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Professional Codes and Business Practice

ONE of the most interesting features in the recently published report of the Medical Research Council for 1930–31 is the evidence it affords of growing relations between the medical profession and manufacturing firms. The disinclination of such professions as law and medicine to have connexion with trade is an inherited prejudice which, however natural or healthy in its origin, in modern society can be greatly to the public disadvantage. As the report points out, the greater reluctance of medical men in Great Britain as compared with their continental colleagues to undertake clinical trials of new synthetic substances of therapeutic importance in co-operation with manufacturers, and to publish the results over their own names, frequently militates against the clinical application of scientific research carried out at the universities. New substances first produced in Great Britain sometimes come into general recognition and use by way of clinical reports published in German and other foreign journals.

The problem of securing trustworthy clinical trials of new substances produced by manufacturing firms has recently been discussed by the Medical Research Council with representatives of the Association of British Chemical Manufacturers, and a Therapeutic Trials Committee has been organised under the supervision and authority of which trials of new products may be arranged. This Committee is in close touch with the Chemotherapy Committee, which may be responsible for the experimental work desirable or necessary before the drugs or preparations are used in man, and, in consultation with the Association of British Chemical Manufacturers, agreed conditions have been accepted under which the new substances may be submitted to the Therapeutic Trials Committee for clinical study.

These developments, while affording a welcome indication of the breakdown of earlier prejudices against participation in industry, are only a new phase of relations between the Medical Research Council and chemical industry which have existed for some time. The function of the Council to assist in rendering the results of scientific discovery available for the public and the medical profession frequently involves establishing close co-operation between the original scientific workers and those whose work is concerned with the developments necessary for manufacture and application of the discovery. Only by such co-operation is it often possible to minimise the delay in the elaboration of the necessary technique for economic and successful

production on a large scale. It is thus inevitable that some relations with chemical industry should exist, and the closer the co-operation the easier it is to negotiate the difficult path between the laboratory discovery and successful manufacture, and the more rapidly will the manufactured product become available for general clinical use.

This problem of development is, however, by no means peculiar to pharmaceutical preparations. It is encountered in many other fields of industry, where new and improved products are continuously being developed as a result of research. The adage that the good is enemy of the best finds perennial expression in, for example, engineering, where the manufacturer of a new and greatly improved alloy is often faced with the problem of convincing a prospective user that it is worth while paying ten per cent more for an article which is really a hundred per cent better than the original. It is undeniable that the successful application of research is largely dependent upon the user's appreciation of the value of the products which it puts at his disposal. Unless the user—who is not necessarily the ultimate public, but may be a professional man, such as a physician, or a manufacturing firm purchasing, for example, alloys for constructional purposes—is ready to adopt new products, the manufacturer finds little encouragement for his expenditure on the development of new and improved articles. The difficulty is increased because, under the present conditions of trade and industry, the mechanism of buying and selling departments is largely in the hands of those who are not trained technicians, and are unable to assess independently the merits of the new products, or to distinguish exaggerated or unreliable claims made in advertising literature.

Serious efforts are, of course, being made to overcome this difficulty in fields other than that of medicine. The Institute of Metals, for example, has endeavoured to bring into personal contact the technical as well as the business men concerned with the manufacture of materials and their application in engineering and elsewhere. Much of the propaganda literature now issued by industrial firms is highly informative and frequently contains scientific data not published elsewhere and of real value to users of the products described. Such publications are now being treated much more seriously, and deserve no longer to be confined to the offices of the buying department, but to be indexed and circulated to the technical staff in the same way as the recognised scientific journals in which much of the information may be afterwards published.

In spite of these efforts, absence of technical knowledge in the buying department may often lead to a mistaken insistence on a cheaper material when the new and possibly more expensive product would really prove far more satisfactory or economical, and at the best the wheels of progress are clogged and efforts to improve products are hampered.

Thus the experience of such diverse industries as the metal and engineering industries and the fine chemical industry indicates that much more is being demanded of scientific workers in every aspect of industry, and that progress demands the rapid disintegration of those prejudices which formerly kept professional men and industry apart. The scientific outlook and a scientific or technical training are becoming as important, if not as indispensable, in the buying and selling organisations of industry as in the control of technical operations or in research. Equally it appears that the scientific worker might make an important contribution even in the publicity or advertising side of industrial organisations, at which in the past he has been prone to look askance. It is only as he contributes both his scientific knowledge and his professional integrity and traditions to the development of advertising literature of real scientific merit that some of the obstacles to the development of new products can be most easily overcome. The development of such methods in advertising is a logical outcome of the rationalisation of industry, but its achievement requires the co-operation of scientific workers as professional men. The report of the Medical Research Council already makes it plain that such professional co-operation is imperative in the public interest if new remedies are to be tested and developed adequately, and a change in the attitude of the medical profession to advertising seems inevitable.

Fundamentally these changes or tendencies are but an indication of the impossibility of dealing with industry or society in watertight compartments, or of restricting the influence of scientific thought once scientific methods have been applied to any extent. Inevitably a scientific outlook is required in every sphere of life, and while this will only be attained when science finds its rightful place in our educational system, much depends on the contribution of the scientific worker himself. It is only as he is brought into closer and more open contact with the general public that society can understand the true meaning of scientific methods and their contribution to the common weal.

The task which thus devolves on scientific

workers is by no means simple. While safeguarding their professional codes and standards of qualification, they are called upon to participate in the general life of the community, divesting themselves of that air of mystery which hinders the proper appreciation of their work and is often regarded as a cloak for humbug and inefficiency. We cannot expect that science and its methods will exercise the influence that is so essential to-day, in all aspects of social and economic life, unless in their own professional conduct and organisations scientific men are dominated by scientific and rational principles. Habits tending to secrecy, with the encouragement which they inevitably give to quackery, must definitely be discarded; and the indications that the medical profession is more disposed to co-operate with other classes of scientific workers and to abandon older prejudices are the more welcome because conservatism and the species of mental inbreeding which it engenders are among the greatest dangers to the efficiency of professional workers, whether in science or in other fields of human endeavour.

Vitamins

The Vitamins. By Dr. Ethel Browning. (Monographs of the Pickett-Thomson Research Laboratory, Vol. 1.) Published for the Pickett-Thomson Research Laboratory. Pp. xxxii + 575 + 7 plates. (London: Baillière, Tindall and Cox; Baltimore, Md.: The Williams and Wilkins Co., 1931.) 42*s.* net.

CONFRONTED with a volume such as that recently written by Dr. Ethel Browning, a reader becomes acutely aware of the interest which the discovery of vitamins has aroused throughout the scientific world and the enormous amount of work this has elicited in the brief period of one decade. It is probably true to say that no other fundamental discovery in biological science has led to such concentrated research in so short a time.

Various kinds of books on the subject of vitamins can be imagined, but two types suggest themselves at once: one to tell the general public the entrancing story of their discovery, history, and practical importance in health; the second to set out for the teacher and laboratory worker the detailed facts of their action and to guide him in tracking down the original source of knowledge on individual points. The writer of either of these books should be possessed of the wisdom of Solomon, but in the second case he must also have a more extensive knowledge, not only of physiology, pathology, and medicine, but also of physics and chemistry, as well as a personal experience of laboratory and clinical feeding tests.

Popular books on vitamins have been published from time to time, but the majority of the writers leave the average reader with a feeling that vitamins are substances of great importance only for polar explorers and those whose diet consists of polished rice. The fact is, of course, that the discovery of these substances and their actions is leading to one of the greatest silent revolutions Great Britain has ever experienced, a revolution in health and physical welfare, which will compare in magnitude with that following the discovery of the part played by micro-organisms in disease. It is becoming more generally recognised that in some respects the nutritional condition of our population is appalling, and that an infinite amount of physical defect, pain, and ill-health results from improper feeding, especially in early life. Knowledge of the nutritional factors responsible for such widespread defects as rickets, decayed teeth and pyorrhœa, and their sequelæ is being firmly established. Instead of an ill-grown, bandy-legged, anæmic population with septic and edentulous mouths, we already know how to substitute a taller, heavier, straight-limbed race with well-grown jaws and strong, healthy teeth. A popular book on vitamins should tell the world these facts and how they can be procured. Ultimately even the politician might be moved to do something in the matter and direct his attention to the prevention rather than the cure of disease.

The second type of book, namely, that dealing in a comprehensive way with all the scientific facts at present known about vitamins, had obviously to be written if progress was not to be impeded by needless repetition, by saturation of the research mind with a mass of unco-ordinated facts, and by endless waste of individual time in exploring the literature. So early as 1919 the Medical Research Council prepared a monograph of this kind; a second edition appeared in 1924, while the third is now in the press. This book has been written by a group of experts and practical workers, for it was thought only in this way could a satisfactory standard be reached. Now we find Dr. Ethel Browning tackling the job single-handed. The least the present reviewer can do is to bow his head and express his admiration of her pluck and energy in making such an attempt. This emotion is not lessened when he sees that the book is of quarto size, contains 432 pages of text, 90 pages of references to literature, about 50 pages of index of authors and subjects, and 7 excellent plates showing

histological changes associated with vitamin deficiency or excess.

In the introduction, the author states that attention has been primarily focused during the last few years on the attempt to isolate vitamins as chemical entities. She has therefore tried to neutralise this tendency to develop the subject into a biochemical treatise by devoting as much attention as possible to the clinical and experimental aspects, for she says that "it is, after all, in the preventive and therapeutic possibilities of vitamin administration that their ultimate importance to humanity in general will consist". This object is undoubtedly to be commended, especially as much of the chemical work has been unproductive.

Part 1 of the book opens with a historical sketch of the discovery of vitamins, and this is followed by a survey of their physiological actions, together with a description of the methods for their quantitative estimation known at the time of writing. The second part discusses in detail the properties, functions, and distribution of the fat-soluble vitamins A, D, and E, while in the third part the water-soluble vitamins B and C are similarly treated. Excellent tables indicating the vitamin content of foodstuffs are given, with references to the various authors from whose publications the facts are taken.

The book is well set out and any particular aspect that the reader wishes to study can be easily traced by means of the index, and the references to the investigations mentioned can readily be found. The author not only gives references to the literature, but also she has obviously read many of the papers carefully (although in some instances she has quoted extracts from them without either knowledge or thought as to their accuracy). Further, she has attempted to give a critical historical account of the development of knowledge in many branches of the subject. This makes the book more interesting to the average reader, but it has obvious pitfalls, for those in the inner secrets of the vitamin story know only too well that the real history of many of these discoveries is familiar to few outside the actual workers themselves.

It is evident that the vastness of the subject has handicapped the writer, especially as she has aimed at the inclusion of all investigations, good, bad, and indifferent, and has mentioned each, irrespective of the weight of scientific evidence. Consequently, the value of the book to the reader with no specialised knowledge is seriously impaired, for sometimes evidence quoted in one sentence is negatived by that given in the next. Again, there are examples of quotations from work which, in the light of later advances in technique, has lost its significance, and therefore its value is negligible to all except the most specialised worker.

In many respects Dr. Browning's book is very good, and its merits are sufficient to outweigh most of the errors, but it is doubtful whether they are great enough to counterbalance the effect of the uncritical 'all-in' method of exposition adopted by the author.

The Nature of Physical Theory

The Nature of Physical Theory: a Study in Theory of Knowledge. By Prof. Victor F. Lenzen. Pp. xii + 301. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 21*s.* net.

"IT is the purpose of this book to analyse the concepts, principles and systems of physical theory." There are many books with that purpose appearing to-day; a feature common to most of them is a lack of reference to any of the others. In this respect Prof. Lenzen's book is no exception; some of the most prolific writers, such as Dingler, Jeffreys, and (perhaps I may add) Campbell, are not mentioned at all; most of the references to the others are merely incidental and give no idea of their main conclusions.

Several explanations suggest themselves. One, doubtless supported by those who still regard any attempt to go behind the imitative orthodoxy of our textbooks as scientifically immoral, is that all such inquiries are inevitably barren, and that no one does or can say anything on such subjects worth the attention of others. Another is that those who are concerned with principles are naturally impatient of conventions, and that writers in this group are reacting—perhaps reacting too far—from the exaggerated importance that is attached in technical writings to giving chapter and verse for every statement, however obvious, that anyone has ever made before. A third is that the subject is so vast that no writer can possibly cover the whole of it, that all treatments of it are necessarily eclectic, and that so far no writer has needed to refer to the work of any other, because he has always been dealing with an untouched part of the field. Prof. Lenzen would obviously reject the first explanation; he would probably admit that the second is partially true, and that many of his ideas, though not formally 'acknowledged', are not original; but the third he would regard, I think, as going to the root of the matter. Others writers, he would

say, though their works may be learned and profound, have not answered the particular questions in which he is interested.

If this is the reason why he has neglected previous work almost completely, it becomes very important to know precisely what are the questions he is trying to answer. After the sentence already quoted, he continues: "The procedure will be to build up physical theory from the aspects of the physical order given in sensation". That suggests that the relation between physical theory and the experiments on which it is based is to be his main theme. As a matter of fact, it is avoided so completely that the problems connected with the terms *induction*, *probability*, *experimental error* are not even mentioned; none of these terms, nor any equivalents for them, appear in the index. Other passages in the introduction suggest that Prof. Lenzen takes the typically philosophical view that physical theory consists of a set of definite propositions, the origin of which is not important, and that his problem is to exhibit them as a systematic whole, free from logical contradiction. But then it is surprising to find him so little concerned with the classical paradoxes, such as those of statistical mechanics; he does not seem to realise that there is any difficulty in the conception of *molekular ungeordnet*. Nor does he actually show himself indifferent to origins. If "the data of experimental physics consist of space-time coincidences", what relevance other than historical can the "sensation of hotness and coldness" have for the concept of temperature? And if history is Prof. Lenzen's concern, what are we to make of his statement that *space*, of which Archimedes knew nothing and Newton very little, is one of the fundamental concepts of physics?

An uncomfortable suspicion is thus generated that Prof. Lenzen has no definite aim, and that his sturdy independence arises from ignorance of what others have said. It is inevitably confirmed by his treatment of subjects, such as measurement, on which much has been said; for it is difficult to find any other reason why he should simply ignore distinctions on which others have insisted. I hope that I am wrong and that others will find a unity and a profundity in Prof. Lenzen's work which I have missed; but as it is, I am debarred from performing adequately even the first duty of a reviewer, namely, to describe clearly what the book is about. Let me end, therefore, by simply giving a list of the chapter headings, from which readers may judge for themselves: General Character of Physical Theory. I.—Special Classical Theories, (i) Fundamental Concepts and Methods, (ii) Euclidean Geometry, (iii) The Theory of Time, (iv) Kinematics, (v) Dynamics, (vi) Electrodynamics, (vii) Thermodynamics. II.—Unitary Systems of Physical Theory, (viii) The Mechanical, Electrodynamic and Geometrical Conceptions of Nature (viii, ix and x, xi and xii). III.—Quantum Theory, (xiii) The Classical Quantum Theory, (xiv) Symbolic Quantum Mechanics. IV.—Methodological Principles, (xv) The Concept of Substance, (xvi) The Concept of Causality.

NORMAN R. CAMPBELL.

Science and Poetry

(1) *The Captive Shrew: and other Poems of a Biologist.* By Julian S. Huxley. Pp. xii + 101. (Oxford: Basil Blackwell, 1932.) 5*s.* net.

(2) *Lyra Modulata.* By Sir Ronald Ross. Pp. 21. (London: Harrison and Sons, Ltd., 1931.) 10*s.* 6*d.*

(3) *In Exile.* By Sir Ronald Ross. Third edition. Pp. xii + 80. (London: Harrison and Sons, Ltd., 1931.) 10*s.* 6*d.*

THE prediction of Wordsworth a hundred years ago seems to be coming true. There is more and more fine verse directly and avowedly inspired by science. We have noticed in these columns more than once the trilogy of Mr. Alfred Noyes on the growth of science, the "Torch Bearers" in their triple aspect towards the heavens, the earth, and suffering man. The works now before us by Sir Ronald Ross and Prof. Julian Huxley have the added and special interest of being poems by men of science themselves. They are alike in this and in being good: all of them are well worth printing and many of them deserve to live. But in other respects the two poets are in marked contrast.

(1) Julian Huxley's little book brims over with merry thoughts and delight and questioning about all the sights in Nature which he remembers from boyhood up. Mountains, trees, birds—especially birds—and all sorts of light-effects in sun and moon; the poems, short as they are, are full of such touches and it is tempting to quote. Then in the later ones come half-serious, half-laughing comments on the universe of Jeans and the self of Freud. It is a delightful book, the fruit of a lively receptive mind, with reminiscences of Walt Whitman in its *vers libres* and of Browning in its ingenious rhymes.

(2 and 3) Sir Ronald Ross is extraordinarily different in style and temper; yet, as another man of science, alike in the questioning spirit displayed so strongly in his life-work and in the thoughts on

man's place in the universe with which the volume ends. The volume called "In Exile" contains verses written during his work in India in the 'nineties on malaria. They are now reprinted in a third edition with a preface in which Sir Ronald comments on the strange neglect with which the earlier issues were received. He is fully justified in his consciousness of their unique interest, deeply moving utterances wrung from the soul of a man in grips with one of the most terrible scourges of the human race. He is longing all the time for the sympathy and refreshing vigour of his native land, and weighed down by the horrors of the pitiless climate and the poverty and suffering of those around him. He is steadily approaching by patient and unrelaxing efforts the solution of one of the great evils which oppress his fellows. The poems have therefore a permanent and intense significance. They are hammered out with the utmost care, and will undoubtedly retain their value both as poetry and as the record of one of the most decisive applications of science to the alleviation of human suffering.

One must regret that the format and the price at which both Sir Ronald's volumes are produced will still confine their appreciation to a small circle of readers. Sir Ronald, akin in this to the late Poet Laureate, is keenly interested in the technique of verse and offers several experiments in the smaller and later book. Of all the poems included, that called a 'Pæan', which concludes the earlier book, best expresses in restrained and pregnant words the spirit of man's upward march. It has something of Shelley's triumphant ode, but ends on a note of greater wistfulness and need of effort.

F. S. M.

Sugar Cane Entomology

Handbook of the Insects and other Invertebrates of Hawaiian Sugar Cane Fields. Compiled by Francis X. Williams. Pp. 400. (Honolulu, Hawaii: Hawaiian Sugar Planters' Association, 1931.)

THIS volume is a handbook dealing with the creatures inhabiting the Hawaiian sugar plantations—it is, in fact, a guide to the invertebrate fauna of the fields. It treats not only of species that are definitely injurious in one way or another, but also of those that are beneficial either in the rôle of parasites or of predators. At the same time, species that are more or less neutral, in their relations with the cane crop, also come in for consideration. In a few words, it enables any creature found in the cane fields to be identified, its biological status to be ascertained, and also whether it is indigenous to the islands or accidentally, or intentionally, imported. Insects naturally occupy the major portion of the book, but there are also included sections dealing with Myriapoda, Arachnida, Isopoda, Mollusca, and Nematoda. Of these several minor sections, that concerned with nematodes is of special importance.

The members of the entomological staff of the Sugar Planters' Experiment Station at Honolulu have built up for themselves a high reputation. Some of the best-known names are those of Englishmen. Their achievements in the domain of biological methods of pest control are unique and are the envy of the rest of the world. It is not too much to say that their achievements resulted in the saving of the whole archipelago from utter ruin of the cane-growing industry.

The policy of the governing body of the Honolulu Station is one that might be emulated with advantage elsewhere. This policy has been based upon the fullest application of scientific principles to the cultivation and protection of the sugar cane. The governing body has selected its staff from among men of real scientific calibre and has given these men constant moral and financial support. We see the reward of a consistent scientific policy in the comparative freedom from serious insect pests enjoyed by the Hawaiian cane fields to-day. This result has not been achieved through the perpetual spraying and dusting of crops with toxic compounds—it has come about through the judicious introduction of the right kinds of parasites and predators from other lands, coupled with a vigilant quarantine system. Let us hope that the same sound principles that have guided the Station's policy in the past will be rigidly pursued without relaxation. Increased facility for communication with the rest of the world affords increased chances for noxious immigrants to be carried to the islands. To preclude their obtaining a foothold in so congenial a climate demands constant watchfulness. Happily, both the quarantine service and the specialists at the Planters' Experiment Station work harmoniously towards this same object.

In his introduction to this volume, the late Dr. F. Muir sets out the guiding principles that have led to the remarkable success of biological control in the Hawaiian Islands. Dr. Muir's practical experience in this domain is perhaps unequalled, and his remarks in consequence are authoritative. The rest of the book is written by Dr. F. Williams, well known for his researches on the aculeate

Hymenoptera and other groups. In carrying out this task he has brought together the work of many investigators over a diverse field. Much of the original information is based on researches the results of which have appeared in bulletins and other publications seldom found in libraries in Europe. It is therefore gratifying to find much of this work thus brought together in a convenient compass and shown in its true perspective, accompanied by the original high-class illustrations. At the end of the book there is a very complete bibliography and an adequate index. A. D. IMMS.

Short Reviews

Handbuch der Klimatologie. Herausgegeben von W. Köppen und R. Geiger. In 5 Bänden. Band 1, Teil A: *Mathematische Klimalehre und astronomische Theorie der Klimaschwankungen.* Von Prof. M. Milankovitch. Pp. iv + A176. 27 gold marks. Band 1, Teil D: *Mikroklima und Pflanzenklima.* Von Dr. Rudolf Geiger. Pp. iii + D46. 9 gold marks. Band 1, Teil E: *Einfluss des Klimas auf den Menschen.* i. *Medizinische Klimatologie*, von Dr. W. Borchardt; ii. *Klima und Kultur*, von Prof. Dr. K. Wegener und Prof. Dr. W. Köppen. Pp. iii + E80. 11·70 gold marks. Band 1, Teil F: *Klimatologie der freien Atmosphäre.* Von Prof. Dr. A. Wagner. Pp. iii + F70. 12·60 gold marks. Band 4, Teil R: *Klimakunde von Hinterindien und Insulinde.* Von Dr. C. Braak. Pp. iv + 125. 31·20 gold marks. (Berlin: Gebrüder Borntraeger, 1930–1931.)

SINCE the last (third) edition of Hann's "Climatology" appeared in 1908–11, the observed data have enormously increased for nearly all parts of the earth. The need for a critical comparative compilation of this mass of facts is evident, and Profs. Köppen and Geiger have therefore planned a large handbook of climatology, dealing with the whole subject, including many more meteorological elements than were tabulated by Hann. The complete work will be more than twice as large as Hann's last edition. Naturally it is to be a co-operative work, and although the main language used in it is German, several British and American authors, dealing with parts of the British Empire and North America, will write in English. It is hoped that the whole handbook will be published in 1934. It will occupy five volumes, each comprising several parts appearing separately; the quoted prices for these parts are for separate sales, there being a reduction of one-third if the whole handbook is ordered; even so, the prices seem high, particularly for the part last issued (vol. 4, part R, costing more than 20 gold marks, reduced price, for less than 130 pages, in paper covers). At present, four parts of volume 1, and one of volumes 2, 4, are issued.

