

761071



NATURE

*"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth*

Vol. 145, No. 3681

SATURDAY, MAY 18, 1940

ONE SHILLING

NIVOC

**LABORATORY
FURNITURE**

Efficient planning
Seasoned wood
Expert joinery

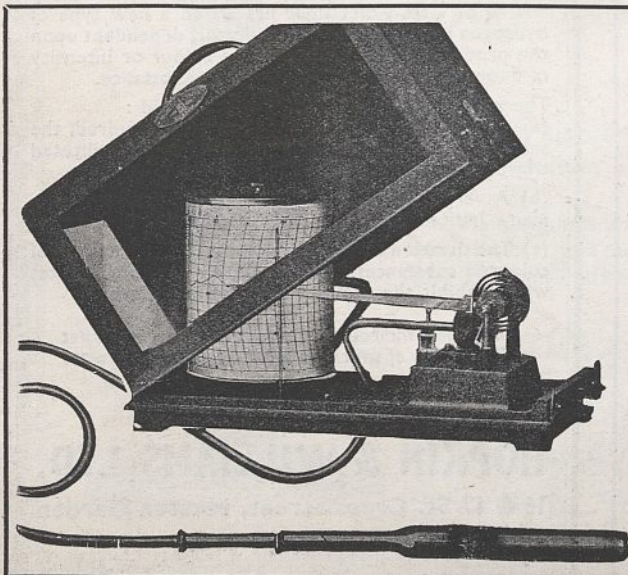
W. & J. George Ltd.
PROPRIETORS OF
F. E. Becker & Co.
LONDON AND BIRMINGHAM

**CHANCE-PARSONS
OPTICAL GLASS**

PLATES AND MOULDED BLANKS
FOR PRISMS AND LENSES OF
FINEST OPTICAL QUALITY

Unworked Coloured Glass for
contrast filters
Sextant shade glasses
Didymium and Uranium Glass

Chance Brothers & Co. Limited
GLASS WORKS SMETHWICK



Temperature Recorders for Air, Earth and Sea

with "micro-bore" capillary
up to 200 feet in length

**NEGRETTI
& ZAMBRA**

38 Holborn Viaduct, London



Fine Chemicals

manufactured by
Boots Pure Drug Co Ltd

ACRIFLAVINE
ASPIRIN
BISMUTH SALTS
CALCIFEROL
CHLORAMINE-T
CHLOROFORM
CITRATES
GLYCEROPHOSPHATES
HEXOESTROL

IODINE RESUBLIMED
MAGNESIUM CARBONATE
MANDELIC ACID AND SALTS
POTASSIUM IODIDE
POTASSIUM PERMANGANATE
QUININE SALTS
SODIUM SULPHATE
STILBOESTROL
SULPHANILAMIDE

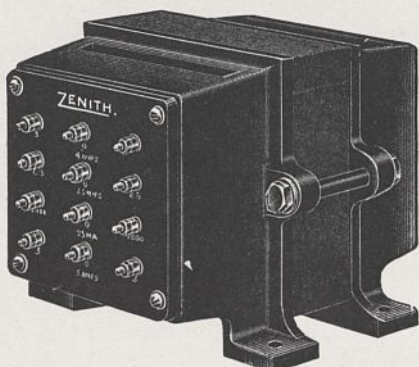
All B.P. products comply with the requirements of the British Pharmacopoeia, 1932, and must also pass exacting tests included in Boots' own specifications.

Quotations for any of the above products may be had on application to the

**Wholesale and Export Dept.,
BOOTS PURE DRUG CO. LTD., STATION ST., NOTTM.**

REGISTERED **ZENITH** TRADE MARK

**TRANSFORMERS
INDUCTANCES & CHOKE COILS
AIR COOLED AND OIL IMMersed
FOR
TEST ROOM AND LABORATORY USE**



Prompt Deliveries—Unequaled Service

THE ZENITH ELECTRIC CO. LTD.

Sole Makers also of the well-known "Zenith" Resistances

ZENITH WORKS, VILLIERS ROAD

WILLESden GREEN, LONDON, N.W.2

Phone: WILlesden 4087-8-9

Grams: Voltaohm, Phone, London

FLUORESCENT INDICATORS

(for acid-alkali titrations in U.V. light)

With the recent accessibility of a satisfactory and cheap source of ultra-violet light has arisen a new type of hydrogen ion concentration indicator, dependent upon the production of a change in the colour or intensity of fluorescence of a suitable organic substance.

The advantages forthcoming are threefold :

- (a) A minute amount of indicator being required, the small errors usually present during an indicated titration are lessened.
- (b) A very sensitive end-point may be obtained with many indicators in titrating deci-normal solutions.
- (c) The titration can be carried out without removal of coloured substances, such as caramel, or precipitates which inhibit the use of quinonoid indicators.

These new indicators are described in our leaflet H21, a copy of which we will be pleased to forward on request.

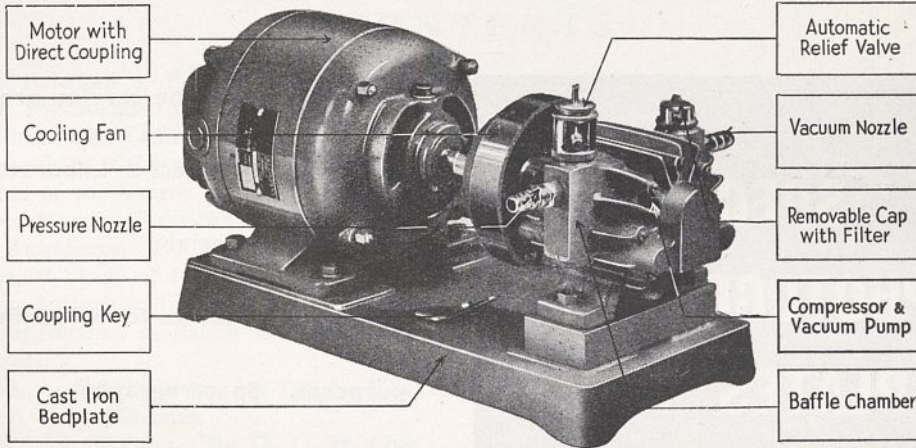
HOPKIN & WILLIAMS LTD.

**16 & 17 St. Cross Street, Hatton Garden
LONDON, E.C.1**

TYPE IV COMPRESSOR and VACUUM PUMP

AN ALL-PURPOSE UNIT FOR EVERY LABORATORY

Vacuum 24 in. Hg. :: Pressure 10 lb. :: Displacement 2½ cubic feet per minute



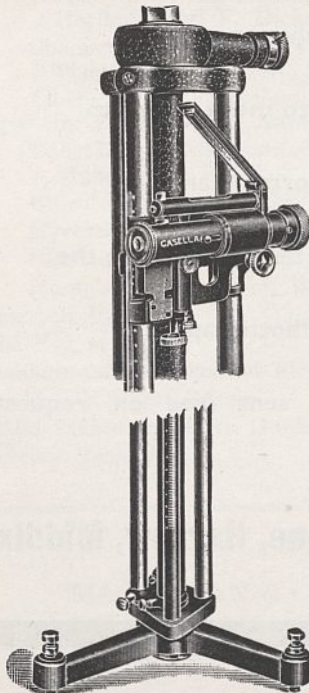
BLOWPIPES—FILTRATIONS—SPRAYING—AIR OR GAS CIRCULATING—ASPIRATING, Etc.

W. EDWARDS & CO. (LONDON) LTD.

Allendale Works, Southwell Road, London, S.E.5

Telephone: Brixton 1195

Telegrams: Edcohivac, Phone, London



UNIVERSAL CATHETOMETER

£38 . 10 . 0

Can also be used as a Comparator, Optical Bench, Galvanometer Telescope, etc.

The main column is surrounded by a cage of three brass rods, one of which carries a metre scale divided to mm. and read by vernier to 0.05 mm. ; ball bearings, clamps and slow-motion adjustments.

¶ "This instrument is not only strikingly versatile, but also, strangely enough, is put on the market at a much lower figure than its more simple predecessor."—NATURE.

C. F. Casella & Co. Ltd, Fitzroy Square, London, W.1

Members Scientific Instrument Manufacturers' Association of Great Britain

A useful Kodak service for scientists

**SPECIAL
PHOTOGRAPHIC
PLATES FOR
SPECIAL NEEDS**

ONE aspect of the service provided by the Kodak Research Laboratory is to supply special photographic plates for scientific purposes. Spectrography, astronomy, infra-red and ultra-violet photography, are examples of fields in which Kodak

Plates are being increasingly used.

Keeping pace with the new applications of photography in scientific work, Kodak Ltd. are prepared to make plates to specification for requirements outside the normal range.

Enquiries for plates for special work should be addressed to the Kodak Research Laboratory; the booklet "Photographic Plates for Scientific Purposes," will be sent free on request.

The Research Laboratory, Kodak Ltd., Wealdstone, Harrow, Middx.

NATURE

Vol. 145

SATURDAY, MAY 18, 1940

No. 3681

CONTENTS

| | PAGE |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Cultural Relations of France and Britain | 757 |
| A Great Psychologist of Sex. By Prof. J. C. Flugel | 759 |
| Atmospheric and Terrestrial Physics | 760 |
| Phenomenology of Literature. By Prof. H. J. Rose | 761 |
| Behaviour of the Uterus | 762 |
| American Nursery Practice. By M. A. H. T. | 762 |
| Animal Hormones. By T. H. Hawkins | 763 |
| Geophysical Study of Submarine Geology. By Dr. E. C. Bullard | 764 |
| Boron in Agricultural and Horticultural Practice | 766 |
| Some Experiments in Rabbit Control. By R. M. Lockley | 767 |
| Obituaries : | |
| Prof. A. G. Högbom. By Dr. L. Hawkes | 769 |
| Prof. V. I. Sihvonen | 769 |
| Mr. J. A. Hobson. By G. D. H. Cole | 770 |
| Colonel C. T. Green | 770 |
| News and Views | 771 |
| Letters to the Editors : | |
| A New Type of Disintegration Produced by Deuterons.—Dr. R. S. Krishnan and T. E. Banks | 777 |
| Calculations on the Energies of Hydrocarbons.—G. J. Kynch, E. H. Lloyd and Dr. W. G. Penney | 777 |
| Structure of the OD Bands of Heavy Water.—Dr. K. R. Rao and M. G. Sastry | 778 |
| The Generalized Kaleidoscope.—Sidney Melmore | 778 |
| Carbohydrate Metabolism of Tumours.—I. Berenblum, Dr. E. Chain and N. G. Heatley ; Dr. F. Dickens and Dr. H. Weil-Malherbe | 778 |
| Chemical Estimation of Vitamin B ₆ in Foods by Means of the Diazo Reaction and the Phenol Reagent.—M. Swaminathan | 780 |
| Liberation of Potassium from Muscle by Acetylcholine and Muscle Contraction and its Absence after Adrenalectomy.—Prof. F. Verzár and J. C. Somogyi | 781 |
| Function of Chlorocruorin in Sabella and of Hæmoglobin in Lumbricus.—Prof. H. Munro Fox, F.R.S. | 781 |
| Bilirubin in Urine.—Dr. Frank Marsh | 782 |
| Mycorrhizal Habit in the Date-Palm (<i>Phoenix dactylifera</i> Linn.).—Younis Sabet | 782 |
| Blind Seed Disease of Ryegrass.—Dr. Malcolm Wilson, M. Noble and E. G. Gray | 783 |
| Humpback Whales off West Australia.—Prof. W. J. Dakin ; George Rayner | 783 |
| Research Items | 785 |
| The Egg as Food | 788 |
| Fundamentals of Classical Electric and Magnetic Theory. By Dr. G. Burniston Brown | 789 |
| Geology in Great Britain | 790 |
| Radio Frequency Wave Guides. By R. L. S-R. | 792 |
| Seventy Years Ago | 793 |

Editorial and Publishing Offices :

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2
 Telephone Number : Whitehall 8831 Telegraphic Address : Phusis, Lesquare, London
 The annual subscription rates are : £2 12 0 British Isles, £2 17 0 Foreign, payable in advance

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4. Telephone Number : City 4211
 Registered as a Newspaper at the General Post Office All rights reserved

KINGZETT'S

Chemical Encyclopædia

A DIGEST OF CHEMISTRY AND ITS INDUSTRIAL APPLICATIONS

Revised and Edited by - - RALPH K. STRONG, Ph.D.

Foreword by - SIR GILBERT T. MORGAN, O.B.E., F.R.S., D.Sc.

Sixth Edition.

Pp. viii + 1088.

Price : 45s.

At a time of national emergency a chemical encyclopaedia becomes more than ever essential, for it gives a concise introduction to the most fundamental of all industries, the chemical trades and manufacturers which subserve the community's needs for food and clothing, shelter and defence. The sixth edition of this work should become as invaluable a handbook of ready reference as were the earlier issues.

BAILLIÈRE, TINDALL & COX

7 & 8 Henrietta Street, London, W.C.2.

Temple Bar 8568/9

New additions to the very popular THINKER'S LIBRARY

Act of God

By F. TENNYSON JESSE. A sparkling work of fiction, noteworthy for its tactful and sympathetic handling of a deep spiritual issue.

The Man v. the State

By HERBERT SPENCER. A penetrating discussion of the problem, peculiarly acute to-day, of safeguarding human liberties. With Introduction by LORD SNELL.

The World as I See It

By Prof. ALBERT EINSTEIN. One of the greatest scientific men of our time here gives his impressions of the revolutionary world in which we live to-day.

Jocasta's Crime

By LORD RAGLAN. The search for a satisfactory explanation of certain sexual taboos general all over the world is here made as exciting as a detective story.

each 1s. 3d. net



WATTS

ISIS

Review of the History and Philosophy of Science and of the History of Learning and Culture, edited by

GEORGE SARTON, S.D.

HARVARD LIBRARY, 185 Cambridge, Mass.

Isis may be obtained from any Bookseller at the price of 6 dollars per volume illustrated. Members of the *History of Science Society* receive each year at least one volume of about 600 pp. free of charge. Annual dues, £1. Corresponding Secretary, Dr. Henry R. Viets, 8 The Fenway, Boston, Mass.

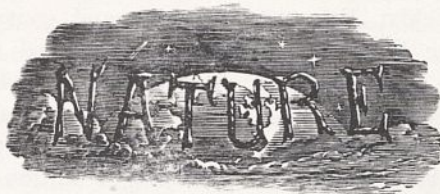
Isis is the foremost journal on the history of science published in the world to-day. It contains articles, reviews, notes, queries, and elaborate critical bibliographies of the history and philosophy of science. Vol. 30 and part of 31 will be published in 1939.

Writers of books and papers on the history of science are asked to send a copy as promptly as possible to the Editor of *Isis* in order that they may be registered in the Critical bibliography. This is the best way of obtaining for their work its certain incorporation into the literature of the subject.

Isis may be examined in any good reference library all over the world.

Editorial & Publishing Offices :

MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2



Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 145

SATURDAY, MAY 18, 1940

No. 3681

CULTURAL RELATIONS OF FRANCE AND BRITAIN

THE cause for which NATURE stands, the disinterested pursuit of scientific inquiry, cannot recognize distinction of race, creed, language or nationality. Wherever the truly scientific spirit is at work, labourers in the intellectual field recognize one another as men and brethren ; and this is still the case, even in the distracted times in which we live. But here a tragic picture presents itself. What we have called the truly scientific spirit is wholly or partly quenched as soon as the lamp of freedom is extinguished. Freedom of thought and expression had been gained at a great price, and after centuries of persecution, in the chief civilized countries of the world. It has been temporarily lost in certain of the traditional and most influential homes of scientific and philosophic culture. In the words of M. Edouard Herriot, the dictators have killed in their countries the spirit of freedom and the idea of human dignity.

It falls, therefore, to the great democratic nations to uphold the banner of freedom. If they are to do so effectively, it must be through a deeper mutual understanding ; and in the long run such a result is really a question of education. It is essentially for that reason that steps have recently been taken by the responsible Ministries in Great Britain and in France to promote a sympathetic understanding of each other's aims and ideals in all educational institutions, and among all branches of the teaching profession, primary, secondary and university. In Great Britain it becomes one of our definite purposes to try to comprehend and appreciate the cultural position of our great ally.

At the close of the War of 1914-18, the general educational position in France closely resembled the position in Great Britain at the beginning of the century. After our Act of 1902, elementary

schools no longer formed a water-tight compartment, having no connexion with secondary schools. But similar conditions remained unchallenged in France another dozen years or more. A French child of six entered either the local elementary school or the preparatory department of the *lycée*. The former was free, but the latter was not, and so at the age of six the educational destiny of the child was fixed, and depended upon the ability of his parents to pay fees. The vast majority of the children of France passed through the elementary schools until the age of thirteen, a small proportion remained for advanced courses, and a very few obtained scholarships at the *lycée* at the age of twelve. The barrier of class and wealth divided the elementary and secondary systems. The fortunate children (about one in ten) who entered preparatory departments at six proceeded at ten or eleven to the *lycée* proper, and at about seventeen took the *baccalauréat*, which gave access to the universities and other places of higher education. The *lycées* provided courses in classics, modern studies, and pure science, and were not vocational in any sense. Elementary and secondary teachers knew as little of each other as if they inhabited different countries. A queer sort of democracy, the reader may say ; however, like our own, it was and it is a democracy with a past.

But a profound educational stir took place during the last War and it is said that the idea of the far-reaching reform known as *l'école unique* was conceived by a group of officers in the trenches on the Western Front in 1917-18. Equal opportunities for all children, without regard to the means of their parents, was the fundamental feature of the reformers' demands. Sympathy and support came from many influential quarters, but

long-established traditions die hard, and root-and-branch reform could not come quickly. For some years after the conclusion of the War the discussion was vigorously continued, and in 1927 a definite scheme was published, taking the form of a parliamentary Bill. It was this scheme which substantially became the law of the land in 1937, when M. Jean Zay was Minister for Education in the Popular Front Government.

The details of the new law, the operation of which is inevitably slowed down by the outbreak of the present War, can here be only briefly summarized. Similar courses of instruction are provided in all schools for children between six and twelve. At the latter age, tests are applied which determine whether a child continues his primary course to a higher stage or starts upon a secondary course. In the latter event he enters the *classe d'orientation* for a year, during which the kind of further education for which he is best fitted is settled. This *classe d'orientation* is from the point of view of British teachers the most remarkable feature of the system, and its working will no doubt be carefully watched, now that opportunities of exchange of duties with French teachers are being increased. In France itself the innovation has been subjected to adverse criticism, but the experiment is being very carefully conducted. This introductory year having been completed, the pupil enters upon a course either in classical or in modern or in technical humanities, the differences between the three being gradually made by increasing emphasis in one of the three directions. The gradual abolition of fees in the case of students who reach scholarship standard brings within sight in France what Mr. Harold Nicolson, M.P., in a recent broadcast talk, has advocated for England—a classless education.

From the point of view of NATURE, perhaps the most interesting and important thing yet remains to be said. Throughout his course, it will be observed, the pupil is engaged upon the humanities, with gradually increasing stress upon the classical or modern or technical side—but always the humanities. In Anglo-Saxon countries, specialization may be carried so far that from a too early age a boy devotes himself so much to what may be found inside a laboratory that, unless his home opportunities are uncommonly good, he may develop into something which one hesitates to call an educated man. From that position the French tradition of general culture is a safeguard. The

more one studies the history of educational changes and controversies in France, the more deeply impressed one becomes by the steadfast adherence of the French mind to that tradition. For three centuries, including the Revolution, the Napoleonic era and the Restoration, the old classical tradition remained intact, partly to secure secondary education as a privilege for the upper and middle classes, but partly also because nothing satisfactory was found to take its place. A change was bound to come, as Matthew Arnold foresaw in 1865, but it came slowly. The legacy left by the classical tradition is seen in the continued determination that French culture, which led the way in Europe for centuries, shall be preserved. To quote Prof. Kandel, an American authority on comparative education, it is through “*études désintéressées*” (general studies), that French secondary education “aims to cultivate judgment, taste, appreciation, and an ability to think clearly and logically. . . . More concretely expressed, the measure of a sound liberal education is the ability to speak well and to write well, as the outward indication of clear thinking”.

More recently, Prof. Kandel has, in his capacity as editor of the 1939 report of the International Institute, Teachers College, Columbia University, brought together two statements by distinguished Frenchmen on the meaning of a liberal education in France in the twentieth century. One of these authorities, the Director of the *École Normale Supérieure*, though making concessions to the modernists, ends by declaring that the advocates of a liberal education based on a general classical culture, if they must yield any territory, will put up a fierce resistance, relying on a tradition of which France is proud. The other, a professor at the *Lycée de Versailles*, and general secretary of *Les Compagnons de l'Université Nouvelle*, equally maintains that a liberal education should subordinate the acquisition of knowledge to the task of so educating the mind as to enable it to attain to as broad and deep a culture as possible. But he denounces the exclusively literary tradition as exhibiting a blind faith in a single ideal supposed to lie beyond discussion. He charges the advocates of that tradition with showing profound ignorance of the vast extensions of the human spirit as a result of the development of experimental sciences since the sixteenth century, and with slighting “the remarkable educative value of the use of the experimental methods for intellectual training”. We think the flowing tide is with the modernists.

