemical Society. Vol. 7: containing Papers read during the Session 1927–1928. Pp. 68. (London.)

Report of the Kodaikanal Observatory for the Year 1927. Pp. 6. (Calcutta: Government of India Central Publication Branch.) 6 annas.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 34: The Biological Control of Prickly Pear in Australia. By A. P. Dodd. Pp. 44+9 plates. Pamphlet No. 7: The Export of Oranges. By W. Ranger and Prof. W. J. Young. Pp. 12+3 plates. (Melbourne: H. J. Green.)

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 3, No. 30: Pollination and Seed Production in the Rye-Grasses (*Lolium perenne* and *Lolium italicum*). By Dr. J. W. Gregor. Pp. 773-794. 2*s.* 9*d.* Vol. 55, Part 3, No. 31: Sporangial Variation in the Osmundaceæ. By Dr. S. Williams. Pp. 795-805. 1*s.* 6*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Archæological Survey of India. New Imperial Series, Vol. 43, Parts 1 and 2: The Bakhshāli Manuscript; a Study in Mediæval Mathematics. By G. R. Kaye. Pp. iv+156+48 plates. (Calcutta: Government of India Central Publication Branch.) 28 rupees; 43*s.* 6*d.*

Manchester Municipal College of Technology. Prospectus of Short Courses of Lectures and Laboratory Work to be given during the Summer 1928. Pp. 27. (Manchester.)

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1928. Pp. 62+6 plates. (Edinburgh.)

FOREIGN.

Building the American Museum, 1869–1927: Fifty-ninth Annual Report of the Trustees for the Year 1927. Pp. xxviii+308+16 plates. (New York City.)

Japanese Journal of Botany: Transactions and Abstracts. Vol. 4, No. 1. Pp. iv+112+29+15 plates. (Tokyo: National Research Council of Japan.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 11, No. 2, March. Pp. 43-117. (Kyoto and Tokyo: Maruzen Co., Ltd.) 1.50 yen.

Proceedings of the Imperial Academy. Vol. 4, No. 3, March. Pp. ix-x+85-135. (Tokyo.)

Bergens Museum. Årsberetning, 1926–1927. Pp. 98. Bergens Museums Årbok 1927. Naturvidenskapelig rekke. Heft 1. Pp. 80+67+15. Heft 2. Pp. 140+16+14+5. Bergens Museums Årbok 1928. Naturvidenskapelig rekke. Heft 1. Pp. 222. (Bergen: A.-S. John Griegs Boktrykkeri.)

CATALOGUES.

Watson's Microscope Record. No. 14, May. Pp. 32. (London: W. Watson and Sons, Ltd.)

Caprokol Antiseptic Solution S.T. 37. Pp. 4. Caprokol Therapy: with Clinical Reports of Representative Cases. Pp. 16. (London: The British Drug Houses, Ltd.)

Diary of Societies.

SATURDAY, JUNE 2.

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology Sections).—Prof. G. Portmann: Vasomotor Affections of the Internal Ear.—W. S. Sharpe: The Influenzal Ear.

MONDAY, JUNE 4.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—G. L. Purser: *Calamoichthys calabaricus* (J. A. Smith). Part 1. The Alimentary and Respiratory Systems.—P. R. C. Macfarlane: Salmon (*Salmo salar*) of the River Moisie (Eastern Canada), 1926–1927.—Prof. R. A. Sampson: The Present-Day Performance of Clocks.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Dr. J. A. Fleming: Relativity and Reality (Presidential Address).

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

INSTITUTE OF ACTUARIES, at 5.—Annual General Meeting.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Capt. W. R. Hay: Pre-Ghal in Wazaristan.

ROYAL SOCIETY OF MEDICINE (Social Evening), at 9.15.—C. L. Woolley: Recent Excavations at Ur of the Chaldees.

TUESDAY, JUNE 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. C. Bolton: The Interpretation of Gastric Symptoms (I.).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. E. B. Poulton: Note on the Feeding-habits of Insectivorous Bats.—Prof. J. P. Hill, F. E. Ince, and A. Subba Rau: The Development of the Fœtal Membranes in *Loris*, with Special Reference to the Mode of Vascularisation of the Chorion in the Lemuroidea and its Phylogenetic Significance.—Frances

M. Ballantyne: Note on the Male Genito-urinary Organs of *Ceratodus forsteri*.—Dr. C. Crossland: Notes on the Ecology of the Reef-builders of Tahiti.—Cambridge Suez Canal Expedition Reports:—L. M. I. Dean: Report on the Alcyonaria.—Dr. C. H. O'Donoghue: Report on the Opisthobranchiata.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—E. H. Ellis: Photomicrography.