An unfortunate feature of this piecemeal production is that most of the parts, which in some cases are of considerable length, have no alphabetical authors' or subject index; these are apparently reserved for the completion of the whole handbook, since the concluding part (F) of volume 1 (of which two parts are still missing) has no index. The first volume deals with general climatological questions, and the remaining four with regional climatology. Part A of volume 1 is largely devoted to a lengthy exposition by Prof. Milankovitch of the radiative equilibrium of the atmosphere, and of his astronomical theory of the ice ages (a much-disputed topic), and contains no mention of Simpson's important work on these subjects. S. C.

Some East African Coniferæ and Leguminosæ. By Dr. L. Chalk, Dr. J. Burtt Davy and H. E. Desch. (Forest Trees and Timbers of the British Empire, 1.) Pp. 68 + 10 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 5*s.* net.

THIS is the first of a series dealing with the forest trees and timbers of the British Empire, edited by Dr. L. Chalk and Dr. J. Burtt Davy, of the Imperial Forestry Institute, Oxford. The series will supply a want which has long been felt, a lack of correlation between our knowledge of the systematy of the tree and the anatomical structure of the wood, in the forestry of various parts of the British Empire. In his preface to this brochure, Prof. R. S. Troup, director of the Institute, remarks that no one has yet perfected an ideal form of description of wood anatomy. The subject is complicated by differences obtaining in different parts of the section, and by the considerable range in the dimensions of individual elements even at the same point in a tree; but with the development of a uniform system it should be possible approximately to determine a species from adequate material of the timber.

The present publication deals with some important east tropical African timber trees, *Juniperus procera* and *Podocarpus gracilior* and *milanjianus*, which form the cedar forests especially on Mt. Kenya, and *Widdringtonia Whytei*, the Milanje cypress, which with *Podocarpus milanjianus* characterises the forests of Mt. Milanje in Nyasaland. Descriptions are also given of ten species belonging to the family Leguminosæ of greater or less importance commercially. Good botanical descriptions of the species are included, with notes on distribution, climatic conditions, etc., but the most valuable feature is the detailed description of wood structure. The illustrations showing habit of the tree, anatomical structure, leaf and floral characters, are a helpful feature, and the introduction of keys to the African species of the various genera will be welcomed by the working botanist or forester. Incidentally, we commend the decision of the authors to regard the East African *Widdringtonia* as generically distinct from the Australian *Callitris* and the North African *Tetraclinis*.

The success of the task undertaken by the editors —the systematic description of the trees and woods of the Empire—will depend largely on a supply of reliable material and on the collaboration of workers with local experience in various parts of the Empire. A. B. R.

The Book of Amber. By Dr. George C. Williamson. Pp. 268 + 5 plates. (London : Ernest Benn, Ltd., 1932.) 15*s.* net.

MR. HERON-ALLEN'S catholicity of interests includes the study of some aspects of amber ; and he therefore very appropriately contributes a foreword to Dr. Williamson's most admirable book upon the origin, history, characters, distribution, and uses of this remarkable fossil resin from pines and other trees. It is, indeed, strange that, with the exception of some rare booklets and scattered papers or incidental chapters in other works, no general monograph of this kind, bringing together everything of interest concerning amber, has been published. Dr. Williamson writes with expert knowledge of his subject, and has devoted his leisure time over a period of twelve years to the compilation of his book. We join with Mr. Heron-Allen in a " tribute of admiration " at the result.

Among the subjects surveyed are classical allusions to amber ; prehistoric amber routes in Europe ; remains of plants, insects, and other creatures enclosed in amber ; folklore, and medical uses ; mineralogical characteristics ; types, the chief of which are represented in a beautiful coloured frontispiece ; tests ; and pressed amber. The bibliography near the end of the book shows that Dr. Williamson is familiar with practically every work or paper relating directly or indirectly to amber. It may be of interest to recall in this connexion that Mr. Minakata described in NATURE of Jan. 24, 1895, Chinese theories of the origin of amber, including the resin of pines, and that Mr. Murray Stuart gave reasons in the issue of Jan. 20, 1923, for believing that some specimens of pale Chinese amber represented fossilised dammar—a resinous substance produced by certain bees.

Recent Advances in Materia Medica : being a Description of the Methods of Preparing and Testing Sera and Vaccines, Hormones and Vitamins, with an Account of their Properties and Medicinal Uses. By Dr. J. H. Burn. (The Recent Advances Series.) Pp. x + 224. (London : J. and A. Churchill, 1932.) 12*s.* 6*d.*

IN this volume of the " Recent Advances " Series, the author has confined himself to a consideration of some of those substances of value in therapeutics which are obtained from animal sources or require the use of animal tests of toxicity and potency before issue. The work is intended chiefly for students of pharmacy, and therefore includes certain elementary physiological details. It covers a field, however, of increasing importance ; and its pages make available in small compass much information which ordinarily could only be obtained by a search of the original literature or a larger book dealing with biological assays. For this reason it can be recommended to physiologists and pharmacologists, as well as to medical practitioners who may wish to have some knowledge of the methods of preparation and test of biological products. The specialist may also find it useful for information on the subject of the biological assay of substances with which he may have had no recent experience.

The earlier chapters deal with antitoxins, sera, and vaccines ; the middle section is devoted to the hormones, liver extract, and the arsenobenzene group of compounds ; in the final chapters the uses and tests of the vitamins are considered. In the last two chapters the application of the results of biological tests to human beings and the principles of biological methods are discussed. The volume gives a readable account of a subject which is related to many branches of medical science, and therefore likely to be neglected except by the specialist.

The Statesman's Year-Book : Statistical and Historical Annual of the States of the World for the Year 1932. Edited by Dr. M. Epstein. Sixty-ninth Annual Publication, revised after Official Returns. Pp. xxxiv + 1474. (London : Macmillan and Co., Ltd., 1932.) 20*s.* net.

THIS valuable volume with its mass of carefully revised statistical information appears with its usual regularity. The arrangement follows that of previous years, and the size of the book is essentially the same. No new States have made their appearance, though the cession of Manchuria occurred in time to be noted among the addenda. New population figures are given for Great Britain, Canada, France, Italy, and many other States the census of which fell in the year under review. In order to indicate more clearly the trend of trade of Great Britain with other countries, re-export figures have been added to the tables summarising the trade of each country. The usual introductory tables are given of world production of petroleum, coal, iron and steel, gold, etc. The two coloured maps show respectively the railways of Manchuria (now Manchow-kuo) and the Zuider Zee reclamation. In the latter, the completion of the North-west Polder marks the success of the first step in the scheme. The lists of books, official and non-official, given for each State are one of the most useful features of this reference volume.

Electrical Machinery and Apparatus Manufacture : a Complete Work by Practical Specialists describing Modern Practice in the Construction and Manufacture of Apparatus and Machinery. Edited by Philip Kemp. In several volumes, by various authors. (London : Sir Isaac Pitman and Sons, Ltd., 1931–32.) 6*s.* net each vol.

THESE volumes are nicely bound, of convenient size, and are clearly printed. They are not intended to replace existing textbooks, dictionaries, or encyclopædias. They may prove useful to experts in particular branches of electricity who desire to supplement their knowledge of the actual construction and manufacture of electrical machinery and apparatus. We liked the section on works organisation and administration by A. P. M. Fleming. The section also on accumulator construction and manufacture contains practical information not easily found elsewhere. The descriptions given range from heavy machinery down to the manufacture of thermionic valves.

Prof. Planck and the Principle of Causality in Physics*

By Dr. ALLAN FERGUSON

THE Guthrie lecturers before the Physical Society have in the past covered a wide range of knowledge in physical science, but they have very definitely concerned themselves with concrete problems. Atomic nuclei, electrodeless discharges, the properties of the elements under high pressures, the scattering of X-rays in gases, positive rays —these are typical of the subjects which have been discussed and illuminated by distinguished lecturers in past years. It has been left to Prof. Max Planck to treat with wide scholarship and philosophic insight one of the most difficult of the problems known to the thought of any age—that of the meaning and validity of the concept of causality.

It was a singularly happy chance which dictated the choice of this topic to Prof. Planck, for he, as much as any other living thinker, has forced upon the minds of the rank and file of physicists the necessity for some measure, at least, of metaphysical knowledge, and has roused us from that attitude of crude realism typified by Johnson, who, required by the insatiably curious Boswell (on Harwich beach, of all places) to criticise Berkeley's idealism, "answered, striking his foot with mighty force against a large stone till he rebounded from it, 'I refute it *thus*'". Nor must it be imagined that this simple attitude was a prerogative of the privates in our army. The habit of mind was to be found in very high places. Thus, turning to a lecture on the wave theory of light by the late Lord Kelvin, we find therein the very definite and uncompromising statement: "You can imagine particles of something, the thing whose motion constitutes light. This thing we call the luminiferous ether. That is the only substance we are confident of in dynamics. One thing we are sure of, and that is the reality and substantiality of the luminiferous ether." Less than fifty years have passed since these words were spoken, less than twenty-five since the speaker died; and the onset of the revolutionary change which has come over our physical thinking is marked by a paper published during Lord Kelvin's lifetime under the name of Max Planck in the last year of the nineteenth century.

It is impossible, and undesirable in the scope of a short article, to attempt an exhaustive review of the development of the concept of causality, but it is not without interest and bearing on present-day thought to consider briefly the development of the concept since the age of Newton. Locke, Newton's elder contemporary, states a clear and simple view, which, however, scarcely touches the fringe of the problem, when he says: "Thus, finding that in that substance which we call *wax*, fluidity, which is a simple idea that was not in it before, is constantly produced by the application of a certain degree of heat, we call the simple idea of heat in relation to fluidity in wax the *cause* of it, and *fluidity* the effect. . . . So that whatever is considered by us to conduce or operate to the producing any particular simple idea, whether substance or mode, which did not before exist, hath thereby in our minds the relation of a cause and so is dominated by us." The notion of *power* in this definition of cause is particularly evident.

The mind of Newton, as Prof. Brodetsky has recently remarked, was dominated by the principle of causality, and he was ever searching for a physical picture which should represent the results of his investigations. This is very true; but it is to be remembered that in this, as in so many other matters, Newton displayed a philosophic breadth of view which was well in advance of the doctrines of his day. He makes, for example, a physical picture of matter as formed in "solid, massy, hard, impenetrable, moveable particles", and assumes that they have not only a *vis inertiae*, but are moved by certain active principles, such as gravity. These principles are to be considered "not as occult qualities . . . but as general Laws of Nature . . . their Truth appearing to us by Phænomena. . . . To tell us that every Species of Things is endowed with an occult specifick Quality by which it acts and produces manifest effects, is to tell us nothing; but to derive two or three Principles of Motion from Phænomena and afterwards to tell us how the Properties and Actions of all corporeal Things follow from these manifest Principles would be a very great step in Philosophy, though the Causes of those Principles were not yet discovered; and therefore I scruple not to propose the Principles of Motion above mentioned, they being of very general extent, and leave their Causes to be found out." Evidently despite, or perhaps it would be better to say, along with his physical picture, Newton takes the view that we have made an important step when we have subsumed a number of perceptual facts under one general formula.

Although he may be indebted to Glanvill and other earlier writers, it is to Hume that we owe the first clearly ordered statement of the experientialist doctrine of causation. Such a generalisation, applied to a falling body, as "the earth attracts the stone", is explained as a generalisation from thousands of such observations. "Adam . . . could not have inferred from the fluidity and transparency of water that it would suffocate him, or from the light and warmth of fire that it would consume him. No object ever discovers by the qualities which appear to the senses, either the causes which produced it or the effects which will arise from it; nor can our reason, unassisted by experience, ever draw any inference concerning real existence and matter of fact." So, basing his argument entirely on experience, Hume defines a cause as "an object, followed by another, and

* Seventeenth Guthrie Lecture before the Physical Society, delivered by Prof. Max Planck on June 17.

where all the objects similar to the first are followed by objects similar to the second. Or, in other words; where, if the first object had not been, the second had never existed."

We may note here that the experientialist position was, in the nineteenth century, further developed by Mill, who states that the law of causation "is but the familiar truth that invariability of succession is found by observation to obtain between every fact in nature and some other fact which has preceded it, independently of all considerations respecting the ultimate mode of production of phenomena, and of every other question regarding the nature of things in themselves". Mill, moreover, meets the objection urged by Reid that on such a doctrine of succession, day must be the cause of night and vice versa, by pointing out that invariable sequence does not necessarily involve the notion of causation. To involve this last-named notion, the sequence must be *unconditional* as well as *invariable*. The day-night sequence obviously does not conform to this test, inasmuch as it is conditioned by the behaviour of our luminary, the sun. "We may define, therefore, the cause of a phenomenon to be the antecedent, or the concurrence of antecedents on which it is invariably and unconditionally consequent."

Kant's discussion of causality, wherein he takes the position that we could never make such a generalisation as "the earth attracts the stone" unless we had knowledge *a priori* and independent of experience that each event in our perceptions has its cause, has great importance in the history of philosophic thought; here we may pass it without comment, inasmuch as Kant's views have not played any decisive part in the development of scientific theory in this or in the last century.

Nineteenth century science, indeed, and specially nineteenth century English science, was in many ways, naïvely realistic; models played a large part in its development, and, while a model may serve a very useful end if it is thrown on one side, as Maxwell discarded his models, when it has fulfilled its purpose, there are, as we have already seen, serious dangers ahead when the model is elevated to the dignity of a 'reality'. None the less, a movement was on foot, owing much to Mach in Germany, and to Pearson in England, which, had its followers been greater in number, would have eased the path of many a physicist who, harassed by the conflicting claims of determinists and indeterminists, exclaims, "A plague on all your houses—let us go and make experiments". Kirchhoff had the root of the matter when he wrote, "Die Mechanik ist die Wissenschaft von der Bewegung; als ihre Aufgabe bezeichnen wir: die in der Natur vor sich gehenden Bewegung *vollständig* und *auf die einfachste Weise* zu beschreiben".

We live in a world of perceptions; sense impressions come and go; and we find that we can regularise these impressions if we devise a *conceptual* world of atoms and molecules, from which we build up particles and molar masses the behaviour of which corresponds to the routine of our sense impressions. Given a frame of reference, we can formulate laws of motion for two isolated particles in a conceptual world, which may be summed up in the statement that whatever the relative positions of the particles, the *ratio* of their accelerations is always found to be constant; we define this ratio as the inverse mass-ratio of the particles; and since in virtue of this we have the relation that

$$\text{mass of } A \times \text{acceleration of } A = \text{mass of } B \times \text{acceleration of } B,$$

we agree to give the name *force* to this product and obtain the law that action and reaction are equal and opposite. Moreover, on the basis of such definitions, we can build up a structure of bodies in the conceptual world the motions of which, predictable under the descriptive laws formulated, will agree with the routine of our world of perceptions. We have, in fact, *explained* certain phenomena.

Obviously, such a scheme of explanation puts out of court at once all those arguments concerning the contrast between dead mechanisms and living wills so dear to the Victorian controversialist. It is purely a matter of the relative complexity of the descriptive laws; one set of astronomical perceptions are subsumed under laws of comparative simplicity; another set of perceptions in the realm of biology requires a more complex scheme for its description. It may or may not be that in the future the two sets of perceptions may be described in terms of a common formula, but the difference, as Prof. Pearson says, is rather "quantitative than qualitative; the descriptions of mechanics are simpler and more general than those of biology". Evidently in such a description the idea of cause as involving power is out of place, and the definition in terms of invariable (and unconditional) succession as developed by Mill is also here appropriate.

Such, then, were the views concerning causality and scientific explanation which had been developed when the twentieth century and the quantum theory came into being. How have they been modified by the discoveries of the last generation?

This is the question which Prof. Planck sets out to answer, and, alive to the fact that most controversies, in the absence of exact definitions, tend to degenerate into logomachies, he seeks for an exact definition of the causal condition and finds it in the statement that *an event is causally conditioned if it can be predicted with certainty*. Prof. Planck goes on to remark that this statement has to be taken to mean that the possibility of making a correct prediction forms an infallible criterion for the agency of a causal connexion, but not that the two mean one and the same thing. In daytime, he remarks, we can predict with certainty the advent of night; but day is not the cause of night.

Prof. Planck then points out that, nevertheless, we assume a causal connexion in cases, for example, weather forecasting, where a correct prediction may not be possible, though in a case such as the last named the unreliability may be determined by the complicated nature of the object considered. In this part of his address, the compression of the

thought has led to obscurity which may give rise to misinterpretation. Any event which may be predicted with certainty is in the universe of causally conditioned events. This latter universe, we note, may be coterminous with or greater than that of predictable events. If we interpret Prof. Planck rightly, the statement has to be taken at its face value and gives no indication of the *sequence* of conditioned events—no indication, that is, of the *two* events which stand to each other in the relation of cause and effect. Thus, *day* is an event which may be correctly predicted in the night-time; all that we assert, then, is that day is a causally conditioned event, not that there is, or is not, any causal connexion between day and night. This definition, in its condensed form, is so different from those advanced by other philosophers, who are concerned, in a definition of cause and effect, with an invariable *sequence* of events, that it should be carefully examined in the light of the arguments of Hume ("Enquiry concerning Human Understanding", Section vii.) and of Mill ("Logic", Book iii. Chap. v.).

Taking the phrase as it stands, we find that, in the realm of quantitative physical events, however simple the event, however delicate our instruments, we cannot calculate *accurately* in advance the result of our measurement—that is, in no single instance can we predict infallibly a physical event. Hence the dilemma—if we adhere to our definition of causality—there is *no* physical event which is causally conditioned, and we become indeterminists, asserting that not one of the laws of Nature is absolutely valid, not even the law of gravitation; the appearance of validity is illusory, and the laws are laws of probability. If, rejecting this indeterminist picture, we endeavour to retain the concept of causality, we find it necessary to introduce some modification into our fundamental definition of causally conditioned events; and that modification is made by transferring the definition to a conceptual world in which exact measurements may be made and events correctly predicted. The mechanism of this conceptual world, and the process of connecting two events in the world of perception by the use of the conceptual picture, fully agree with that previously outlined, and it would seem that the adoption of the theories of Mach and of Pearson would enable us, even while recognising that an unavoidable uncertainty is attendant on the prediction of an event in the perceptual world, to retain the concepts of causality as accurately valid in our conceptual picture, the relation between perceptual and conceptual events being subject to a slight inaccuracy in the process of translation from the conceptual world to the world of sense impressions.

More than this; in the region of gas-kinetic theory—a domain which, more than any other, might be regarded as a happy hunting ground for the indeterminist seeking a description based entirely, even down to the collisions of individual molecules, on statistical laws—the principle of causality won one of its greatest triumphs: for it has been found possible to build up in the conceptual world a strictly causal mechanism, the conclusions drawn therefrom, on transference to the world of sense impression, giving a remarkably accurate picture even of those irregular fluctuations which are the chief hope of the indeterminists.

How is this state of affairs modified by the introduction into our concepts of the quantum of action and of Heisenberg's uncertainty principle, which states that the product of the uncertainties of, for example, the position and momentum of a particle is constant, so that any gain in accuracy of the one determination is balanced by a corresponding loss in accuracy of the other? Here again a new conceptual world of quantum physics may be framed in which a strict determinism reigns, and the problem of transfer between this world and the world of sense impressions is philosophically identical with that of our classical problem. In actual fact, it is more difficult; for the symbols of our classical conceptual world bore some resemblance to the routine of our perceptions—our mechanism of billiard ball atoms and the like was based on our everyday sense impressions. The wave function is not so easily interpreted in terms of the world of sense. It does not refer to ordinary space; it does not give the values of the co-ordinates as functions of the time, but gives the probability that the co-ordinates will possess given values at a definite time—a position which gives an obvious loophole for the indeterminist.

So we find a continual sway between determinism and indeterminism. For the indeterminist the statement that the wave function is a probability function is sufficient and satisfactory; laws such as the law of gravitation present to him unsolved problems to which he must find exceptions, calculating the probability that the force will diverge from the inverse square law by a certain definite amount. For the determinist, the inverse square law is a law of Nature, and he puts up with the probability function only as a *pis aller*, to be resolved later into relations subject to law.

Prof. Planck's test of the relative value of the two positions is a pragmatic one—there is nothing for it, he says, but to adopt one of the two points of view and to see whether we obtain valuable or useless results. At the moment, in his opinion, the indeterminists are in the majority, but, while he holds the balance with remarkable fairness, it is not too much to say that his sympathies are with the advocates of causality. Nowhere does he show this sympathy more deeply than in a daring final speculation. After reverting to the fundamental propositions that an event is causally conditioned if it can be infallibly predicted and that in no single case is it possible to predict an event accurately, he points out that we retained the principle of causality by modifying the *event*—by referring this to a conceptual world.

Since, however, all predictions imply a predicter—since the certainty of a prediction depends in a high degree on that predicter—suppose we modify the subject of prediction, the predicting mind, and assume an ideal mind capable of apprehending in their minutest details all the physical occurrences of the

universe: we have here a 'conceptual' mind which would predict accurately all physical events. What the good Bishop Berkeley would think of this, we do not presume to say; the speculation is fascinating, even though, as Prof. Planck remarks, in order to accomplish such a notion we must subject ourselves to a severe restriction—we must forgo making the ideal mind the subject of a scientific investigation.

Although Prof. Planck's conviction, that the law of causality is, in spite of the difficulty of a general proof or disproof, a valuable sign-post to guide us through the tangle of perceptions in which we live, shows the direction of his own sympathies, he does not suggest that the answer he had given to the question originally raised is more than a tentative one. But, tentative though the answer may be, the question has provoked a brilliant, thoughtful, and stimulating address, which will live long in the memories of those whose privilege it was to be present at the Guthrie Lecture for 1932.

Jérôme de Lalande, 1732–1807

THE absorbing interest felt by the general reader in the outstanding men and events of the French Revolutionary period is to a great extent experienced by the student of the lives and characters of the French men of science who laboured during that remarkable time. During the latter part of the eighteenth century Paris was the centre of amazing intellectual activities, which even the vicissitudes of the most perilous days could not quench, and which, after the worst dangers were past, were resumed with increased zest. Especially was this the case with scientific studies and instruction. Old institutions of which the very life had been threatened were reorganised, and beside them sprang into existence others destined quickly to rival in renown any that had gone before. To one or other of the many institutions belonged most of the eminent men of science of France, among whom were Laplace, Lagrange, Delambre, Monge, Haüy, Berthollet, Chaptal, Coulomb, Lacépède, Lamarck, and last but not least, the astronomer Lalande, the bicentenary of whose birth occurs this month.