There, however, we must leave the matter, trusting to have said enough to suggest the immense importance of supplementing the defensive and economic relations of Great Britain and France by a better understanding than ever before of the educational aims and aspirations of the two countries. As M. Sarraut has recently said to the educational leaders of France, the spirit of sympathy and cordiality for the people of the Allied

countries must be created among all young people from school children to university students. There can, he wisely added, be no question of exercising any pressure in influencing their minds. Neither familiarity nor affection can be imposed. But we can prepare the ground which favours their development, and this is less perhaps a matter of direct teaching than of providing opportunities of bringing about an intuitive understanding.

A GREAT PSYCHOLOGIST OF SEX

My Life

By Havelock Ellis. Pp. xviii + 542 + 8 plates. (London and Toronto: William Heinemann, Ltd., 1940.) 15s. net.

HERE we have the life-story of one who, with many other literary and cultural achievements to his credit, will be known above all as the man who made it his chief work to bring sanity into the sphere of sex and to remove those taboos which had hitherto kept sex so largely outside the pale of impartial scientific thought. This autobiography is no mere product of the author's declining days; it is the fulfilment of a project formed in early life, a project that, like all his other enterprises, came slowly but steadily to fruition, being written at what he judged to be the most favourable moments from the age of forty onwards. Ellis indeed held autobiography in high esteem; it was his view that "of all forms of prose, outside the limits of imaginative art, there is no other form so precious in its nature and so permanent in its value". There can be little doubt that the book does well and truly fulfil its author's purpose. Although it is unlikely that it will ever be considered one of the world's very few imperishable monuments of self-revelation, it yet provides a sympathetic and illuminating picture of a delicate, sensitive and philosophic being, who was willing to accept himself with the capacities and limitations that Nature had provided, and who understood well how to reconcile himself to his limitations and to make the most of his capacities—a task that few accomplish with so good a grace and in such ample measure.

More than half of the book is concerned with the years of his marriage, and this provides a fascinating study of the long union of two very dissimilar personalities—the retiring, methodical, introvert Havelock, and the gifted but tempestuous

extravert Edith (née Lees) who was his wife—a union further complicated by the existence of a strong homosexual tendency in the latter partner, though at the same time one that was firmly cemented by a deep personal affection and a lively common concern for the welfare and progress of humanity. With the death of Mrs. Ellis in 1916 (after an illness that affected both her mental and her physical health) the detailed story ends, and but a few pages are devoted to the remaining twenty-three years of his life. His marriage ended and his major self-appointed task accomplished (the last of the six original volumes of the "Studies in the Psychology of Sex" was completed in 1910, though a supplementary seventh volume appeared in 1928), he felt he had drunk deeply of the well of life and could afford to enjoy in relative tranquillity such years as yet remained. These years, filled with loving companionship, with tender memories, and with the sense of a task well accomplished and in its outcome successful beyond all expectation, were very happy ones, and the book ends on a note of optimism that nowadays is rarely to be met with. In an age in which we are beginning to look back with nostalgic longing to the calm days of the later nineteenth century, it is cheering and refreshing to realize that, in the eyes of one who lived and strove in those days, our modern world, for all its insecurity and manifest disorder, holds many compensations—compensations which to Ellis were the greater in as much as he felt that he himself had contributed to their existence.

Many readers will regret that the book does not deal more fully with the author's intellectual development and the emotional factors underlying it. We are, it is true, told how, as a young man of about twenty, he had already dimly formed the project which afterwards found fulfilment in his *magnum opus*. Looking back some fifty years he

recognized that "here had come a youth whose impulse it was to intellectualize and moralize his own personal situation, thereby transferring it into an impersonal form and universalising it"; but we learn all too little as to how his thought developed as the work progressed. We know of the paramount importance of the writings of James Hinton for his early years, but we are told almost nothing about his reactions to the great movements, events and figures of his own time; there is no mention, for example, of his great contemporary Freud, whose work lay so largely in the same field

as that of Ellis himself. For more enlightenment in these directions, we would perhaps willingly have sacrificed some of the rather speculative reflections on hereditary influences that fill a good many of the early pages and some of the letters to and from his wife that are found in such abundance in the later chapters. But an autobiographer has clearly the right to say what seems to him of chief importance, and, taken all in all, this book constitutes a worthy monument to a noble and prolific life.

J. C. FLUGEL.

ATMOSPHERIC AND TERRESTRIAL PHYSICS

Physik der Atmosphäre

Herausgegeben von V. Conrad. Bearbeitet von J. Zenneck, Rudolf Steinmaurer, P. Gruner, H. Landsberg, F. W. Paul Götz. (Ergebnisse der kosmischen Physik, Band 3.) Pp. xi + 333. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 32 gold marks.

Gerland's Beiträge zur Geophysik, Supplementband 4

Ergebnisse der kosmischen Physik, Band 4: Physik der Hydro- und Lithosphäre. Herausgegeben von V. Conrad. Pp. x + 293. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1939.) 31 gold marks.

IN 1931 appeared the first volume of the series "Ergebnisse der kosmischen Physik mit Einschluss der Geophysik", being a supplementary volume to Gerland's "Beiträge zur Geophysik". It contained a series of excellent articles, on the aurora, cosmic rays, ozone, sound propagation, the earth's figure, and wave-motions. A second volume appeared in 1934, containing articles on glaciers, atmospheric ionization, gravity, seismology, cosmic rays, and earth faults. These two volumes, edited by Conrad and Weickmann, were finely produced by the Leipzig Akademische Verlagsgesellschaft.

Two new volumes have since appeared, produced in the same fine style as before, under the sole editorship of Conrad, now in the United States, a refugee from Austria. The price-level remains at the high figure which practically precludes most readers from possessing copies of their own, and forces them to resort to library copies (perhaps consoled by the reflection that the contributors' remuneration was probably more generous than is usually accorded to those who perform this valuable public service of reporting

on developing topical branches of science). The quality of the contributors and their work also preserves substantially the standard of the two previous volumes. A somewhat different plan of editing has been followed, however, in that volume 3 deals exclusively with atmospheric physics, and volume 4 with non-atmospheric subjects.

Volume 3 contains five articles; the first, written by Zenneck with much freshness and lucidity, is on the ionosphere (37 pp.), the second (75 pp.), by Steinmaurer, on cosmic ray studies during the years 1933-37, the third (42 pp.), by Gruner, on dawn phenomena, next a small treatise, by Landsberg, on condensation nuclei (98 pp.), and finally a continuation (73 pp.), by Götz, of his excellent article on ozone in volume 1. Each article contains its own bibliography, which in most cases ends with 1937 references; there is, for example, no reference to mesons and their instability, in connexion with the barometric effect on cosmic rays. There is an authors' index to the whole volume, but no subject index. Similar remarks apply to volume 4.

Volume 4 opens with a 74-page article by Ekman on convective streams in the oceans; the remaining articles deal with the physics of the solid earth. Jeffreys discusses deep-focus earthquakes (31 pp.), Tsuboi writes on crustal deformations as indicated by geodetic measurements (63 pp.), Gutenberg on the development of seismic prospecting methods (50 pp.), and the volume concludes with a somewhat curious article (71 pp.), by Fritsch, on "the structure and properties of geological conductors", dealing with their electrical resistivity, earth currents, and the underground reception of radio waves.

All the articles are written in German except three—those by Landsberg (volume 3) and by Jeffreys and Tsuboi (volume 4)—which are in English.

PHENOMENOLOGY OF LITERATURE

The Growth of Literature

By H. Munro Chadwick and N. Kershaw Chadwick.
Vol. 3. Pp. xxvi+928. (Cambridge: At the University Press, 1940.) 35s. net.

THIS bulky and well-printed volume concludes the ambitious enterprise of its authors to give a history, illustrated by abundant examples, of the origin and growth of literature from what they call the 'heroic' ages of various peoples down to the time when, owing to the general knowledge of reading and writing and the improved communications between different nations, compositions, whether intended to instruct or delight, take on the forms with which Europe has been familiar, at least in its more civilized regions, for the last couple of millennia. In short, the work deals largely with that literature which existed, and here and there continues to exist, without the aid of letters or with but a minimum of help from them.

Having examined the early European literatures in the first volume and those of India, the Hebrews and the Slavs in the second, the authors devote this third volume mostly to a survey of the 'oral' literatures of the Tatars, the Polynesians, with some twenty pages added to sketch that of the Ibans or Sea Dyaks, and a few African peoples. With that frankness and lack of pretence which is one of the best features of their work, they point out their own involuntary deficiencies, the causes of which range from the difficulty of procuring from Russian booksellers recent monographs on Tatar culture to the sheer non-existence of records of the doings of many African peoples, at least so far as their songs and stories are concerned. It has been indeed a defect of many collectors that, when getting together material from their chosen fields, they have paid attention too exclusively to folk-tales (not noticed in this work, as being in their nature international) and not sought as diligently as they might for beginnings of higher forms which might one day develop into epics or hymns, the products of courtly or priestly circles. But with these defects, and others which must needs arise in a treatise covering so many linguistic areas, the work is still a most valuable repository of well-commented information on its subject. It may claim to be the most complete account yet given of what may be styled the phenomenology or typology of literature, within the limits of study which the authors have set themselves.

It may, however, be questioned whether it is in

any proper sense a history of early literature, or indeed whether such a history is possible for anyone, however learned, to produce in the present state of our knowledge. We are shown abundantly that the various types of composition examined (there is an elaborate classification, repeatedly explained, of the different *genres*) exist in sundry parts of the world. We are given several short specimens of each type from each area and good synopses of other works. Speculations are modestly put forward as to the conditions favourable to their growth and the kinds of society which produced them. Here and there (as on p. 409, which discusses the affinities of Polynesian and Japanese poetry) we are at least furnished with material for investigating a historical connexion between one area and another. The question of diffusion or polygenesis is fairly faced, more than once (as on pp. xxiii, 216-18, 495-6).

All these are necessary steps toward constructing a history of early literature, but not yet the history itself. It may be seriously doubted whether the most diligent student of the book could write an accurate sketch of the process by which, given a certain environment, this or that type might be expected to appear, the conditions under which it would naturally give place to another and the extent to which it will co-exist with a third. Indeed, since the subject is the doings of man, which are in the last resort unpredictable, it is reasonable to doubt whether such a feat will ever be possible. But, even with the help of the last two hundred odd pages of this volume, devoted to a "general survey" of the subject, it is scarcely true that the less ambitious task of showing how, in fact, the literary forms have hitherto come about has been completed.

This is not meant to be derogatory to the authors; it merely states that they have not achieved what the reviewer believes to be impossible. Some part of that task they have accomplished, and this is no small praise. They have shown, for example, that 'heroic' poetry, that of more or less epic type, is the offspring of what they call 'heroic' society, for example, that stage of barbarism in which the ruling class is warlike, predatory and as a rule illiterate. Its necessary subject-matter appears to be raids and wars waged at least partly with a view to plunder, with elementary tactics and strategy, giving much scope for the courage or cunning of the individual chieftain. It is, however, the fact

that they have pressed this principle too far, and come out to some theories of the growth of the "Iliad" and "Odyssey" (see p. 770), which confuse the activities of the Ionian Homer, a man of comparatively high civilization, with those of the ruder minstrels who went before him. That is to say, they confound the early literary epic with the hero-ballad or the nascent epics to which it often gives rise. On p. 886, when the authorship of certain kinds of oral literature is referred (correctly, no doubt, for many countries) to a priestly class,

it is forgotten that no such class existed in Greece. If this were a classical journal, some other inadequacies in this sphere might be pointed out; here it is enough to say that they are small and not very numerous, quite outweighed by the abundant light thrown on that and other areas.

In short, where the authors succeed, they deserve their success; where they seem to the reviewer to have failed, it is doubtful whether any amount of diligence or erudition would have done better.

H. J. ROSE.

BEHAVIOUR OF THE UTERUS

Physiology of the Uterus

With Clinical Correlations. By Prof. S. R. M. Reynolds. Pp. xx + 447. (London: Hamish Hamilton, Ltd., 1939.) 42s. net.

THE publication of a book entirely devoted to the behaviour of the uterus is an index of the remarkable advances that the last few years have seen in knowledge of reproductive physiology. Dr. Reynolds is a distinguished investigator of the problem of uterine motility, and while this topic is given great prominence, it cannot be said to be over-emphasized, and an excellent balance is maintained throughout the book between all aspects of uterine physiology.

The monograph opens with a brief account of the topography and anatomy of the Fallopian tubes and uterus, and with a description of the various patterns of contractility to which they are subject in the non-pregnant, pregnant, and parturient individual. The hormonal and other

factors which control these patterns are then discussed, after which the author deals with the problem of uterine growth, laying particular emphasis on the nature of the growth which occurs in pregnancy, and on the factors responsible for it. The circulatory changes which take place in the uterus, their hormonal control, and their relation to the process of menstruation are reviewed in detail, and the problem of uterine metabolism is also dealt with. The book closes with a section devoted to the hormonal therapy of uterine disturbances.

The volume is a notable record of the scientific advances that have been made in the laboratory study of a subject which until recently has been the domain of clinical gynaecologists only. There can be little of value in the literature which has been overlooked by Dr. Reynolds, and his achievement may well serve as a stimulus and a model for further reviews of other fields of endocrinology and reproductive physiology.

AMERICAN NURSERY PRACTICE

Propagation of Horticultural Plants

By Guy W. Adriance and Prof. Fred R. Brison. (McGraw-Hill Publications in the Agricultural Sciences.) Pp. ix + 314. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 20s.

THIS is a new American text-book dealing with the various methods employed in the multiplication of cultivated plants. After a short elementary introduction to the structure and function of plant organs, including the flower and its parts, chapters are devoted to 'layerage',

'cuttage', 'graftage', and other methods. Throughout, the text reads clearly; the descriptions are brief and direct. Modern methods are advocated, and the necessary equipment for carrying out the work is always described. However, the allocation of space is somewhat uneven; for example, the propagation of lilies, investigated and reported upon in America, is more fully dealt with in the text and by illustrations than that of hyacinths, studied by the Dutch, of which there is but brief mention and no illustration. Also the index contains no references to hyacinths. Root cuttings,

leaf cuttings, and the propagation of ferns from spores are not dealt with.

Common names of American plants and diseases are frequently used. These may be unfamiliar to some English readers; the legends to Fig. 105 and Fig. 106, to which no further reference in the text is made, read "A live oak top growing on a post oak rootstock" and "Upper part of this tree is live oak, top worked on to a post oak". In both illustrations posts are also shown, so that some confusion may arise, for every reader will not realize that *Quercus Virginiana* and *Q. stellata* are the plants concerned.

There is a useful chapter dealing with the relation of propagation practice to diseases. This could,

with some advantage, be extended to include more pathology, for "Phony peach" conveys little, and the reader is not informed that it may be a virus disease. The grape root louse (*Phylloxera*) and woolly aphis are included in this chapter on 'diseases'.

There are selected short lists of references, most of which are to American publications, for the several chapters, but the questions at the end of each chapter are of doubtful value. The index would be improved by the inclusion of Latin names. As it briefly surveys a wide field, this will prove a useful book for students desirous of learning the outlines of American nursery methods.

M. A. H. T.

ANIMAL HORMONES

Hormones in Invertebrates

By Prof. Bertil Hanström. (Monographs on Animal Biology.) Pp. x+198+13 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 12s. 6d. net.

OF recent years increasing attention has been paid to invertebrates to determine whether they provide evidence of chemical correlation similar to those hormonal reactions that are now recognized as being of tremendous physiological and philosophical importance in the life of man and other vertebrates. Even in 1933 the view was held by some workers that no clearly demonstrated incretory activity in invertebrates, nor any demonstrable influence of vertebrate hormones on invertebrates, had up to that time been found.

Since that time an ocean of endocrinological investigations has been charted, and here Prof. Bertil Hanström has found it useful to present in collated form a more or less complete summary of what is known at present about hormonal reactions in invertebrates. It is now realized that in invertebrates the presence of several incretory organs and many physiological processes cannot be explained without adopting the hypothesis of hormonal action. These investigations show that the previously accepted definition of a hormone as a substance which is secreted into the blood-stream by an endocrine organ, and which exerts a specific effect at another place in the body, is no longer tenable. The absence of blood in many invertebrates and the production of hormonal substances not in incretory glands but in portions of organs the chief function of which is quite other than

hormonal, the hypotheses of 'gene hormones', 'growth hormones', 'wound hormones', 'organizers', etc., are evidence that a new hormonal concept should be adduced. In this work Hanström has accepted Köller's hypothesis of considering a hormone as an organic substance which is produced by the organism for its own use, and which has a specific regulatory function within it. As the author suggests, it is clear from the evidence already obtained, which is set out so lucidly in this monograph, that at least some invertebrate hormones may one day be used for important experimental and perhaps pharmacological purposes in vertebrates, including man.

The value of this book to endocrinologists no one would gainsay, but for the non-specialist it is lacking in appeal. In addition to presenting this comprehensive epitome of present-day knowledge, the author might have attempted to introduce a little hypothetical argument when discriminating between apparently diverse statements of fact. For this reason the book, which deals with a fascinating topic, loses a great deal of its attraction for the non-endocrinologist.

The literature index is comprehensive and up to date, but since a considerable portion of the book is given over to the discussion of the influence of vertebrate hormones on invertebrates, it is surprising that the author has omitted any reference to Szent-Györgyi's work on the relations between hormones, vitamins and enzymes. Some original plates make up a volume that must remain as a source-book of information for some time. Incidentally, the book is the first of a new series of monographs on animal biology.

T. H. HAWKINS.

GEOPHYSICAL STUDY OF SUBMARINE GEOLOGY*

BY DR. E. C. BULLARD,

SMITHSONIAN RESEARCH FELLOW OF THE ROYAL SOCIETY

TWO thirds of the earth's surface are covered by water. Our direct knowledge of the geology of this area is derived from samples obtained by lowering grabs and similar instruments on to the sea bottom. To realize the inadequacy of this evidence we have only to consider how little we should know of the past history and structure of the continents if our information were confined to that which could be obtained from a few thousand samples of surface soil collected from points scattered over the earth. In recent years a number of methods have been developed for finding out something about the form, constitution, and structure of the rocks hidden beneath the sea. These methods form part of geophysics, that is to say, they involve the application of techniques derived from physics to solve problems about the earth.

By merely examining a map of a piece of country, it is often possible to say something of its more recent history, for the form of the surface is a consequence of its constitution and history. Further, an adequate map is an essential basis on which to plot lithological and structural information.

The first problem of submarine geology is therefore to devise methods of making maps of the ocean with a detail and accuracy comparable with the maps of land areas. In doing this, two things have to be determined, (a) the depth of the sea, and (b) the position at which the depth is measured. The measurement of depth is easily and rapidly carried out with the echo sounder. In the type of instrument developed by the Admiralty, a pulse of supersonic sound is produced by a magnetostriction oscillator attached to the bottom of the ship. The sound travels to the bottom of the sea where part of it is reflected. The reflected part returns to the oscillator, which acts as a microphone and records the arrival of the pulse on a moving piece of paper. In this way a continuous record of the time taken for the echo to return can be made, and if the velocity of sound in sea water is known, this gives a continuous profile of the route over which the ship has steamed.

The determination of the position of the ship when the sounding is made is considerably more difficult if the ship is out of sight of land. Wind and currents soon cause a course steered by dead

reckoning to become uncertain by several miles, and astronomical position finding can involve considerable errors and is not always possible. To overcome these difficulties the method of 'taut wire' control has been developed. In this method a number of mutually intervisible buoys are laid, and the distances between them determined by running out piano wire from a drum on the ship and measuring the length run out by passing it over a measuring sheave. This method gives an accuracy of the order of one in a thousand, but is too elaborate to use for any purpose beyond the fixing of the positions of a few control points for use in the detailed survey. The position of the ship when taking a sounding may be found by observations on three buoys in known positions, but this requires good visibility and a close network of buoys.

To obviate this difficulty, the United States Coast and Geodetic Survey has developed the method of 'radio-acoustic ranging'. A small bomb is thrown from the ship the position of which it is desired to determine. The sound from the bomb travels through the sea and actuates a microphone suspended from a buoy. The microphone is connected to a wireless transmitter in the buoy which signals the instant of arrival of the sound. Thus, if the original explosion and the arrival of the wireless signal are recorded on the ship, the time interval between them will give a measure of the distance of the ship from the buoy. If there are two or more such buoys in known positions, the position of the ship may be found with an accuracy of a few tenths of a mile. In the practical application of this method, a bomb is thrown overboard about every six minutes, so that the position of the ship is found about once every mile. In the past few years, the greater part of the waters around the United States have been mapped by such methods out to the thousand-fathom line.