WEDNESDAY, JUNE 6.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—From 7.30 to 10.—Annual Pond Life and General Microscopical Exhibition.

EUGENICS SOCIETY (at Linnean Society), at 8.—Prof. Malinowski and Dr. Gray: Marriage and Eugenics.

ROYAL SOCIETY OF MEDICINE (Surgery Section) (Annual General Meeting), at 8.30.—Dr. V. Veau, C. H. Fagge, and others: Discussion on Hare-lip.

THURSDAY, JUNE 7.

ROYAL SOCIETY, at 4.30.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. C. Bolton: The Interpretation of Gastric Symptoms (II.).

CHEMICAL SOCIETY, at 5.30.—F. L. Gilbert and Prof. T. M. Lowry: Studies of Valency. Part X. Electrometric Titration of Vernon's α and β-dimethyl-telluronium Bases.—F. L. Gilbert and Prof. T. M. Lowry.—Studies of Valency. Part XI. Molecular Conductivities and Extinction-coefficients of Derivatives of *cyclo*-telluropentane.—A. Key and P. K. Dutt: The Action of Diazo-salts on Aromatic Sulphonamides. Part II. The Mechanism of the Reaction and Constitution of the Diazo-sulphonamides.

FRIDAY, JUNE 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—W. H. Wright: Photography of the Planets in Light of Different Wave-lengths (George Darwin Lecture).—S. R. Pike: Note on the Separation of Gases in Prominences.—N. Goryatscheff: The Definitive Elements of the Orbit of Comet 1925 *c* (Orkisz).

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 5.—At 6.15 (Annual General Meeting).—M. Hine: Report on a Case of Neuro-fibromatosis of the Eyelid, and of a Case in which a Glass Ball burst in the Socket.—F. Ridley: Lysozyme-antibacterial Body present in Great Concentration in Tears, and Especially its Relation to the Human Eye.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.

MALACOLOGICAL SOCIETY (at Linnean Society), at 6.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—T. Robertson and T. N. George.—The Carboniferous Limestone of the Northern Outcrop of the South Wales Coalfield.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Dr. T. Robertson and T. N. George: The Carboniferous Limestone of the North Crop of the South Wales Coalfield.—Dr. R. L. Sherlock: The Alleged Pliocene of Buckinghamshire and Hertfordshire.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. G. P. Thomson: The Waves of an Electron.

PUBLIC LECTURES.

MONDAY, JUNE 4.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. M. Mauss: The Theory of the Elementary Forms of Prayer (Australia) (I.). (Succeeding Lectures on June 5 and 6.)

ROYAL SCHOOL OF MINES, at 5.15.—G. Mortimer: The Founding of Aluminium and its Light Alloys. (Succeeding Lectures on June 11 and 18.)

TUESDAY, JUNE 5.

BATTERSEA POLYTECHNIC, at 7.—Dr. J. M. Robertson: The Heat Treatment of Steel. (Succeeding Lectures on June 12 and 19.)

THURSDAY, JUNE 7.

CHELSEA PHYSIC GARDEN (Swan Walk, Chelsea Embankment), at 5.—Prof. W. E. Dixon: Narcotic Plants (Chadwick Lecture).

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital), at 5.—Sir Oliver Lodge: The Uses we make of the Ether of Space.

FRIDAY, JUNE 8.

KING'S COLLEGE, at 5.30.—Dr. J. Krzyzanowski: Polish Culture in the Middle Ages: Education and the University of Cracow.

CONGRESSES.

JUNE 3 TO 7.

INSTITUTION OF CIVIL ENGINEERS (Celebration of Centenary of Incorporation. Also Engineering Conference).

Sunday, June 3, at 3 P.M.—Divine Service in Westminster Abbey.

Monday, June 4, at 11 A.M.—Address by President, etc.

At 4.30.—Sir James Alfred Ewing: A Century of Inventions (James Forrest Lecture).

Tuesday, June 5, 8 to 11.30 P.M.—Conversazione.

10.30 to 11.45.—Recent Developments in Concrete and Cement for Engineering Structures. Introduced by F. E. Wentworth-Sheilds.—Steel for Shipbuilding. Introduced by Sir William J. Berry.—Utilisation of Solid and Liquid Fuels. Introduced by Dr. C. H. Lander.—Coke-Oven, Town, and Producer Gas. Introduced by R. Ray.—(At Institution of Mechanical Engineers.) The Properties of Materials for Use at High Temperatures, with special reference to Boilers for Superheated Steam. Introduced by R. G. C. Batson.—(At Surveyors' Institution.) Electric Transmission of Power as applied to Large Areas. Introduced by A. Page.