Joseph Jérôme Lefrançais de Lalande was born at Bourg-en-Bresse in the department of Ain, on July 11, 1732, and died in Paris on April 4, 1807, in his seventy-fifth year. Never in need of labouring for his daily bread, his life was yet one of unceasing effort, and from the time when as a boy he came under the Jesuit schoolmasters at Lyons until old age came upon him, his industry was remarkable. It is true that as an astronomer he has never been reckoned in the first rank as a discoverer or an investigator, but as an exponent of astronomy and a populariser of science he has had few equals. His industry is attested by the list of more than two hundred memoirs and books he wrote, but much of his influence on the progress of astronomy was due to the lectures he gave during the forty-six years he held the chair of astronomy at the Collège de France and to his encouragement of students. Though no great discovery stands to his credit, by his writings and lectures he gained for his favourite science a popularity previously unknown, and it is for that he is chiefly remembered.

Lalande's interest in astronomy is said to have been aroused by seeing a comet and watching an eclipse, and to have been further stimulated by reading Fontenelle's "Plurality of Worlds". It was, however, his contact with Delisle and Lemonnier which led him to abandon the law courts for the observatory, and it was through Lemonnier that as a youth of nineteen years of age he was sent to Berlin to make observations simultaneously with those being made at the Cape by Lacaille for determining the parallax of the moon. From the court of Frederick the Great and the society of Euler, Lalande returned to Paris and at the age of twenty-one was given a place as 'adjoint-astronome' in the Paris Academy of Science. He became an 'associé' in 1758 and a 'pensionnaire' in 1772.

With the account of his work at Berlin began the long series of memoirs referred to. A few years later, for Clairaut he made a mass of calculations in connexion with the predicted return of Halley's comet; in 1761 he succeeded Maraldi as editor of the "Connaissance des Temps"; in 1762 he succeeded to Delisle's chair at the Collège de France, and in 1764 he published the first part of his "Traité d'astronomie". Other parts followed in 1771 and 1792. "This compilation", wrote Thomas Young, "far excelled in utility all former works of the kind, and will always be considered as exhibiting the most perfect picture of the science such as it existed from 1760 to 1790 with all the details of practice and computation." Lemonnier called Lalande's work "the great newspaper of astronomy". Another notable work of Lalande was his "Histoire céleste", published in 1801, giving the places of 47,390 stars, the observations for which were made chiefly by his nephew Michel Lalande and D'Agelet, both of whom he had instructed.

The character of Lalande was no less interesting than his work. It was once said of him that he was as anxious to direct attention to himself as an individual as to astronomy as a science. His love of flattery and publicity was undeniable; but he possessed many admirable traits. Generous to a fault, he encouraged and provided for many young and needy students, and during the Revolution his courage led him to protect others at his own risk. He visited England in 1788, conversed with George III., crawled through Herschel's great telescope at Slough, and it was due to him that Herschel's newly discovered planet, Uranus, was for a time called after its famous discoverer. Living abstemiously himself, he placed his fortune at the disposal of others, and towards the end of his life founded the Lalande medal, which became the 'blue ribbon' of the astronomical world. Quite early in his career, in 1763, he was made a foreign member of the Royal Society, while the esteem in which his memory is still held in France was shown by the inauguration in 1909 of a monument to him at his birthplace, Bourg-en-Bresse.

New Buildings for the University of London

FRIENDS of university education throughout the world will welcome the announcement contained in an official publication of the University of London entitled, "New Buildings on the Bloomsbury Site" (pp. 18, illustrations and map), that the architect, Mr. Charles Holden, selected and appointed by the Court of the University, has completed a model of the proposed University buildings. We reproduce a photograph of the model (Fig. 1), kindly supplied by the University, and of the air photograph of the site (Fig. 2), which forms the frontispiece of T. Ll. Humberstone's "University Reform in London" (Allen and Unwin, 1926). The pamphlet is designed to give "a short account of the work of the University, of its present location and of its aims and aspirations". Not an appeal for funds! That will come later, and the University is confident, we are told in a "Foreword" signed by the Chancellor, the Earl of Athlone, and the other high officers of the University, "that in due time money will be forthcoming from its friends and from all who esteem learning and scholarship".

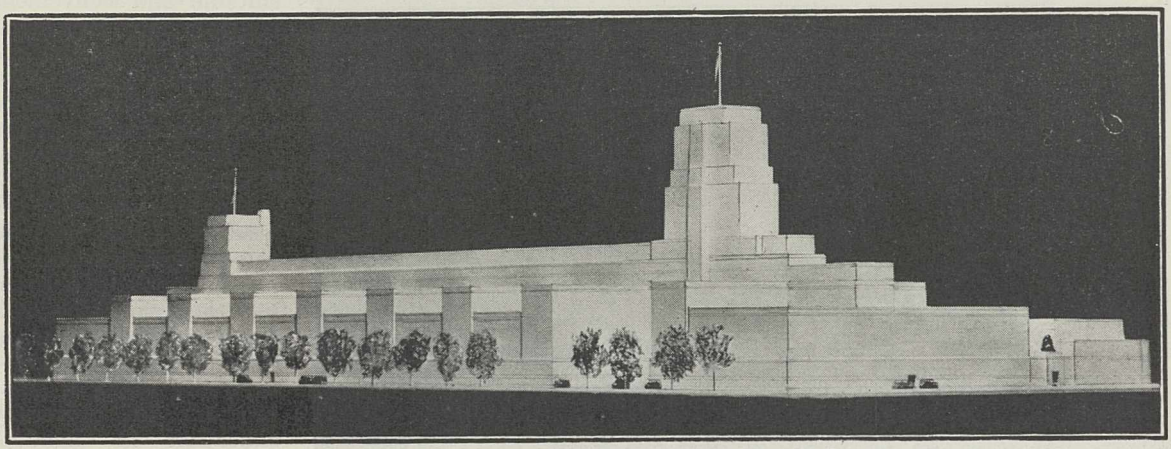


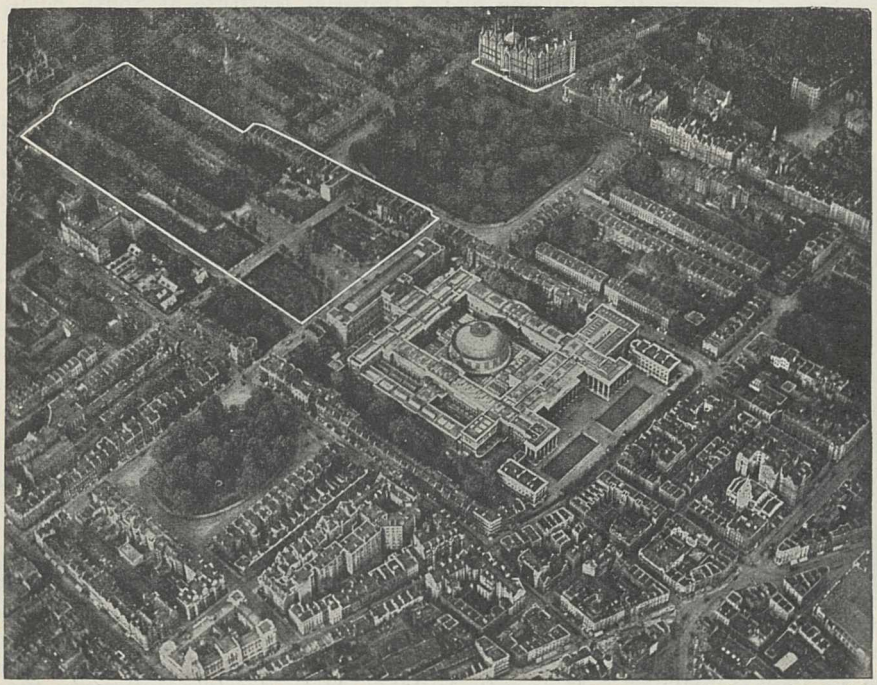
FIG. 1.—View of a model of the proposed buildings in Bloomsbury for the University of London, showing the main features of the general design.

How peculiarly Victorian is the early history of the University of London! Founded in 1836 by Royal Charter, the University was in one sense a Government bureau, accommodated, rent free, in quarters provided by the Government. "For some thirty years", the writer of the pamphlet states, "it discharged its modest duties in modest apartments in Somerset House. From 1870 to 1900, it had a home of its own when it was housed in a building erected at the expense of the Government in Burlington Gardens, now occupied by the Civil Service Commission." The point is not of essential importance, but this account of the early migrations of the University does not tally with that given in the Calendar (1928–29). "From the beginning", we are there informed, "the Government accepted the responsibility for housing the University, and at first apartments were provided in Somerset House, which were also occupied by various learned societies; but in 1835 the Senate were deprived of these and housed in what was described as a 'miserable garret in Marlborough House'. This accommodation was of a temporary nature only, and in the spring of 1855 the University again removed this time to Burlington House."

Powerful influences were brought to bear on the Senate of the emancipated University—it was reconstituted as a teaching university under the Act of 1898—to induce it to agree to the removal of the University headquarters to the partially derelict building of the Imperial Institute at South Kensington. Without any question the accommodation offered in that beautiful building was in many ways superior, especially for examinations. H. G. Wells used his caustic pen to denounce the old University building, dusty, desolate and empty, the thin permanent odour of dogfish and rabbits pervading the library, in which practical examinations were held; and to express his surprise that any person should oppose any sort of reform for the University of London. Moreover, the accommodation in the Imperial Institute was much more extensive, and this no doubt explains the famous Treasury minute of Feb. 16, 1899, giving a guarantee that the accommodation to be provided would include "such provision as may hereafter be needed for the full extension and development of the University under the Statutes and Regulations made by the Commissioners appointed by the Act". This carelessly worded minute proved troublesome in later years. As a fact, when immediate administrative needs were satisfied, there remained a whole floor, and this was used, not very appropriately, as a research laboratory for physiology, directed for many years by Prof. A. D. Waller. When the accommodation problem became acute, the laboratory was abolished *sans phrase*, the staff pensioned, and the valuable apparatus given away. Perhaps it was well that Dr. Waller did not survive to see this *débâcle*! The point to be emphasised is that

the University always held the Government to its obligation to provide adequate accommodation for its administrative work.

Of course, the real question was not one of providing comfortable rooms for a number of University officials and their clerks, for meetings of committees, and for the examination of candidates. This was recognised by the Royal Commission on University Education in London, appointed in 1910, generally known as the Haldane Commission. So impressed was the Commission by the inadequacy of the administrative headquarters of the University in the Imperial Institute that this question was made the subject of a special preliminary report dated Dec. 15, 1911. One would have expected that on the sound principle enunciated by the cookery book author, "First catch your hare", it would have appeared expedient to the Commissioners to ensure the reconstitution of the University, and to define its new duties, before considering the question of accommodation, a matter not directly within their terms of reference.



Central Aerophoto Co., Ltd.

FIG. 2.—British Museum and the site (enclosed in a white line) of the University of London. From "University Reform in London".

The Haldane Commission in its preliminary report strongly urged that a site should be secured of sufficient size to allow a large measure of freedom in determining the nature of the buildings to be erected, including such scientific institutes as had been referred to earlier in the Report, if these should be found to be necessary or desirable. Both in the public interest and in the interest of the University, the Commission said, buildings should be erected for a reconstituted University, "which would be a visible sign of its recognition as a great public institution". Be it understood, however, that the Commission at this stage did not recommend the Bloomsbury site. Apparently a friend of Lord Haldane's made investigations, and was able to convince him that this was the most suitable site—at this time it was the $2\frac{1}{2}$ acres forming the southern part of the site—whereupon, having secured the personal approval of Lord Rosebery, Chancellor of the University, he began to collect money for the purchase of the site. These proceedings caused much dissension within the University. On Presentation Day (May 7, 1912) the Principal, Sir Henry Miers, was able to announce that £355,000 had been offered towards site and buildings. Alas! those golden sovereigns have been used for other purposes. Many alternative sites were considered, notwithstanding the view expressed by the Haldane Commission in its Final Report dated March 27, 1913, that the most suitable and convenient quarters for the central University buildings would be found in Bloomsbury. Guerrilla warfare was maintained until the outbreak of the War of 1914–18.

We do not question the wisdom of the writer of the pamphlet in scattering the poppies of oblivion over the period 1911–1932, years of controversy, of war, of reconstruction—assuredly years of great progress in university education in London. Twenty have passed before the Royal Commission's dream has taken form and substance in an architect's model; and Lord Haldane and most of his colleagues, including Lord Milner, Sir Robert Morant, and Sir William McCormick, have not survived to see this Pisgah-view. If we lift the veil, it is to honour those to whom they handed the torch—particularly Mr. H. A. L. Fisher, who in 1920, while president of the Board of Education, moved the Government to offer the site to the University. "The Government", he wrote on April 7 of that year, "are now in a position to acquire a site of about $11\frac{1}{2}$ acres behind the British Museum, and they offer to devote it gratis and in perpetuity to the provision of a site for new headquarters of the University and for colleges and institutions connected with it, including King's College, whose premises in the Strand are now inadequate for its needs." After the five years' grace allowed by the Government, the University found it could not satisfy the conditions attached to the gift, particularly in regard to the removal of King's College, and therefore refused the site, which was re-sold to the Duke of Bedford. It was a black

day for the University, perhaps the blackest in its history. But as Mr. H. V. Lanchester wrote (*New Troy*, June 3, 1926):

"So our Site has gone back to the Duke of Bedford. This does not mean that it might not yet be reclaimed if the will to do it were there. The Duke is in no way antagonistic to the scheme, and the only difference in the position is that the Government offer, to the value of half-a-million or so, is in abeyance, for it seems inconceivable that were a reasonable programme put forward, any Government would fail to offer substantial assistance."

The position soon became desperate. The Duke had signed a few long leases of houses on the site, some of which, we believe, still remain in alien hands, and was on the point of signing building leases. Victory was snatched from a stricken field by the Vice-Chancellor, Sir William Beveridge, who secured a most generous benefaction from the Rockefeller Foundation for the purchase of the site. In addition, a substantial contribution was made by the Government, which thus gained release from its putative obligation to provide for the housing of the University; and the London County Council, after coquetting with alternative sites, including Somerset House and Holland Park, offered open-handed co-operation for the Bloomsbury policy. On May 11, 1927, at the annual graduates' dinner, Lord Eustace Percy, president of the Board of Education, announced the purchase of the site. Let us remember with gratitude those who saw the vision—Gregory Foster, Haldane, Rosebery, Morant, McCormick—and congratulate those whose privilege it will be to transmute the vision into perdurable stone.

The dust of the site controversy has settled. The University is reconciled to Bloomsbury, even when it is described by the official historian of King's College as "an obscure and decaying suburb, off all the main lines of traffic and difficult of access"! But controversy follows controversy. For what purposes are these vast buildings to be used? We turn for information to the official pamphlet, not without misgiving. In addition to the administrative accommodation, there is to be a spacious and well-equipped library building, worthy of the treasures it will hold; and adjacent, but forming a part of the whole design, will be brought together a number of other University institutions. These include the Institute of Historical Research, the Courtauld Institute of Art, the School of Oriental Languages when it leaves its present building in Finsbury Circus, the School of Slavonic Studies, the Institute of Education (formerly the London Day Training College), and Birkbeck College. There will be a Great Hall, facing Russell Square, and accommodation for the Officers Training Corps and the University Union.

An ambitious programme—but the reader of NATURE will at once ask, what provision is to be made for scientific research? We have seen that the Haldane Commission in its preliminary report contemplated the possibility of scientific institutes. Before reaching the stage of the final report, other counsels prevailed. "Special research institutes", it declared, "should not form part of the University organisation." In the opinion of the Commission, the proposal supported by the Medical Committee of the British Science Guild for the establishment of post-graduate laboratories "would be full of danger to the development of the University". In a letter to the *Times* (Nov. 1, 1913), not long after the publication of the Final Report, Dr. A. D. Waller expressed an opinion which we believe will be generally shared by readers of NATURE. "My own opinion," he wrote, "confirmed by the experience of my last 12 years of work at the University—agrees with the opinion expressed in the report of Lord Cowper's Commission to the effect that the establishment of institutions for research was the only way in which existing defects could be supplied . . . and would not in any degree affect injuriously the course of ordinary teaching or discourage the spirit of research in the university schools, but would, on the contrary, promote throughout the university and its other institutions that zeal for the advancement of knowledge which is the highest mark and aim of university training." Nor are we told in the official pamphlet whether suitable and well-equipped lecture theatres are to be provided in the new buildings, where professors could give their inaugural lectures and foreign scholars could communicate the results of their researches. The Haldane Commission expressed a definite view on this question—"We are of opinion that several, though not a large number, of commodious lecture halls should be provided in the central buildings to be first erected". A school of law, a school of music, and a school of journalism are a few of the other institutions which might stake claims on the site.

Of the architectural merits of Mr. Holden's design, we cannot claim to express an expert view. Certain questions the layman, the *homme moyen sensuel*, may be allowed to ask. First, what reasons caused the University to abandon its declared policy of holding a world-wide competition for the best design—a graceful compliment to the most generous donor for the purchase of the site—followed by a competition limited to architects of selected designs and to a small number of architects specially invited to compete? That the Court of the University should take upon itself the selection of an architect is a procedure contrary to all the traditions of the University. Secondly, ought not the members of the University, and the public generally, to insist that the building shall express its idealistic purpose—that long tradition of the search for knowledge, Abelard drawing seekers after truth to Paris, *alma mater* of our universities; Roger Bacon in his tower on the Isis; Newton on the Cam "voyaging through strange seas of thought, alone"; Michael Faraday, London's own man of science, an original member of the Senate of the University of London, who could not afford to get rich, but added untold millions to the wealth of the world; Lister, a graduate of the University, of whom it has been said that no man has done more to relieve human suffering; Ramsay, a professor

of the University, discovering argon and helium in his laboratory at University College; Jeans, a member of the present Senate, peering over the edge of the universe. . . .

We do not suggest that the architect of the new University building should attempt to recapture —in Bloomsbury—the last enchantments of the Middle Age. If he succeeds in capturing the spirit of the present age, he will deserve his niche in the Pantheon of architects. Questions of style apart, air, sunlight, and accessibility are crucial in considering the design. Is it wise, from these viewpoints, to build a single huge building, possibly the largest in London, a break-air, if the word may be coined? Science has not yet discovered any effective method of ventilating a great building with numerous wings—witness the Houses of Parliament. On this question it is possible to appeal to expert opinion. Three distinguished architects in their lay-outs for the site have provided a forecourt and abundant internal air space.

Mr. H. V. Lanchester's sketch of "the University of the Future" showed a forecourt flanked by offices and library and facing the hall and institutes with a dome and two graceful towers. Prof. A. E. Richardson, professor of architecture in the University, adopted a somewhat similar lay-out in a brilliant impromptu sketch, the forecourt facing the Great Hall, not crowned with a dome or tower, a feature he regarded as wasteful and unnecessary. Prof. S. D. Adshead, professor of town planning in the University, prepared a sketch showing an open space running through the site north and south, broken only by arches. He did not consider there was sufficient space for a Great Hall. "Should a great hall ever be built in the neighbourhood," he said in a paper read to the Town Planning Institute (April 29, 1927), "I think it should occupy one of the adjoining residential blocks." This view has been endorsed by Mr. Holden, who has sited the Hall on the part of the site facing Russell Square. All these architects have recognised the importance of Sir John Burnet's columned northern extension of the British Museum in relation to the University building. Mr. Holden's design presents to this frontage of the Museum the least dignified part of its anatomy, as will be seen from the photograph. Whatever else may happen, this should be rectified. We should prefer, however, that the idea of a single great building should be abandoned and an alternative design adopted treating the problem in a more free and characteristic way. T. LL. H.

News and Views

Sir Joseph Larmor, F.R.S.

SIR JOSEPH LARMOR, whose resignation of the Lucasian professorship of mathematics in the University of Cambridge is announced, succeeded Sir George Gabriel Stokes in the chair in 1903. Stokes had been elected so long ago as 1849, and one of the early acts of his successor was to edit his "Scientific Correspondence" (2 volumes, 1907). After being Senior Wrangler in 1880 and first Smith's Prizeman, Mr. Larmor (he was knighted in 1909) was elected to a fellowship in St. John's College and was appointed professor of mathematics at Galway, but in 1885 he returned to Cambridge as College and University lecturer in mathematics. "Æther and Matter" appeared in 1900, and his election as secretary of the Royal Society in 1901 (he had been a fellow since 1892) was a recognition of his eminence as a mathematical physicist. Scientific papers have continued to flow from his pen since 1881 or before, but the long-hoped-for treatise on electrodynamic theory did not materialise. The works of many younger men, however, clearly show the inspiration which they derived from his lectures. In 1929 the Cambridge University Press published two handsome volumes of "Mathematical and Physical Papers", with Sir Joseph's own comments in the form of notes and appendices; a glance at the table of contents will give an idea of his enormous range of interests. In addition, his frequent letters in NATURE and elsewhere, though as a rule not easy to understand, have always been worth serious consideration.

THOSE who were privileged to be present will not readily forget the inimitable, racy address which Sir Joseph gave in the Arts School in Cambridge at the Clerk Maxwell Celebration in October 1931; it was quite different from the paper, "The Scientific Environment of Clerk Maxwell", published in the Commemoration Volume, and this in turn is only an extract from a more extended investigation into the historical origins of thermodynamics and the kinetic theory which, it is hoped, will soon be published. One of the duties of the Lucasian professor, as of the other professors of mathematics in Cambridge, is the reading of the essays submitted year by year for the Smith's Prizes; and thus Sir Joseph has kept constantly in touch with the best of the younger Cambridge mathematicians. Perhaps he has occasionally been a little out of sympathy with some of the recent developments in pure mathematics, but he has always been ready with advice and encouragement; in particular, the succession of Isaac Newton Students have reason to bless his name. From 1911 until 1922, Sir Joseph sat as member of Parliament for the University of Cambridge, and other administrative duties, in the University and elsewhere, have been thrust upon him and conscientiously discharged. A congenial office has been his chairmanship, in the absence of the Vice-Chancellor, of the Observatory Syndicate and the Solar Physics Committee in Cambridge; he always seems thoroughly to enjoy presiding over the body of distinguished men of science who assemble once a year to lunch with the professor of astrophysics and discuss the affairs of the Solar Physics Observatory. It is to be hoped that Sir Joseph's retirement from his professorship will not mean his leaving Cambridge, for his College and the University can still profit by his services.

Geological Society Elections

THE following have been elected foreign members and foreign correspondents of the Geological Society of London: Prof. R. A. Daly, Sturgis Hooper professor of geology in the Museum of Comparative Zoology at Harvard College, an authority on igneous rocks and mountain building and on coral reefs; Prof. Paul Niggli, University of Zurich, distinguished for his work on ore deposits and crystallography; and Prof. Bailey Willis, Stanford University, known for his work on geological structures, to be foreign members of the Society. Prof. C. P. Berkey, Columbia University, New York City, secretary of the Geological Society of America, who has carried out geological studies in Mongolia and elsewhere; Prof. H. A. Brouwer, University of Amsterdam, known for his work on the geology and petrology of the Dutch East Indies; Prof. Hans Cloos, University of Bonn, an authority on the tectonics of igneous intrusions; Prof. W. K. Gregory, curator in the American Museum of Natural History, New York City, distinguished for his studies on fossil vertebrates; and Dr. Victor Van Straelen, director of the Natural History Museum in Brussels, distinguished for his work on fossil Crustacea, to be foreign correspondents of the Society.