The seas around the continents almost invariably consist of a comparatively shallow 'Continental Shelf' sloping very gently to 100 fathoms in a distance of 50-200 miles, that is, with an average slope of a tenth to a fortieth of a degree. At about the 100-fathom line, the slope suddenly steepens to about 4°, and in a few miles the sea deepens to 1,000-2,000 fathoms. The American surveys give a map of this area on a scale of two miles to one inch. These maps have brought to light several remarkable features. First, there is

* Substance of a Friday Evening Discourse delivered at the Royal Institution on April 26.

a very sharp demarcation between the shelf and the slope at its outer edge; when sailing outwards from the continent the sudden change of slope is very conspicuous on the echo sounder, and its start can be placed on the record within a few hundred yards. Secondly, the sloping edge of the shelf is cut into by a remarkable series of submarine valleys. The existence off the coast of America and elsewhere of these valleys has been known for many years, but it is only recently that much attention has been paid to them. They are steep-sided features generally with flat bottoms, often lying several thousand feet below the level of the sea bottom on each side.

The origin of these features has been the subject of considerable controversy. It has been maintained that they were cut by rivers at a time when the level of the sea was much lower than at present. The recent surveys, which show the valleys to extend to the 1,000-fathom line, make the necessary lowering of the sea so great that this hypothesis must be abandoned. The difficulties of supposing the land to have been raised 6,000 ft. and lowered again are no less severe. Such a change must have left its mark on the flat-lying sediments of the coastal plain and have caused changes in the drainage which would be apparent in the present-day physiography. We are therefore compelled to believe that the valleys were formed under the sea. Unfortunately, very little is known of submarine erosional processes, largely owing to the lack of detailed surveys and to our scanty knowledge of the nature of the rocks forming the submarine topography.

It is, in fact, not possible to discuss these questions profitably without more information about the nature of the rocks forming the sea floor. Cores up to ten feet long have recently been secured from these rocks by firing a tube into the bottom from a gun lowered from a ship. Such methods are of great importance, but we can scarcely hope to obtain by their aid information about rocks more than a few tens of feet below the bottom of the sea. To penetrate deeper, indirect methods must be used. The most promising of these is the seismic method. In this, charges of explosive are detonated on the sea bottom and the elastic waves produced are recorded by seismographs also placed on the bottom. When an explosion is made, waves spread out from it in all directions, and from the time taken for the waves to travel a known distance their velocity may be found and an indication obtained of the nature of the rock through which they have travelled.

Reflexions of waves from the interfaces between hard and soft rock may also be observed. If a layer of a soft rock in which the velocity of the waves is relatively slow overlies a hard rock in

which the velocity is high, it is possible for a wave to travel down to the hard rock, along in it, and up again in a shorter time than it can traverse the direct path through the soft rock. It is on the observation of such 'refracted' waves that the work done at sea depends. Measurements have been made off the eastern coast of the United States, and to the west of the British Isles, with broadly similar results. In the case of the British Isles, igneous and well-consolidated sedimentary rocks are exposed on land, and measurements at sea near the shore show them to be covered by only a few feet of recent sediments. On going farther from shore the thickness of the sediments increases steadily until at the 100-fathom line about 150 miles out to sea, the hard rocks are buried beneath more than 8,000 ft. of sediments. Beyond this it was not possible to go with the facilities available, but if the surface of the hard rock be extrapolated for a few miles, it runs over smoothly into the floor of the deep ocean.

It therefore seems that the Continental Shelf is a mass of sediments lying on a gently sloping surface of solid rock, and that the edge of the shelf is simply the edge of the sediments and does not represent a fault line dividing the ocean from the continent. This suggests that the Continental Shelf is growing seaward by deposition of the sediments worn from the land, the level of its surface being determined by the level at which the sediments can just rest without being disturbed by currents and wave motion. If this picture be correct, a particle of sediment brought down by a river is washed hither and thither on the sea floor until at last it comes to rest beyond the edge of the Shelf in water so deep and still that it can no longer be moved. It is probable that such a process would result in the deposition of sediments at an angle too steep for stability and that landslips would occur producing the jumbled topography typical of the edge of the Shelf. Great masses of rocks showing signs of contortion while plastic would also be produced; such rocks have been found in many parts of the world, and may well have been produced in this way.

Measurements of gravity over the Continental Shelf should also give useful information. Unfortunately, only a few measurements have so far been made; these show, rather unexpectedly, that the sediments are in isostatic equilibrium; that is to say, the crust has sunk under their weight, until it is in equilibrium.

Present technique can give much information about the geology of the shallow seas, but these form only a small proportion of the whole. The outstanding problem is to develop accurate methods of position-finding far out at sea, so that accurate surveys can be carried out in mid-ocean,

and to develop a variation of the seismic method that can be used in deep water. A start has been made with this work, and when conditions again allow experiments at sea, there is little doubt that rapid progress will be made. The problems to be studied are of great importance for geology. The mapping of a section of the mid-Atlantic Ridge, for example, together with determinations of the velocities of elastic waves in it, could not fail to yield results of great interest. We know already that it includes features which are on a scale

comparable with the Himalayas, and such a survey would indicate whether these mountains were a folded range that had never been exposed to denudation, a sunken land mass, or a system of submarine volcanoes. The major rival geological theories, such as the permanence of ocean basins and Continental Drift, involve theories about the oceans. As they are derived almost entirely from data obtained on land, the study of the other two thirds of the earth's surface may be expected to be illuminating.

BORON IN AGRICULTURAL AND HORTICULTURAL PRACTICE

DURING the past year some three hundred and fifty papers and articles relating to the uses of boron compounds in agriculture and horticulture were published in twenty-one different countries. Nearly half of these contributions were made in the United States, where the rapidly growing interest in the subject was particularly marked. According to a recent report, boron investigations covering a wide range of soils and crops are now in progress in at least twenty-six American States. Important among the new findings published in the United States during the year was the efficacy of applications of boron to the soil in controlling canker disease, also termed girdle or internal black spot, of table or canning beet. The disorder appears to be closely related to heart rot, the well-known boron deficiency disease of sugar beet and mangolds. Canker is said to be very prevalent and of considerable economic importance in the canning beet growing districts in the States of New York, Michigan, Oregon and Wisconsin. Its presence has also been observed in Washington State.

The beneficial use of boron on daffodils was reported from North Carolina, and further advance was made in New York State in the study of internal bark necrosis of apple trees and its control by the application of boron. A first progress report on drouth spot of prunes was also issued in the latter State. The first recorded instance of boron deficiency in cabbage and related crops, under field conditions, was reported from Wisconsin. The disorder, an internal breakdown of the stem in the region of the core, was largely controlled by the application of boron. In Florida, the condition of citrus trees in several groves is considered to suggest a lack of boron. An investigation of this possibility has been begun. An apparently new disorder of tomato plants, experienced in New Jersey, and characterized by a form of yellowing of the leaves, was controlled by suitable applications

of boron. In the same State, the first recorded symptoms of boron deficiency in roses grown in sand cultures were described.

Three important reviews of literature were published in the United States during the year. The first supplement to the American Potash Institute's Bibliography of Literature "Boron as a Plant Nutrient" was issued in May and listed 171 papers reviewed during the period July to December, 1938. The Chilean Nitrate Educational Bureau Inc., New York, published the third edition of its well-known "Bibliography of References to Literature on the Minor Elements". This lists 449 papers relating to boron. A booklet entitled "Boron in Agriculture", published by the Pacific Coast Borax Company, New York, presents a concise and well-illustrated review of work conducted in the United States and Canada.

In New Zealand and Australia the list of crops which may suffer from boron deficiency under field conditions was also extended. In the former country, workers at the Cawthron Institute found that a disorder of apricot fruits, which is sometimes prevalent in the orchards there, is due to lack of boron and can be controlled by the addition of boron to the soil or by spraying it on to the tree. The disorder in question has been termed 'brown spotting'. Further investigation of the subject is in progress. In Queensland, Australia, a condition of young pineapple plants, known as 'crookneck' (so called on account of the manner in which the heart leaves are twisted) was largely controlled by spraying the plants with boron. Progress was reported from New South Wales concerning the investigations being conducted there on needle fusion of pines. The application of boron to diseased trees has given complete or partial recovery in some cases, but in others has so far been without result. This disorder of pines also received further attention in Great Britain, where it was shown that the leaves of affected trees contained

consistently less boron than did those of healthy trees. The results of additional investigations concerning the control of brown heart of swedes in New Zealand by the use of boron were reported. It was stated, too, that the use of boron for the control of cork disorders of apples in New Zealand is likely to have wide application in the Alexandra district of Central Otago.

Other notable contributions came from the Dutch East Indies and Holland. The symptoms of boron deficiency in coffee have been studied at the Besoeki Experiment Station in Java, and similar investigations on potatoes under both laboratory and field conditions were carried out in Holland. French workers extended their investigations to a study of the boron content of various types of soil, and have published their first results. Work in Canada related to swedes and turnips more particularly, and the use of boron there on additional crops is now being studied.

The Institute for Tobacco Research of the German Reich has investigated the essential nature of boron for the healthy growth of tobacco. As a result boron has been applied to its tobacco fields for some years, with good results. The well-known German worker, Brandenburg, published early in the year a review in German of available information concerning the use of boron in plant nutrition, with special reference to his own investigations. It was also reported from Germany that the production of borated superphosphate for use on the sugar beet crop in 1938 was 30,000 tons, compared with

20,000 tons in 1937. Another noteworthy feature was the publication by several workers in the United States, in Germany and in Great Britain of methods relating to the determination of boron in soils, plants and fertilizer materials.

Important developments, in addition to those already mentioned, took place in the British Isles. Further successful results relating to the control of brown heart in swedes and turnips by the use of boron were reported from Northern Ireland, the north-east of Scotland, and the north-west of England, in experiments carried out in 1938. These were the first investigations in the areas concerned. The disease was also reported to have been prevalent in Devon and Cornwall. In an experiment in Scotland in 1938, boron (applied as 'Boronite') gave a large measure of control of internal rust spot of potatoes.

Special mention must also be made of the publication early in the year, of the third of the reviews "Boron and Plant Life" (*Fert. Feed. J.*, February-April, 1939.) This review, written by A. C. and R. W. G. Dennis, summarized developments reported in some two hundred papers during the latter half of 1937 and in 1938. The article was later published in French.

The foregoing is naturally only a brief outline of some of the more important items of information reported. It may serve, however, to indicate the wide range and extent of investigational work on boron now in progress and to record the more important advances recently made.

SOME EXPERIMENTS IN RABBIT CONTROL

By R. M. LOCKLEY,

SKOKHOLM ISLAND, PEMBROKESHIRE

ATTEMPTS have been made over a period of twelve years to control and if possible exterminate the wild rabbit *Oryctolagus cuniculus* on the island of Skokholm, Pembrokeshire, so as to reserve pasture for other livestock.

Skokholm is composed almost entirely of Old Red Sandstone rising to an average height of 100 ft. above sea-level, is rock-bound, and often inaccessible in bad or moderate weather owing to its exposure to the strong Bristol Channel tides and the open Atlantic. The island was once a general farm (1800), but is now covered with rough grazings of rabbit-worn turf, heather, bracken and thrift. There are about 200 acres of rough grazings and some 42 acres of broken-up cliff ground and outcropping rock. So far back as 1324 rabbits were marketed from the island

("Inquisition post mortem" of Aymer de Valence, Earl of Pembroke. 18 Edward II, No. 75), and later records show no break in the occupation of the island by rabbits up to the present day. This isolation in an exposed situation over centuries has produced a type weighing about four ounces less than the typical rabbit on the mainland of Pembrokeshire, from which the present-day Skokholm rabbit further differs in possessing a more plentiful admixture of black hairs on its upper parts.

The broken-down nature of the cliffs affords ideal refuge in the heaped-up boulders and talus, and makes control work difficult. While, owing to the use of all holes and burrows on the island by nesting sea-birds over a protracted breeding-season, treatment of burrows has to be confined to the three months November-January.

MECHANICAL CONTROL

During 1927-28, twelve dozen steel-toothed traps in daily use caught 2,415 rabbits—approximately two thirds of the estimated population. In 1928-29, twenty-four dozen traps and 120 wire-noose snares caught 2,908 rabbits, again leaving about one third on the ground. It was found that traps were too slow to catch sufficient numbers in a limited time, and in both winters considerable numbers of wild birds were trapped and so killed. Traps were given up as being inefficient and inhumane. Snares could only work successfully in the few flat and wide areas where rabbits could run fast enough to draw them. Snares fitted with various 'humane' devices were proved too clumsy and conspicuous to be successful. Nets and fence-netting traps were successful only in the flat, open meadows, but were useless in the major portion, which consists of a honey-comb of bird-burrows in rough ground.

Ferrets were unsatisfactory, possibly because for centuries rabbits on Skokholm have known no underground enemies such as the stoat and weasel, and they would not bolt in sufficient numbers.

During the years 1931-36, rabbits were not worth more than 2*d.* or 2½*d.* per lb., and could not have been economically marketed even if they had been caught. They were therefore allowed to increase almost unhindered and soon reached a climax state of about 10,000, the natural increase of summer or its equivalent dying out each winter from natural causes, it is believed chiefly from diseases associated with overcrowding and malnutrition, the common fate of rabbits on many small islands where no human control is attempted.

DISEASE

In the summer of 1936, Sir Charles Martin suggested that the introduction of the virus disease *Myxomatosis cuniculi* might be effective in controlling the population of rabbits. He had found that this malady was 100 per cent fatal to wild rabbits, and in two experiments the disease had exterminated colonies living under natural conditions in an enclosed area of 500 sq. yards in a paddock at Cambridge¹. The virus of *Myxomatosis* had been tested upon a variety of domestic animals and wild fauna in the United States, England and Australia and, so far, found to be entirely specific for the European rabbit. The disease produced by it has an incubation period of 5-10 days, at the end of which time the animal becomes feverish and ill, and the eyelids and the nasal mucous membranes become swollen and inflamed. Afterwards a purulent fluid is exuded from the conjunctivæ and nose. Sometimes the mucous membranes at the anal and generative

orifices are similarly affected. The exudation from all these situations contains the virus and the infection passes to other animals by contact.

During the last two weeks of September, 83 rabbits were marked, inoculated and released at points scattered over the whole island; 12 of them were afterwards discovered dead in the open. Unfortunately, it was not possible to make this first attempt earlier in the year, so that rabbits infected from those inoculated would not be likely to be found dead before October 4, when the island was abandoned for the winter. It is, therefore, not possible to say to what extent spread of the disease occurred; but when the island was visited in the following spring, there was no trace of the disease in a population which seemed as numerous as ever.

A second attempt was made during the summer of 1937, when 55 rabbits were inoculated with the virus and distributed as widely over the island as before. It was hoped that closer contacts in the breeding season would result in the wider spread of the disease. Both marked and unmarked individuals were found dead of the disease, proving it had spread somewhat; but it appeared to have died out by September, and with no obvious effect on the numbers of the rabbits. A final inoculation of seven rabbits in one warren in the spring of 1938 had the same result—the disease spread but soon died out without exterminating all the members of the warren. Sir Charles Martin had shown that with the strain of virus used intimate contact of healthy and sick animals was required to ensure transmission of the disease, and it may be that the instinctive behaviour of the sick animal in isolating itself and squatting about in the open at the most contagious period was responsible for the failure of the virus as a means of control under natural conditions.

FUMIGATION

Smoke pumped into burrows from a cartridge containing sulphur was found expensive, difficult to handle, and produced a painful death. In 1938 the Universities Federation for Animal Welfare (then the University of London Animal Welfare Society), through Captain C. W. Hume, arranged to make the Skokholm rabbit population the subject of a demonstration of humane rabbit control, using calcium cyanide in the dust form known as 'Cyanogas'. The dust is blown through the passages of warrens by means of hand-pumps, and on contact with the air, gives off the fatal hydrocyanic acid gas. As the dust emerges from exits in a warren, these are blocked so as to ensure concentration of the gas within.

Work was begun in the winter of 1938-39, when tests made on rabbits in rock crevices and shallow

holes proved that death occurred within a few seconds, the animals stretching out without excessive movement and without screaming. All the accessible holes were then closed, as so many were bird-holes only. The re-opened holes were treated a fortnight later with the dust, and it was possible to fumigate all holes except those in the steepest parts of the cliffs and among cliff-falls and boulders. When this first treatment was completed, it was estimated that about 90 per cent of the rabbits had been killed. Rabbits from the cliffs seemed to be responsible for many holes afterwards found re-opened inland, and it is probable that had the island been connected with the sea without cliff or boulder 100 per cent extermination would have been achieved.

As it is, after the holes had been gone over for a third time, it was calculated that only about 400 of the original 10,000 (in round maximum figures) rabbits were left, and all of these appeared to be rock-dwellers coming to the top of the island to feed only at night. On this showing, 'Cyanogas' was therefore 96 per cent successful for the island as a whole; excluding the economically untreatable cliff-land, it was still nearer complete success.

Proof of this success was forthcoming in the summer of 1939. White clover appeared where it was always rare and stunted before, grass grew long and luxuriantly, and the absence of rabbit-pellets was remarked. As much as four tons of hay were cut off an acre of the best land; and hay had not been cut since the land was farmed in the last century. The grass continued to grow; one hundred sheep imported in the autumn were found quite inadequate to graze it down and it was eventually beaten down by winter storms.

The residue of rabbits in the cliffs began to breed with rapidity. Normally, under climax conditions, the island rabbits only breed from March until July inclusive. At present they are breeding all the year round as a result of the abundant feed. During the summer of 1939 they spread somewhat inland, helped by the sea-birds, which opened all the blocked holes in that spring. Control has again been carried out this winter by means of 'Cyanogas', and at the moment of writing, the population is again reduced to a residue of rock-dwelling rabbits.

¹ Martin, C. J., *Univ. Cambridge Inst. Animal Pathol. Report*, 4, 16-38 (1934-35).

OBITUARIES

Prof. A. G. Högbom

PROF. ARVID GUSTAF HÖGBOM, who died on January 19 at the age of eighty-three years, had been a leader in geological work and thought in Sweden for more than half a century, and he came to occupy a dominant position among the geologists of his native land similar to that of his contemporary the late Prof. W. C. Brøgger in Norway (see *NATURE* of April 27, p. 652). A student at Uppsala, Högbom was appointed lecturer there in 1885. In 1891 he joined the staff of the University of Stockholm, but returned to Uppsala in 1896 as professor of geology and mineralogy, occupying the chair until his retirement in 1922; he continued active in investigation and writing until the end. He was born in northern Sweden, most of his field work was carried out there, and he was ever active in promoting the economic development of this sparsely populated region.

Högbom's work was mainly concerned with the Pre-Cambrian and the igneous rocks, the ores, glacial and geomorphological problems, and in latter years with historical and philosophical aspects of the science. Many of the views now widely held regarding Swedish geology were propounded by him, and they had considerable influence in shaping the thought of workers in other lands. The following is a selection only of the subjects on which Högbom made important contributions: the magmatic origin of the

iron ores of northern Sweden, the Caledonian overthrusts, the nepheline syenites and associated rocks, the sub-Cambrian penepplain, the Norwegian coastal platform, glacial and fluvio-glacial erosion, the glacial lakes of Sweden, the significance of the clay 'varve', solifluxion, the post-glacial uplift of Scandinavia and the sequence of its climatic changes. Vol. 15, 1916, of the *Bulletin of the Geological Institution of the University of Uppsala* was dedicated to him on the occasion of his sixtieth birthday, and the bibliography of 145 items given there bears witness to the remarkable range of his studies.

Högbom was an active participator in international geological congresses, and he will be remembered as a prominent figure at the Congress in Stockholm in 1910. The Geological Society of London honoured him by electing him foreign correspondent in 1911 and foreign member in 1927.

L. HAWKES.

Prof. V. I. Sihvonen

ONE of the first victims of the recent Finnish-Russian War, killed on November 30 during an air raid on Helsinki, was Prof. Väino Ilmari Sihvonen, professor of physical and electro-chemistry in the Tekniska Högskolan of the University of Helsinki. Born in Kangasniemi in 1889, he became a student

at Viborg in 1907, a lecturer at the Helsinki Technical High School in 1923, a teacher at the University in 1925 and in 1936, the first holder of the chair of physical and electro-chemistry in the University. He also worked as a student at Dresden, Breslau, Copenhagen and Zurich.

Sihvonen's scientific work was concerned almost exclusively with the oxidation of carbon. Inspired by Langmuir's experiments upon the combustion of carbon filaments in oxygen at low pressure, Sihvonen attempted by similar, more elaborate methods, to gain a deeper insight into the primary mechanism of carbon oxidation. He carried out both static and dynamic experiments, the results of which are published in a large number of papers which have appeared since 1930. In order to explain the relative amounts of carbon monoxide and dioxide formed in these experiments he elaborated a detailed theory which involves the formation of ketone and ketene groupings on the border carbon atoms. His studies included experiments upon the oxidation of graphite and diamond by oxygen in the presence of X-radiation, and the oxidation of carbon by steam and in fused electrolytes. He also made a study of the electrolytic oxidation of tartaric acid and alkali tartrates.