11.45 to 1.—Developments in the Use of Materials in Railway Engineering. Introduced by C. J. Brown.—Railway Design and Maintenance as affected by the Application of Electricity. Introduced by A. R. Cooper and G. Ellson.—The Generation and Utilisation of High-Pressure Superheated Steam for Marine Propulsion. Introduced by Lord Weir and H. E. Yarrow.—Progress in the Adoption of the Internal-Combustion Engine for Marine Purposes. Introduced by Prof. C. J. Hawkes.—Waterless Gasholders. Introduced by F. Prentice.—(At Institution of Mechanical Engineers.) The Present Trend in Boiler Practice. Introduced by W. H. Patchell. (At Surveyors' Institution.) Domestic Lighting and Heating and its Influence on Load-Factor of Supply. Introduced by A. F. Berry.

Thursday, June 7.

10 to 11.30.—The Dimensions of Harbour and Dock Approaches. Introduced by Sir Cyril R. S. Kirkpatrick.—Harbour Breakwaters. Introduced by H. H. G. Mitchell.—Latest Types of Steam and Internal-Combustion Locomotives. Introduced by Sir Henry Fowler and H. N. Gresley.—The General Trend of Modern Development in Steam-Turbine Practice. Introduced by H. L. Guy.—(At Institution of Mechanical Engineers.) Tidal Power, and Turbines suitable for its Utilisation. Introduced by Prof. A. H. Gibson.—Progress in Hydro-Electric Installations, including Intakes, Leats, Tunnels, Dams, Headraces, Pipe-Lines and Tailraces. Introduced by J. McLellan.—(At Surveyors' Institution.) The Filtration and Treatment of Water for Domestic Purposes. Introduced by Sir Alexander Houston and H. E. Stilgoe.—Floods, with special reference to Waste-Weir Capacity. Introduced by W. J. E. Binnie and Dr. H. Lapworth.

11.30 to 12.15.—(At Institution of Mechanical Engineers.) Problems involved in Mining at Great Depths. Introduced by J. Whitehouse.

11.30 to 1.—Modern Road and Bridge Construction. Introduced by F. C. Cook.—The Problem of Road Traffic from the Engineering Point of View. Introduced by H. R. Hepworth.—Light High-Speed Internal-Combustion Engines. Introduced by H. R. Ricardo.—Heavy Internal-Combustion Engines. Introduced by G. Porter.—Prospective Development in the Generation of Electricity and its Influence on the Design of Station-Plant. Introduced by Dr. S. L. Pearce.—(At Surveyors' Institution.) The Advantages of Different Types of Sewage-Tanks. Introduced by W. Clifford.—Sewerage, with special relation to Run-off. Introduced by J. B. L. Meek.

12.15 to 1.—(At Institution of Mechanical Engineers.) The Metallurgy of Complex Lead-Zinc-Copper Ores. Introduced by S. Field.

JUNE 4 TO 9.

INSTITUTE OF QUARRYING (at Blackpool).—Prof. P. G. H. Boswell: Silica—its Commercial Properties and Markets.—W. J. Rees: Commercial Sands.—M. I. Williams-Ellis: Electric Traction as Applied to Quarries and Slate Mines.—T. R. Druitt: Cutting Costs in Slate Quarries.—H. S. Seaborne: Research.

JUNE 6 TO 9.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Rochester).

Wednesday, June 6, at 8 P.M.—Sir Martin Conway: Mountain Exploration (Presidential Address).

Thursday, June 7.

Archæological Section.

At 11 A.M.—
Dr. W. Martin: Presidential Address.
At 12 NOON—
A. E. Hurse: Archæology of the Medway Valley.

Botanical Section.

At 11 A.M.—
C. E. Salmon: Fruits and Seeds as a Means of distinguishing Allied Plants (Presidential Address).
At 12 NOON—
Rev. L. D. Sayers: Gall Formation in Plants.
At 12.30—
G. E. Hutchings: Vegetation of Rochester District.

Friday, June 8.

Geological Section.

At 10.30 A.M.—
H. H. Milner: Geology from the Air (Presidential Address).
At 11.30 A.M.—
Dr. S. W. Wooldridge: The Geomorphology of the North Downs.
At 12.30—
H. G. Dines: The Bapchild Palæolithic Site.

Zoological Section.

At 11 A.M.—
Prof. E. W. MacBride: The Conditions for Progressive Evolution (Presidential Address).
At 12 NOON—
H. H. S. Bovingdon: The Reflections of a Biologist on Food and Efficiency.

Saturday, June 9.

Regional Survey Section.

At 11 A.M.—
C. C. Fagg: The History of the Regional Survey Movement (Presidential Address).
At 12 NOON—
G. E. Hutchings: A Regional Survey of the Lower Medway Valley.