Beilby Memorial Awards

AWARDS are made from time to time from the interest on the Beilby memorial fund to British investigators in science for original work, preference being given to the investigation of problems connected with fuel economy, chemical engineering, and metallurgy. The administrators of the fund have just awarded £105 each to Mr. W. J. Rees, of the Department of Applied Science in the University of Sheffield, and Dr. W. R. Schoeller, metallurgist, Messrs. D. C. Griffith and Co., London. Mr. Rees was educated at George Dixon Technical School, Birmingham, and at the Royal College of Science, London. In 1901, he became assistant to Dr. Walter Rosenhain, in the laboratories of Messrs. Chance Bros. and Co., Ltd., at Birmingham; in 1906–17, he was chief chemist to the same company, and since 1917 he has been lecturer in charge of the Department of Refractory Materials in the University of Sheffield. He is an honorary member of the British Cast Iron Research Association, to which he was elected in recognition of services rendered in connexion with research on moulding sands; and hon. secretary of the Refractories Association of Great Britain. Dr. Schoeller was born at Antwerp and educated in Belgian State schools at Antwerp and Tournai. He studied chemistry at the Polytechnic Institutes at Darmstadt and Stuttgart, and at the University of Greifswald, where he obtained the degree of Ph.D. in 1902. In the following year, he joined the staff of Messrs. D. C. Griffith and Co., assayers to the Bank of England, and in 1909 was naturalised as a British subject. After experience in the United States, South America, China, and elsewhere, he rejoined Messrs. D. C. Griffith and Co., specialising in rare metals. From 1913 onwards, he has devoted much of his spare time to original research work, especially on tantalum and niobium. He is joint author with Mr. A. R. Powell, of "The Analysis of Minerals and Ores of the Rarer Elements".

The Peking Man

AT a meeting of the Geological Society of China on June 28, Prof. Davidson Black made the first public reference to the discovery of parts of *Sinanthropus* other than the skull—an ungual phalanx of the foot found more than two years ago, a clavicle and a semilunar bone (wrist) found last season. The announcement of these discoveries was withheld until the close of the present season's excavations at Chou Kou Tien in the hope that other parts of the limbs might be recovered. This hope has not been realised. Hence an account is now given of the small fragment that seems to demonstrate that the Peking man's hand "differed in no essential respect from our own", of the peculiar obliquely-directed toe-bone, which "makes it probable that the feet differed much more widely from ours than the hands", and of the robust clavicle. On July 5 Prof. Davidson Black left Peking for England to deliver the Croonian Lecture to the Royal Society next December; he is visiting fossil beds in India and Egypt on the way. Before leaving China, he made casts of the five jaw fragments, the complete skull of the youth found in 1929, and of the endocranial cast of *Sinanthropus*, for transmission to London for reproduction, and completed his report on the endocranial cast and its significance. Its capacity is not more than 900 c.c. It reveals the asymmetry claimed to be distinctive of right-handedness. The cast displays many primitive features of exceptional interest, which shed important light on the distinctive characters of the earliest human brain.

Women Graduates in Modern Life

AT the annual reunion on June 30 of the University of Edinburgh Graduates' Association, held in the Women's Union, Sir Josiah Stamp referred to the alumni associations in America as constituting one of the strongest sides of American university life, and said that he hoped the graduates of Edinburgh would similarly endeavour to make the University a real and active part in themselves, letting its influence remain with them and helping it in every way they could. Speaking more particularly to the women graduates, he reflected upon the gravity of the times in which we live and the tremendous importance and value of the collective mental training represented by the graduates who had just been 'capped', mobilised and conserved for the future. While it may be said that the careers of many of these women will be cut short and some people may say all they have done at the University would so be wasted, he considers that a wrong view. Why should not man and wife act together in the great task of thinking out the world's problems, thus making for a higher standard of civic and individual judgment than we have to-day?

The Universities and Civilisation

SIR JOSIAH was emphatic that civilisation is at the crossroads; it may go one way under the influence of mass desire and mass impression, or the other way under the influence of intellectual and moral leader-

ship. If a university is not a great force, if the members of a university are not a great force in that decision, then who is ? Where are we to look for it ? In this crisis in civilisation there is a terrific responsibility on university graduates for elasticity of mind, probity and clarity of judgment, and industry of thought on the concrete issue before them. There are many great issues on moral principles in these days, when the widely-held view is that the proper place for a path is the edge of the precipice. The world is full of good people who are thoroughly muddle-headed ; this is a time for level-headed decisions and carefully worked out ones. Sir Josiah concluded with a call to the students to be true to the great ideals the university has given them ; and to try to make the university what he believes it ought always to be—somewhere where the reasoned thought and soul of our country can have the perpetual association of great ideas, the discipline of serious and persistent aims, the purification of candid and purging humour, and lastly the company of souls that are kindled to noble purposes.

Society for Psychical Research

THE last of the jubilee meetings of the Society for Psychical Research was held on July 4 at the Conway Hall, when Dr. William Brown, Wilde reader in mental philosophy in the University of Oxford, lectured on "Psychology and Psychical Research". The president, Sir Oliver Lodge, took the chair. Dr. Brown said that hypnotic and psycho-analytic investigations have greatly supplemented the theory of the 'subliminal self' first propounded by F. W. H. Myers, one of the founders of the Society for Psychical Research, without, however, really supplanting it. The employment of the statistical method on large numbers of cases is entirely in the spirit of strict science, yet the predominantly negative results recently obtained along these lines as regards manifestations of telepathy and clairvoyance should not blind the public to the possibility of such phenomena in special cases and under special conditions. The intensive study of well-attested individual cases is needed to correct the balance, and it is especially along this line that the Society for Psychical Research has done much useful work. One might base one's belief in survival most firmly on general philosophical and religious considerations as to the nature and value of human experience ; nevertheless, the sum total of evidence of a scientific nature accumulated by the Society for Psychical Research in support of survival is far from negligible.

Marconi Beam Stations for Shanghai

NEW Marconi transmitting and receiving stations are to be erected near Shanghai for the operation of the proposed short-wave beam services between China and Europe and the United States. A unique feature of the installation will be the inclusion of auxiliary Marconi apparatus enabling the transmitters to be utilised for broadcasting services when they are not in use for telegraphic communications. The auxiliary apparatus for this purpose consists of a modulating equipment which can be connected to either of the telegraph transmitters to provide telephone signals of broadcasting quality. A complete set of Marconi studio equipment is also to be supplied to enable the service to be conducted in accordance with the most modern practice. The aerial system of the transmitting station is of particular interest. For the commercial telegraph services to Europe, of which the principal is the service to Great Britain, two bays of beam aerials, accurately oriented to concentrate their signals on the receiving stations, are to be erected, one being tuned to the wave-length of 17 metres and the other to 26 metres, the wave-lengths allotted to these circuits. A third beam aerial array will be directed on San Francisco for the American service. In addition, there will be four omni-directional aerials, one of which will be used for broadcasting. The others are provided to afford the station the maximum flexibility in the range and extent of its telegraphic services. At the receiving station four high-speed commercial service receivers of the Marconi beam type are to be installed, with two beam aerial systems directed on Europe and two on San Francisco. Four omni-directional receiving aerials are also to be supplied for the reception of short-wave signals from other countries with which beam services are not required. On the completion of these stations near Shanghai a direct commercial wireless circuit will be provided for the first time between Great Britain and China.

Emergency Lighting Sets

IN addition to the usual source of electric power for supplying lamps and signalling devices, it is sometimes necessary, in order to safeguard life and property, to have another source of power that can be available in emergency. Such additional sources are necessary for theatres, cinemas, hospitals, and for all large buildings through which there is a continuous stream of traffic. Up to the present time, storage batteries have often been used for this purpose, but their drawbacks are their expense and the gases they develop, often necessitating the use of a large separate room. A petrol electric set has sometimes been suggested, but there is frequently difficulty in starting it after a long period of standstill. Fire risks also impose restrictions in the selection of rooms for these sets. In a recent issue of *Allgemeine Elektricitäts Gesellschaft* (*A.E.G.*) *Progress*, a new emergency lighting set is described which eliminates practically all these difficulties. It consists simply of a small water turbine, which can be connected to the municipal water mains and drives a direct current generator (turbinamo). The water supply to the turbine is normally cut off. Should the normal supply voltage fall for any reason, an electro-magnet ceases to act and so a cut-off device is released, and the pressure of the water in the mains opens a valve and the machine rotates. The water pressure required is anything between 3 and 6 atmos. (42·5-85 lb. per sq. in.). The lighting set has a vertical axis, and takes up very little space. It should be placed near the water supply mains. As a disturbance rarely occurs, and lasts only very little time, the cost of the water used is negligible.

Mechanised Farming

"MECHANISATION and British Agriculture" was the subject of the fourteenth Conference held at Rothamsted Experimental Station, Harpenden, the full report of which has been published and can be obtained on application to the Secretary, price 2*s*. 6*d*. In these times of agricultural depression, the use of labour-saving machinery and implements is one of the most feasible means by which farmers may reduce their costs, and the appliances available and their probable lines of development are described by Mr. J. E. Newman, of the Oxford School of Agricultural Engineering. Successful practice in the new cereal husbandry is set out in a series of papers by leading farmers, the record of whose experience is of the utmost value. The question of live stock is not, however, overlooked, and Prof. J. A. S. Watson contributes a stimulating account of the combination of animal husbandry with mechanised farming. The maintenance of soil fertility under the frequent growth of cereals is the subject of a paper by Sir John Russell, who discusses, amongst other problems, the most economical means of restoring to the soil the surplus straw which is now an encumbrance on the large cereal farms. The booklet contains a full account of the discussion following the papers and a summary of the agricultural problems involved.

Prehistoric Pot-Boilers

MR. WILFRED L. BULLOWS, of Streetly, Warwickshire, adverting to a reference to flint pot-boilers by Sir Arthur Smith Woodward in his article on fossil man in China (see NATURE, May 28, p. 784), writes to point out the unsuitability of flint for this purpose. In the course of an investigation of a prehistoric cooking site in Sutton Park, Warwickshire, in 1926, Mr. Bullows carried out a number of experiments with the view of ascertaining the methods probably employed in making use of several cooking pits which had been discovered on the site under mounds of broken stone of an undoubted antiquity. On a considerable area of ground laid bare by a fire which had taken place a few years previously, there were found not only a number of cooking pot-holes, oval in shape and of an original depth of about 1½ ft., but also hearths for heating the stones, as well as ridges of stone, which probably represented the clearings of the cooking pots. The pot-holes had not been lined with clay; but evidently undressed skins had been used as a lining, the shape of the hide probably being responsible for the oval shape of the pit. In a trial in a small pit lined with a sheepskin, it was found that four gallons of water could be raised to boiling point with heated stones in about forty minutes. Fifty pounds of stones, each weighing from two to three pounds, were required. The stones used here by prehistoric man were quartzite pebbles from the Bunter pebble beds, and the same kind of stone was used in the experiment. Flints were found to be useless, as not only did they split alarmingly in the fire, but sudden contraction in cold water reduced them almost to powder. A report by Mr. Bullows on his investigation of this interesting site in Sutton Park and its bearing on methods of cooking by the use of heated stones appeared in *Trans. Birmingham Archæol. Soc.*, vol. 52, pt. 2, 1927.

Egypt Exploration Society's Exhibition

THE exhibition of archæological finds during the past season, now open at the Wellcome Historical Medical Museum, Wigmore Street, London, covers the work of the expeditions of the Egypt Exploration Society at Abydos, Amarna, and Armant. At Abydos, the Society, working in co-operation with the Oriental Institute of Chicago, is engaged in copying the frescoes of the temple of Seti. The work is in the hands of Miss A. M. Calverley and Miss M. F. Broome, who contribute a magnificent series of paintings as the result of their activities during the past winter. The exhibits from Amarna include a number of photographs, some taken from the air; frescoes which have been restored skilfully; statuary of the age of Akhenaton, mostly broken by his successors, and profiles engraved on limestone, which are thought to be sculptors' trial pieces. Among the other miscellaneous objects included from this site are glass, pottery, and ostraka of the Roman period. At Armant the most remarkable finds were the predynastic plaster 'flags' already familiar from the published description by Mr. O. H. Myers, director of the excavation. Slate palettes, black-topped ware in remarkably good preservation, other pottery, and flints are of a more familiar character than painted skulls and two hippopotami in pink limestone which accompanied them.

Habits of the Pangolin

How the Indian pangolin combines attack with defence is told by Mr. W. G. Adam in the *Field* for June 11, p. 882, in an article on the species as studied by him in Ceylon, of which island it is a native. When rolled up in the defensive position with its tail turned forward, it keeps up a slapping and grinding movement with that member, and if this results in any part of the assailant's body being caught between its own body and tail, begins a sawing movement of the latter which, the scales of the body and tail being opposed in the rolled-up position, inflicts a severe wound. Whether this act be due to instinct or intelligence, the pangolin seems to be an animal of fairly high mentality and advanced instincts. Both male and female care for the young ones, and Mr. Adam has seen the pair jointly hunting for a strayed one by scent and carefully convoying it home when found. Moreover, a young pair stayed about his premises in a semi-domesticated condition for more than a year, recognising strangers with squeaks, but answering to names with those they knew, while the female would even let puppies play with and pull her about.

Woad as a Crop Plant

PLANTS and animals when taken under man's care have to face natural selection in a new and special form, the struggle now being to retain his favour against competitors in cultivation and against his inventions. That highly historical dye-plant, woad, has at last succumbed in this conflict, according to an

article by Mr. A. W. Exell in the *Gardeners' Chronicle* for June 18, p. 403. Last grown in France in 1887, its cultivation in Germany had ceased about twenty years before this date, but was continued in England, in spite of the competition first of natural and then of synthetic indigo, for many years later, the product being used in the dyeing of police and naval uniforms. The industry had, however, long been a declining one, and in 1930 only two farms, both in Lincolnshire, were growing woad. Of these, one ceased to do so last year, but the other raised a small crop; this year none at all has been grown, and Mr. Exell thinks the day of woad as a crop-plant is over, though some stock of the prepared product is still left. Woad was an expensive crop to raise, and the labour and land devoted to it have been diverted to the production of potatoes and sugar-beet.

William Morgan

MR. PALIN ELDERTON in a recent lecture to the Faculty of Actuaries (*Trans. Fac. Act.*, **14**, 1932, pp. 1-20) gave an interesting sketch of the life of his distinguished predecessor William Morgan, who became assistant actuary of the Equitable in 1774, actuary a year later, and retired so long after as 1830. Morgan, who was a self-taught mathematician, owed his appointment to the famous Dr. Richard Price, whose biography he wrote (not, according to Mr. Elderton, very well), and although some of his mathematical work in connexion with joint survivorships might not have commended itself to better trained mathematicians, it was, writes Mr. Elderton, "the first serious attempt to obtain a general solution to the problems of survivorship, and had the merit—a great one indeed—of giving expressions that could be used to obtain arithmetical results from any mortality table".

Pharmacy in Scotland

THE forthcoming British Pharmaceutical Conference at Aberdeen on Sept. 12–16 has been the chief influence in the choice of material for the handsome special issue of the *Chemist and Druggist* for June 25. The majority of space has been devoted to various phases of Scottish activity from the point of view of pharmacy. An interesting account of the early history of pharmacy and the apothecary in Scotland is given by Dr. Thomas Ferguson. The cod-liver oil industry of Aberdeen and the extraction of the oil in Newfoundland are described, with useful illustrations. The appreciation of Aberdeen, the host city for the 1932 Conference, is well worth reading, and the illustrations (in photogravure) of its streets, industries, and colleges are very striking. Among the more descriptive articles is an illustrated account of the British Drug Houses, Ltd.

Announcements

THE following Royal Society research appointments are announced: Mr. C. N. Hinshelwood, Trinity College, Oxford, and Dr. M. L. E. Oliphant, Trinity College, Cambridge, to be Messel Research Fellows. Dr. W. Hume-Rothery, Magdalen College, Oxford, and Dr. A. J. Bradley, University of Manchester, to be Warren Research Fellows.

THE fourth Victor Horsley Memorial Lecture of the British Medical Association will be delivered by Prof. E. D. Adrian, on "The Visceral Sense Organs", at University College Hospital Medical School, Gower Street, London, W.C.1, on July 20, at 5 P.M. Admission to the lecture is free on presentation of a visiting card.

IN connexion with the centenary meeting of the British Medical Association at London, the popular lecture will be delivered by Prof. Julian Huxley in the Great Hall, University College, Gower Street, W.C.1, on July 29. The subject of the lecture will be "The Biology of Human Nature". Tickets can be obtained from the Organising Secretary, British Medical Association Centenary Offices, Tavistock House (North), London, W.C.1.

THE first Hinchley Memorial Lecture of the Institution of Chemical Engineers will be delivered on Oct. 28 by Mr. H. T. Tizard, Rector of the Imperial College of Science and Technology, on "Chemical Engineering and the Aircraft Industry". These lectures have been inaugurated to commemorate the long and intimate association of the late Prof. J. W. Hinchley with the Institution, and will be delivered at intervals of three years.

AN International Conference on Social Work is to be held at Frankfort-on-Main on July 10-14. The main theme of the conference will be "The Family". The work of the Conference will be divided among six commissions dealing with health services, educational influences, economic insecurity, and other subjects. Arrangements for British delegates have, at the request of the British National Committee, been undertaken by the Institute of Sociology. Particulars can be obtained from Miss E. W. Spear, Secretary, Institute of Sociology, Le Play House, 65 Belgrave Road, Westminster, S.W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the Department of Mathematics and Physics at the Polytechnic, Regent Street, W.1—The Director of Education, The Polytechnic, Regent Street, W.1 (July 11). A head of the Chemistry Department at Sunderland Technical College—Chief Education Officer, Education Offices, 15 John Street, Sunderland (July 11). A chemist in the Department of Government Chemist—The Government Chemist, Clement's Inn Passage, Strand, W.C.2 (July 16). A poultry pathologist in the Department of Agriculture and Horticulture at the University of Bristol—The Agricultural Officer, The University, Bristol (July 16). A biologist for the biological survey of the Hampshire Avon—The Registrar, University College, Southampton (July 16). A lecturer in chemical engineering in the Department of Chemical Engineering at the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, London, S.W.7 (Sept. 9).

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.*]

New Evidence for the Neutron

SEVERAL important communications dealing with the properties of rays emitted by atomic nuclei when bombarded with α-particles have recently appeared,[1] on which we should like to make a few comments.

It has been shown by F. Joliot [2] that the rays emitted by boron under the action of α-particles from polonium are much more penetrating than had originally been indicated. Their penetrating power, while superior to that of the most powerful γ-rays obtained from radio-active sources, is inferior to that of the rays obtained from beryllium bombarded by α-particles from polonium. This result does not agree with Webster's findings, but agrees with the fact that the protons ejected from boron are slower than those ejected from beryllium. Secondly, we have shown that the ejection of protons is a general phenomenon. By means of the Wilson chamber, we have photographed the paths of the helium nuclei ejected by beryllium rays, and from absorption measurements were able to conclude that other atoms are also ejected. Further, our experiments showed for the first time the important part played by the nuclei in the absorption of the rays emitted by beryllium under the influence of α-particles, a phenomenon which clearly marked them off from all previously known radiation.

J. Chadwick was led simultaneously to the same generalisation concerning the ejection of nuclei, and he put forward the view that the penetrating rays produced by the bombardment of beryllium by α-particles from polonium are neutrons. This interpretation is necessary if energy and momentum are conserved in the collision.

Recent experiments which we have carried out with M. Savel clearly show that the rays emitted by lithium have a penetrating power, in lead, less than that of the γ-rays of polonium (they are completely absorbed by 5 mm. of lead), and that they are much more readily absorbed, at equal surface mass, by paraffin than by lead. This proves that they cannot be of an electronic or electromagnetic nature. Since for various reasons it is extremely improbable that we are dealing with hydrogen nuclei or α-particles (the energy of which would be enormous), these results prove—*independently of the ejection of nuclei and the laws of elastic collisions*—that the rays emitted by lithium under bombardment by α-particles from polonium are different from previously known radiation and are probably neutrons. The above reasoning does not apply to the rays ejected from beryllium, boron, or to those emitted by lithium when bombarded with the α-rays from the active residue of radium,[3] because in such cases we do not have γ-rays of equivalent penetrating power, for comparison.

Our latest experiments, in collaboration with M. Savel, indicate that the protons ejected from beryllium form two groups. This suggests that there are also two groups of neutrons (each group not necessarily homogeneous); one group has a range of 28 cm. in air, and an energy of $4{\cdot}5 \times 10^6$ electron volts; the other has a range of about 70 cm. and an energy of approximately $7{\cdot}8 \times 10^6$ electron volts. We find it difficult to reconcile Chadwick's result of a *maximum range* of 40 cm. with the curves which we have obtained for the absorption of protons.

The mass of the neutron calculated by Chadwick [4] (based upon the experimentally estimated energy of the neutrons from boron), according to the reaction $B^{11} + \alpha = N^{14} + n$,[5] is about 1·006 (He = 4), and the atomic mass of Be^9, based on the energy of the fast neutrons ($7{\cdot}8 \times 10^6$ ev.), is 9·006. This suggests that the binding energy between the two α-particles and the neutron in the Be^9 nucleus is relatively weak. Further, we know that the rays emitted by beryllium are composed of neutrons and photons, and we may therefore suppose that they are emitted simultaneously according to the equation

$$Be^9 + \alpha = C^{12} + n + h\nu.$$

The photons of 2 to $4{\cdot}5 \times 10^6$ ev. energy, which we have detected, would correspond to the group of neutrons of maximum energy $4{\cdot}5 \times 10^6$ ev. (protons having a range of 28 cm.).

IRÈNE CURIE.
F. JOLIOT.

Institut du Radium,
Laboratoire Curie,
1, Rue Pierre-Curie, Paris (5e),
June 25.

[1] H. C. Webster, J. Chadwick, N. Feather, P. I. Dee, *Proc. Roy. Soc.*, A, **136**, 428, 692, 708, and 727; 1932.
[2] F. Joliot, *C.R. Ac. Sci.*, **193**, 1415; 1931.
[3] M. de Broglie and L. Leprince-Ringuet, *C.R. Ac. Sci.*, **194**, 1616; 1932.
[4] J. Chadwick, *Proc. Roy. Soc.*, A, **136**, 702; 1932.
[5] I. Curie and F. Joliot, *C.R. Ac. Sci.*, **194**, 1229; 1932.