Sihvonen visited Great Britain as recently as 1938 on the occasion of the Faraday Society's general discussion at Bristol upon "Chemical Reactions Involving Solids" when everyone was impressed by his quiet, friendly, unassuming manner. He was a member of the Suomalainen Tiedakatemia and had rendered his country great service in the Finnish war of independence. His tragic death deprives Finland of an outstanding scientific worker and a distinguished teacher.

Mr. J. A. Hobson

JOHN ATKINSON HOBSON, who died on April 1, was one of the most distinguished among British economists, although he never held any regular academic post and had to wait until the last years of his life for his fellow economists to recognize the importance of his work. Born at Derby on July 6, 1858, Hobson, on leaving Oxford, spent seven years as a schoolmaster, and thereafter for ten years was engaged chiefly in extension lecturing and teaching for the Universities of London and Oxford.

The first book published by Hobson, "The Physiology of Industry" (1889) was written in collaboration with the late A. F. Mummery, well known as business man and Alpine climber; and it contained the germ of his later work. Hobson was already putting forward in 1889 that theory of 'underconsumption' which was for many years to be ridiculed by the great majority of professional economists, though the very great element of truth contained in his theory has in recent years been widely appreciated, and there is a close resemblance at a number of points between his doctrines and those enunciated by Mr. J. M. Keynes in his more recent work. Hobson developed his views in many later books, among

which the most important are "The Industrial System" (1909), "The Science of Wealth" (1911) and "Work and Wealth: a Human Valuation" (1914).

In the general approach to economic problems, Hobson was greatly influenced by Ruskin, and he treated economics not as a self-contained science, but rather as a branch of social science as a whole. His works contained much acute criticism of the narrowness of modern orthodox economic theory, and he was continually insisting on the need to approach economic problems from the point of view of human welfare in the broadest sense. Outside the field of economic theory he wrote widely; and at least two of his books have become historical classics. These are "The Evolution of Modern Capitalism" (1894) and "Imperialism" (1902). They remain the most penetrating studies yet written in their respective fields.

During the War of 1914-18, Hobson was actively associated with the Union of Democratic Control, in which he continued to take a lively interest up to the time of his death. He wrote extensively for the *Manchester Guardian*, and was for a long time one of the leading theorists of advanced Liberalism. In his later years, however, he had come to accept a Socialist position, led thereto by the conviction that the capitalist system was essentially restrictive in its working, and was therefore incapable of emancipating itself from the vice of underconsumption.

Hobson, on several occasions, lectured in American universities: indeed, his work was, until quite lately, much better appreciated in the United States than in Great Britain. Personally, he was a man of exceptional charm, with a very lively wit and great capacity for friendship. His series of war-time dialogues, published in the *Nation* during the War of 1914-18 under the name "Lucian", showed how wittily he could write when he chose.

G. D. H. COLE.

Colonel C. T. Green

THE death of Colonel Conrad Theodore Green, in his seventy-seventh year, at Birkenhead on April 17, removes one of the best known of Merseyside botanists, for at his own cost and initiative he edited the 1902 and 1933 editions of "The Flora of Liverpool". An active member of many national and local societies, he was a past president of the Liverpool Botanical Society and other societies, and on the executive council of Flora's League he assisted Sir John Abbot-Anderson in the national protection of wild plants by lecturing in numerous parts of the country.

Born at Kirkburton, West Riding, in 1863, Dr. Green obtained a medical practice in Birkenhead in 1887; he was elected to the Linnean Society in 1901; and, after pre-War duty as medical officer in the Territorial Army, he was promoted Colonel, Army Medical Service, in 1915. In 1905 the Chester Society of Natural Science awarded him the Kingsley Medal, for botanical research. He made a long series of microscope slides of micro-fungi attacks upon plants for that Society.

NEWS AND VIEWS

War in the Low Countries

LAST week saw a further extension of the theatre of war in Europe. The Germans, in flagrant defiance of all the rules of international law and courtesy, invaded Holland, Belgium and the Duchy of Luxembourg without any warning whatsoever. The blow was not unexpected, but the manner of its delivery was marked by the callous disregard for all human rights and values which has characterized the Nazi regime and is now seen in its full hideousness. It is not our purpose, even were it possible, to record the progress of the War, but reference must be made from time to time to definite stages of a catastrophe which is affecting the life of every human being in Europe and in many countries outside Europe itself.

As President Roosevelt pointed out in his address on May 10 to the Eighth American Scientific Congress which had just opened in Washington, men of science are not responsible for the misuse of the discoveries of peace to dominate hundreds of millions of people, and there will be universal approbation for the further comment that scientific workers as a whole are prepared to "act together to protect and defend by every means our science, our culture, our freedom, and our civilization". The suppression of individual and intellectual freedom which is being extended through Europe by the hammer-blows of war must be resisted by every means in our power, and the war must be carried to the enemy with the utmost scientific efficiency in the sure hope that, by so doing, we may shorten the period of suffering which is now upon the world.

Advisory Research Council of the Chemical Society

At the annual general meeting of the Chemical Society held on April 4, the president, Sir Robert Robinson, dealt at some length with the activities of the Advisory Research Council of the Chemical Society which was formed in September 1939, its object being to act as a liaison between chemists engaged in unremunerated research who are seeking guidance as to subjects for investigation of potential value to the national war effort and Government departments or industrial organizations in a position to suggest such topics. Sir Robert said that the response to the suggestions made and invitations issued by the Advisory Research Council has been very gratifying, and that he is sure that the initiative will continue to receive the generous support of the Society's fellows. The situation in regard to scientific research in its application to the War is very different from that of 1914. This is due, partly to the effort made in the War of 1914-18 itself, partly to the intensive work of the intervening years, and in part to the unanticipated course of the present emergency, which has not yet thrown up so many new problems as might have been expected. Nevertheless, there are clear indications that the original work of research chemists will be needed in

the present struggle, possibly to a greater extent than in the past, and the relative slowness of the start should deceive nobody in regard to the vitally important part which may be played by the Chemical Society. Certain research committees under Government auspices are already showing a marked tendency to make full use of the Society's facilities in connexion with the longer-range investigations in which they are interested.

It has been laid down by the Advisory Research Council of the Chemical Society that the only subjects to be studied should be such as have a definite relation to the conduct of the War. It is, however, generally agreed that the maintenance of our export trade in a flourishing condition is of the utmost importance, and therefore the Council is prepared to assist the chemical industry so far as lies in its power. Here the attack must be on a broad front and, as it is impossible to spot the winners before the race, there must be losers also. Co-operative effort is essential, and this reflection should console those who are unable to see in what way the suggestions made to them could have any influence on the fortunes of the nation. Fellows may rest assured that more urgent needs will be made known to them when they become apparent to the Council, and all suggestions of a specific nature are welcomed and carefully examined. The Council does not supervise or direct work undertaken at its suggestion, and the results may be used or published in any way that the investigator desires, subject of course to his own private commitments to firms which may have given material assistance or confidential information. Similarly, it can accept no responsibility for the accuracy of the work or for losses sustained or accidents to personnel. As an advisory body the Council is prepared to give any assistance in its power to investigators who wish to ensure that their work is utilized to the full in the national interest. When work is undertaken on behalf of a Government department, this fact is clearly stated, and fellows need not be reminded of the existence of the Official Secrets Act. The Council has no funds at its disposal, but workers on projects suggested by the Council may make application at any time to the Research Fund Committee of the Society. Finally, Sir Robert emphasized that the Council is always available for consultation if any fellow is doubtful of the proper procedure at any stage of his work.

Electrical Invention and Re-Invention

In the course of his work at the Science Museum, South Kensington, Mr. W. T. O'Dea has had occasion to examine the history of many notable inventions; he gave an account of some of his investigations in a paper bearing the title "Electrical Invention and Re-Invention" read to the Newcomen Society on March 13. His paper contained sections treating of electric lighting, the dynamo, the accumulator,

wireless telegraphy, the loud-speaker, television and other subjects. There were instances, he said, of phenomena explored not far enough, or discovered and not fully appreciated. Some inventions, too, lay dormant pending the discovery of a necessary, but ancillary device, or the growth of conditions suitable for their development.

Much interest lay in the story of the dynamo. The first proposal for a self-exciting machine appears to have been made by Sören Hjorth, of Copenhagen, in a patent of 1855. In 1861, another self-exciting machine was proposed by Ányos Jedlik of Budapest, but these proposals led to no development. In 1863-65, Henry Wilde, of Manchester, built machines so nearly self-exciting that it seemed amazing that he should not have continued further. In a paper to the Royal Society in 1866, Wilde wrote that "an indefinitely small amount of magnetism or dynamic electricity is capable of inducing an indefinitely large amount of magnetism", given, of course, the expenditure of mechanical power. In 1866, too, Varley patented a self-exciting machine, but then lost interest in the subject. It was left to Wheatstone and Siemens to describe their self-exciting machines in 1867, but the principle of self-excitation had been discovered and re-discovered three or four times. The paper was illustrated with slides of some of the historic apparatus from the Science Museum.

Water-Power in Durham

A SCHEME for utilizing water-power in Upper Teesdale to generate electricity is put forward by Mr. G. F. Kennedy, who has investigated the matter for the South-West Durham Development Board. According to the *Electrical Review* of May 3, his report has been considered by the Executive Committee of the Board, which has submitted it for Government consideration. The potentialities of the waterfall at Cauldron Snout have been investigated, the object being to facilitate by a cheap supply of electricity the development of industries in Teesdale and Weardale. The report traces the course of the Tees from its source on Cross Fell. Basalt rock forms a natural dam capable of holding 1,250,000 cub. ft. of water, and the overflow from this dam forms the Cauldron Snout cascade into a ravine 135 ft. deep. Mr. Kennedy suggests that as the catchment area extends over 20 square miles a plentiful supply and head of water are assured. It is proposed that the volume should be augmented by the construction of an eight-foot concrete dam, which would increase the natural storage by a further $2\frac{1}{4}$ million cub. ft., making a total of nearly 4 million cub. ft.

A suggested hydro-electric scheme capable of producing approximately 2 million electric units annually is outlined. At Langdon Beck, Mr. Kennedy suggests that a charge-engineer's house might be built for the control and maintenance of a power station. A pipeline of 28-in. diameter steel pipe 1,200 ft. in length, housed in a concrete duct or tunnel in order to protect it and to avoid spoiling the amenities of the district, is advised, and this, as well as the dam, could

be surfaced to resemble the natural contour and appearance of the surrounding terrain. The volume of water thus secured would be able to operate a 21-in. diameter twin-impulse type directly coupled turbine to a 150 kw. alternator. The annual overhead and maintenance costs of the scheme, which would require the services of only one regular attendant as it would be automatically controlled, are calculated to yield a supply at an average cost of a farthing per electric unit.

Transmission Lines on the French Grid

AN article on "Transmission Lines on the French Grid" by D. J. Tynan-Byrd is published in the *Electrical Times* of April 25. The building of the French grid scheme was begun soon after the War of 1914-18, when, owing to the increased industrial and domestic load in different parts of the country, the demand for new generating stations and transmitting stations became urgent. In France, the coal-fields lie to the north, and here steam generation to produce electricity is most commonly used. In the southern half of the country, there is abundant water-power available in the Rhône district, in the regions of the French Alps and the Pyrenees, particularly in the spring and summer months when the glaciers begin to melt. The area of France is more than 200,000 square miles, and some regions of dense population possess no facilities for generating electrical energy, while the regions where facilities are abundant often possess few local inhabitants. Hence the policy adopted is to transmit power from areas where it can be generated cheaply to areas where it is in demand.

When a hydro-electric station is built, if no water-storage facilities are available, the station is practically always used for base-load purposes. If, however, a dam can be constructed, the station will normally be used for peak-load supply. The building of the line is usually arranged and financed by a company which is formed by all the concerns interested, such as power undertakings, railway companies and industrial firms. The Ministry of Public Works, which is equivalent to the Electricity Commissioners in Great Britain, takes a controlling interest in these companies and sees that lines are not built unnecessarily and that they are not duplicated. In some thickly populated areas, where the erection of overhead lines is inadvisable, oil-filled underground cable has been installed. The operation of some of these stations is very ingenious as some of them are 'remote controlled' from larger stations nearby. In some cases, even when the distance of the power station from the distributing area is about ten miles, the whole operation of opening the water valves synchronizing the alternators and finally placing them on load is performed by remote control methods.

The Antarctic Snow Cruiser

THE *Engineer* of May 3 gives an illustrated description of the remarkable vehicle which has been constructed for use by the American Antarctic Expedition which sailed from Boston, Mass., on November 15, 1939, in command of Rear-Admiral

R. E. Byrd, U.S.N. The vehicle, called the *Snow Cruiser*, is to be used as a mobile base, and it is reported to be capable of travelling across ice fields, of climbing gradients of 35 per cent, of sliding down them on its steel-ribbed under-floor and of crossing crevasses in the ice 15 ft. wide. The *Snow Cruiser* is more than 55 ft. long, 20 ft. wide and 15 ft. high, and weighs, fully equipped, 33½ tons. It has four pneumatic-tyred wheels 10 ft. in diameter which can be turned independently to various angles, and which can also be retracted into the vehicle. The structure is of steel electrically welded, and the motive power consists of two 150 h.p. oil engines driving electric generators supplying current to the traction motors. In the interior are the living quarters, store-rooms, the engine room, a machine shop and a laboratory, and also tanks for the storage of 2,100 gallons of oil fuel and of nearly 850 gallons of petrol for the aeroplane carried on the back of the vehicle. The *Snow Cruiser* was designed and constructed by the Research Foundation of Armour Institute in Chicago, under the direction of Dr. T. C. Poulter, scientific director of the Foundation, who was second-in-command of the second Byrd expedition.

Puffin Crosses North Atlantic

ONE of the most important results of bird-ringing experiments is the first recovery in North America of a puffin (*Fratrercula arctica arctica*) ringed in Europe. This was a specimen ringed by Lord Dumfries as a young bird on St. Kilda on August 10, 1939, and shot at Herring Neck on the north coast of Newfoundland on December 20, 1939 (*British Birds*, March 1940). The instances of European-marked birds traced to North America are very few. The most numerous records are of the kittiwake (*Rissa tridactyla*); specimens marked as young on the Farne Islands, Northumberland, have been recovered in autumn and winter months at Davis Strait, Labrador, and Newfoundland over periods since 1924; another specimen ringed at Khasilov Island, in the Barents Sea, was recovered at Little Fogs Island, Newfoundland. Black-headed gulls (*Larus ridibundus*) ringed at Rossitten, East Prussia, have been recovered in Mexico and the Barbadoes, and there is the celebrated record of Cumberland lapwings (*Vanellus vanellus*) shot in Newfoundland after a gale forced them from their normal migration to Ireland. Previous ringing returns of Scottish puffins have shown no marked westerly migration. Specimens from Northumberland have been recovered at Norway.

Effect of Winter Frosts on Bird-life

IN a lecture to the Hastings and St. Leonards Natural History Society on April 23, Mr. Eric Hardy described the serious effect upon the numbers of insectivorous British birds as a result of the severe frosts during the past winter, when, particularly in the north, vast numbers of thrushes, blackbirds, titmice and other birds were killed by the long absence of food and water. In recounting at length many of his ornithological studies in the north, Mr. Hardy stressed the possible effect of this partial loss

of useful insectivorous birds at a time of national food-growing efforts, and the possibilities of increased wireworm damage to cornland, and cabbage white caterpillars to cultivated greens. There is a marked shortage of many of the residential insect-eating birds in woods in the north, although Nature has recovered from the severe winter toll of bird-life more rapidly than was anticipated and it will be interesting to compare the future results with previous hard winters. Nevertheless, there is an urgent need to protect and increase insectivorous birds by providing more nesting and feeding haunts, for example, growing more undergrowth in woods and plantations, and preventing loss of existing bird haunts by river pollution and heath fires.

Canada's Indian Policy

AN interesting review of the circumstances and problems of the Indian population of Canada was given by Mr. Diamond Jenness of the National Museum of Canada, at the recent meeting of the American Association for the Advancement of Science at Columbus, Ohio. The Indian policy of the Canadian Government was framed at a time when to civilize in accordance with the white man's ideals, rather than to conserve, was the aim of liberal and humanitarian administration. Further, it was considered inevitable that such backward peoples would be unable to withstand the difficulties and dangers of contact with civilization and must become extinct. Hence Canadian policy was fusion of the two populations rather than segregation. The Indian was gradually to be absorbed by the white.

Of recent years, however, in Canada, as in other parts of America, the Indian population is increasing; but a more or less successful adaptation to changed conditions, if it has not actually contributed to the increase, as is probable, has certainly averted untoward consequences. This is implied in the comment by Mr. Jenness that the Iroquoians of eastern Canada, "being an agricultural people, . . . were not forced to undergo any sudden revolution". Among the Plains Indians, in the difficult transition from buffalo hunting to growing wheat, the Blackfoot, now the most prosperous, had the advantage of being guided by able and far-sighted chiefs. The Indians of the Pacific coast, both in temperament and economy, have proved less capable of readjustment; but in the Arctic, as might be expected, the Eskimo show themselves well able to hold their own, while the women make excellent wives for the white pioneers who settle on this frontier.

Bureau of American Ethnology, 1938-39

THE major field research with which the Bureau of American Ethnology was associated in the fiscal year 1938-39 (Fifty-sixth Annual Report, 1938-1939, 1940) continued to be that of the United States De Soto Expedition Commission. For the greater part of the year Dr. John R. Swanton was in the field in the interests of the Commission or engaged in the preparation of its report. With various members of the Commission he visited points in North

and South Carolina, Georgia, Florida, Missouri, Mississippi, Arkansas and Louisiana. The report has since appeared in a volume of 400 pages.

A joint expedition of the Bureau and the National Geographic Society, under M. W. Stirling, chief of the Bureau, carried out an excavation on a mound site at Tres Zapotes, Vera Cruz, Mexico. Nine major stone monuments were excavated and a large collection of ceramics and figurines obtained. The most important find was a Mayan stone monument inscribed with an initial-series date which apparently records a late Baktan 7 date and is thus among the earliest at present known. The style is closely related to the Tuxtla statuette. This important document has now been deposited in the National Museum, Mexico City. Among other researches, special interest attaches to the investigation of the northern provenience of the Navajo, the largest single-dialect Indian population in the United States, numbering some 50,000 souls, inhabiting Arizona and New Mexico. Their language is an aberrant form of Western Apache, belonging to a group of which the northern origin is patent and traceable as closely related to Athapascan tongues occupying the interior of Alaska and western Canada. Dr. F. H. H. Roberts, continuing his researches on the character and distribution of Folsom man in the period under review, has traced this early prehistoric culture so far north as Saskatchewan, along the postulated migration route of peoples coming from Asia into the New World.

Canadian Polar Year Expeditions, 1932-33

THE Second International Polar Year, 1932-33, during which many nations joined in the simultaneous recording of meteorological, geomagnetic and auroral data in the polar and other regions of the globe, belonged to an epoch when the nations of Europe and elsewhere could still devote money and energy to a great co-operative scientific enterprise. Though receding in memory, some of its fruits still remain ungarnered; this has now been accomplished, for the share of Canada in the magnetic and auroral part of that enterprise, by the publication of volume 2 of the report of the three Canadian expeditions (volume 1 deals with the meteorological results). A new magnetic observatory was set up for the year at Chesterfield Inlet (63.3° N., 90.7° W.), which is not far from the north magnetic pole—the magnetic needle at Chesterfield Inlet departs from the vertical by only 3.6° —and is also near the auroral zone, the centre of which is the pole of the earth's magnetic axis. In addition, the equipment of the Meanook Observatory, set up in 1916, was improved for the Polar Year work: Meanook (54.6° N., 113.3° W.) is also in a high magnetic latitude.

The report gives very full details, on an internationally arranged plan, of the magnetic observations made during the year at these two stations; the tables cover more than eighty quarto pages closely printed; they are likely to prove, for many years, valuable raw material for theoretical studies, as was the case with the records of the first Polar Year (1882-83), the value of which is still not exhausted.

In addition, the report gives particulars of earth current observations at Chesterfield Inlet, and of magnetic measurements at field stations visited from Chesterfield; together with more than fifty pages of records and discussion of auroral observations made at Saskatoon and at Chesterfield Inlet; this part of the report is illustrated by many line diagrams and photographs of auroras. Height measurements were made by simultaneous photography from two stations separated by 112 km.; they showed that the most usual height of the lower edge of the auroras measured was about 100 km., as in Norway. Auroras extending below 80 km. were observed on at least one occasion.

Robert Mond Bequest to the British Museum

A FURTHER instalment of descriptive notes on outstanding objects in the collection of antiquities bequeathed to the British Museum by the late Sir Robert Mond (*Brit. Mus. Quarterly*, 14, 1; 1940) deals with funerary portraits of the Roman period from the Fayyum, an example of a theriomorphic vase possibly of the middle predynastic period in the form of a frog and two small granite heads, of which the smaller presents the remarkable and unusual feature that the eyes are shut, so that the effect is that of the portrait of a dead person, while the contour of the main features resembles that of a skeleton. It seems to be without parallel, and no opinion can be expressed as to its age without the greatest reserve. Much interest is attached to a small hollow cylinder of black and white porphyritic rock, which belongs to a class of objects of which the use has not yet been determined satisfactorily. At one time they were thought to be mace heads, though secure hafting seems an impossibility; but recent discoveries at Wadi Halfa, in which they were found in association with other weapons and in some burials with two fingers of the right hand, have led to the suggestion that they were archers' looses, and in their use resembled the Mongolian ring. All datable examples are from sites occupied by the people to whom archaeologists apply the term the X-group, who occupied Upper and Lower Nubia from the third to the sixth centuries A.D., variously identified with the Blemmyer of the Eastern Desert, the Noubades, a mixed race of negroid and Meroitic elements, and the Nobatae, who are alleged by Procopius to have formed a buffer State between the Roman frontier at the First Cataract and the southern barbarian tribes.

Taxonomy in the Amaryllidaceæ

THE present trend towards specialization makes possible, and indeed necessary, a detailed volume such as *Herbertia*, the year-book of the American Amaryllis Society. The editor, Dr. Hamilton P. Traub, has brought together in the sixth book, for 1939, a collection of knowledge upon all matters pertaining to the horticulturally valuable members of the Amaryllidaceæ. There are the usual descriptions of exhibitions and garden culture, of grouping and floral artistry; there is a dedication of the present volume to the Union of South Africa; there are

J. & A. CHURCHILL

LTD

PHYSIOLOGY

- STARLING'S PRINCIPLES OF HUMAN PHYSIOLOGY**
7th Edition. Revised by C. LOVATT EVANS, F.R.S. 554 Illus. (6 in Colour). 25s.
- EVANS' RECENT ADVANCES IN PHYSIOLOGY**
6th Edition. Revised by W. H. NEWTON, M.D., M.Sc. 109 Illustrations. 16s.
- WINTON & BAYLISS' HUMAN PHYSIOLOGY**
2nd Edition. 221 Illustrations. 16s.
- THORPE'S BIOCHEMISTRY FOR MEDICAL STUDENTS**
2nd Edition. 4 Plates and 33 Text-figures. 14s.
- CAMERON'S TEXTBOOK OF BIOCHEMISTRY**
5th Edition. 3 Plates and 25 Text-figures. 15s.
- HAWK & BERGEIM'S PRACTICAL PHYSIOLOGICAL CHEMISTRY**
11th Edition. 7 Coloured Plates and 281 Text-figures. 35s.

ANATOMY

- WHILLIS' ELEMENTARY ANATOMY AND PHYSIOLOGY**
87 Illustrations. Reprinted. 14s.
- MASSIE'S SURGICAL ANATOMY**
4th Edition. 158 Illustrations (many in Colour). 21s.
- FRAZER'S ANATOMY OF THE HUMAN SKELETON**
4th Edition. 219 Illustrations (many in Colour). 30s.
- JOHNSTON'S SYNOPSIS OF REGIONAL ANATOMY**
4th Edition. 17 Illustrations. 14s.

GENERAL

- CURRY'S MECHANISM OF THE HUMAN VOICE**
20 Illustrations. 10s. 6d. *A new Book.*
- SARTORI'S WAR GASES—Chemistry and Analysis**
Translated by L. W. MARRISON, B.Sc. 20 Illustrations and 15 Tables. 24s.
- BOLLES LEE'S MICROTOMIST'S VADE-MECUM**
Edited by J. BRONTË GATENBY, Ph.D., D.Sc., and T. S. PAINTER, A.M., Ph.D. 10th Edition. 11 Illustrations. 30s.
- STEAD'S ELEMENTARY PHYSICS. For Medical, First Year University Science Students and General Use in Schools**
5th Edition. 430 Illustrations. 12s. 6d.
- MARSHALL'S EXPLOSIVES**
2nd Edition. Vols. I and II. 157 Illustrations. 63s. Vol. 3. 14 Illustrations. 42s.
- HARRIS' VITAMINS AND VITAMIN DEFICIENCIES. Vol. 1. Introductory and Historical—Vitamin B₁ and Beri-Beri**
50 Illustrations. 8s. 6d.
(To be completed in 7 volumes.)

CHEMISTRY

- HENRY'S PLANT ALKALOIDS**
3rd Edition. 42s.
- LYOYD & SHORE'S CHEMISTRY OF THE PROTEINS**
2nd Edition. 101 Illustrations. 24s.
- BLAIR'S INTRODUCTION TO INDUSTRIAL RHEOLOGY**
Foreword by EUGENE BINGHAM, Ph.D., D.Sc. 20 Illustrations. 7s. 6d.
- ALLEN'S COMMERCIAL ORGANIC ANALYSIS**
Edited by C. A. MITCHELL, D.Sc. 5th Edition. 10 Vols. 32s. each.
- SUTTON'S SYSTEMATIC HANDBOOK OF VOLUMETRIC ANALYSIS**
12th Edition. Revised by A. D. MITCHELL, D.Sc., F.I.C. 128 Illustrations. 35s.
- COX'S CHEMICAL ANALYSIS OF FOODS A Practical Treatise on the Examination of Food-stuffs and the Detection of Adulterants**
2nd Edition. 41 Illustrations. 21s.
- CLOWES & COLEMAN'S QUANTITATIVE CHEMICAL ANALYSIS**
14th Edition. Revised by D. STOCKDALE, Ph.D., A.I.C., and J. DEXTER, B.Sc., A.I.C. 130 Illustrations. 18s.
- LYONS & APPEYARD'S ELEMENTARY ANALYTICAL CHEMISTRY (Qualitative and Quantitative)**
13th Edition. 15 Illustrations. 7s. 6d.
- HACKH'S CHEMICAL DICTIONARY**
Containing the Words generally used in Chemistry, and many of the Terms used in the Related Sciences. 2nd Edition. Fully Illustrated. 48s.
- GLASSTONE'S RECENT ADVANCES IN PHYSICAL CHEMISTRY**
3rd Edition. 31 Illustrations. 15s.

BIOLOGY

- SANSOME'S RECENT ADVANCES IN PLANT GENETICS**
2nd Edition. 55 Illustrations and 49 Tables. 18s.
- SMITH'S TEXTBOOK OF PLANT VIRUS DISEASES**
101 Illustrations. 21s.
- DARLINGTON'S RECENT ADVANCES IN CYTOLOGY**
2nd Edition. 16 Plates, 160 Text-figures and 81 Tables. 24s.
- HUNTER & LEAKE'S RECENT ADVANCES IN AGRICULTURAL PLANT BREEDING**
16 Plates. 15s.
- SMITH'S RECENT ADVANCES IN THE STUDY OF PLANT VIRUSES**
68 Illustrations. 15s.
- GATENBY'S BIOLOGICAL LABORATORY TECHNIQUE**
An Introduction to Research in Embryology, Cytology and Histology
8 Illustrations. 7s. 6d.

MACMILLAN'S NEW BOOKS



A Text-Book of Zoology

By the Late **T. JEFFERY PARKER, D.Sc., F.R.S.**,
and the Late **WILLIAM A. HASWELL, M.A., D.Sc., F.R.S.**

In this new edition of an outstanding zoological text-book, with its change of type and format, considerable alterations and additions to the text and illustrations have been made, and certain parts which appeared no longer to serve a useful purpose have been omitted.

The thorough revision of Vol. I (Invertebrata and General Structure and Physiology of Animals) has been carried out by Dr. Otto Lowenstein, Lecturer in Zoology in the University of Glasgow, and that of Vol. II (Phylum Chordata) by Dr. C. Forster-Cooper, Director of the British Museum (Natural History). Sixth Edition. In 2 Volumes. Vol. I. *With 733 illustrations. 36s. net.*

The Jewish Fate and Future

By **ARTHUR RUPPIN, Ph.D.**
Professor of Jewish Sociology at the Hebrew University of Jerusalem
Translated by E. W. DICKES

Professor Ruppin's practical and scientific work over a long period, and his recognized impartiality, have made him exceptionally qualified to discuss the Jewish problem, at a time when this problem is in the forefront of public interest. His new book equips the reader with all the facts, down to the immediate past, which are needed in order to form an opinion in regard to the position of the Jews in the world. It also states briefly and clearly Professor Ruppin's own views. The volume may be regarded as the standard work on the Jewish problem of to-day. *21s. net.*

Foundations of Sociology

By **GEORGE A. LUNDBERG**
Professor of Sociology, Bennington College, U.S.A.

"The relatively undeveloped state of the social as compared with the physical sciences and the resulting problems are subjects at present much in the foreground of public discussion," says Professor Lundberg in his Preface. "The nature of the remedy for this state of affairs is the general theme of the present work."

With Figures and Tables. 15s. net.

Feeding the People in War-Time

By **SIR JOHN BOYD ORR, D.S.O., F.R.S.**
and **DAVID MILES LUBBOCK**

"A highly important contribution to this subject which demands and will doubtless receive the closest attention of all who are concerned with the organization of our food supplies."—*British Medical Journal.*

"No short résumé can do justice to this most important publication which, if as widely read as it should be, will give the nation that clear view of food policy which has been so conspicuously lacking in official pronouncements."—*The Statist.*

Paper Boards. 1s. 6d. net.



MACMILLAN & Co. Ltd., LONDON, W.C.2



Mathematical Methods in Engineering

By **THEODORE V. KARMAN**

Director of the Daniel Guggenheim Aeronautics Laboratory, California Institute of Technology

and **MAURICE A. BIOT**

Assistant Professor of Mechanics, Columbia University

505 pages, 9 × 6, illustrated, 26/- net

THIS introduction to the mathematical treatment of engineering problems seeks to acquaint the reader with the art of setting up equations for a definite problem, carrying out solutions numerically and graphically, and discussing the physical and engineering significance of the results. The book draws its subject from the fields of civil, mechanical, aeronautical and electrical engineering, and demonstrates the practical application of mathematical analysis. The mathematical pre-requisites are ordinary calculus, elements of analytical geometry and elementary algebra, which includes linear equations, determinants and the fundamental theorems concerning algebraic equations.

Special Features of the Book

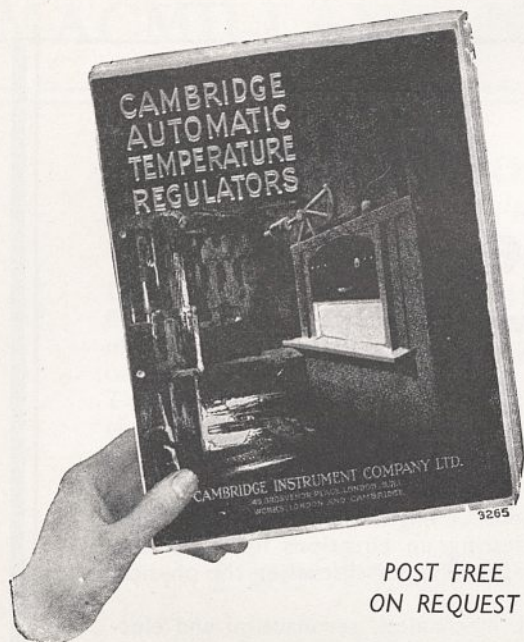
1. The authors offer a new approach in the simultaneous treatment of mathematics and engineering problems. Many unpublished original methods are included.
2. Topics such as elliptic integrals, Bessel functions, matrices, operational calculus, Lagrangian methods in dynamics, which are generally considered difficult mathematical subjects, are presented with a minimum mathematical formalism and are illustrated by examples familiar to the engineer.
3. Special attention is given to recent progress in applied mathematics: e.g., the use of matrices for the solution of vibration problems, energy and iteration methods and the use of Fourier series in structural analysis.
4. Equations of finite differences applied to engineering are treated more systematically than usual.
5. The book contains 144 problems. Some are suitable for discussion by the instructor during class hours; others are intended for assignment to the students as individual problems.

Chapter Headings

Preface
Introduction to Ordinary Differential Equations
Some Information on Bessel Functions
Fundamental Concepts of Dynamics
Elementary Problems in Dynamics
Small Oscillations of Conservative Systems
Small Oscillations of Non-conservative Systems
The Differential Equations of the Theory of Structures

Fourier Series Applied to Structural Problems
Complex Representation of Periodic Phenomena
Transient Phenomena
Operational Calculus
Equations with Finite Differences Applied to Engineering
Words and Phrases
Answers
Index

McGraw-Hill Publishing Company Ltd.
Aldwych House London, W.C.2



POST FREE
ON REQUEST

AUTOMATIC TEMPERATURE REGULATORS

THE LATEST INFORMATION
on automatic Regulators for accu-
rately controlling any temperature
up to 1700°C. by operating valves,
switches, levers or other mechan-
ism, will be found in

THIS NEW
32-PAGE PUBLICATION No. 150-N

May we send you a copy ?

CAMBRIDGE INSTRUMENT CO LTD

WORKS
LONDON & Head Office: - 13 GOSVENOR PLACE
CAMBRIDGE & Showrooms: LONDON, S.W. 1

17.

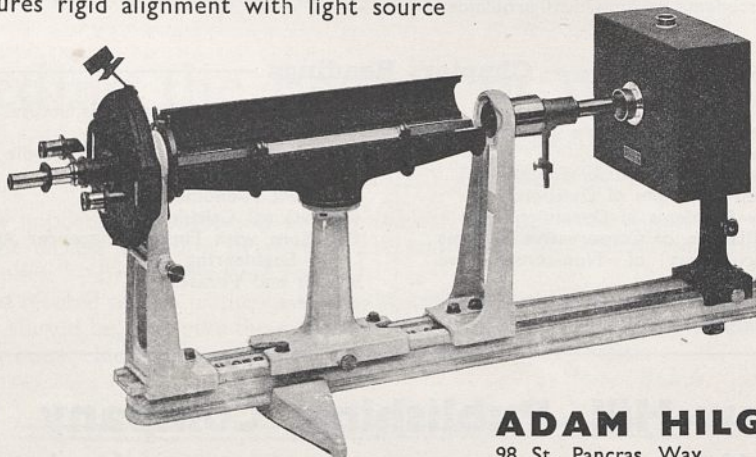
*Specially Suitable for academic and
research use*

THE HILGER BARFIT* POLARIMETER

Circle, totally enclosed, reads to 0.01°. Takes tubes up to 400 mm.

Barfit (unit) construction simplifies combination with other apparatus for visual
or photographic spectro-polarimetry

Bar ensures rigid alignment with light source



* Trade Mk. Rgd. in
Gt. Britain and U.S.A.

Phone: GULLIVER 4451
(3 lines)

ADAM HILGER LTD.
98 St. Pancras Way Camden Road
LONDON N.W.1 ENGLAND

personal references, mainly to the work of South African investigators and to the Herbert medallists of 1939, among whom is Dr. J. Hutchinson. There are also several short papers of scientific interest, but the outstanding contribution of the volume is to the science of taxonomy.

"A Review of the Genus *Cyrtanthus*" by Dr. R. A. Dyer contains detailed descriptions of forty-four species in the genus which occur in the eastern and southern regions of South Africa. Three species are described for the first time, namely, *C. falcatus*, *C. attenuatus* and *C. bicolor*. Dr. H. P. Traub and J. C. Th. Uphof have also made a further revision of the genus *Amaryllis*, and publish a key to the species, of which seventy-seven are now recognized. Other new species described in the volume are *Amaryllis Kromerii*, *Zephyranthes insularum* and *Z. Plumierii*, the two last-mentioned being described by H. Harold Hume from the West Indies. A cytological confirmation of taxonomy in the genus *Cooperia* is furnished by Walter S. Flory, who shows by means of chromosome counts that the recently discovered *C. Traubii* is distinct from the earlier *C. Drummondii* and *C. pedunculata*. A useful correlation between rainfall and the distribution of *Amaryllis* is drawn by Frances M. Leighton, who shows that these plants prefer the moister parts of South Africa, with equal distribution of the rainfall between summer and winter. They will, nevertheless, grow in quite arid regions, but in dry summers the plants lose their leaves before flowering.

Infra-Red Drying

In the spectrum the radiations which have a wavelength greater than 7600 Å. include those that produce a maximum sensation of heat. The *Electrical World* of New York gives an important practical application of this scientific fact which has effected appreciable economies in drying the paint of letters made for advertising signs, which in many cases have to withstand rough usage. In a test the average time of air-drying took about twelve hours, occupying valuable space and giving time for dust to collect on the surface of the product and so spoiling its finished appearance. With the new arrangements, the sprayed letters are placed on an endless chain, travelling in one direction on the upper level and in the other on the lower level before being dumped into a bin. During this period, which lasts only $7\frac{1}{2}$ minutes, the letters are exposed to the rays from twenty-four 250-watt infra-red lamps staggered at 10-in. centres. An earlier use of infra-red rays was made at Ford's works in Ohio. This method has apparently been successful, and if suitably modified would be useful in other practical applications.

Accidental Deaths in Old Age

ACCORDING to an editorial in the September issue of the *Statistical Bulletin*, issued by the Metropolitan Life Insurance Company of New York, the 7,500,000 persons of 65 years and more form only 6 per cent of the total population of the United States, but fully a quarter of the annual fatal accidents in that country

occur in persons of that age. This excessive mortality is found both in men and women, but is relatively higher in women. Falls are by far the most frequent causes of fatal accidents in old people, and account for about 15,000 such deaths annually in the United States. The commonest types are falls on floors, stairs and in the street, and relatively few deaths are due to falls from high places. Motors cause the death of about 5,500 old persons, about two thirds of the deaths being due to accidents in which vehicles strike pedestrians. Accidental burns (apart from conflagrations) account for 1,100 deaths every year at this age, a large number of the deaths being caused by clothing catching fire at stoves and grates. Deaths from illuminating gas poisoning are frequent in elderly persons, probably because they do not detect the smell of escaping gas so well as younger persons, and are less likely to recover from carbon monoxide poisoning. The writer expresses the hope that the education of youth to-day in safe ways of living will be of value not only at the present time but will also benefit the aged of the future.

The Imperial Cancer Research Fund

THE thirty-seventh annual report (1938-40) of the Imperial Cancer Research Fund was presented to the annual meeting of the Governors on April 17. Prof. H. R. Dean, Prof. H. W. Florey, Prof. C. A. Lovatt Evans, and Prof. J. Beattie have been appointed members of the council. Mr. Hugh Lett gave a brief historical account of the work of the Fund since its foundation. Two events of importance to the Fund have occurred since the publication of the last report: a royal charter of incorporation was granted on August 29, 1939, and the new laboratories at Mill Hill were opened on June 27 of the same year. The director, Dr. W. E. Gye, summarizes in the report the researches that have been conducted in the Fund's laboratories. These include work by Dr. R. J. Ludford on the comparative reactions of normal and malignant cells in tissue culture to some chemotherapeutic compounds. A Polish State scholar, Dr. Dmochowski, has investigated antigenic differences between normal and malignant cells. His results demonstrate that there is a fundamental difference between transplanted tumours and spontaneous tumours that may arise in an animal. In the former the malignant cells are introduced and are 'foreign' to the animal, and give rise to reactions which are absent in animals bearing spontaneous tumours, in which the tumour cells are part of the animal's body and are not 'foreign'.

The South-West Essex Technical College

DR. LOWERY, principal of the South-West Essex Technical College and School of Art, has presented to the Governors the first annual report, for the session 1938-39. The College replaces former technical institutes at Leyton and Walthamstow, together with a commercial school for girls at the same place and a school of art at Leyton, and embodies a comprehensive scheme for the development of technical education in the county. When the Principal took over duty in April 1938, the buildings

were far from complete and the workshops and laboratories only outlined. These handicaps were well overcome; besides the teaching staffs transferred, many new heads of departments and lecturers were appointed; and at present the full-time staff numbers 82 with 180 part-time instructors. The number of students for the session reached 6,842. Association with the four institutes mentioned and various junior schools has been achieved without a hitch.

We notice a general building course, three foreign language clubs which have run successfully on self-governing lines, and classes on milk technology, bee-keeping and glass-blowing. Biology on Saturday mornings has attracted local teachers, who have maintained a high standard of work and steady attendance. The success of the College and the demands for its teaching are a credit to all concerned. It may well be a model for a substantial advance in education elsewhere.