Concentration of Slow Neutrons in the Atmosphere

RECENT evidence [1, 2] of neutral particles of atomic mass and great penetrating power suggests the possibility that terrestial matter may contain similar particles of low (thermal) energies, undetected hitherto by reason of their small interaction with matter. While it has been argued that neutrons of mass 1 would rapidly escape from the earth, one would hesitate to deny the possible existence of similar bodies of greater mass, and it seems pertinent to remark that experimental evidence already exists which, if we knew the laws of collision of neutrons with matter, would at once fix an upper limit to their concentration in the atmosphere.

Consider a gravitation experiment of the Michell-Cavendish type and suppose the large attracting masses to be heated above room temperature. If the atmosphere contains a constituent enjoying relatively free passage between the 'attracting' and the 'suspended' masses, but, nevertheless, capable of some slight exchange of momentum with them, a radiometer repulsion should be experienced by the suspended masses. The arrangement constitutes, in fact, a radiometer pressure-gauge. Let m be the mass of a neutron, M, M' those of atoms of the 'attracting' and the 'suspended' bodies respectively, T' the temperature of the attracting bodies, and T that of the remainder of the system. Let us suppose that $m \ll M$ and $\ll M'$ and that the scattering of the neutrons by the atoms is elastic and nearly isotropic.[3] The law of scattering is then that for the elastic collision of a light with a heavy sphere, and it becomes possible to calculate the average rate at which momentum is exchanged between the two atoms, provided that the free path of the neutron is so great that multiple scattering in any one of the bodies is negligible. If the collision cross-sections for a neutron with the atoms in question are a, a', the average force on the atom M' due to the excess temperature of the atom M is found to be approximately

$$\frac{2paa'}{\pi^2 r^2}\left(\sqrt{1+\frac{8}{3}\frac{m}{M}\left(\frac{T'}{T}-1\right)}-1\right) \text{ dynes},$$

r being the distance between the two atoms and p

(dynes . cm.$^{-2}$) being the 'partial pressure' of neutrons in the atmosphere. The presence of neutrons should thus entail an apparent decrease of the Newtonian gravitational constant with rise of temperature. The experiments of Shaw [4] (who found a small increase of gravitation with temperature) show that, if M refer to lead and M' to silver, a negative temperature-coefficient of more than 5×10^{-5} per °C. is improbable. If for illustration we put $m/M = 1/200$, $a = a' = 10^{-25}$ cm.^{2}, we find that $p < 5 \times 10^{-6}$ of an atmosphere. The correct cross-sections for slow neutrons are not yet known.

P. B. MOON.

Imperial College of Science,
South Kensington, London, S.W.7,
June 20.

[1] Chadwick, NATURE, **129**, 312, Feb. 27, 1932.
[2] Chadwick, *Proc. Roy. Soc.*, A, **136**, 692, 1932, and following papers.
[3] Cf. §5 of (2).
[4] Shaw, *Phil. Trans.*, A, **216**, 349; 1916.

Currents produced by the Gills of Mayfly Nymphs

BABAK and Foustka [1] were able to show that the movements of the gills of ephemerid nymphs were dependent on the oxygen tension of the water. Later, Dodds and Hisaw [2] demonstrated a relation between the gill area per gram weight of the animal and the oxygen tension of the water inhabited by these animals. That the currents produced by the gills might differ in different species, and that such currents might have an adaptive significance, appear to have escaped notice.

The following five species from stagnant and running waters are being examined: *Chlœon dipterum* and *Leptophlebia marginata* as examples of pelagic animals in stagnant water; *Ephemera vulgata*, a form burrowing in fine mud or sand in running water; *Ecdyonurus venosus*, associated with fast streams with stony beds; and *Cœnis horaria*, a form which burrows in fine mud to such a small depth that the gills are left exposed in the water at the mud surface.

In each case the gills move in metachronial rhythm, and problems comparable with those elucidated by Cannon and Manton [3, 4] on the feeding mechanisms of Crustacea are presented.

The erect plate-like gills of *Chlœon* moving in metachronial rhythm create differences of pressure in the intergill spaces. Thus in any intergill space a period of suction is followed by a period of compression. The main result of this is a symmetrical current passing backwards over the abdomen and outwards in an upward direction between the gills. The last gills are stationary and act as buffers, directing the current strongly to each side. This prevents the setting up of eddies near the animal in that region and ensures that the same water will not be used again for respiration.

In *Leptophlebia* it is not yet clear how far pressures set up between the gills are significant, since the gills lie at different angles to the body. The gills act as paddles, and by their rotation throw water over themselves from in front, or the sides of, or from beneath the body to the middle dorsal line. Since the gills are moving at different levels of the water opposite the several segments of the abdomen, water from all regions round the body is explored for respiratory purposes.

Ephemera in its mud tunnel creates a simple posteriorly directed current over the dorsal side of the abdomen. The gills are held upwards over the back in a roof-like manner. Moving in metachronial rhythm from before backwards, they press backwards the column of water beneath them and thereby set up a rapid current very appropriate for a creature with such burrowing habits.

The gills of *Ecdyonurus* project postero-laterally from the body. Lying in the angles between the broad hind femora and the abdomen these gills are protected from the rapid flow of water in which the animal lives. There is little difference of phase in the metachronial movement of the gills. The current produced passes from the outer sides of the body upwards between the gill plates to the mid-dorsal line. The animal commonly faces upstream, and the environmental flow of water thus assists in the removal of the 'gill current' along the animal's dorsal side to the posterior region.

Cœnis possesses a pair of elytroid protective gills. These are held upwards at an angle of about 40°, while the remaining four pairs of gills, behind and beneath

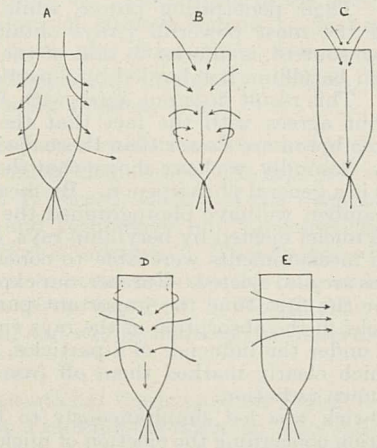


FIG. 1.—Diagrams of currents over the abdomen in A, *Chlœon dipterum*; B, *Leptophlebia marginata*; C, *Ephemera vulgata*; D, *Ecdyonurus venosus*; and E, *Cœnis horaria*.

them, beat in metachronial rhythm. In this form, as opposed to all the others mentioned, the current is asymmetrical. It flows in between the moving gills, beneath the 'elytra' at one side and out at the other. To this fact may be related a remaining one. Whereas, in the first-mentioned species, members of a pair of gills beat simultaneously, here the members of a pair of gills in motion are out of phase with each other. Thus, in addition to a metachronial rhythm along the animal, there is a similar rhythm from side to side in two elements of a pair.

The details of the above phenomena are being investigated with the aid of the stroboscope.

L. EASTHAM.

Department of Zoology, University,
Sheffield.

[1] Babak, E., und Foustka, O., *Arch. Ges. Phys.*, **119**; 1907.
[2] Dodds, G. S., and Hisaw, F. L., *Ecology*, **5**; 1924.
[3] Cannon, H. G., *Trans. Roy. Soc., Edin.*, **55**; 1927 and 1928.
[4] Cannon, H. G., and Manton, S. M., *Trans. Roy. Soc., Edin.*, **55**; 1927.

Discontinuous Distribution in Bees

IN 1898, I described a new genus of bees, *Hesperapis*, based on a species found in New Mexico. Since that time, sixteen other species have been referred to this genus, which proves to be especially characteristic of the south-western deserts, in California, Lower California, and adjacent regions. In 1911, Friese described a genus, *Capicola*, from the deserts of South Africa.

Last year's African Expedition led to the discovery of no less than seven new species in South Africa, the localities being Graaff-Reinet, Calvinia, Nieuwoudtville,

and Van Rhyn's Pass. One of these species, collected by Miss Alice Mackie, I have named *Capicola alicecæ*. The female has the clypeus with a median sulcus; hind tibiæ and tarsi red; spur of mid tibia with about thirteen oblique closely set fine spines; hair at apex of abdomen black. The male has the hind tarsi reddish; hair at apex of abdomen not black; sixth sternite light red, strongly bilobed. The species comes from Calvinia and Nieuwoudtville. It was when describing this species that I was struck by the extraordinary resemblance to the American *Hesperapis*. On making comparisons, I failed to find any generic character to separate *Hesperapis* from *Capicola*. This was so extraordinary that I sent a pair of *C. alicecæ* to Mr. P. H. Timberlake, of California, who has a much larger collection of *Hesperapis* than anyone else. He made a minute study, including the genitalia, and now reports (May 12):

"My conclusion is that *Capicola* is exactly the same as *Hesperapis*, and the distribution is of course very extraordinary. Perhaps the genus is a very ancient one, formerly wide spread, but has mostly died out, except under desert conditions. If that is so, why does it not occur in the desert regions of Asia? I dissected *C. alicecæ* and found good specific differences to distinguish it from the California and New Mexico species, but certainly nothing generic. All our North American species that I have examined have the genitalia extraordinarily alike, these parts being in fact rather poor for the differentiation of species. *C. alicecæ* has the genitalia of the same type, and in fact there is not a great deal of difference in the ædeagus itself. The eighth ventrite is somewhat more specialised in the South African insect, and the seventh still more so."

Thus *C. alicecæ* must become *Hesperapis alicecæ*. I cite these details in order to show that apparently these insects are truly congeneric, and the resemblances are not due to convergence.

We are reminded of the distribution of the tsetse flies (*Glossina*), which at present live in Africa (we had the pleasure of collecting both *G. palpalis* and *G. morsitans* in the vicinity of Bukama), but in Miocene times were represented by several species in Colorado.

These facts, and others like them, serve to show the enormous antiquity of many insect genera, and at the same time their liability to be exterminated over large areas.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado,
May 16.

A Hermaphrodite Sea-Urchin

COMPARATIVELY few cases of hermaphroditism have been recorded among echinoids. Gadd [1] has described a specimen of *Strongylocentrotus drœbachiensis* with four segments of the gonad female and one segment male. Gray [2] has described a specimen of *S. lividus* with three segments female and two mixed female and male. He has also described [2] a specimen of *Arbacia pustulosa* which was apparently a castrated male with some secondary female characters.

A specimen of *Echinus esculenteus*, taken in twenty fathoms on the 'Breast' ground, off Port Erin, in April, had four segments of the gonad female and one male. These were all typical in colour—translucent yellowish in the female and ivory-white in the male. In volume and condition also they were typical for the locality, though less full than from inshore specimens. Two of the female segments were joined, but the rest were discrete. These two segments and the one opposite to them were ripe and had full vesicles. The fourth female segment was less full and only about three-quarters ripe. The male segment was ripe and had full vesicles, but was smaller in volume than the ripe female segments. A self-fertilisation yielding normal plutei was obtained. This is the only hermaphrodite which has been found among about three thousand urchins opened in the past year.

HILARY B. MOORE.

Marine Biological Station,
Port Erin, I.O.M., May 23.

[1] *Zool. Anz.*, **31**, 635; 1906.
[2] *Proc. Camb. Phil. Soc.*, **20**, 481; 1921.

Rectilinear Propagation and Diffraction of Electrons

DURING the preliminary adjustment of an electron diffraction apparatus for use with organic vapours, some interesting phenomena were observed.

Fig. 1 is a diagram of the camera; AB is 15·8 cm., BC is 14.4 cm., and CP is 43·8 cm. A is a plane,

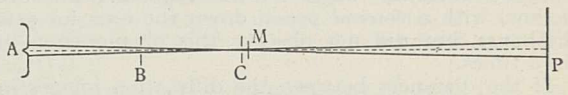


FIG. 1.

highly polished cathode of electron metal (magnesium alloy). B and C are two circular holes 0·3 mm. and 0·15 mm. in diameter respectively. M is a piece of mica showing thin film colours of the first order. P is a photographic plate. The space between C and P was evacuated to 10^{-5} mm. and was only connected to the discharge space ($A - B$) through the holes B and C. The centres of A and B and C were accurately aligned along the axis of the apparatus, and the plane of A was at right angles to same.

After adjusting the discharge so as to obtain a clearly defined cathode beam, using air as the medium, a brilliant diffraction pattern was visible on a fluorescent screen placed at P. On enlarging the pattern,

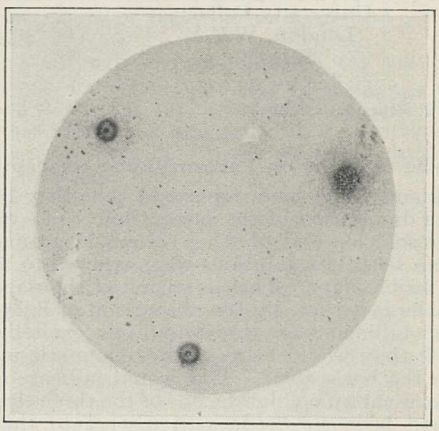


FIG. 2.

the spots were found to consist of a circle with a bright spot at the centre. Fig. 2 shows three of these spots (×3). In the case of this photograph, the diameter of the rings was 0·45 mm. and of the centre spot 0·06 mm., using electrons of wave-length 0·07 A. The small size of the central spots enables very accurate measurements of length to be made between them.

A monochromatic beam of electrons was assured by keeping the high voltage ripple below one-tenth of 1 per cent and the discharge conditions constant. This resulted in clearly resolved diffraction images.

With no mica in the path of the beam, a similar spot with a bright centre was obtained and could be observed directly on the screen through a microscope. On starting the discharge with a fresh cathode, only a single spot of about 0·5 mm. diameter is seen, diminishing in intensity towards the edge. After a few minutes a ring forms, and gradually increases in diameter with the formation of a centre. The centre brightens until the comparatively stable condition shown in Fig. 2 is attained at the end of about an hour of discharge.

These variations in the spot seem to show that we have here a pin-hole picture of the emitting surface of the cathode. The central spot only forms after a minute crater has appeared on the cathode through positive ion bombardment. This crater grows and with it the intensity of the spot. On examining the geometry of the system, we see that hole *B* plays but a small part, and that *C* acts as pin-hole lens for reproducing the cathode on *D*. This shows that electron beams obey the simple laws of geometrical optics. Campbell Swinton [1] suggested that cathode beams are hollow, with a central pencil down the axis for soft discharge, but did not observe this phenomenon in hard tubes.

If the distances between the diffraction images in Fig. 2 be measured, we find that the triangles formed by the images are nearly isoceles and definitely not equilateral (see Kikuchi [2]). Accurate measurements on various micas are being made.

By using beryllium as a cathode we hope to achieve more constant conditions than with electron metal. After a few hours of discharge the centred ring is formed and should remain fairly constant for a long time. On inserting fused quartz or mica diaphragms in front of the cathode with a hole about 0·2 mm. in diameter, we hope to eliminate the circle and thus obtain the very fine central pencil by itself.

HENRY DE LASZLO.
V. E. COSSLETT.

The Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College,
London, W.C.1,
May 20.

[1] *Proc. Roy. Soc.*, **61**, 79; 1897.
[2] *Jap. J. Phys.*, **5**, 87; 1928.

Influence of Light on Paramagnetic Susceptibility

BOSE and Raha have reported [1] that they had observed a diminution of the susceptibility of a chromic chloride solution and of other coloured paramagnetic solutions, when the solutions were exposed to concentrated visible light. They interpreted their result as due to the fact that, by the absorption of light, some of the metallic ions are transferred into excited states, in which they would have a lower magnetic moment than in the basic state. This would indicate that in the case of chromic chloride, one of the three electronic spins had been reversed, with respect to the other spins, in the transition.

Specchia [2] tried to repeat these observations by the capillary ascension method, but came to no definite results. My own preliminary observations, with the aid of a long-periodic torsion balance, confirmed Bose and Raha's observations.

It occurred to me [3] that the explanation given by Bose and Raha would necessitate an extraordinary long life of the ions in the excited states, which had to be at least of the order of 0·1 second. Moreover, the energy which is absorbed will in the end for the greater part be transformed into heat, and the resulting rise of temperature of the substance will, according to Curie's law, also cause a decrease of the susceptibility. One can calculate the influence of this temperature effect for the extreme case when the excited ions have no magnetic moment at all during a time T, if we suppose that the absorbed light of a wave-length of 6000 A. is transformed into heat after the same time T. It appears that for a saturated solution of chromic chloride, in a time so short as 4·5 T, the influence of the temperature effect will already be equal to the effect due to the presence of the excited atoms.

The result of this calculation suggests that the observed change of the susceptibility is entirely due to the rise in temperature.

I have tested this latter hypothesis in the following way: Two equal bulbs, filled with a saturated solution of chromic chloride, were suspended by a torsion wire symmetrically in an inhomogeneous magnetic field, so that the magnetic forces exerted on the bulbs were in equilibrium. The periods of the torsion balances used were rather short: 15 and 30 seconds.

When the light of a high-pressure mercury arc was concentrated on one of the bulbs, a change in the susceptibility could be observed, which increased with the time, and could be interpreted, assuming Curie's law, as due to a rise in temperature of 0·0010° per second. The red and infra-red rays were filtered off by a solution of cupric chloride, and as the arc was calibrated with a flicker photometer, it could be estimated that the energy of the visible light falling on the bulb was sufficient to cause a rise of temperature of about 0·0013° per second. Afterwards the rise of temperature was measured directly in the same arrangement with a thermo-element and proved to be 0·0011° per second, the rise being linear with regard to time during the experiment.

The agreement with the measurements on the change of the susceptibility is satisfactory, and it may be concluded that the effect observed by Bose and Raha really exists, but is very probably due to a rise of the temperature of the substance. No conclusions about magnetic moments in excited states can thus be drawn from such experiments.

I wish to express my thanks to Prof. A. D. Fokker and to Dr. A. C. S. van Heel for the active interest they showed in this research, and to Prof. W. J. de Haas, who kindly put the mercury arc at my disposition.

C. J. GORTER.

Natuurk. Laboratorium van
Teylers Stichting,
Haarlem, May 23.

[1] NATURE, **127**, 520, April 4, 1931.
[2] O. Specchia, *Il Nuovo Cimento*, **8**, 179, 291; 1931.
[3] C. J. Gorter, *Arch. du Musée Teyler*, **37**, 182; 1932.

Infra-Red Bands in the Aurora

IN his letter in these columns [1] regarding the infra-red aurora spectrum observed by Vegard, Jevons failed to say anything about an intensity phenomenon in the first positive bands of nitrogen to which I first directed attention in a note in the *Physical Review*.[2] I called this phenomenon the variation of intensity within a progression, the progression in this case being a 'v' progression. It is strikingly demonstrated in Lord Rayleigh's [3] experiments on the afterglow in mixtures of nitrogen and the rare gases. In this paper Lord Rayleigh suggested that the auroral radiation of wave-length 6323 A. was probably the first positive nitrogen band (10, 7). In directing attention to Lord Rayleigh's experiments, I pointed out that his results could be interpreted as either real or apparent violations of the Franck-Condon rule for band intensities. Recently, a similar result in iodine, namely, the observations of Ramsauer on the quenching of a fluorescence series in an iodine-oxygen mixture, was explained by Loomis and Fuller,[4] who

suggested that the effect was due to irregular reabsorption of the fluorescent light. The irregularity of the reabsorption was explained by enhanced predissociation in the upper electronic state. A similar explanation could apply just as well to nitrogen, since enhanced predissociation is produced in the upper electronic state of the first positive bands in the presence of rare gases. In both iodine and nitrogen the phenomenon of variation of intensity in a 'v' progression would have to be interpreted as an apparent violation of the Franck-Condon rule.

The connexion between the phenomenon which has been discussed above and the identification of the 7883 radiation in the aurora as the first positive nitrogen band (7, 6) is obvious. If (7, 6) is observed in the aurora, then why are (7, 3), (7, 4), and (7, 5) missing? According to the Franck-Condon rule, these bands should be stronger than (7, 6), and yet they have never been reported in any auroral displays. The 6323 radiation which was identified as the band (10, 7) presents a similar problem. The observation in laboratory experiments of violations of the Franck-Condon rule, be they real or apparent, enable us to identify such bands as 7883 and 6323 as nitrogen bands.

JOSEPH KAPLAN.

Department of Physics,
University of California at Los Angeles,
June 6.

[1] NATURE, **129**, 759, May 21, 1932.
[2] *Phys. Rev.*, **36**, 778; 1930.
[3] *Proc. Roy. Soc.*, A, **102**, 453; 1922.
[4] Loomis and Fuller, *Phys. Rev.*, **39**, 180; 1932.

Chain Reactions in Enzymatic Catalysis

I MUST thank Dr. Richter[1] for raising the fascinating problem of whether enzymes act by initiating chain reactions. If this is correct, the value which I calculated[2] for the number of hydrogen peroxide molecules destroyed by a catalase molecule per second, namely, about 10^5, retains its biological significance, but the enzyme surface is far less active than I supposed. The view that oxidative enzymes in general initiate chain reactions was put forward by Haber and Willstätter.[3] I propose to examine this view, but only some of the arguments which I shall bring against it would be valid if catalase were unique among enzymes in starting a chain reaction. This is, however, very unlikely. Peroxidase was shown by Kuhn, Hand, and Florkin[4] to have the same degree of activity per molecule per second, and a very similar active hæmatin grouping.

The chain theory renders the proportionality observed in many cases between enzyme concentration and reaction velocity unintelligible. If the chains end when two free radicals meet, as Haber and Willstätter assume, their length should be shorter the greater the concentration of radicals, and the reaction velocity should be about proportional to the square root of the enzyme concentration, as Allmand and Style[5] found it proportional to the square root of the illumination when hydrogen peroxide was photolysed. If the chains end on the walls or other foreign substances, the velocity should be appreciably reduced by some of the very miscellaneous impurities found in catalase preparations. Zeile and Hellström,[6] among others, found that neither of these conditions was fulfilled in the case of catalase.

Again, the chain theory does not account for specificity. Thus Haber and Willstätter postulate free OH radicals not only in the catalase reaction, but also in the actions of acetaldehyde oxidase and alcohol oxidase. If this were the case, catalase would catalyse the oxidation of acetaldehyde and alcohol by hydrogen peroxide. Similarly, they postulate meriquinoid radicals as links in the chain produced when a dehydrogenase catalyses the reduction of a quinone by a hydrogen donator such as succinic acid. If this were so, dehydrogenases would not be specific, for a meriquinoid radical produced by the dehydrogenation of succinic acid could proceed to remove a hydrogen atom from a different hydrogen donator, for example, glucose or lactic acid.

Finally, the theory does not explain the fundamental fact that most intracellular oxidations do not yield heat directly, but the energy of oxidation is mainly transferred to other molecules. For example, the energy of oxidation in muscle is largely used to resynthesise glycogen from lactic acid. These coupled reactions, involving as they do the interaction of at least four molecules, can only occur at a specific surface where the various reactants are held simultaneously. It is extremely difficult to see how such a reaction could occur in a homogeneous medium, especially when the molecular concentrations of some of the reactants are very low. For example, the oxygen concentration in tissues is less than 10^{-4} M, and it can fall below 10^{-7} M without slowing down bacterial respiration.