Progress in Education

EDUCATION in the United States is well served by several periodicals. The issue for February last of *School Life*, the official organ of the U.S. Office of Education, is well illustrated and full of live discussion of controversial issues, while it illustrates the enterprise of educational authorities. The science department of Dover High School in Ohio has leased twenty-five acres of potential flood land which are to be used as a field laboratory for the study of ecology and the management of streams and ponds. It is suggested that the Decennial Census, which is due in April, might be discussed in schools, as it has a very wide scope and will include housing for the first time. *School and Society*, February 17, begins with a good article on "The Teacher Pupil Relationship in a Democracy" and ends with a striking one on "Vocabulary and Success in College". Vocabulary and style are, in fact, of great importance for success in life. Max Müller was not well informed when he put down the words used in a country parish as less than 300; but the rustic world, which has its own expert information to give, is still hampered by its incoherence, and education should be always enlarging the effective use of language. On the elementary side, it is to cost Great Britain, according to the latest yearly estimate, well over 36 million sterling. Forty years since, men of science were below the educated standard in books and journalism; now they are distinguished for good writing, which is appreciated by the general public. This is particularly needed in science, since discoveries are exaggerated and misstated by fluent 'stunt' writers who popularize without adequate knowledge.

Announcements

DR. W. SUCKSMITH, lecturer in physics in the University of Bristol, has been appointed to the chair of physics in the University of Sheffield, in succession to Prof. S. R. Milner, who is retiring at the end of the present session.

THE following appointments and promotions in the Colonial Service have recently been made: D. C. Edwards, agricultural officer, senior agricultural officer, Kenya; E. T. Holmes, senior agricultural officer, Nigeria, senior agricultural officer, Sierra Leone; G. W. Nye, senior botanist, deputy director of agriculture, Uganda; A. H. W. Weir, conservator of forests, deputy chief conservator of forests, Nigeria.

IN commemoration of the centenary of the foundation of King's College Hospital a tablet was unveiled on April 17 at Strand House, Portugal Street, London, which showed the site occupied by the hospital from 1839 until 1913.

THE Rockefeller Foundation has made a grant of some £200,000 to Prof. E. O. Lawrence for the construction at the University of California of a cyclotron of 184 in. diameter. The total weight of this apparatus will be about 5,000 tons and it will take about three years to build. Such a machine is expected to produce deuterons of 10^8 volts energy.

DR. PHILIP E. SMITH, professor of anatomy at the College of Physicians and Surgeons, Columbia University, was elected president of the American Association of Anatomists at the fifty-sixth annual convention held at Louisville, Kentucky, on March 21.

To encourage the preparation of papers by students of fuel technology, the Council of the Institute of Fuel has decided to make an annual award of a medal, together with a prize consisting of books and/or instruments to the value of £5. A copy of the rules governing the award can be obtained from the Secretary, Institute of Fuel, 30 Bramham Gardens, London, S.W.5.

THE Egypt Exploration Society, of 2 Hinde Street, Manchester Square, London, W.1, and 1450 Broadway, New York, announces that on September 1 it will publish in two volumes "Temples of Armant" by Sir Robert Mond and Oliver H. Myers. Lady Mond has generously made it possible to finish the work of the Mond Expedition in the manner originally contemplated, and the last three years work is being published in two memoirs, "Temples of Armant, a Preliminary Survey", and "Cemeteries of Armant II and a Saharan Culture". Each work will be published in two volumes, one of text and one of plates (some of which will be coloured), in the same style as "Cemeteries of Armant I".

REFERENCE was made in NATURE of May 4, p. 701, to the amalgamation under the style of Newton and Co., Ltd., of two well-known firms of the name of Newton. It should have been stated that the combined business is now being carried on at 72 Wigmore Street, London, W.1.

ERRATUM.—In the letter entitled "Rhythmical Impedance Changes in the Trout's Egg" in NATURE, May 11, p. 744, line 11, for "sodium nitride" read "sodium azide".

LETTERS TO THE EDITORS

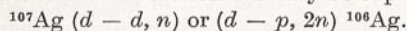
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 784. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New Type of Disintegration Produced by Deuterons

In a previous communication from this laboratory, Krishnan and Gant¹ reported the formation of ¹⁰⁶Ag when silver was bombarded with 9 Mev. deuterons. It appears that this reaction can only be explained by



Since it is well known that ⁶²Cu can be produced by certain methods which also yield ¹⁰⁶Ag (namely, $n - 2n, \gamma - n$), it was therefore considered that deuteron bombardment of copper might also produce ⁶²Cu. We have bombarded pure copper foil with a few microampere-minutes of 9 Mev. deuterons from the Cavendish cyclotron. The copper fraction was chemically separated from the bombarded sample and its positron activity was examined with a Geiger-Müller counter (the magnetic field used to resolve

the curve clearly indicates that the effect cannot be due to the neutron or γ -ray background, and it would seem to explain why the effect was not observed earlier, in that previous experimenters did not use deuterons of more than 8 Mev. energy.

Further experiments were made in an attempt to decide whether the reaction was $(d - d, n)$ or $(d - p, 2n)$. If the latter alternative be correct, the $(d - p)$ reaction should be observed to decrease as the $(d - p, 2n)$ reaction increases, these two being opposing reactions. The excitation function for the formation of ⁶⁴Cu (12.8 hr.) by deuteron bombardment of copper [$(d - p)$ reaction] was measured (this was first done by A. G. Ward in this laboratory and later confirmed by us), and it was observed that the yield from this reaction decreased above 8 Mev. This result would seem to show that in the formation of ⁶²Cu the $(d - p, 2n)$ reaction is more probable than the $(d - d, n)$ reaction.

R. S. KRISHNAN.
T. E. BANKS.

Cavendish Laboratory,
Cambridge.
April 10.

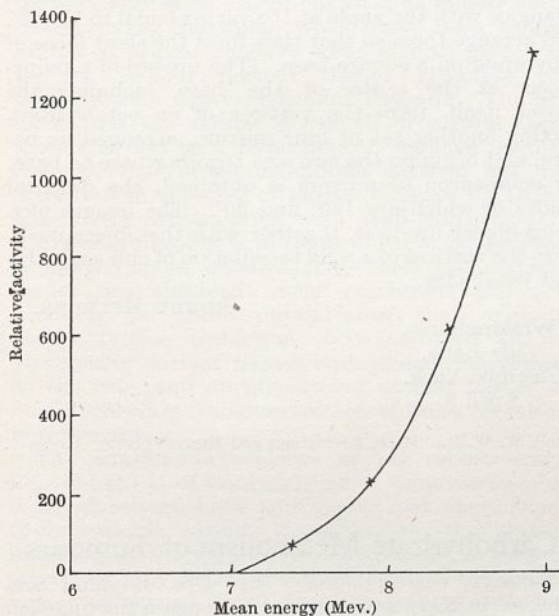
¹ Krishnan and Gant, NATURE, 144, 547 (1939).

² Livingood and Seaborg, Rev. Mod. Phys., 12, 30 (1940).

Calculations on the Energies of Hydrocarbons

WE have made a number of calculations on the energies of various hydrocarbons and have also obtained related properties such as the internuclear distances in the ground and simple excited states, the heats of formation and the approximate wavelength of certain absorption bands. Incidentally, an estimate of the heat of sublimation of carbon has been made which is probably as reliable as any other value hitherto given.

The energy of the most stable state of benzene may be written $6H + 6S - 0.4J$, while the energy of the nearest excited singlet state is $6H + 6S - 3.0J$, where H is the energy of the carbon-hydrogen bond, S and J are functions defined by Lloyd and Penney¹. The shape of the excited state is found to be regular, with the C-C link about 1.44 Å. in length. The experimental value of the 'breathing frequency' in this state is 920 cm.⁻¹. The calculated value is a little more than 900 cm.⁻¹, the exact value depending on the type of potential function assumed for the double bond and the normal 'benzene' bond (namely, parabolic law, Morse function, etc.). The energy difference between the two states is roughly $2.6J$, where J has its value at the normal ring distance, and is therefore 1.85 e.v. Hence the absorption band



the positrons being adjusted so that the positrons from ⁶⁴Cu were excluded). A single positron activity of energy more than 2 Mev. with a half-life of 10.5 minutes was observed. This would appear to be due to the well-known ⁶²Cu². Excitation function measurements were made by exposing a pile of copper foils (11.4 mgm./sq. cm.) to the deuteron beam and then measuring the activities after chemical separation as above. The accompanying energy-yield curve was obtained.

The threshold for the production of this radioelement seems to be at about 7 Mev. The nature of

corresponding to the transition from one state to the other is calculated to be about 39,000 cm^{-1} —almost exactly the observed value. When suitable refinements are made in the theory, the agreement with experiment is still almost exact. This part of our work may be regarded as an extension of a theory of the origin of the absorption bands of benzene proposed by Sklar².

Similar calculations on butadiene show that the central C—C link has a length 1.42 Å. in the excited state, compared with 1.43 Å. in the ground state, and the outer links have lengths 1.61 Å., compared with 1.34 Å. in the ground state. The energy difference between the two states is 45,000 cm^{-1} , compared with the experimental value 48,000 cm^{-1} . For this molecule, it will be noticed, the internuclear distances in the two states are very different, and as a result, the band in the fluorescent spectrum arising from the transition from one to the other should show considerable vibrational structure.

Calculations on more complicated polyenes have also been made, with results similar to those quoted for butadiene.

The theory employs only the double bond and benzene bond energies and force constants. Now the force constants are known within a few per cent, and in any event their importance in the theory is only subsidiary. Thus the only uncertainty is that arising from the unknown value of the heat of sublimation of carbon, placed by various observers between 130 and 170 kcal./mol. Pauling³ adopts the latter value. Support for his view may be obtained as follows. Suppose that the heat of sublimation is changed to $(170 - \Delta)$ kcal./mol. Then the calculated value of the energy of the absorption band of benzene mentioned above is decreased roughly by $8\Delta/7$. Thus if $\Delta = 40$, the calculated energy of the band is changed from 111 kcal./mol. to 65 kcal./mol., the observed value being 110. Similarly, the agreement between theory and experiment for butadiene is completely spoiled. We conclude that the heat of sublimation of carbon is 170 kcal./mol., with a possible error of 10 kcal./mol.

Full details will be published later.

G. J. KYNCH.
E. H. LLOYD.
W. G. PENNEY.

Imperial College of Science and Technology,
London, S.W.7.
April 15.

¹ *Trans. Farad. Soc.*, **35**, 835 (1939).

² *J. Chem. Phys.*, **5**, 669 (1937).

³ *J. Amer. Chem. Soc.*, **54**, 3570 (1932).

Structure of the OD Bands of Heavy Water

BANDS due to the OD molecule have been photographed with a large quartz Littrow and a 10-ft. concave grating spectrograph by using discharges through vapour of heavy water of a high degree (99.6 per cent) of purity. The bands at $\lambda 2872$ and $\lambda 2916$ have been measured. They correspond to the (1, 0) and (2, 1) bands of OH with heads at $\lambda 2811$ and $\lambda 2875$ due to the electronic transition ${}^2\Sigma^+ \rightarrow {}^2\Pi_{\text{inv}}$. With the aid of the rotational differences derived from the six main P, Q and R branches the mean values of the constants for the band $\lambda 2872$ are found to be (in cm^{-1}) as follow:

$$\begin{aligned} B'_v &= 8.736 & ; & D'_v = 0.548 \times 10^{-3} \\ B''_v &= 9.870 & ; & D''_v = 0.420 \times 10^{-3} \end{aligned}$$

The values B'_v and B''_v are in good agreement with those calculated from the corresponding constants of the OH molecule using the mass ratio, $P^2 = 0.5301$ (${}^1\text{H} = 1.0081$ and ${}^2\text{H} = 2.0142$) for the two isotopic molecules OH and OD. The wave numbers of $R_1(1)$ and $Q_1(1)$ are 34796.9 and 34761.6 cm^{-1} respectively.

Full details of the structure will be published elsewhere.

K. R. RAO.
M. G. SASTRY.

Andhra University,
Waltair.
March 14.

The Generalized Kaleidoscope

PROF. H. S. M. COXETER, in his recent admirable essay¹ on polyhedra, has brought the generalized kaleidoscope to the notice of a wider public. In the accounts of this apparatus which I have seen, there is no reference to those cases in which the angle between two of the mirrors is 120° . The trihedral examples, though interesting, are perhaps of less importance than the case described below.

It is said to have been proved that a kaleidoscope cannot have more than six mirrors; it is, however, possible to have one with eight arranged in a manner suggested by the faces of the rhombic dodecahedron. Take four mirrors the shape of congruent isosceles triangles with the angle at the vertex equal to $70^\circ 32'$, and arrange them so that they form the slant faces of a pyramid on a square base. (The images of a point-object at the centre of the base, including the object itself, form the vertices of an octahedron). Taking another set of four mirrors, arranged as before, and bringing the two sets together base to base, an octahedron of mirrors is obtained, the dihedral angles of which are 120° and 90° . The images of a point-object inside it, together with the object itself, form the vertices of a solid tessellation of cuboctahedra and octahedra.

SIDNEY MELMORE.

Winkinghurst,
Carr Lane,
Acomb, York.
April 9.

¹ Ball, W. W. R., "Math. Recreations and Essays" (1939), chapter v.

Carbohydrate Metabolism of Tumours

RECENT correspondence by Drs. Boyland and Dickens in NATURE has raised once again the question of the existence of an abnormal carbohydrate metabolism of tumours.

Dr. Dickens¹ maintains that, whilst neither aerobic glycolysis alone nor in combination with a low respiratory quotient is "in the strictest sense specific for tumours, . . . nevertheless, the association in tumour metabolism of relatively high aerobic and anaerobic glycolysis with the lowered respiratory quotient is such a constant one that to dismiss it is to discard as unimportant the most characteristic of established biochemical peculiarities of tumour tissue". We agree with Dr. Dickens that this type

of metabolism is very common in tumours, but whereas Dr. Dickens (whose opinion on this matter is still shared by many other workers) considers it as the most characteristic of established biochemical peculiarities of tumour tissue, we feel that such features of carbohydrate metabolism, as stressed by Warburg, Dickens and others, are in no sense peculiar to tumour growth, and have no significance in the elucidation of the tumour problem.

In his communication to NATURE, Dr. Dickens brings forward the following arguments in support of his case: (a) Practically all tumours have a strong aerobic glycolysis and a low respiratory quotient; (b) normal tissues, with few exceptions, do not possess this type of metabolism; (c) in the experimental production of hepatomata, the liver cells acquire the type of metabolic activity characteristic of malignant tissue; and (d) when muscle is replaced by malignant sarcoma, a great increase of glycolysis occurs.

These arguments would seem untenable on the following grounds:

The tumours, the metabolism of which has so far been investigated, are derived from tissues which normally glycolyse aerobically (for example, from skin and intestinal epithelium and fibroblasts). On the other hand, a number of spontaneous tumours have been found to be entirely free from aerobic glycolysis².

With regard to the metabolism of normal tissues, to say that, with few exceptions, they do not possess this type of metabolism, is erroneous. On the contrary, as Boyland points out³, ". . . most body tissues (with some exceptions such as kidney cortex, spleen, ovary and lung) which have been carefully examined appear to have some aerobic glycolysis". Indeed, several normal tissues glycolyse more strongly than many malignant tumours. The argument that the aerobic glycolysis of certain normal tissues is due to a hypothetical 'damage' resulting from the use of an unsuitable medium has been disproved in the case of kidney medulla by Dickens himself (in collaboration with Weil-Malherbe⁴). In the case of fibroblasts in tissue culture, the argument is all the more unreasonable, since the metabolic values are obtained under conditions which are probably far more physiological than with the accepted slice technique. To consider all non-glycolysing normal tissues and glycolysing tumours as the rule, and all glycolysing normal tissues and non-glycolysing tumours as exceptions, is clearly unreasonable.

The citation as evidence of the metabolism of hepatomata is of doubtful value, since normal liver itself glycolyses both aerobically and anaerobically to a variable extent, depending on the state of nutrition of the organ. In a hepatoma, the aerobic glycolysis may be several times that of the average values of normal liver⁵, but hepatomata with little or no aerobic glycolysis have also been reported⁶. In any event, many investigators (including Dr. Dickens) have long since abandoned the idea that aerobic glycolysis is, in itself, peculiar to tumours. According to the current theory, it is only aerobic glycolysis together with a low respiratory quotient which is taken as a metabolic defect characteristic of tumour growth. So far as we know, no one has yet measured the respiratory quotient of hepatomata, and it is difficult to see what significance can be expected from such measurements, since normal liver is known to have a low respiratory quotient⁷.

Finally, as regards the great increase in glycolysis when "muscle is replaced by malignant sarcoma", this is the most misleading argument of all, since the sarcoma in question (Rous I) is of connective tissue origin (macrophage⁸ or fibroblast⁹), and is not derived from the muscle "which it replaces".

Most investigators who consider aerobic glycolysis in combination with a low respiratory quotient as significant features of tumour metabolism, base their arguments (1) on a comparison between the metabolism of tumours derived from skin or intestinal epithelium or connective tissue with such normal tissues as pancreas, liver, spleen, testis, etc., instead of with the normal tissues from which these tumours happen to be derived, and (2) on the hypothetical assumption that the glycolysis of most normal tissues is due to an artificially induced damage.

In an attempt to avoid both these sources of error, we have carried out a comparative study of the metabolism of normal rabbit skin epithelium (a tissue evidently resistant to damage) and the Shope papilloma derived from it. We found^{10,11} that the values for respiration, aerobic and anaerobic glycolysis and respiratory quotient for the two were almost identical, and similar to many of the values for skin carcinoma quoted in the literature.

From these observations and from the work recorded in the literature on the glycolysis of normal mucous membrane and fibroblasts, we draw the conclusion that, when a tumour is compared with the tissue from which it is derived, there are no characteristic differences or peculiarities between the carbohydrate metabolism of the two.

I. BERENBLUM.

E. CHAIN.

N. G. HEATLEY.

Oxford University Research Centre of
the British Empire Cancer Campaign,
Sir William Dunn School of Pathology,
University of Oxford.

April 19.

¹ Dickens, F., NATURE, 145, 512 (1940).

² Murphy, J. B., and Hawkins, J. A., J. Gen. Physiol., 8, 115 (1925).

³ Boyland, E., NATURE, 145, 513 (1940).

⁴ Dickens, F., and Weil-Malherbe, H., Biochem. J., 30, 659 (1936).

⁵ Nakatani, M., Nakano, K., and Ohara, Y., Gann, 32, 240 (1938).

⁶ Hayashi, I., and Tomita, T., Gann, 31, 232 (1937).

⁷ Dickens, F., and Simer, F., Biochem. J., 35, 985 (1931).

⁸ Carrel, A., Compt. Rend. Soc. Biol., 91, 1069 (1929).

⁹ Ludford, R. J., Amer. J. Cancer, 31, 414 (1937).

¹⁰ Berenblum, I., Chain, E., and Heatley, N. G., Ann. Rep. Brit. Emp. Cancer Campaign, 16, 215 (1939).

¹¹ Berenblum, I., Chain, E., and Heatley, N. G., Amer. J. Cancer, 38, 367 (1940).

WE agree with Berenblum, Chain and Heatley, and with Boyland¹, that high aerobic and anaerobic glycolysis and low respiratory quotient, while very common properties of tumour tissue, are not specific. In fact, we have in hand additional work to be published soon which shows that intestinal mucosa² possesses very active aerobic and anaerobic glycolysis combined with a low respiratory quotient.

On the other hand, these authors maintain that the tumours so far studied which have high aerobic glycolysis and low respiratory quotient have arisen from normal tissue which itself has this type of metabolism. The present evidence for and against this view does not seem to us conclusive. Only two

examples are yet known in which such a strict comparison is possible; for in our opinion the value for this purpose of measurements on cultured tissue-cells, growing under conditions which are certainly unphysiological, is very doubtful.

The first example is the hepatoma, to which Berenblum *et al.* take exception on the grounds that aerobic glycolysis may sometimes be lacking in hepatomata, and that normal liver has variable and often considerable aerobic glycolysis. Both in our own experience, however, and in the recorded values, we have always found the aerobic glycolysis of liver to be small compared with its respiration, especially when it is remembered that the often large formation of acetone bodies by this tissue must be taken into account. The second example is the transformation of skin epithelium into Shope papilloma, studied by Berenblum, Chain and Heatley³. Some experimental data are not detailed in this paper, such as the medium used, the number of observations and the consistency of the results; also it is not stated if normal tissues give the same values of aerobic glycolysis and respiratory quotient in the minute pieces used as they do in the usual larger-scale experiments. The purity of the papilloma tissue used for comparison with 100 per cent pure epithelium and the stage of malignancy arrived at are also desirable data. However, in the one example given, there was no change of metabolism other than a slight general lowering of all the figures, including respiratory quotient, when a tumour had resulted.

In our opinion, these two cases counterbalance one another, and no general conclusion can as yet be drawn as to the occurrence of an alteration of metabolism in the development of cancer.

F. DICKENS.

H. WEIL-MALHERBE.

Cancer Research Laboratory,
North of England Council of the
British Empire Cancer Campaign,
Newcastle-upon-Tyne.
April 22.

¹ Boyland, E, *NATURE*, **145**, 513 (1940).

² Weil-Malherbe, H., *Biochem. J.*, **32**, 2257 (1938).

³ Berenblum, I., Chain, E., and Heatley, N. G., *Amer. J. Cancer*, **38**, 367 (1940).

Chemical Estimation of Vitamin B₆ in Foods by Means of the Diazo Reaction and the Phenol Reagent

THE recent investigations of Kuhn and his co-workers¹ and Harris and Folkers² have shown that vitamin B₆ is 2-methyl-3 hydroxy-4 : 5 di(hydroxy-methyl)-pyridine. It contains a hydroxy group in the β -position of the pyridine ring, which gives the characteristic red coloration of true aromatic phenols with ferric chloride. The vitamin also gives colour reactions with diazotized aromatic amines and the phenol reagent of Folin and Ciocalteu³.

A method has been developed for the estimation of the vitamin in biological materials using diazotized sulphanic acid or the phenol reagent. Since these reagents are not specific for vitamin B₆, it is necessary to remove all interfering substances before colorimetric estimations can be carried out. By the procedure outlined below it has been found possible to obtain values for the vitamin B₆ content of various foods

which appear to correspond approximately to those obtained by other workers using biological methods.

A suitable quantity (2-50 gm. containing 10-20 rat units of vitamin B₆⁴) of the finely minced or powdered test material was digested with pepsin for twenty-four hours. Protein and its derivatives were removed by tungstic acid. Purine, pyrimidine and imidazole bases were precipitated with silver nitrate and barium hydroxide and the excess silver removed. The solution was adjusted to pH 1-2 and the vitamin B₆ present was adsorbed on clarite (2 gm.). The vitamin was eluted from the clarite with hot barium hydroxide and the silver precipitation was repeated. The solution was then adjusted to pH 6, concentrated to 25 ml., and treated with sodium nitrite and acetic acid for 15 minutes to destroy any amino group that might be present. After bringing the pH to 7, the solution was filtered and made up to 50 ml. 10 ml. aliquots were treated with diazotized sulphanic acid and the azo colour formed estimated colorimetrically by comparison against a standard of 20 μ gm. of pure vitamin B₆ treated in the same way. The method is highly sensitive. 10 μ gm. of vitamin B₆ is easily estimated and the colour obtained is proportional in intensity to the amount of vitamin present. The values for fifteen foodstuffs are given in the accompanying table.

VITAMIN B₆ CONTENT OF VARIOUS FOODSTUFFS

| Foodstuff | Vitamin B ₆ μ gm./gm. |
|---------------------------------------------------|-----------------------------------------|
| Yeast, dried (brewer's) | 54.0 |
| Yeast, dried (brewer's) (autoclaved at pH 9.4) .. | 53.0 |
| Rice polishings | 13.4 |
| Liver, sheep | 13.4 |
| Muscle, sheep | 4.5 |
| Milk, cow's | 1.7 |
| Maize, yellow, whole | 7.1 |
| Wheat, whole | 7.6 |
| Cholam (<i>Sorghum vulgare</i>) | 8.0 |
| Rice, husked | 6.6 |
| Rice, highly milled, raw | 3.0 |
| Soya bean | 8.0 |
| Beetroot | 1.3 |
| Cabbage | 3.1 |
| Plantain, ripe | 1.3 |

Known amounts of vitamin B₆ were added to weighed quantities of foodstuffs and the recovery was good in all cases, ranging from 70 to 100 per cent.

The method described is applicable to all types of foodstuffs. It is probable that in some cases it may be abbreviated. For example, treatment with nitrous acid has been found to be unnecessary in the case of yeast. Possibly the second silver precipitation is not always necessary. A variety of different phenolic reagents may be used and many modifications in detail are possible. For example, with yeast and potatoes, comparable values have been obtained using diazotized sulphanic acid and *p*-nitroaniline and the phenol reagent, nitrous acid treatment being omitted.

A fuller account of these investigations will be published in the *Indian Journal of Medical Research*.

M. SWAMINATHAN.

Nutrition Research Laboratories,
Indian Research Fund Association,

Coonoor, S. India.

March 27.

¹ Kuhn, Westphal, Wendt, and Westphal, *Naturwiss.*, **27**, 469 (1939). Cited in *Nut. Abstr. Rev.*, **9**, 606 (1940).

² Harris and Folkers, *J. Amer. Chem. Soc.*, **61**, 1245 (1939).

³ Folin and Ciocalteu, *J. Biol. Chem.*, **73**, 627 (1927).

⁴ Birch, György and Harris, *Biochem. J.*, **29**, 2830 (1935).

Liberation of Potassium from Muscle by Acetylcholine and Muscle Contraction and its Absence after Adrenalectomy

Cicardo and Moglia recently announced in *NATURE*¹ that, after injecting acetylcholine into the sciatic artery of a toad, "the contracture of the muscles is accompanied by an increase in the concentration of potassium in the liquid flowing from the vein".

In a paper presented to the Swiss Physiological Society on January 27², we announced a similar result in four normal cats. An injection of 5-40 acetylcholine was made into the femoral artery towards the muscle, and all the venous blood coming from the leg muscles was collected.

There was a great increase of plasma potassium, from 15 mgm. per cent without injection of acetylcholine, to 25 mgm. per cent or more after the injection. The liberation of potassium ceased a few seconds after the injection. The total quantity of potassium liberated was about 0.5 mgm., most of which came from the gastrocnemius muscle.

In confirmation of numerous previous experiments, we were also able to show, on the same preparation, that the plasma potassium is also raised during contraction of the gastrocnemius caused by electrical stimulation of the sciatic nerve.

In nineteen experiments on twelve cats, the plasma potassium increased from 16.1 mgm. per cent to 28.2 mgm. per cent. The gastrocnemius (weighing about 30 gm.) liberated about 1.5 mgm. of potassium during 4,000 gm. cm. work per minute. This reaction also ceased immediately after the end of the contraction, while lactic acid production continued for some minutes.

We were especially interested, in these experiments, in their bearing on the question of muscle metabolism after adrenalectomy.

As we have shown in previous experiments³, there is a close connexion between carbohydrate and potassium metabolism which is disturbed after adrenalectomy. We therefore repeated the above experiments on adrenalectomized cats, and were able to show that after injection of acetylcholine into the muscle artery, no potassium whatever was liberated (nine experiments on four cats).

Similarly, after electrical stimulation of the sciatic nerve, the plasma from the muscles of adrenalectomized cats showed no (or only a minimal) increase of potassium (eleven experiments on five cats).

The plasma potassium of these animals, on the second to fifth day after the second adrenalectomy, was raised as usual, but did not change after stimulation. The total quantity of potassium liberated for 4000 gm. cm. work per minute was only 0.2 mgm., which is an almost negligible quantity.

Since potassium plays a part in carbohydrate metabolism, we believe that these changes in plasma potassium are connected with the absence of glycogen re-synthesis after adrenalectomy.

The detailed report of these experiments will be published later.

F. VERZÁR.
J. C. SOMOGYI.

Physiological Institute,
University of Basle.
April 10.

Function of Chlorocruorin in Sabella and of Hæmoglobin in Lumbricus

A NUMBER of invertebrate animals possess blood pigments which are generally assumed to be respiratory, although only in a few instances has a respiratory function been demonstrated experimentally. One or more of three functions are imputed to these pigments: (a) they may act like hæmoglobin in themselves, as a transporter of oxygen at all times; (b) they may come into action as oxygen transporters only when oxygen is deficient in the outside world, there normally being enough of the gas in simple solution in the blood for the restricted wants of the relatively sluggish animal; (c) they may serve as a reservoir of oxygen to be drawn upon during temporary shortage of the gas in the environment.

Among the invertebrates, function (a) has hitherto been demonstrated only in a single case, namely, in *Tubifex*. When the hæmoglobin of this freshwater oligochaete worm is put out of action with carbon monoxide, the animal consumes less oxygen at atmospheric and all lower oxygen pressures¹.

Because the hæmoglobin of the polychaete worm *Arenicola* has a very low loading tension (oxygen pressure for 95 per cent oxyhæmoglobin)² and can therefore take up oxygen from water in which the pressure of the gas is low, function (b) has been suggested for it³. But this suggestion lacks experimental proof, and if the oxygen pressure in the respiring tissues were close to zero, the oxyhæmoglobin, in spite of its low unloading tension (oxygen pressure for 50 per cent oxyhæmoglobin), would still give up its oxygen to these tissues even when the worms are in air-saturated water. Experimental evidence has, however, been adduced that function (b) is exhibited by the hæmoglobin in the blood of the earthworm^{4,5}, but work on *Lumbricus* now completed in this laboratory by Dr. M. L. Johnson has proved that this is not so and that the blood pigment of the earthworm has function (a) in a modified form. When the earthworm's hæmoglobin has combined with carbon monoxide the animal consumes less oxygen, both at normal atmospheric and at lower oxygen pressures, although the greatest use of the hæmoglobin is made at oxygen pressures about half atmospheric.

As regards function (c), the amount of oxygen in the blood of *Arenicola* is sufficient to last the animal about an hour; it could therefore help to supply the animal's needs while buried in mud at low tide and then presumably unable to obtain fresh supplies of oxygen^{2,3}. When in its mud tube under water, the ventilation movements of *Arenicola* are intermittent, and its hæmoglobin may act as a temporary oxygen store between successive ventilation periods⁶. In the gephyrean worm *Urechis*, the amount of oxygen combined with hæmoglobin is also sufficient to last the animal for about an hour, and is thought to act as a store both between ventilation periods and at low tide⁷. This assumed function of *Arenicola* and *Urechis* hæmoglobin lacks proof. Would these animals in their burrows use less oxygen if deprived of their respiratory pigment?

Chlorocruorin is a unique chemical relative of hæmoglobin, present only in the blood of a few kinds of marine worms⁸. Work in this laboratory recently concluded by Mrs. R. F. Ewer has shown that the chlorocruorin of *Sabella* exhibits function (a). Like earthworms, frogs and certain fishes⁹, and unlike human beings, *Sabella* can be gassed with carbon

¹ Cicardo, V. H., and Moglia, J. A., *NATURE*, **145**, 551 (1940).

² *Verh. Schweiz. Physiol.*, 25 (Jan. 1940).

³ Verzár, F., and Somogyi, J. C., *NATURE*, **144**, 1014 (1939).

monoxide and yet not be killed. In these circumstances chlorocruorin cannot combine with oxygen, and the gassed animals were found to consume less oxygen both at atmospheric and at lower pressures of oxygen in the environment. It is clear, then, that the function of chlorocruorin is to clear a certain proportion of the worm's oxygen consumption. That oxychlorocruorin would part with its oxygen to the animals' tissues, even when the worm is in well aerated water, could be foreseen from two circumstances: (1) the unloading tension of chlorocruorin is relatively high⁸, and (2) we found that the oxygen consumption of *Sabella* declines soon after the oxygen pressure in the water decreases, so that the oxygen pressure in the tissues is presumably very low¹⁰.

Carbon monoxide inhibits intracellular oxidase. Although the relative pressures of carbon monoxide and oxygen in our work on *Sabella* and *Lumbricus* made it very improbable that this had happened, it was made certain by further measurements of the oxygen uptake of tissue slices with and without carbon monoxide; they were not significantly different.

This work will be published in the *Proceedings of the Royal Society*.

H. MUNRO FOX.

Zoology Department,
University of Birmingham.
April 9.

¹ Dausend, K., *Z. vergl. Physiol.*, **14**, 557 (1931).

² Barcroft, J., and Barcroft, H., *Proc. Roy. Soc.*, B, **96**, 28 (1924).

³ Borden, M. A., *J. Mar. Biol. Assoc. U.K.*, **17**, 709 (1931).

⁴ Jordan, H., and Schwarz, B., *Pflüg. Arch. ges. Physiol.*, **185**, 311 (1920).

⁵ Dolk, H. E., and van der Pauw, F., *Z. vergl. Physiol.*, **10**, 324 (1929).

⁶ Van Dam, L. Thesis (Groningen, 1938).

⁷ Redfield, A. C., and Florin, M., *Biol. Bull. Wood's Hole*, **61**, 185 (1931).

⁸ Fox, H. Munro, *Proc. Roy. Soc.*, B, **99**, 199 (1926); **111**, 356 (1932); **112**, 479 (1933); **114**, 161 (1933); **115**, 368 (1934); **125**, 554 (1938).

⁹ Nicloux, N., *C.R. Soc. Biol. Paris*, **89**, 1331 (1923).

¹⁰ Krogh, A., *J. Physiol.*, **52**, 391 (1919).

intravascular hæmolysis after blood transfusion, in cases of malaria, blackwater fever, Weil's disease, yellow fever, etc.

FRANK MARSH.

Pathological Laboratory,
Anglo-Iranian Oil Co., Ltd.,
Abadan, Iran.
March 30.

Mycorrhizal Habit in the Date Palm (*Phoenix dactylifera* Linn.)

THE date palm grows in Egypt in a great variety of soils and conditions. I have seen palms even growing on the seashore of the Gulf of Suez in places which are occasionally flooded with sea-water and where the pH of the soil ranges from 8 to 9. It was thought worth while to test the presence or absence of mycorrhiza in such a widely distributed plant.

In the preliminary tests carried out about two years ago, it was found rather difficult to get satisfactory material from old palms owing to the nature of root growth. However, I started to raise plants from seeds and examine their roots at intervals. It has been found that roots of seedlings up to eight months old and grown in the sandy garden of the Faculty of Science, Abbasiéh, are free from mycorrhizal association. At such a stage marked swellings are recognized at the tips of some roots, and on their examination they have been found to contain no fungus. Nevertheless, in plants fifteen months old and grown in pots containing Nile silt, the mycorrhizal association is quite visible.



Fig. 1.
INVADING HYPHA WITH THE CHARACTERISTIC SPIRAL COILS.

Bilirubin in Urine

MANY chemical tests for bilirubin in urine have been described, none very satisfactory and none very sensitive. In blood, bilirubin is estimated quantitatively and qualitatively by the well-known method of van den Bergh, which will indicate accurately quantities diluted to one in a million; and Fouchet's reagent, which is sensitive, in the same circumstances, at the dilution of one in sixty thousand.

Hitherto, the van den Bergh test has not been applicable to urine without complicated preliminary manipulations. I have found a very simple manoeuvre which enables the van den Bergh or Fouchet test to be applied to any specimen of urine with results that are reliable, sensitive and accurate. The method consists in the addition of ten per cent very finely powdered dried normal egg albumen to an aliquot portion of the urine under test; the mixture must be very well shaken until the powder has all been taken up. The van den Bergh and Fouchet tests can then be conducted with the albumized urine exactly as with blood serum, and with results comparable in sensitivity.

The method will be described in full later.

This new test has obvious application in cases of

Infected roots become hypertrophied, relatively more thickened and more opaque than the non-infected. They sometimes simulate coralloid roots.

The association is of the vesicular-arbuscular type. The extramatrical mycelium is easily observed and

is of usual type. Root hairs are absent. The invading hypha forms a sort of appressorium before penetration. It is sometimes developed between the epidermal cells and it is also found directly opposite their outer walls. After invasion of the thick outer cellulose wall, the fungus proceeds through the cell cavity. It then develops in a very characteristic spiral fashion through a radial row of cortical cells 3-4 layers deep. After that it spreads laterally and inwardly for 3-4 layers producing these spirally coiled hyphae within the cells. Then it ramifies in the cortex, producing intra- and inter-cellular mycelia and developing vesicles and arbuscules. Vesicles differ in shape

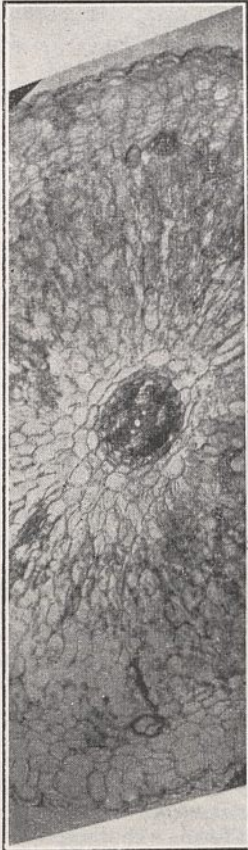


Fig. 2.

TRANSVERSE SECTION OF INFECTED ROOT SHOWING DISTRIBUTION OF THE FUNGUS. IN THE TOP PART SPIRALS AND VESICLES ARE SHOWN.

and size and they may be inside the cells or between them. Arbuscules chiefly develop in the mid-cortex and in the deeply seated layers. In good material the whole of the cortical cells and the intercellular spaces, with the exception of the outermost 4-6 layers and the two layers next to the endodermis, are seen to be packed with the fungus.

Cultivation of the fungus and its cytological characters are under investigation.

YOUNIS SABET.

Botany Department,
Faculty of Science,
Abbasieh, Cairo.
March 20.

Blind Seed Disease of Ryegrass

It is now known that the blind seed disease of ryegrass, associated with low germination, has been present in Great Britain for at least four years. It appears that the true perennials are particularly susceptible and, as these are the more valuable forms, the disease is of considerable economic importance.

This disease of ryegrass was described in New Zealand by Hyde^{1,2} and by Neill and Hyde³. The causal fungus was associated by these writers with the genus *Pullularia*, although it does not exhibit spore budding characteristic of that genus. When work was begun on this disease in Britain, a *Pullularia* form was isolated from seeds which were infected by the blind seed fungus⁴ and, as at that time the paper by Neill and Hyde³ was not available, the two fungi were not clearly distinguished. They are, under certain cultural conditions, very similar and therefore, in view of the original description of the blind seed disease as the 'Pullularia disease', it is desirable to record that, in Britain, the blind seed fungus as well as *Pullularia* sp. are often present on one and the same ryegrass seed. The exact identity, relative pathogenicity and frequency of occurrence of these fungi are under investigation.

MALCOLM WILSON.

M. NOBLE.

E. G. GRAY.

Department of Mycology,
University of Edinburgh.
April 23.

¹ Hyde, E. O. C., *N. Zealand J. Agric.*, **44**, 316 (1932).

² Hyde, E. O. C., *N. Zealand J. Agric.*, **57**, 301 (1938).

³ Neill, J. C., and Hyde, E. O. C., *N. Zealand J. Sci. Tech.*, **20**, 281a (1939).

⁴ Noble, M., *Ann. App. Biol.*, **26**, 630 (1939).

Humpback Whales off West Australia

I NOTICE in NATURE of December 16, 1939, an interesting article by G. W. Rayner on the "Preliminary Results of the Marking of Whales by the Discovery Committee". In this article it is stated that a north and south migration of Humpback whales "along the western coast of Australia has been conjectured for some time past". While I am interested to note that Humpback whales marked in the Antarctic have appeared off the north-west Australian coast, I must criticize the use of the word *conjectured* in the above reference to western Australia.

During the years 1913-15 the movements of the whales on this coast were very carefully watched by the Norwegian whalers, and I had an opportunity on several occasions not only of observing this migration at different points, but also I had access to log books which indicated fairly clearly the times of appearance of the whales and the direction of migration.

The whaling season off the coast of north-west Australia is very definitely limited by the restriction in the time of occurrence of the breeding humpbacks. The dates of their arrival and departure are well known; and in my book "Whalemen Adventurers" (Angus and Robertson, Sydney, 1934) I have given a map to illustrate the direction of the west Australian migration so far as could be judged by the data available. I venture to think that this can scarcely be called a mere conjecture. The *place* whence the

northern migrating whales *came* was a matter of conjecture, and here the results of the Discovery marking experiments have established new facts of value.

W. J. DAKIN.

Department of Zoology,
University of Sydney.

PROF. DAKIN's book "Whalemen Adventurers" and the map therein are well known to me. I am surprised that Prof. Dakin takes such exception to the passage in my article in which I express my view that "a north and south migration [of Humpback whales] along the western coast of Australia has been conjectured for some time past".

In this article the term 'migration' was used only when referring to Humpback whales, for it is only in that species that we have clear evidence, derived from whale-marking, of long-range movements at certain times of the year. Since this evidence is supplemented by the observed movements of Humpback whales off the north-west coast of Australia, we can now speak confidently of a migration along the west Australian coast. I feel that a distinction should be made between 'movements' and 'migrations', and do not consider that the local observations hitherto made fully established a 'migration' along this coast.

In his book, Prof. Dakin does not give very fully the evidence on which he bases his map and the few references to migration in his text. The log book records of which he speaks are for three seasons of very rapidly declining production and for the most part, I imagine, cover only a limited part of the north-west coast of the Australian continent in the vicinity of Norwegian Bay. Prof. Dakin is scarcely justified in extending his conclusions from this neighbourhood to the whole of the west coast, especially as he admits in his letter that the place whence the northward migrating whale came was not known. Whilst Prof. Dakin may have demonstrated the regular movements of Humpback whales off a part of the north-west coast, my remark referred to the west coast, which has a length of about 1,000 miles. For these reasons the word conjectured was used.