For the above and other reasons, I think that the majority of biochemists will demand very strong experimental evidence before they accept the chain theory of enzyme action.

J. B. S. HALDANE.

Biochemical Laboratory,
Cambridge.

[1] NATURE, **129**, 870, June 11, 1932.
[2] *Proc. Roy. Soc.*, B, **108**, 559; 1931.
[3] *Ber.*, **64**, 2844; 1931.
[4] *Z. physiol. Chem.*, **201**, 255; 1931.
[5] *J.C.S.*, 606; 1930.
[6] *Z. physiol. Chem.*, **192**, 171; 1930.

Occurrence of *Bathynella* in England

IN 1927 I happened to visit the well-known Bath Stone Quarries at Corsham, near Bath, for the purpose of collecting *Cyclops* from the underground water of the district.

Looking through the material on my return to Marlborough, I came across two specimens of a small crustacean that I was unable to identify and they were put on one side, as I was working at the time exclusively on the distribution of *Cyclops* and hydrogen ion concentration.

In 1931, quite by accident, I again examined these two specimens, and found them to belong to the very remarkable group, the Syncarida. Both specimens were immature and not well preserved, but they were evidently *Bathynella* or *Parabathynella* and were sent to Dr. W. T. Calman, keeper of zoology at the British Museum (Natural History), who identified them provisionally as *Bathynella chappuisi*, Delachaux.

The Bath Stone Quarries are very extensive, comprising some sixty miles of trolley lines and containing a number of underground wells. In addition, one has to work entirely in the dark except for an electric torch, since the galleries are about 100 feet below the surface, and it seemed as if the rediscovery of these minute animals might be a very long task.

On June 15 of the present year I came across twenty to thirty living specimens and there is reasonable evidence that the piece of water in which they occurred is a remarkably permanent one, so that now, knowing the exact spot, one can go there with a reasonable amount of confidence.

Dr. Calman and Dr. Isabella Gordon have now examined some fresh specimens and are apparently satisfied that the original diagnosis was correct. The species is therefore *Bathynella chappuisi*, Delachaux.

Since no member of the Syncarida has been recorded from the British Isles before, the occurrence of these animals is of more than ordinary interest.

A. G. LOWNDES.

Marlborough College,
Wilts.

MR. LOWNDES is to be congratulated on a discovery of exceptional interest. Since *Bathynella* has scarcely yet penetrated into English textbooks of zoology, it may not be superfluous to give a brief summary of its history.

Just half a century ago, Prof. Vejdovsky found in a well in Prague two examples of a minute crustacean which he was unable to refer to any of the recognised groups. Eighteen years later he kindly allowed me to re-examine the surviving type specimen and I was able to point out its resemblances to the Tasmanian *Anaspides*. Another fifteen years had to elapse, however, before the animal was found again, this time in Switzerland by Dr. P. A. Chappuis. A second species was later described from Switzerland by Dr. Th. Delachaux, and has also been recorded from Rumania. It is to this second species that Mr. Lowndes's specimens appear to belong. Since then a related genus, *Parabathynella*, has been described by Chappuis from Serbia, and the gap separating the European Syncarida from their Australian and Tasmanian relatives has been partly bridged by Sars's unexpected discovery of another species referred to *Parabathynella*, from a cave in the Malay Peninsula.

These minute, blind, subterranean crustacea are the degenerate survivors of the Syncarida found as fossils in the Carboniferous rocks of Europe and America, which have disappeared from the surface of the earth, except in Tasmania and Victoria.

No doubt careful search in the subterranean waters of wells and caves would greatly extend the known range of these crustacea, and it is to be hoped that Mr. Lowndes's example will lead cave explorers to turn their attention to the almost unknown cavernicolous fauna in the British Isles.

W. T. CALMAN.

British Museum (Natural History),
Cromwell Road, London, S.W.7,
June 24.

River Gauging and Flood Prevention

IT is with great satisfaction that I have read the leading article on this subject in NATURE of July 2 with its complimentary reference to my measurements on the Ness Basin. On this area there are six principal water-level stations at which continuous records are being kept on clock-driven gauges. The measurements of flow, at ordinary flood and low water stages, of the three principal rivers are completed, and all that is now necessary is the maintenance, for all time, of the water-level records—a continuity that no individual can assure. The Caledonian Canal has kept daily water-level records over a great number of years and it is now possible to give with considerable accuracy the flow from Loch Ness during the great floods of the past. If the big water interests of the area will combine to assure the maintenance of my established water-level stations, and to establish other stations when required, there is no problem connected with the use of their water resources which cannot be tackled satisfactorily.

There is no doubt that inland water survey should become a national matter and that it demands a water survey department, such as forms part of the Geological Survey of the United States, which publishes hundreds of papers on systematic investigations of surface water supply.

Local associations or bodies representing the water interests of the areas should be formed to carry out the water-level work and to keep the records. The superintendent of the local association should be under the authority of the national water survey department.

In the article in NATURE it is suggested that the new Drainage (or Catchment) Boards should carry out all this survey work; and I agree, provided the water survey work is definitely under the control of a water survey department of the Ministry of Agriculture, because it is necessary to assure that the many arduous duties which will devolve on these Boards will not deflect the course of systematic measurement.

Existing water users have already a mass of useful data; and as these users are invaluable collectors of data, they should be represented in any water survey organisation. This is effected in the United States through the central control of the Geological Survey.

The lead given in NATURE should be most helpful in bringing us one step nearer to the much-needed organisation of a water survey of Great Britain. The subject is to be discussed at a joint meeting of Sections A and E at the forthcoming York meeting of the British Association; and it is to be hoped that the result will be the formation of a national body to carry out the survey required.

W. N. MCCLEAN.

Parliament Mansions,
Victoria Street,
Westminster, S.W.1.

Scientific Method

THE subject of the leading article of NATURE of May 28 must commend itself to the earnest consideration of all those who view with consternation the present drift of our civilisation towards chaos. Nothing is more needful than what, for want of a better word, we call the 'scientific' point of view. Nevertheless, experience has shown that the great investigator is seldom well fitted to guide the course of practical affairs; the 'passion for discovery' differs little from other passions in being linked with a certain prejudicial obstinacy. On the other hand, the exposition of the rules and principles of scientific method can be made intelligible only when the intellect has been already hardened by the educational disciplines inseparable from a system the prizes of which are awarded to those with most 'knowledge'—often synonymous with good memory.

There is, I submit, a middle course, namely, in the teaching of the history of scientific ideas. I say, "scientific ideas", since the usual hotch-potch of names and dates is scarcely history and certainly not science. But in the scholarly and critical exposition of such works as Newton's "Opticks", Harvey's "Disquisition", and Boyle's "Sceptical Chymist", in their true historical setting (in the absence of which they appear merely as 'out of date'), illustrated by such experimental methods as were available to these great thinkers, we may show science as a living, growing organism, born of intellectual *struggle*; we may teach the little known truth that theories which have been 'proved' to be 'wrong' have often only been shown to be inadequate.

By some such means we may, I believe, inculcate a just appreciation of the *real* meaning of fact and hypothesis, of cause and law. Incidentally we may both learn and teach caution and modesty, two qualities that do not always characterise the pronouncements of modern science.

WILLIAM P. D. WIGHTMAN.

23 Howard Place,
Edinburgh.

Research Items

Mortuary Caves of Szechwan, China.—Relics from the artificial caves of Szechwan Province in western China have been described by the collector, Mr. David C. Graham (*Proc. U.S. Nat. Mus.*, Art. 16, vol. 80). Thousands of these artificial caves are to be found in the sides of the hills and cliffs from Hupeh Province on the east to the highlands of the Szechwan-Tibetan border and along the Yellow River in the province of Kansu. Varying from a few feet to 130 ft. in depth and about six feet high by six feet wide, they are carved from the solid stone, the sides plainly showing chisel marks. Some are so close to one another that holes have been knocked in the dividing walls. It is popularly believed that they are 'barbarian'; but on both historical and archæological grounds it is demonstrable that they do not antedate the Chinese and almost certainly belong to the Han dynasty at about the beginning of the Christian era. The best caves have elaborate carvings above and around the front openings and on the sides and pillars near the entrance. Certain conventional designs in these carvings are also found on Han monuments of various types. A large number of burnt clay figures have been collected from the caves. Glazed figures are rare, but a fragment of a bottle-neck and part of a pottery bell show a green glaze. The figures include the foot of an elephant, dogs, fowls, horses' heads, human figures—among these, servants, actors, a figure playing a flute, etc., in costumes which indicate that little change has taken place in dress down to the present day. The clay vessels show the use of the potter's wheel. The commonest artefact is the earthenware coffin. Many carvings and artefacts reflect customs or represent implements in present use among the Chinese, but not among any primitive tribes.

Archæology of Eastern Colorado.—The second report by Dr. R. B. Renaud, director, on the work of the Archæological Survey of Colorado (published by the Department of Anthropology, University of Denver) describes the field-work carried out during the summer of 1931. It covered the valley of the Upper Arkansas in southern Colorado and the valley of the South Plate River and the territory north of it in the northern part of the State. The ground has now been cleared for preparing a better contact between Colorado and Wyoming and for an approach to western Nebraska, the next field of operation. The total number of sites covered in the present report is 116, of which eleven are double, that is, pictographs are found on both sides of the river or there is a major site on one side and a minor, possibly a look-out, on the other. Camp sites were by far the most frequent, 37 being reported from the South-Platte drainage area, 19 from the Upper Arkansas, and 8 south of Denver. A great many possibly date from the prehistoric period. 19 workshops were found, of which 13 were in the north. The northern area is distinguished by its more abundant camp sites and workshops, its more frequent sites with tipi rings, as well as its more numerous metates and manos. On the other hand, the southern area comprises all the sites with pictographs and stone enclosures, as well as two of the three known rock shelters. There are evidently cultural and geographical differences between the two areas. The collection of artefacts made in 1931 was not extensive; but some large collections in private hands were examined. The same distinction between the culture of the northern and southern areas is to be noted in the distribution of the classified types of implements; while in regard to their material, in both areas that most commonly employed is quartzite, but the place of flint, which comes second in the south, in the north is taken by chalcedony.

Brachial Muscles of Primates.—In a paper on the brachial flexor muscles in primates, A. B. Howell and W. L. Strauss, jr. (*Proc. U.S. Nat. Mus.*, vol. 80, 1-31; 1931), state that these muscles as a whole exhibit no distinct phylogenetic trend; the variations are individual rather than generic. The authors direct attention to the contrasting specialisations of the biceps muscle in the Lorisinæ and the Hylobatidæ. In all other primates this muscle is normally composed of the coracoid and long heads. In the lorises (*Nycticebus*, *Loris*, and *Stenops*) the biceps possesses one head of the long variety, the coracoid head being missing. In the gibbons (Hylobatidæ) the long head is present, but the coracoid head is replaced by one arising from the humerus, and there are most intimate connexions with the surrounding muscles, for example, the pectoralis major and the forearm flexors, which produce a mechanical arrangement well adapted to the extreme mode of brachiation exhibited by the gibbons. This unique anatomical arrangement is clearly an extreme functional adaptation peculiar to the gibbon, and cannot be regarded as representing a stage in the evolution of the biceps of man and the anthropoid apes. While this structure of the gibbon's biceps seems undoubtedly to be adaptive, it is apparently not a necessary outcome of the brachiating mode of locomotion, for such able and constant brachiators as *Ateles*, *Colobus*, *Pan*, and *Pongo* exhibit no trace of such an arrangement.

Deep Sea Collecting.—For three years now the Bermuda Oceanographic Expeditions of the New York Zoological Society under the leadership of Dr. William Beebe have made collections of deep-sea animals in the same region nine and a quarter miles south south-east of Nonsuch Island, Bermuda. That these collections must be becoming very complete as representative of the deep-sea fauna in that area is shown by a recent publication (*Zoologica*, **13**, No. 3), which gives the lists of hauls made during May-November in 1931. Up to the present date, 1350 collections have been made at all depths down to 2000 fathoms in mid-water, the majority being at the surface and between 500 and 1000 fathoms. The fruitfulness of these collections is already shown by two further publications in the same periodical (**13**, Nos. 4 and 5). In the former Dr. Beebe describes nineteen new species of deep-sea fish, and in the latter the same author and John Tee-Van record six new species of shore fish from that region. It is by such continuous collecting that the sparsely distributed members of the pelagic deep-sea fauna will become better known, and we hope that more material will be accumulated; for until the many unknown forms have been fully classified and described the study of their life histories is impossible.

Nuclear Structure.—Prof. Ruggles Gates devoted his presidential address to the Royal Microscopical Society (*J. Roy. Micr. Soc.*, **52**, 1932, pp. 1-19) to a consideration of recent work on nuclear structure. Evidence is accumulating that in plant cells the nucleolus generally contains two substances which may occasionally form separate bodies, and that one of these substances enters into the prophase transformations of the chromosomes, while the other does not. He referred to observations on the chromosome vesicles or karyomeres which show that these become closely appressed in the resting condition of the

chromosomes (for example, in the teleost *Fundulus*), but the delicate vesicle-walls persist and the vesicles do not completely coalesce until after each has formed a chromosome within itself in the prophase. This and other examples afford evidence that each chromosome maintains its morphological peculiarities from one cell generation to another, and confirms the view that the resting nucleus contains the chromosome materials in the same spatial arrangement as in the preceding telophase. Interesting comments are given on the spindle fibres and on cases of polyploidy in certain somatic tissues while the germ cells in the same animals remain diploid. Prof. Gates discussed the internal structure of the chromosomes and their method of division and made reference to mitoses in cells of root tips, which show that the chromosome splitting occurs in one metaphase for the separation which is to take place in the next. In an estimate of the size of genes, Prof. Gates remarked that it would appear probable that they and virus particles are about the same order of size, each containing not more than a few hundred organic molecules, and that it seems likely particles of this size are the smallest in which vital phenomena can be exhibited.

Virus Diseases of Potatoes.—The results of the studies of plant virus diseases financed by the Empire Marketing Board are now being published. The most recent works are to be found in the *Scientific Proceedings of the Royal Dublin Society*, vol. 20 (n.s.), Nos. 15, 18, and 20, May 1932. Paper No. 15 is by Dr. Phyllis Clinch and reports the results of " Cytological Studies of Potato Plants " (pp. 143-172). The green parts of mottled leaves have a structure similar to healthy organs, whilst the yellow areas are distinctly thinner. The peculiar vacuolate inclusions known as *X*-bodies have been found in the chlorotic areas of leaves infected with crinkle, streak, interveinal, and simple mosaics. They were not seen in aucuba mosaic or leaf roll plants, or on healthy leaves. Their discovery seems to confirm their inclusion in the virus diseases, since the *X*-bodies are almost exclusively found in this group. Paper 18 is by Dr. P. A. Murphy and is entitled " A Critical Review of some Recent Work on the Occurrence of Virus Complexes in the Potato " (pp. 193-210). The author reviews the literature, which suggests that many virus diseases of the potato are not single diseases but are the results of two or more viruses acting together. Dr. Murphy considers that it would be easier to explain these phenomena by regarding the virus as a chemical substance. Paper 20 is by Dr. P. A. Murphy and Mr. R. McKay. It describes " The Compound Nature of Crinkle and its Production by Means of a Mixture of Viruses " (pp. 227-247). A virus, called 'virus *A*', has been found to produce symptoms of the disease known as crinkle on the variety Irish Chieftain if the latter was previously infected with simple mosaic. This finding is in accord with the work of Dr. R. N. Salaman of Cambridge, who has separated three constituent viruses from English crinkle.

Age of Monazite from Portland, Conn.—Dr. C. N. Fenner has analysed for uranium, thorium, and lead a crystal of monazite from a pegmatite occurring at Portland, Connecticut (*Amer. J. Sci.*, April 1932). The results may be summarised as follows :

$PbO = 0{\cdot}1086$ per cent	$Pb = 0{\cdot}1007$ per cent
$U_3O_8 = 0{\cdot}00$	$U = 0{\cdot}00$
$ThO_2 = 8{\cdot}52$	$Th = 7{\cdot}489$
$\frac{Pb}{0{\cdot}36Th} = 0{\cdot}037.$	Age = 278 million years.

The age corresponds with the close of the Devonian. Special interest is attached to this result from the fact that the uraninite from the same quarry which was analysed by Hillebrand many years ago has a lead-ratio of 0·038. The check is very gratifying and gives additional support to the essential correctness and reliability of the principles on which the age of radioactive minerals are based. In particular it should be noticed that the agreement depends on the use of the value 0·36 for k (the factor by which Th is multiplied in the formula). With $k = 0{\cdot}25$, as recently advocated by Kirsch, there would be a considerable discrepancy. The value 0·36 is further supported by the concordant results obtained by Fenner from samarskite and monazite from Brazil.

A Fossil Horned Artiodactyl Ungulate from Texas.—Among the fossils recently acquired by the Palæontological Museum of the University of California through the generosity of Miss Annie M. Alexander, is the skull of a remarkable horned artiodactyl from the Pliocene of Texas. It is described by Dr. R. A. Stirton (*Bull. Dept. Geol. Univ. California*, vol. 21, No. 6, 1932), who shows that it represents an extreme development of the four-horned skull of *Protoceras* which was discovered by the late Prof. O. C. Marsh in the Oligocene of South Dakota. *Protoceras* has a pair of frontal horns and a pair of premaxillary horns of moderate size. A somewhat larger animal, *Syndyoceras*, from the Lower Miocene of Nebraska, has the same horns much elongated. The new skull from Texas, which is of still later geological age and is named *Synthetoceras*, is again larger, and has the premaxillary horns relatively enormous and fused together except at their free tips. The succession is thus interesting as showing the same increase in the relative size of the horns which is already known in successive members of other groups of artiodactyls, such as the deer.

Estimation of Ground Water.—In connexion with the important series of reports on ground water supplies in the United States, the Geological Survey of that country has published a pamphlet on " Methods of Estimating Ground-water Supplies " (*Water-Supply Paper* 638-c), which contains a full discussion of the problems involved, with references to the literature of the subject. No one method is applicable to all conditions. Some water-bearing formations function chiefly as reservoirs, others chiefly as conduits, but all of them have some of the properties of both. Some of the methods estimate the intake from surface streams by gauging stations, others estimate the discharge from springs, or the intake may be estimated from rain and melting snow and the discharge by evaporation from the soil or by the transpiration of certain selected plants grown in tanks with measured quantities of water. It would appear, however, that the most trustworthy measurements are obtained by water-stage recorders installed over wells. Water levels in wells are sensitive to every change that takes place in ground water, and these changes can be almost perfectly recorded by an automatic recorder. But all methods are being tried, and great improvements have been effected in recent years.

Spectrum of the Solar Corona.—A paper was read by M. Bernard Lyot on Feb. 19 before the Société Française de Physique, in which he gave an account of the success which has now attended his efforts to study the solar corona at the Pic du Midi at other than eclipse times (*J. Phys.*, **3**, 31 S). The main new feature in his work is the great care taken to avoid parasitic light in the optical system ; the other usual source of trouble, diffraction by gross particles in the atmosphere, was not serious. The spectrum of the green line has been obtained on a grating with a dispersion of 1·2 A. per mm., and the red line has been photographed with a prism giving 11 A. per

mm.; the average wave-lengths for these are given as 5302·83 ± 0·03 A. and 6374·75 ± 0·15 A. respectively. One feature of special interest is the breadth of the green line, which extends over 1·3 A. and has an intense core about 0·6 A. wide. These results were obtained at relatively unfavourable times, three or four years after the maximum in solar activity, and show that the methods employed will permit of the study of the red and green lines at any time, whilst it is quite possible that other lines can be obtained at times of greater activity.

The Positive Column.—Two accounts of the positive column which have just appeared, by R. Seeliger (*Physik. Z.*, April 1) and R. Holm (*Z. Phys.*, March 31), emphasise how unsatisfactory our knowledge of the passage of electricity through gases still is, even in the simplest cases. Langmuir has given a very full theory of the uniform positive column, and Schottky and Townsend less complete treatments, but attempts to compare these with experiment, except perhaps in the case of mercury, are limited both by lack of data for such discharge parameters as the temperature of the gas and of data for various atomic properties. Seeliger's article, which deals with monatomic gases, is largely an elaboration of Schottky's diffusion theory. Seeliger accepts the experimental result which lies at the basis of much of Langmuir's work, that the electrons have often a Maxwellian distribution of velocities corresponding to a temperature much in excess of that of the gas, and makes some interesting comments on how this temperature may be maintained. There are, however, special difficulties with the noble gases on account of the frequent occurrence of moving striations and the practical impossibility of finding the concentration of metastable atoms by other than delicate optical methods. Holm discusses diatomic gases, again starting from Schottky's theory, which he shows to be in reasonable agreement with his and Güntherschulze's measurements of the field in the positive column, but makes a distinct break from earlier work in his insistence on the importance of negative molecular ions, the conditions for the formation of which are still little understood.

Astronomical Topics

Comets.—An interesting point has arisen with regard to Newman's comet (1932 *f*). It appears that there are two comets, several minutes of arc apart, that have similar motion. This was first detected by Herr Schmitt, and was announced in a telegram from the I.A.U. Bureau on July 1. It is quite probable that some of the observations supposed to belong to Newman's comet actually belong to the other one. The following orbits of Newman's comet have been computed; the first is by Dr. Whipple and Mr. Cunningham from positions on June 1, 7, and 20 (*Harvard Card* 222), the second by Dr. M. Davidson from observations by Dr. W. H. Steavenson on June 21, 25, and 30:

T	1932 Sept. 27	1932 Sept. 25·01 U.T.	
ω	73° 50′	70° 9′ 16″	
Ω	244 50	245 7 33	1932·0
i	76 50	78 21 20	
q	1·57	1·6421	

Three positions are given below; the first is presumed to belong to Newman's comet, the second is the discovery position of Schmitt's comet. Dr. Davidson considers that the third also belongs to Schmitt's comet:

U.T.	R.A. 1932·0.	N. Decl. 1932·0.	Observer.	Place.
June 22·1454	15h 33m 44·4s	9° 12′ 10″	van Biesbroeck	Yerkes
25·8662	15 28 36	11 45	Schmitt	not stated
July 1·9666	15 16 59·8	15 0 56	Steavenson	Norwood

Schmitt gave the daily motion of his comet as −1m 40s, N. 35′, which was practically the same as that of Newman; it can scarcely be doubted that these two bodies are portions of a single comet that split into two portions at some date in the past, like Biela's comet; this would make it probable that the period of the comets is not very long. A search through the catalogues has not revealed any comet with similar elements; there is a distant resemblance to 1898 I (Perrine), but that has a period of three or four centuries.

Orbits of Double Stars.—*Circular* No. 86 of the Union Observatory, Johannesburg, contains a determination by Dr. R. T. A. Innes of the orbit of the star Innes 35, the duplicity of which he discovered in 1897; the position is R.A. 6h 53·7m, S. Decl. 35° 22′ (1900). It is a very close binary, the greatest elongation being only 0·3″. It has now completed two revolutions since discovery, and the period is thus known with considerable accuracy. This, as Dr. Innes points out, is a help in finding the other elements; they run as follows; Period 16·5 years, periastron 1926·8, *e* 0·586, *a* 0·315″, *i* 56·3°, 269·7°, 116·4. Applying Eddington's mass-luminosity relationship, Innes finds a parallax of 0·040″, masses of 0·91 and 0·87 of the sun, and absolute magnitudes of 4·8 and 5·0. The apparent magnitudes are 6·8 and 7·0, the spectral type *F*5. The separation of the stars at periastron is only 0·07″, so that most of the observations are in the region near apastron. Dr. Innes gives a second paper, explaining his method of computing double-star orbits, which makes use of the *X*, *Y*. Tables that he published in 1927; he adds a new table that gives the value of arc *minus* sine for various angles.

Norman Lockyer Observatory.—The Council of this Observatory has recently published its report for the year ended on March 31 last; great satisfaction is expressed at the large amount of work carried out by Dr. W. J. S. Lockyer and Mr. Edwards. The former has recently published in the *Monthly Notices of the Royal Astronomical Society* a study of the relation between the corona and the prominences; the latter has made a study of the spectra of stars of type *B*, and continued the work of deducing spectroscopic parallaxes which has been going on for some years. The collection of stellar spectra photographed at the Observatory now amounts to 6458. The chief event of the year has been the completion of the photographic equatorial presented by Sir Robert Mond (see NATURE, June 4, p. 838); it includes four Zeiss triplet lenses of different diameters, and has an electrically controlled driving clock by Messrs. Cooke, Troughton and Simms. An interesting photograph of a bright meteor passing the Pleiades was obtained with it by Dr. Lockyer on Jan. 11; it is reproduced in *Monthly Notices, R.A.S.* for March, and gives much information as to the changes of brightness exhibited by the meteor in its flight; unfortunately it was not observed visually, so the exact time of its appearance is not known. It will be remembered that Dr. Lockyer photographed another interesting meteor in 1922 (*Monthly Notices, R.A.S.*, vol. 83). The investigations at present in hand include studies of the spectra of ζ Tauri, β Canis Majoris, and 52π Aquarii; also of certain stars with bright hydrogen lines.

Robert Brown and the Cell Theory

THE Linnean Society has issued as an extract from its *Proceedings* (1931–32, pt. 2) the series of addresses delivered at the general meeting on Nov. 19, 1931, which took the form of the centenary celebration of Robert Brown's discovery of the nucleus of the vegetable cell. The brochure contains an account, by Mr. J. Ramsbottom, of Brown's life and botanical work, one by Mr. S. Savage of his connexion with the Linnean Society, the passage from the memoir containing Brown's account of his discovery, and an address by Lieut.-Col. J. Stephenson on Brown's discovery in relation to the history of the cell theory.

The discovery was announced at the close of a paper "On the Organs and Mode of Fecundation in Orchideæ and Asclepiadeæ" read at the meetings of the Society on Nov. 1 and 15, 1831. The paper was afterwards printed in the Society's *Transactions*.

It was characteristic of Brown to refer incidentally in communications the main purport of which was taxonomic, to discoveries of fundamental importance. In 1809, in a monograph on the Proteaceæ, which he had studied in Australia, he indicates the true relation between endosperm and embryo in the seed. In 1825, to a description of the remarkable Australian Juncaceous tree, *Kingia*, he adds his observations on the structure of the ovule and female flower in the Cycads and Conifers, which established the distinction between the Gymnospermous and Angiospermous flowering plants. To Brown also is owed the recognition of the Brownian movement of small particles (1827), and of the streaming of protoplasm, which latter he observed in the staminal hairs of *Tradescantia* (1831) many years before the 'discovery' of protoplasm.

Brown described the nucleus as a more or less distinctly granular areola, generally somewhat more opaque than the cell membrane, to which it sometimes adheres, projecting into the cell cavity, but it is not infrequently central or nearly so. It was observed in several families of Monocotyledons and Dicotyledons. Brown was the essence of caution, but the remark of Prof. F. E. Weiss, after reading the extract from the memoir, that Brown was inclined to regard the nucleus as an attribute of all vegetable cells, is justifiable.

Lieut.-Col. Stephenson pointed out that in 1831 we have already no inconsiderable part of that body of doctrine that goes by the name of the 'cell theory'. It is incomplete, in that it has scarcely as yet been applied to animals, no account of the origin of cells has been given, and the emphasis is mainly on the cell wall. Between 1831 and 1838, through the activities of the Breslau school under Purkinje and the rival Berlin school led by Joh. Müller, cells had been described in all the chief tissues of the animal body; the production of new cells by division had been seen by Dumortier and other botanists, nucleus and nucleolus had been recognised, and animal and plant cells appreciated as equivalent structures. Purkinje had noted the absence of a special membrane in animal cells.

The cell theory was therefore practically established by the year 1838, and Lieut.-Col. Stephenson protested vigorously against the general use in lectures and textbooks of the phrase "the Cell-Theory of Schleiden and Schwann". He insisted that Schleiden's erroneous theory of endogenous cell formation, accepted by his pupil Schwann, was a distinctly retrograde movement. Schwann also conceived the erroneous idea of the origin of new cells in the intercellular substance; and his mode of comparison of the plant and animal cell tended to accentuate and to perpetuate the view of the cell wall as the chief and distinctive character of the cell. Schwann's "Microscopical Researches" was published in 1839. In 1850, Braun expressed the opinion that the cell was, properly speaking, the substance within the membrane; but it was 1861 before Max Schultze defined a cell simply as a particle of protoplasm containing a nucleus. Therewith Brown may be said finally to have come into his own. Among the builders of the cell theory he holds an honourable place. A. B. R.

The Value of 'Protective' Adaptations of Animals

ONE of the hypotheses on which the theory of natural selection is based consists in the interpretation of the coloration and general appearance of animals from the point of view of protection from enemies. The range of 'protective' devices considered to be sufficiently effective as factors in the selection is very great, but exact investigations aiming at proving that such devices actually protect their possessors are scarce.

Selectionists assume a discrimination in the choice of prey on the part of predators, and one of the methods by which the existence of such a discrimination can be tested obviously consists in studies on the food of predators, by analysing the contents of their stomachs. Results of the studies, however, can only be convincing if the series of records are sufficiently long to eliminate the accidental and to arrive at statistically sound conclusions. In this respect, the investigations on the contents of birds' stomachs undertaken by the U.S. Bureau of Biological Survey * are beyond reproach, for they cover a period of more than forty years (since 1885), during which about 80,000 birds have been examined and as many as 237,399 identifications of animals found in their stomachs made. A common objection to this method is that anything found in a bird's stomach would be in an unrecognisable state. This, however, proved to be a misconception, since most birds swallow their food whole, and even in the cases of the most fragile insects, such as butterflies, certain parts, for example, wing scales, are perfectly well preserved, so that an approximate identification is possible.

The first conclusion arising out of the accumulated data is that the animals serving as food for birds belong to all the systematic groups of the animal kingdom from Protozoa to mammals. Within the size limits, animals of practically every kind accessible to birds are preyed upon, so that no groups can be considered immune from their attacks. Still more significant is the conclusion, supported by abundant statistical data, that the number of captures from each group is in proportion to the abundance of animals of that group. The figures for insects are particularly striking. Records for Rhynchota, for example, constitute about 11 per cent of all records of insects found in the stomachs of birds, and the percentage of known species of Rhynchota in relation to all known insects is about 8 per cent; the respective

* Smithsonian Miscellaneous Collections, vol. 85, No. 7, "Effectiveness in Nature of the so-called Protective Adaptations in the Animal Kingdom, chiefly as illustrated by the Food Habits of Nearctic Birds". By W. L. McAtee. Pp. 201. (Washington, D.C.: Smithsonian Institution, 1932.)

figures for Lepidoptera are 9 and 15 per cent; for Coleoptera, 44 and 46 per cent; for Hymenoptera, 14 and 17 per cent; and so on. This means that various animals are captured by birds approximately in proportion to their numbers, and no selective discrimination between groups on the part of birds is apparent. In other words, the predation takes place in much the same way as if there were no such thing as protective adaptation.

As regards various devices interpreted by selectionists as protective, their value can be gauged by the relative abundance of animals with such devices in birds' stomachs. The data in this respect are very discouraging to selectionists. It is not surprising, of course, that animals with coloration harmonising with their surroundings are eaten freely, since this can be interpreted as the selection in action. Much more important is the fact that animals presumably protected by poisonous secretions are also consumed in proportion to their numbers and, therefore, cannot be said to enjoy any protection. A beetle, *Macrodactylus*, is definitely poisonous and many young birds are killed by eating it, but it is, nevertheless, eaten freely, and the advantage of being poisonous is not obvious. Again, all spiders are venomous, but the 10,000 records of spiders having been eaten by more than 300 species of birds emphasise the complete disregard by birds of this method of protection. All the members of the group of Rhynchota (bugs) are always regarded by selectionists as being specially well protected by their taste or unpleasant smell. The fallacy of this statement is made clear by the 22,395 records of Rhynchota found in stomachs, the percentage of the records being in close agreement with the relative abundance of these insects.

Bright and contrasting colours of insects are usually considered as 'warning', and the Coccinellid beetles, or ladybirds, represent a classical example of 'warning coloration', possibly developed by selection and serving to advertise their unpalatability. There are, however, 1455 records of Coccinellids found in the stomachs of 127 species of birds; since up to 15 insects have been found in one stomach, their 'warning' coloration and the inedibility must be a fiction. Another equally well-known example of a specially protected group of insects is represented by the ants, and their immunity from attacks is said to be so great that many other arthropods secure protection from enemies by mimicking ants. The 12,000 records of ants eaten by well over 300 species of birds make the status of ants as a protected group untenable. Some birds eat ants in very large numbers, and up to 2000 ants have been found in one stomach. It is particularly noteworthy that even ants of the family Myrmicidæ, notorious for their stinging habit, are not avoided, as is shown by 1200 records of their presence in stomachs, containing in some cases up to 400 individuals. Wasps are considered also as regular models for mimicry, being themselves presumably well protected by sting and also 'warningly' coloured, but 140 species of birds eat them, up to 30 wasps at a meal.

The whole book is full of examples of this kind, most carefully collected and thoroughly analysed, and represents an array of arguments of which selectionists will find it very difficult to dispose. The principle of proportional predation is exhibited so clearly and forcefully that a discrimination in the choice of prey by birds (and other vertebrates, also considered in the paper) is shown to be simply non-existent. Indeed, the data at hand denote a complete indiscrimination, the very antithesis of selection, and the phenomena classed by theorists as protective adaptations are shown to bear no relation to the survival of the fittest. B. P. U.

Aluminium in Foodstuffs

THE meeting of the Society of Public Analysts on June 1 was devoted to papers on the effects and estimation of aluminium in foodstuff.

A survey of the physiological effects of aluminium was given by Dr. J. H. Burn. He said that the first extensive investigation of the physiological effects of aluminium salts was made in 1886 by Siem, working under Prof. H. H. Meyer. Siem found that doses corresponding with 30-40 grains of alumina for a man had no effect whatever when administered by mouth to cats daily for four weeks. When the aluminium salt was injected under the skin, the fatal dose varied from 0·25 to 0·30 gm. of alumina per kilogram. These results, indicating that aluminium has some toxicity when injected, but is harmless by mouth, have in substance been confirmed by many subsequent workers.

Siebert and Wells examined the pathological changes produced by injecting alum and aluminium chloride; they found that anæmia was manifested after nine or ten daily injections, a fall in the hæmoglobin percentage and in the red cell count being recorded. In the spleen, pigmentation, thrombosis, and fibrosis were observed.

The experiments of McCollum and his colleagues, and those of Myers and Mull, show conclusively that the addition of aluminium salts to the diet of young rats has no ill effect on growth, health, and reproduction, even when four successive generations are observed. The experiments of Myers and Morrison, and of Underhill and Peterman, show that when aluminium compounds are given by mouth to dogs, only insignificant changes in the amounts of aluminium in different tissues are found. It follows that aluminium salts are not absorbed from the alimentary tract, except in traces.

As a result of a scare in the United States that the use of aluminium baking powders was dangerous to health, the Department of Agriculture instituted a board of inquiry. The report, published in 1914, described experiments on twenty-six university students carried out in three different universities, who were given amounts of alum varying from 0·2 gm. to 10 gm. daily for about six months. It was unanimously reported from the results of these experiments that the amounts of alum likely to be consumed as a result of alum in baking powder, estimated as up to 1·16 grain of aluminium per person per day, are much too small to have any ill effect. The amounts of aluminium which arise from aluminium vessels were estimated from analyses carried out by Massatch to be about 0·1 grain per person daily.

Indeed, the possible dangers arising from aluminium utensils have been very thoroughly investigated by many workers, on many species of animals; they have also been investigated with equal thoroughness on man. These dangers are non-existent. Clinical reports that symptoms of abdominal pain are relieved by discontinuing the use of aluminium can be ascribed to psychological effects.

Dr. L. H. Lampitt and Mr. N. D. Sylvester outlined a method for the accurate determination of small amounts of aluminium in foodstuffs, in which the Aurin tricarboxylic acid lake is formed under standardised conditions, the red colour of the final solution being measured in the Lovibond tintometer. Separation of aluminium from the 'wet ash' of the foodstuff is effected by a preliminary precipitation

with ammonia, the aluminium being obtained in alkaline solution. Other metals which are liable to be present have been proved not to interfere. The actual determination is carried out on an aliquot portion containing 0·01-0·06 mgm. of aluminium. Using 20 gm. of sample, so little as 0·2 part per million of aluminium can be determined.

The results obtained indicate that the aluminium content of foodstuffs is increased by only a few parts per million after cooking in aluminium utensils. For example, the aluminium content of milk was increased from 0·4 to 0·6 part per million after boiling in an aluminium saucepan, and to 2·5 parts per million after standing overnight. Apples before cooking contained 2 parts per million of aluminium, and after boiling in an aluminium vessel for thirty minutes with sugar and water they contained 14 parts.

Mr. P. L. Bilham described a spectrographic method for the determination of small quantities of aluminium. The aluminium of a biological material is concentrated on to a special electrode. The spectrum is then excited by a condensed spark discharge, modified to remove air-lines as much as possible, and a quartz spectrograph is employed to photograph the spectrum. The plate is developed under standard conditions and then compared with sets of standards on plates prepared under precisely similar conditions. The results show that aluminium is detectable down to 0·01 mgm., and that the intensities of the lines at 3944 A. and 3961·5 A. can be used to judge the amount present up to 0·2 mgm. The method is, of course, specific for aluminium and of a reasonable accuracy.

Carnegie Grants for Libraries and Museums

THE eighteenth annual report of the Carnegie United Kingdom Trust, for the year ended Dec. 31, 1931, has recently been issued.* The opening paragraphs reflect the influences of the financial position of the country upon policy, inasmuch as the main object of the trustees in the immediate future will be one of consolidation rather than the inauguration of new and pioneer schemes. In their view, the urgent demand for drastic economy in national and local expenditure, coupled with the restriction of private generosity, compels limitations of policy. Grants from the Trust will be made in order to maintain and stabilise activities which have already been assisted and have themselves tended to move forward under their own momentum. But grants for entirely new purposes are to be few in number, and to be made only for exceptionally strong and urgent reasons. These decisions, however prudent, must inevitably bring disappointment in various quarters, but, at any rate, they cannot fail to be understood.

Though most people are aware how wide the net is cast, it may be useful and opportune at this juncture of affairs to recall some of the more important schemes which have received allocation of revenue. Outstanding among these is the acquisition of freehold property in Bloomsbury, intended to form the headquarters of the National Central Library and of the Library Association, in an area contiguous to and ultimately destined for occupation by the new buildings of the University of London. The total sum contemplated for this undertaking is large, amounting in fact to about £60,000. It is believed that the two institutions, housed as neighbours, will play an essential part in completing the unification of the nation's library service. For the first time in its history the Library Association will be in possession of premises of its own, large enough for practical operations, and consistent with its dignity as a national body established by Royal Charter. It is hoped that the quarters will be ready within about eighteen months. Complementary in interest is the information that the trustees are still prepared to receive applications on behalf of municipal libraries serving populations between 10,000 and 70,000. Aid is given for book-purchase only, and will be made to such authorities as are prepared to carry out, as fully as financial conditions permit, the main principles of approved modern practice.

Substantial grants have been allotted to various research associations and societies—among these we note British Non-Ferrous Metals, Wool Industries, Linen Industry, British Rubber Manufacturers, British Flour Millers, London School of Economics, Entomological Society, Society for Psychical Research. Rural and Social Service includes schemes affecting community centres, boys' and girls' clubs, youth hostels, and village halls. Enterprises relating to activities in the departments of music and drama have received attention; while the sympathy and support extended to rural preservation schemes and playing fields is a record of much interest.

The trustees' 'museum policy', initiated rather more than two years ago, is still in the experimental stage, and there may be a temporary period of inaction. Thirteen centres had accepted or been offered grants up to the end of 1931 for reconstruction purposes. These grants are conditional upon the adoption of a scheme prepared by an expert appointed by a joint committee of the Trust and the Museums Association. The substitution of modern cases, the disposal of miscellaneous and irrelevant material, adequate display and labelling, coupled with the adoption of a progressive policy on the lines recommended in Sir Henry Miers's report, are essential considerations.

Finally, the remarkable development of county libraries, closely fostered by the Library Association, established in local areas, demands a few words. Throughout Britain generally the story is one of judicious expansion. At the end of the year 1930–31, some sixteen millions of the population of the United Kingdom were served through 14,000 library centres, almost all of which were administered by voluntary librarians and enlisted voluntary helpers. In no other country as yet could it be stated that any village librarian, in addition to his periodic supply of anything from 50 to 2000 books, can obtain for borrowers access not only to the county stock of, say, 50,000-150,000 volumes, but also through the county headquarters to nearly 5,000,000 volumes held or procurable by the National Central Library, and that, as a rule, special books may be sent by post for private study.

* The Carnegie United Kingdom Trust. Eighteenth Annual Report (for the year ending December 31, 1931), approved by the Trustees on March 11, 1932. Pp. ii+95+4 plates. (Dunfermline.)

University and Educational Intelligence

CAMBRIDGE.—The governing body of King's College, having made provision for four additional fellowships open for competition to graduate members and research students of the University, is offering a fellowship to be associated with the name of the late Mr. E. B. Stringer. Candidates must be members of the University, less than thirty years of age on March 1, 1933, who have worked in (i) chemistry, (ii) experimental physics, or (iii) the chemistry or physiology of plant or animal life. Applications should reach the Provost by Nov. 1.

DUBLIN.—At a meeting of the Senate of the University of Dublin, Trinity College, on June 29,

honorary degrees were conferred upon the following, among others: *M. Eng.*—Prof. F. S. Rishworth, professor of civil engineering in University College, Galway. *D.Sc.*—Prof. R. G. Harrison, professor of biology in the Yale University; and Prof. T. M. Lowry, professor of physical chemistry in the University of Cambridge. *LL.D.*—Prof. W. R. Scott, Adam Smith professor of political economy in the University of Glasgow.

EDINBURGH.—At the graduation ceremonial on June 30 the honorary degree of Doctor of Laws was conferred upon the following, among others; Prof. C. V. Boys, Mr. H. M. Cadell; Mr. D. M. Greig, conservator of Museum, Royal College of Surgeons, Edinburgh; Dr. R. S. MacDougall, formerly reader and Steven lecturer in agriculture and forest entomology in the University; Mr. Andrew Mellon, United States ambassador; Prof. A. Robinson, emeritus professor of anatomy in the University; Sir Archibald Sinclair, Secretary of State for Scotland; and Sir Josiah Stamp.

The following were admitted to the degree of Doctor of Science, titles of theses appearing after the names: Mr. S. C. Devadatta, "The Distribution of Lactate between the Corpuscles and the Plasma in Blood"; Dr. Honor B. Fell, "Morphological and Experimental Studies on the Skeletogenesis of the Fowl"; Mr. D. Finlayson, "Some Physical Problems associated with the Internal Combustion Engine"; Mr. D. S. MacLagan, "An Ecological Study of the 'Lucerne Flea' (*Smynthurus viridis*, Linn.)"; Dr. D. Meksyn, "Electromagnetic Phenomena in the General Theory of Relativity"; Mr. H. S. Ruse, "Theorems in the Tensor Calculus"; Dr. R. H. Slater, "Synthesis of Quinoline Compounds of possible Therapeutic Value".

At the close of the ceremony, the Principal, Sir Thomas Holland, referred to two medallions by Emeritus Professor Schlapp, representing Sir Walter Scott and Thomas Carlyle as students, which have been placed in the McEwan Hall. Walter Scott matriculated in the University in 1783, attended classes for three years but failed in Greek, and his father took him away to his own business. Scott returned in 1789, studied in the Faculty of Law and was admitted to the Faculty of Advocates in 1792. At the age of fourteen years, in 1809, Thomas Carlyle trudged from Ecclefechan to the University of Edinburgh. He seemed to have profited mainly from the teaching of the professor of mathematics, and later in life, just after he had failed to persuade any publisher to accept "Sartor Resartus", he made an unsuccessful attempt to obtain the professorship of astronomy in the University. He was rejected, and that incident probably turned him finally to letters.

LONDON.—The following doctorates have been conferred: D.Sc. in anthropology on Dr. E. J. Dingwall (University College) for two works entitled "Male Infibulation" and "Artificial Cranial Deformation" (Bale, Sons, and Danielsson, 1931); D.Sc. in chemistry on Mr. J. W. Smith (University College) for a thesis entitled "Studies in Intensive Drying and Related Phenomena" (*J. Chem. Soc.*, 1929 and 1931; *Phil. Mag.*, 1929); D.Sc. (Engineering) on Mr. H. C. H. Townend (Northampton Polytechnic Institute) for ten contributions to the study of aerodynamics.

ST. ANDREWS.—Amongst those who received the honorary degree of LL.D. at the graduation ceremonial on June 28 were Sir James Frazer, author of "The Golden Bough", Dr. Albert Schweizer, and Prof. L. R. Sutherland, emeritus professor of pathology in the University.

Calendar of Geographical Exploration

July 11, 1616.—Samuel de Champlain

Samuel de Champlain, the great French explorer, returned to Quebec, which he had founded in July 1608, after his third and greatest journey. He set out in 1615 and, travelling down the Ottawa and Mattawa Rivers, Lake Nipissing, and French River, reached Georgian Bay. Thence he proceeded inland and explored Lake Ontario. Champlain's earliest voyages were to the West Indies and Mexico. In 1603 he travelled up the St. Lawrence, and in the following years surveyed the coasts of Nova Scotia, the Bay of Fundy, and the mainland so far as Cape Cod. In 1613 he reached Allumette Island in the Ottawa River, in an endeavour to discover a supposed short route to the ocean via the Ottawa River. Lakes Champlain, Nipissing, and Simcoe were discovered by him, and he made further journeys on Lakes Huron and Ontario, which had been visited a few years earlier by Brulé. Interestingly enough, Champlain contemplated, during a visit to Panama, the project of a ship canal across the isthmus.

July 11, 1897.—First Air Attempt on the North Pole

S. A. Andrée, a Swedish aeronaut, with two companions and about five tons of supplies, set out in a balloon for the north pole. Heavy guide-ropes dragging over the ice were to be used for steering. Andrée had already made successful flights in this way. Rising from Danes Island, Spitsbergen, at 2.30 P.M., the balloon passed out of sight within an hour. A buoy containing a message that at 10 P.M. the balloon was in 82° N., 25° E., moving towards the north-east at an altitude of 800 ft., was found. But until Aug. 22, 1930, nothing more was known of the fate of Andrée and his companions. On that date, members of an expedition to White Island found their bodies and their diaries. They had reached 82° 56′ N., but had been compelled to return on foot, and had died at Giles Land, White Island, to the east of Spitsbergen.

July 13, 1102.—An Early Pilgrimage to Jerusalem

Saewulf, or Saewlf, an Anglo-Saxon native of Worcester, a merchant, took ship at the little harbour of Monopoli, near Bari, for his pilgrimage to the Holy Land. The effect of the Crusades was to encourage such pilgrimages, and Saewulf, though not the first to make the journey, was the first who left a narrative of it. His outward journey was made direct from Italy to the Ionian Islands, from Negropont to Rhodes, and thence to Palestine. His record shows the great increase of European influence in the Levant in war, commerce, and pilgrimage; his account of the destruction of pilgrim and trading vessels in Jaffa during a great storm is specially valuable from this point of view. His description of the sites of Hebron is detailed and interesting. Among other places, he visited Nazareth and Cana of Galilee. He embarked on his return journey at Joppa, coasted down past Tyre, Sidon, and Acre, touched at Cyprus, and put in at Rhodes. There he changed to a smaller vessel and later to another, and proceeded through the Dardanelles. The narrative breaks off abruptly at the point when Saewulf was near Constantinople and wished to worship there before returning home. Inevitably, many of Saewulf's historical explanations seem quaint to modern students, but his narrative throws a good deal of light on conditions in his time.

July 13, 1909.—Mikkelsen's Voyages

Ejmar Mikkelsen left Thorshavn in the *Hekla*, in command of an expedition to explore north-east Greenland. Mikkelsen had, with Amdrup, explored

the east coast of Greenland in 1900, worked with the Baldwin-Ziegler 1901–2 expedition in Franz Josef Land, carried out oceanographical survey in the North Atlantic in 1903–4, and, in joint command with Leffingwell, explored northern Alaska in 1906–8. In 1908–10 Mikkelsen discovered the records left by Mylius-Erichsen of his tragic journey of 1907.

July 13, 1923.—American Scientific Expeditions to Mongolia

George Olsen, a member of one of the above expeditions, found the first complete dinosaur eggs. The theory that Central Asia must have been a centre of origin for ancestral types of mammalian life aroused the interest of Prof. Henry Fairfield Osborn, president of the American Museum of Natural History, and eventually led to the organisation of a series of remarkably well equipped scientific explorations of the region of Mongolia which lies between the Kalgan and the Altai Mountains. Palæontology, geology, palæobotany, archæology, topography, zoology, and photography were all represented in the 1925 expedition. But palæontology took first place in the 1922–23 expedition, which justified the theory in such a remarkable way. Dr. R. C. Andrews, the leader of the expeditions, reports that the major geographical features of the Gobi have been determined, and a surveyed line of more than 1000 miles has been run north-west through the heart of the desert.

July 15, 1836.—Sir T. Livingstone Mitchell in Australia

Sir T. L. Mitchell discovered the Grampian Hills, on a journey in Australia during which he also discovered the Wimmera and Glenelg Rivers and cleared up the main features of the Murray-Darling basin east and south of the Darling. Mitchell's explorations in Australia began in 1831, and to him and Sturt is due the elucidation of the drainage system of south-eastern Australia. In 1846 he crossed the Carnarvon Range and discovered the upper portion of the Barcoo River.

July 15, 1874.—The Road to Lhasa

The famous Indian explorer, Nain Singh, left Leh on a journey through western Tibet to Lhasa and the region south of that city. He travelled 1319 miles, of which about 1200 were across country never previously explored, and made detailed surveys of the route. Numerous lakes were discovered, as was the existence of a vast snowy range parallel to and north of the Brahmaputra River. Of this range, Nain Singh recorded the position of several peaks and estimated their heights. Nain Singh on his previous memorable journey had made a route survey of the road between Katmandu and Tradom and of the great Tibetan road from Lhasa to Gartok. He had traced much of the upper course of the Brahmaputra, and made estimates of the heights of various mountain peaks.

July 16, 1906.—Sven Hedin in Central Asia

Sven Hedin, the famous Swedish explorer, started from Srinagar on his journey to the region lying between Shigatse and Leh, and north of the Brahmaputra. He discovered a range of mountains lying parallel to the Himalayas on the Tibetan side, and mapped this previously unknown region. In 1893–97, Hedin crossed the desert between the Yarkand and Khotan Rivers, discovered the buried cities of the Takla Makan, and found that Lob Nor had changed since Przhvalsky visited it. In 1899–1902 he surveyed the Yarkand River and much of northern Tibet. Apart from his archæological work, Hedin made great contributions to the mapping of central Asia, and especially of the sources of the Sutlej and Brahmaputra.

Societies and Academies

LONDON

Royal Society, June 30.—**J. W. Cook, I. Hieger, E. L. Kennaway, and W. V. Mayneord**: The production of cancer by pure hydrocarbons (1). Tests for cancer-producing action on mice are in progress, or have been completed, with preparations of the following polycyclic aromatic hydrocarbons composed entirely of benzene rings:—(1) All the six possible four-ring compounds, (2) all the ten known compounds out of the fifteen possible five-ring compounds, (3) some compounds containing six and eight rings, and others. Some of the hydrocarbons examined are of very low solubility, and hence all tests carried out with them are unsatisfactory. No hydrocarbon in the pure state has produced cancers except 1 : 2 : 5 : 6-dibenzanthracene and some closely related compounds. It produced cancer of the skin when applied in a concentration of 0·003 per cent in benzene.—**J. W. Cook**: The production of cancer by pure hydrocarbons (2). Preliminary results suggest that 6-*iso*-propyl-1 : 2-benzanthracene is carcinogenic, and a pure sample of this has been synthesised and is being examined for carcinogenic activity, together with other *iso*-propyl and methyl derivatives of 1 : 2-benzanthracene. 5 : 6-*cyclo*penteno-1 : 2-benzanthracene produced metastases in the axillary glands and lungs in four mice to which it was applied. There is evidence that a molecular structure consisting of new rings attached to the 1 : 2- and 5 : 6- positions of the anthracene ring system is particularly efficacious in promoting carcinogenic activity.—**G. H. Eagles and A. H. H. Kordi**: The cultivation of vaccinia virus: a new series of subcultures in cell-free medium. The cell-free medium has been prepared with the view of obtaining from adult rabbit kidney an extract rich in cell substance while eliminating the presence of actual cells. The medium must be freshly prepared. Vaccinia virus has been propagated in this medium through ten subcultures in one series, representing a multiplication of 10^{20} times the original culture with a dilution of 10^{17} of the virus content of the original culture. Though greater irregularity in growth occurs in cell-free medium than in medium containing living cells, experience has shown that with the former substantial yields of virus have been realised.

Physical Society, May 20.—**A. O. Rankine**: (1) On the representation and calculation of the results of gravity surveys with torsion balances. An alternative method of indicating the functions of the Eötvös torsion balance, and of calculating those quantities, depending upon the distortion of the earth's gravitational field which the balance measures, is described and a convenient method is indicated of applying graphically the necessary corrections for the effects of the earth's rotation and irregularity of the surface of the ground. —(2) Some observations with a gravity-gradiometer. An account is given of a series of observations with a Shaw and Lancaster-Jones gravity-gradiometer, during which it was discovered that very persistent, although small, electric charges could be developed on the mica ring forming part of the oscillation-damping system. Such charges, which may persist for weeks, may not arouse suspicion, although in fact they lead to spurious results in the normal use of the instrument.—**R. L. Smith-Rose and J. S. McPetrie**: The propagation along the earth of radio waves on a wave-length of 1·6 metres. A description is given of the simple transmitting and receiving apparatus which has been employed for the experiments on this wave-length. Measurements of the field-intensity at different distances from the transmitter have been carried out

for various heights of the apparatus above the ground level. When both transmitter and receiver are used very close to the ground, the attenuation curve obtained is similar to that encountered at longer wavelengths. When, however, the apparatus is elevated by an amount comparable with, or greater than, the wave-length, the field-intensity distance curves have maximum and minimum values, the positions of which depend upon the actual heights employed. These maxima and minima are due to interference between waves transmitted directly from the transmitter to the receiver and those which arrive at the receiver after reflection from the earth's surface.—**Allan Ferguson** and **S. J. Kennedy**: Notes on surface tension measurement. This paper deals with a method for the accurate determination of the surface tension of liquids available in volumes of not more than one or two cubic millimetres. The method described does not involve any knowledge of the density of the liquid. A series of measurements of the variation with concentration of the surface tension of aqueous solutions of *p*-toluidine are also described. Here, also, the method employed is independent of a knowledge of the density of the solution.—**D. K. McCleery**: The fall of potential in a charged insulated cable. The expansion theorem of Heaviside is applied to the solution of the problem in which a cable, having been charged until it reaches its steady state, is insulated at the sending-end, and the potential is required at any point and at any time after insulation. At the sending-end there is an initial steep fall of potential which is due to a part of the charge being drained away from this end, in order to equalise the potential throughout the line when the exciting source has been removed. After the potential has become uniformly distributed, it falls with time according to a simple exponential law.

DUBLIN

Royal Irish Academy, May 23.—**Joseph Algar, Anne E. O'Reilly**, and **Mary Joy**: Some derivatives of dicoumarin. When diacetoresorcinol is heated for five hours with acetic anhydride and the sodium salt of phenylacetic acid, a good yield of α-α′-diphenyl-β-β′-dimethyl-dicoumarin, m.p. 276°-277° C., is obtained. By employing the sodium salts of substituted phenylacetic acids a number of dicoumarin derivatives may be prepared, the yields being satisfactory in most cases.—**Joseph Algar, Vincent C. Barry**, and **Tadhg F. Twomey**: Derivatives of benzo-difurfurane. The condensation of bromacetic ester with diacetoresorcinol gives the diethyl ester of diacetoresorcinoldiacetic acid (m.p. 130°-131° C.), which on hydrolysis affords the corresponding acid (m.p. 264°-266° C.). The latter is converted into β-β′-dimethyl-benzo-difurfurane (m.p. 107°-108° C.) by heating with acetic anhydride and sodium acetate. Various derivatives were obtained.

PARIS

Academy of Sciences, May 23 (vol. 194, pp. 1769-1868).—**L. Cayeux**: The condition and diffusion of phosphoric acid in old sedimentary formations. Consequences.—**Charles Achard, Mlle. Jeanne Lévy**, and **Fernand Gallais**: Experimental researches on some colloidal modifications produced in the blood serum by the injection of concentrated serum and by plasmatic bleedings.—**Armand de Gramont** and **Daniel Beretzki**: The temperature of a piezo-electric crystal as a function of its vibratory regime.—**Georges Claude**: The extraction of the dissolved gases in the Claude-Boucherot method.—**Maurice Fréchet**: Remarks on the probabilities of events in sequence.—**T. Wazewski**: The stability of the integrals of a system of differential equations.—**Alex. Froda**: Measurability in support of functions of real variables.—**G. Valiron**: Some consequences of Ahlfors' theorems.—**M. Delfosse** and **R. Swyngedauw**: The measurement of the friction couple of an axle in its bearing.—**M. Mendes**: The application of the method of variation of constants to the problem of *n* bodies with variable masses.—**V. Smirnoff** and **S. Soboleff**: Some problems of elastic vibrations.—**Mlle. Jacqueline Hadamard**: Perfecting a high precision Nernst bridge.—**Maurice Fallot**: The atomic moments and Curie points of ferro-silicon. Superstructures.—**Pierre Lacroute**: The method of using a large Rowland grating and the study of its faults.—**R. Lucas** and **Mlle. D. Biquard**: The influence of solvents and of temperature on the rotatory powers and dispersions of active bodies.—**Marcel Cau**: The rôle of multiple reflections in the magneto-optic Kerr effects of thin layers of iron.—**M. Chatelet**: Some organic solutions of iodine. Studies of the absorption spectra of iodine in some mixtures of solvents.—**Trajan D. Gheorghiu**: The influence of diffused light on photoelectric measurements.—**G. Mano**: The slowing down of the α-rays in air and Bethe's theory.—**P. and M. Lecomte du Noüy**: Studies on the critical temperature of serum. The absorption spectrum of horse serum in the ultra-violet. A curve is given showing the changes in the ultra-violet absorption spectrum produced by heating to 55° C. and 65° C.—**Mme. L. Walter-Lévy**: Contribution to the study of the system MgO, CO_2, H_2O at the temperature of 100° C.—**E. Vellinger**: Contribution to the study of dissociation phenomena in organic media.—**Jean Cournot** and **Marcel Chaussain**: The determination of the loss of weight in corrosion tests. The usual method of cleaning the test specimen by brushing, washing, and drying is shown to be inexact; two alternative methods are described.—**Neda Marinesco**: The action of an oscillating piezo-quartz on sols and suspensions. The ultra-sonic thixotropism of gels.—**Lucien Semichon** and **Michel Flanzy**: The application of chromic oxidation to some mono-acids. Detailed study of the oxidation of volatile fatty acids, and of hydroxy and ketonic acids.—**G. Vassiliadès** and **L. Capatos**: The action of diethylamine on methyl acetylene-dicarboxylate.—**Charles Dufraisse** and **Maurice Loury**: Researches on the dissociable organic oxides. The isomerism of the dimethylrubrenes and the constitution of the rubrenes.—**P. Carré**: The relative mobilities of the radicals in the chlorides of acid alkyl sulphites (R.O.SO.Cl). From a study of the temperatures at which these chlorides decompose in the presence of pyridine, the comparative mobilities of the radicals has been obtained. The mobility of the aryl groups is lower than that of the alkyl groups.—**Ch. Courtot, M. Chaix**, and **J. Kelner**: The mechanism of the action of sodium amide on diphenylsulphinone.—**Louis Meunier** and **M. Gonfard**: The analysis and some properties of the benzylcelluloses.—**J. Duclaux** and **M. Hugon**: The transparency of the pure atmosphere. A study of the limiting distance of vision as a function of the wave-length.—**P. Chofardet**: The transparency of the air. A statistical study of the results of nineteen years' observations on the visibility of Mount Blanc from two stations (Chailluz, Montfaucon).—**Paul Corsin** and **Georges Dubois**: The characters of the Dinantian culm-flora of Champenay in the upper valley of the Bruche.—**A. N. J. Heyn**: Researches on the plasticity of cellular membranes and the growth of plants.—**W. A. Becker**: Experimental researches on cytokinesis and the formation of the cellular plate in the living cell.—**Louis Gallien**: Neotenic reproduction in *Polystomum integerrimum*.—**Mlle. S. Firley** and **M. Fontaine**: The proportion of proteins in the serum of the eel and its variations in the course of changes in salinity.

—Ph. Lasseur, A. Dupaix, and L. Georges: Remarks on the Boas phenomenon.—Georges Deflandre: The Archæmondaceæ, a new family of marine fossil protists with siliceous covering.—G. Delamare and C. Gatti: Spirochetes and intraleucocytary annular bodies.—J. Lignières: The variability of the pathogenic and immunising quality of the aphthous virus.—S. Nicolau and Mme. L. Kopciowska: The elective zone for the Negri bodies in rabbits dying of experimental hydrophobia with fixed virus.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 18, No. 3, March 15).—A. Einstein and W. de Sitter: On the relation between the expansion and the mean density of the universe. The density derived on the assumption of zero curvature is of the right order of magnitude.—Marston T. Bogert and David Davidson: Azo derivatives of the pyrimidines.—L. F. Randolph: Some effects of high temperature on polyploidy and other variations in maize. The ear-shoot region was enclosed in a wire mesh cylinder and heated by an electrical heating pad to 38°-45° C. for a period of an hour at a time during the 48 hours beginning 27-30 hours after fertilisation. Among the effects observed were the doubling of entire chromosome sets, chromosomal deficiencies and translocations, direct morphological effects such as defective seedlings, and various deviations from the normal fertilisation process. It is suggested that since organisms in Nature are subjected to even higher temperatures than those used in the experiments, high temperatures may have played an important part in the natural production of variations.—Henry Margenau: Note on the quantum dynamical correction of the equation of state. A correction.—W. G. Penney: Effect of nuclear spin on the radiation excited by electron impact. No theory of polarisation of radiation excited by this means can be complete without taking into account nuclear spin. Calculations for mercury λ2537 give results not in agreement with the experimental data available; the first order cross-section and approximate wave functions are not sufficiently accurate.—E. H. Kennard: Entropy, reversible processes, and thermo-couples. A discussion, with two examples, suggesting that the usual statement to the effect that a reversible process never changes the entropy of the universe is valid only when the process can be isolated completely from all other processes.—P. W. Bridgman: Comments on the note by E. H. Kennard on "Entropy, reversible processes, and thermo-couples".—Francis D. Murnaghan: On the field of values of a square matrix.—Aurel Wintner: Remarks on the ergodic theorem of Birkhoff.—E. B. Stouffer: A geometrical determination of the canonical quadric of Wilczynski.—B. O. Koopman and J. v. Neumann: Dynamical systems of continuous spectra.—J. v. Neumann: Physical applications of the ergodic hypothesis.—Edward Kasner: Complex geometry and relativity: theory of the 'rac' curvature. Rac curvature or 'rac' for a given curve is defined as the limiting ratio of arc to chord. For ordinary real curves rac equals unity, but for certain imaginary curves it has other values, the chief of which is $\sqrt[3]{2}$. In space of more than two dimensions, curves can be constructed such that it has any assigned value. In general, the rac curvature changes discontinuously if the point moves continuously along the curve or the curve is varied continuously.—Hassler Whitney: Regular families of curves (1).—G. D. Birkhoff and B. O. Koopman: Recent contributions to the ergodic theory.—J. Shohat and J. Sherman: On the numerators of the continued fraction

$$\frac{\lambda_1}{|x-c_1|} - \frac{\lambda_2}{|x-c_2|} - \cdots$$

Forthcoming Events

SATURDAY JULY 9

SOCIETY OF CHEMICAL INDUSTRY—South Wales Section (Special Joint Meeting with the South Wales Section of the Institute of Chemistry at the laboratories of the Cardiff Gas, Light and Coke Company, Bute Terrace, Cardiff), at 3 P.M.

WEDNESDAY, JULY 13

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting at Nottingham), at 10.15.—Prof. G. T. Morgan: "Ourselves and Kindred Societies" (Presidential Address).

THURSDAY, JULY 14

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting at Nottingham), at 10.—Sir William Pope: "Forty Years of Stereochemistry" (Messel Memorial Lecture).

INSTITUTION OF WELDING ENGINEERS (in conjunction with the Acetylene and Welding Consulting Bureau at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1).—Exhibition of a film dealing with practical applications of oxy-acetylene welding, at 2.30 P.M.

Official Publications Received

BRITISH

Proceedings of the Linnean Society of London, Session 1931-32. Part 3. Pp. 57-72. (London: Linnean Society.) 6*d*.

Empire Cotton Growing Corporation. Report of the Eleventh Annual General Meeting. Pp. 18. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 21: Report of the Irish Radium Committee for the Year 1931; including Reports by Oliver Chance, John A. Geraghty, Oswald J. Murphy, C. Conor O'Malley, Dr. Bethal Solomons, Sir Robert Woods. Pp. 249-266. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. 6*d*.

The Institute of Chemistry of Great Britain and Ireland: Register of Fellows, Associates and Students, 1932. Pp. 396. (London: Institute of Chemistry.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 25: Termites (White Ants) in South-eastern Australia; a Simple Method of Identification and a Discussion of their Damage in Timber and Forest Trees. By Gerald F. Hill. Pp. 28. Pamphlet No. 26: The Irrigation of Horticultural Community Settlements; Notes for the Guidance of Advisory Boards in Murray Valley Settlements. By A. V. Lyon. Pp. 22. (Melbourne: H. J. Green.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 20: Spinning Tests on Mixings of Long Staple and Short Staple Indian Cottons. By Dr. Nazir Ahmad. Pp. ii+21. (Bombay: The *Times of India* Press.) 1 rupee.

The National University Handbook, 1908-1932. Pp. xi+288+50 plates. (Dublin.)

British Non-Ferrous Metals Research Association. Twelfth Annual Report for the Year ending December 31st, 1931. Pp. 54. (London.)

FOREIGN

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 8: Investigations on Coconuts and Coconut Products. By F. C. Cooke. Pp. x+99+9 plates. (Kuala Lumpur.) 1 dollar.

Philippine Earthquake Epicentres (1920 to 1929), South of Manila. By Rev. William C. Repetti. Pp. 35-52. (Manila: Bureau of Printing.)

Smithsonian Institution: United States National Museum. Bulletin 160: Mexican Tailless Amphibians in the United States National Museum. By Remington Kellogg. Pp. iv+224+1 plate. (Washington, D.C.: Government Printing Office.)

Japanese Journal of Geology and Geography. Transactions and Abstracts, Vol. 9, Nos. 3 and 4, March. Pp. 141-266+7-23+6. (Tokyo: National Research Council of Japan.)

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 422: Accelerated Weathering Tests of Soldered and Tinned Sheet Copper. By Peter R. Kosting. Pp. 365-379+11 plates. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 79, Art. 28: Revision of the Chalcid Flies of the Tribe Decatomini (Eurytomidae) in America north of Mexico. By W. V. Balduf. (No. 2894.) Pp. 95+4 plates. (Washington, D.C.: Government Printing Office.)

Spisy Lékařské Fakulty Masarykovy University (Publications de la Faculté de Médecine), Brno. Svazek 11, Spis 109-114. Pp. iii+18+26+76+46+42+158. (Brno: A. Píša.) 40 Kč.

CATALOGUES

The Nickel Bulletin. Vol. 5, No. 6, June. Pp. 121-144. (London: The Mond Nickel Co., Ltd.)

Ornithology. (New Series, No. 28.) Pp. 56. (London: Wheldon and Wesley, Ltd.)

Books relating to America. (Catalogue 550.) Pp. 57. (London: Francis Edwards, Ltd.)

Astronomie. (Catalogue No. 133.) Pp. 160. (Paris: Hermann et Cie.