I admit our whale-marking data only show, *per se*, that Humpback whales once in the Antarctic may appear later off the north-west Australian coast, but this is a very positive fact and does support much that was previously, of necessity, conjectured.

GEORGE RAYNER.

"Discovery" Investigations,
c/o British Museum (Natural History),
London, S.W.7.

Points from Foregoing Letters

R. S. Krishnan and T. E. Banks report the formation of ^{62}Cu by deuteron bombardment of copper, as a result of a new type of disintegration, namely, $(d - d, n)$ or $(d - p, 2n)$. The threshold for the production of this radio-element seems to be at about 7 Mev. and the yield increases rapidly between 8 and 9 Mev. Further evidence has been adduced to show that in the formation of ^{62}Cu the $(d - p, 2n)$ reaction is more probable than the $(d - d, n)$ reaction.

G. J. Kynch, E. H. Lloyd and W. G. Penney summarize the results of some new calculations on the energies, internuclear distances and vibration frequencies of the benzene and butadiene molecules. An argument is outlined leading to the conclusion that the heat of sublimation of carbon is 170 kcal./mol.

S. Melmore describes a kaleidoscope of eight mirrors; it yields a solid tessellation of cuboctahedra and octahedra.

I. Berenblum, E. Chain and N. G. Heatley present evidence from the literature and from their own work to show that the respiration, glycolysis and respiratory quotient of tumour tissue does not differ fundamentally from that of the normal tissues from which the tumours are derived. In reply, F. Dickens and H. Weil-Malherbe consider that in view of the alteration of metabolism accompanying the formation of a hepatoma from normal liver, no general conclusion can as yet be drawn as to the occurrence of an alteration of metabolism in the development of cancer.

A chemical method for the estimation of vitamin B₆ in foodstuffs, using the diazo reaction or the phenol reagent, has been developed by M. Swaminathan.

F. Verzár and J. C. Somogyi show that although potassium is liberated from the muscles of normal cats by acetylcholine, and muscle contraction is

stimulated, these phenomena do not occur with adrenalectomized cats. They suggest this is connected with the absence of glycogen re-synthesis after adrenalectomy.

Work by Mrs. R. F. Ewer on the function of the chlorocruorin of Sabella and by Dr. M. L. Johnson on that of the hæmoglobin of the earthworm (Lumbricus) shows that both pigments act as oxygen carriers at and below atmospheric oxygen pressures in the environment, and provide for part of the oxygen consumption of the worms.

Younis Sabet records some observations on the development of the mycorrhizal habit in the date palm. The infected roots become hypertrophied and more thickened. Before penetrating the cell wall, the invading hypha develops an appressorium; once in the cell cavity it forms a characteristic spiral. Finally, the whole of the cortex (cells and intercellular spores) become packed with fungus.

The fungus which in New Zealand has been described as the cause of blind seed disease of rye grass resembles under certain conditions *Pullularia* sp. In view of the original description 'Pullularia disease', M. Wilson, M. Noble and E. G. Gray record that *Pullularia* sp. as well as the blind seed fungus are present. Investigation of these two fungi, as well as of others described on rye grass, is being carried out.

W. J. Dakin queries statements made by G. Rayner in his recent article on whale marking. Rayner states that he distinguishes between 'movement' and 'migration', the latter term only being used when discussing Humpback whales. Dakin's evidence is considered to show movement rather than migration, and his conclusions are thought to lack full confirmation. This has been supplied by the knowledge gained from marking experiments.

RESEARCH ITEMS

Prehistory in Haiti

EXCAVATIONS over a period of three months in 1935, carried out by F. G. Rainey and Irving Rouse, on eleven sites near Ft. Liberté Bay, Haiti, produced some twelve thousand specimens. A report on the excavations is about to be published, but in the meantime the specimens have been examined by the latter in the Peabody Museum with a view of testing the possibilities of a new technique of archaeological analysis in elucidating the facts of both space and time relation in prehistory (*Yale Univ. Pub. in Anthropology*, No. 21; 1939). Of the eleven sites (all kitchen midden sites) five were small, consisting of a single deposit on a restricted area, and are termed "camp sites". The remaining six are groups of middens, deep and spread over a broad area, and are termed "village sites". Two phases are distinguished: the Flint Phase, without pottery and apparently food-gathering, and the Shell Phase, with pottery and agricultural. In the second, flint becomes rare and the place of the double-fitted axe is taken by the petaloid celt. From comparative analysis it is suggested that the people of Period I who were responsible for the camp sites migrated from the south-eastern parts of the United States by way of Cuba, being semi-nomadic and living in small groups. In Period II, the region may have been uninhabited. To Period III belong the Macady and Diale sites, settled by a people migrating from South America, possibly in Period II. Presumably, they spoke Arawak and brought agriculture and the petaloid celt, but not pottery. Probably it was the descendants of these people who inhabited the region in Period IV. They adopted the pottery of their Dominican neighbours in place of the local type which had been introduced from North America early in Period III.

The Delinquent as a Type

In a paper read before the Second Institute of the Washington Child Adjustment Clinic (*J. Crim. Psychopath.*, 1, 24; 1939) Dr. Ben Karpman, of Washington, D.C., who records four illustrative cases, maintains that there is no such thing as the delinquent as a type or personality, but that there are many persons who may be delinquent, in each of whom the delinquency expresses a different problem. The criminal offences for which they are sent to prison are different, the sentences are different and the crime of each means to each one individually something much more and different than it means to the others. Generally speaking, a delinquent is one whose behaviour is such that society must obviously take measures to defend itself against him, and delinquency refers mainly to petty transgressions as distinct from major crimes such as murder, highway robbery, etc. Transitional cases exist between the juvenile delinquent on one hand and the major criminal on the other who has passed the age of sixteen but has not yet quite entered manhood. Karpman's four cases of juvenile delinquency, whose ages ranged from eleven to fifteen, represent respectively the defective, the psychopathic, the neurotic and psychotic, each of which had a different background and a different crime motivation, though superficially they showed much resemblance to one another.

Substances which Modify Carcinogenic Action

DR. CRABTREE has investigated the effect of substances, which might be considered to inhibit metabolism of tissues, on the production of skin tumours in mice with the carcinogenic 3:4-benzopyrene. Certain reactive organic chlorine compounds which check glycolysis delayed the carcinogenic process but never completely inhibited it. The application of naphthoyl nitrile along with 3:4-benzopyrene to the skin of mice induced a high incidence of multiple warts. The carcinogenic agent alone usually produced single warts. A preliminary account of this work is given in the thirty-seventh annual report of the Imperial Cancer Research Fund.

Action of Methylcholanthrene on Normal Tissue Cultures

TISSUES from mice of a strain (C_3H), which are known to be particularly sensitive to the action of carcinogenic agents, have been grown in tissue culture in the presence of methylcholanthrene. W. R. Earle and Carl Voegtlin (*U.S. Public Health Reports*, 55, 303; 1940) describe the changes which the cultures undergo in response to the carcinogenic agent. The initial effect of the carcinogen is to retard growth, and this is followed by gradual changes throughout each culture. The tissue finally had the appearance of cultures of malignant growths, but on injection into mice they did not produce tumours.

Japanese Anomura

GUSTAV MELIN describes a number of species of Pagurids and Galatheids from the Bonin Islands, Japan ("Paguriden and Galatheiden von Prof. Dr. Sixten Bocks Expedition nach den Bonin-Inseln 1914", *Kunigl. Svenska Vitenskapsakademiens Handlingar*, Tredje Serien, 18, No. 2; 1939). There is also included a new species of the Thalassinid Callianidea (*C. planocula*). The descriptions are very carefully made and detailed, with good simple drawings of essential parts. The classification of the Pagurids is discussed at length and revised, and a clear key given for all the genera and sub-genera. Several new species of Eupagurus are described, and the new genus Paguritta established for *Paguritta gracilipes* n.sp. Among the Galatheids there are also new species including *Bathymunida quadratirostrata* from a depth of 70 fathoms, one of the specimens being a female with eggs. There are several species of Petrolisthes, one new, and a new species of Pachycheles. A note at the end of the paper by Prof. Balss states that this valuable addition to our knowledge of the Pagurids and their relatives was completed in 1918-21, but comparison with other work from Japan shows that the new species included have not been described by more recent workers.

Microbiology of the 'Leaf Carpet'

UNDER this term, D. J. Scourfield discusses the microscopic life in the continuous carpet of decaying leaves that forms the characteristic feature of the upper layer, the "mor", of the forest soil. The paper appears in the *Essex Naturalist* (26; 1940) and is

extremely appropriate to the activities of a natural history society. Mr. Scourfield makes it clear that our information about the characteristic fauna and flora of this leaf carpet is exceedingly scanty, and that a very profitable field lies ready to the investigation of the field naturalist. Knowledge of the organisms characteristic of this position must precede any substantial advance as to the influence this leaf carpet has upon the forest, though it is abundantly clear that the leaf carpet follows quickly upon the closure of the forest canopy and initiates the sequence of changes in the habitat that characterize the establishment of the forest. No fewer than sixteen groups of organisms, present in the leaf carpet, are passed briefly in review. Some of these groups are still little worked out and require, as Mr. Scourfield emphasizes, the collaboration of a number of specialists, but here is a field entirely appropriate to the naturalist and ultimately, probably, of great interest to the forester.

Crossing Experiments with Rusts

THE recent discoveries of the function of the rust spermatia or pycnospores have permitted an active investigation of strains by crossing methods, and Thorvaldur Johnson and Margaret Newton, of the Dominion Laboratory of Plant Pathology, have just reported upon an extensive crossing and selfing experiment with physiological races of oat stem rust (*Canadian J. Res.*, 18, 54-67, 1940). In crosses the less virulent characteristics are usually dominant, and heterozygous lines, when selfed, tend to produce more virulent strains. Reciprocal crosses suggest that the cytoplasm, as well as the nucleus, contributes to the inheritance of certain pathogenic characters. One great difficulty, of course, is the scarcity of characters the inheritance of which can be studied. In crosses between races of normal (red) and orange uredospore patches the red colour has invariably proved dominant. Selfing studies of one race carried out with teleutospore material of different age give evidence of a marked genetical change in the material brought about in four years, presumably through the ageing of the teleutospores. Normally all infections of this strain produced pycnidia, but in the old material half the infections showed no indications even of rudimentary pycnidia.

Control of Tobacco Mildew

THE downy mildew fungus disease of tobacco is of sporadic occurrence in certain of the United States; but two simple and effective methods of control have been described by P. J. Anderson (Conn. Agr. Exp. Sta. Circular 128, New Haven, Conn.; January 1939). Both methods involve fumigation of the seed bed, and the fumigants recommended are benzol or paradichlorobenzene. Sidewalls and sashes, which normally cover the beds, are made as air-tight as possible. Benzol is evaporated from shallow pans or from wicks placed in suitable vessels; paradichlorobenzene crystals are placed in wire baskets at suitable intervals along the beds. Both methods are curative and not preventive measures, and both offer a useful measure of practical control.

The Permian System

THE original Permian rocks of Murchison occupy a vast structural basin lying west of the Urals and

measuring about 700 miles from west to east and 1,000 miles from north to south. A review of the stratigraphy of this region, of the classification of the type Permian, and of the correlation of the five series into which it is divisible with the Permian formations of South China and the south-western United States is attempted by C. O. Dunbar (*Bull. Amer. Assoc. Pet. Geol.*, 24, 237-281; 1940). The limestones of the Russian platform, commonly considered Upper Carboniferous, are shown to be equivalent to the Artinsk detrital deposits, which are generally recognized as Permian. The lower boundary of the Artinsk is found to be not a constant stratigraphical horizon, but a contact between overlapping facies. Although no widely recognizable break has been demonstrated in the deposits of the basin from the beginning of the Upper Carboniferous into Permian time, it has become clear that a specially rapid subsidence of the Uralian geosyncline over a great area began with the incursion of the Pseudoschwagerina fauna. This beginning of rapid geosynclinal development is correlated with the regional hiatus at the base of the Wolfcamp series in America and with a profound regional break at the same horizon in China. It is concluded, therefore, that the most natural lower limit of the Permian system is at the base of the Pseudoschwagerina zone.

Thionyl Chlorofluoride

THIONYL fluoride, SOF_2 , was obtained as a gas by Meslans in 1896 by the action of zinc fluoride and certain other metal fluorides on thionyl chloride, and Moissan and Lebeau in 1900 obtained it from thionyl chloride by the action of free fluorine and arsenic trifluoride on thionyl chloride. An intermediate thionyl chlorofluoride, SOCIF , was not reported, but this has been discovered by H. S. Booth and F. C. Mericola (*J. Amer. Chem. Soc.*, 62, 640; 1940) by the action of antimony trifluoride on thionyl chloride in presence of antimony pentachloride as a catalyst. It is a liquid, b.p. 12.2° , m.p. -139.5° , density 1.58. It reacts with very few metals at temperatures up to 150° , but with copper and mercury reaction readily occurs at room temperature and with iron at 70° . The products are thionyl fluoride, sulphur dioxide, and the sulphide and chloride of the metal, so that SOCIF probably first decomposes into SOCl_2 and SOF_2 , and it is found that gaseous SOCIF undergoes this decomposition very slowly at room temperature. A new determination of the freezing point of thionyl chloride gave -99.5° .

Surface of Solutions

IN papers by J. W. McBain, W. V. Spencer, J. R. Vinograd and D. A. Wilson (*J. Amer. Chem. Soc.*, 62, 239, 244; 1940) some novel results obtained by the use of the film balance and the modified Langmuir trough with ordinary solutions are described. These bear little relation to previous conceptions derived from analogy with insoluble monomolecular films on water. The various phenomena of surface pressure and of time frequently pass through a high maximum in an intermediate range of dilute solution. Whether a pellicle forms or not depends on the concentration and the degree of compression of the surface, and when a pellicle is formed and is sufficiently compressed, the final pressure is characteristic only of the substance. The initial pressure may be greatest where the final pressure vanishes. The trough

apparatus, consisting of a film balance divided into two compartments by a water-tight flexible float, has been used with solutions of hydrocinnamic acid, potassium laurate, sodium butylbenzene sulphonate and lauryl sulphonic acid. The surface tension of hydrocinnamic acid solutions is not fully established until after periods of time enormously greater than those expected from classical diffusion processes. A type of curve with a minimum is established, and in this a trace of solute first lowers the surface tension of the solvent while further small addition raises the surface tension to a low maximum or constant value (lauryl sulphonic acid; sodium butylbenzene sulphonate). With potassium laurate, addition of alkali appears to lower the flat maximum to the value of the minimum.

Nitrogen Tribromide

NITROGEN chloride and iodide have been known for many years, but the bromide has not yet been isolated. Bromine appeared to be as passive towards nitrogen as towards oxygen, oxides of bromine having been discovered only within recent years. The existence of NH_2Br and NHBr_2 in solution seems fairly certain, and the azide N_3Br has been prepared, but the compound NBr_3 has not yet been obtained. Recent investigations, however, of the mechanism of the reaction between ammonia and bromine at low temperatures (Schmeisser, *Naturwiss.*, 28, 63; 1940) show the existence of an ammoniate of nitrogen tribromide with the formula $\text{NBr}_3 \cdot 6\text{NH}_3$. The compound was obtained when bromine and excess ammonia were mixed at 1–2 mm. pressure, and cooled to -95° . It is a dark purplish-red compound, which decomposes violently above -70° into nitrogen, ammonia, and ammonium bromide, according to the equation $\text{NBr}_3 \cdot 6\text{NH}_3 = \text{N}_2 + 3\text{NH}_4\text{Br} + 2\text{NH}_3$.

An Acoustic Generator

PROF. HARTMANN of the Physics Laboratory of the Technical College, Copenhagen, discovered more than twenty years ago that if a small resonance tube is placed with its mouth facing a nozzle from which air at a pressure of a few atmospheres is issuing, at certain distances from the nozzle the resonator becomes the source of a note of high pitch and considerable intensity. With the aid of funds from the Carlsberg, Oersted and Mansted Foundations the mode of action and the best form of the apparatus have since been investigated by Prof. Hartmann and his assistants, and the results are collected in a well-illustrated paper of more than 200 pages by himself, Peter and Elisabeth Mathes and Freimut Lazarus (*Ingeniørvideenskabelige Skrifter* of the Academy of Technical Sciences, No 4; 1939). In general, the jet of air issues from a nozzle of 2–6 mm. diameter, the excess pressure being 1.8–4.8 atmospheres, and the resonator has its diameter and length equal to the diameter of the nozzle. The wave-length of the note emitted varies from 1 to 5 cm., according to the position of the resonator and the air pressure used. The intensity of the sound is measured by the Rayleigh disk, the pressure disk, and three other methods. It is greatest in a direction nearly at right angles to the axis of the apparatus, and the acoustic efficiency is a maximum of about 5.5 per cent when the excess pressure is 1.5 atmospheres.

Sensitometry of Photographic Material used in Astronomy

D. R. BARBER, Norman Lockyer Observatory, Sidmouth, has published a paper on this subject (*Mon. Not. Roy. Astro. Soc.*, 100, 3; January 1940) in which he gives a full description of his investigation on the influence of three different developers upon various negative materials, comprising three blue sensitive, three 'orthochromatic', and three panchromatic emulsions. A variety of diverse characteristics is essential for the ideal developer, from the astrophysical point of view, among which may be noted high contrast, combined with a low value of background (chemical) fog, and freedom from excessive graininess in the case of super-speed materials. In actual practice, however, a compromise is essential, since a pronounced reduction of graininess resulting from the use of ultra-fine emulsions, or specially compounded developers, will be obtained only at the expense of a lowered effective threshold response. Each plate was calibrated by the tube sensitometer (*Bull. Norman Lockyer Observ.*, 1, 14; 1938), and blue light through a Wratten No. 47a cemented filter, having a transmission band from 3750 Å. to 5200 Å., was used in the calibration, as the effective response of a photographic material is known to depend on the quality of the radiation incident upon it. A number of diagrams shows the change in the effective response of the emulsion at different densities, and this is expressed as a magnitude gain or loss, referred to standard development. The main conclusion reached is that the standard metol-hydroquinone developer, even when used with a wide variety of sensitive materials, always produces results most suitable for use in astronomical photography.

Alpha Photometric Observations of the Solar Spectrum

DAVID S. EVANS has published a paper criticizing some of Unsöld's views, in particular that which suggests that the Balmer series of the solar spectrum is formed effectively by pure absorption (*Mon. Not. Roy. Astro. Soc.*, 100, 3; January 1940). Evans undertook a programme of observations of the centre-to-limb variations in the contour of $H\alpha$ and carried out the work with the Oxford solar telescope. The spectroscope used was of the Littrow form with two 60° prisms and one 30° . Its aperture ratio was the same as the telescope, its dispersion being 2.06 Å. at $H\alpha$ and 1.47 Å. per mm. at the sodium D lines. At the suggestion of Prof. H. H. Plaskett, the D lines of sodium in absorption were used for the determination of the instrumental pattern of the spectroscope and of the amount of scattered light; a preliminary account of the method appeared in the *Observatory* (62, 231; 1939). A new method of drawing characteristic curves was used, and if this introduced errors into the results, these would have revealed themselves as a correlation between determined residual intensity and plate opacity. No such correlation, however, was found for plates ranging in opacity from 0.40 to 0.97. A comparison is made with the results obtained by other workers, Minnaert, Thackeray, Royds and Narayan. The low value of the equivalent width found by the last two workers is suspected to be due to their lack of precautions to guard against scattered light. On approaching the limb, it has been found that the residual intensity increases at each wave-length. There is some support for the view that uncompensated cycles are not of importance in the formation of $H\alpha$.

THE EGG AS FOOD

ONE of the most difficult of the tasks which has always confronted the scientific worker possessed of a proper appreciation of his responsibilities to society has been the choice of a way of making his results known so that they will do most good. Material of an abstruse or technical nature is fitly presented to a learned society. Such a society, however, only comprises producers of knowledge. It is much more difficult to pass on knowledge to the consumers: those who make use of it. Nutrition is a branch of science which applies so directly to the population at large that any attempt to shorten the distance between the scientific investigator and the dining-table is to be viewed with especial interest.

The Nutrition Panel of the Society of Chemical Industry, the membership of which is made up of workers in all branches of science ranging from the academic Scylla of biological oxidations and reductions to the practical Charybdis of canning, has conceived itself to be peculiarly well fitted for the task of disseminating the knowledge of nutrition. A series of meetings has been planned at each of which a single food will be discussed. These meetings are not addressed to a purely scientific audience, neither are they intended to be 'popular'. Rather are they for all those whose business it is to take an intelligent interest in nutrition.

The first meeting of the series was held on April 24 and was concerned with the egg as food. Besides the members of the Society of Chemical Industry itself, representatives of educational, agricultural, and medical associations were invited, as well as members of the great women's associations interested in general welfare.

Dr. Joseph Needham, of the Biochemical Laboratory, University of Cambridge, who spoke on "The Biological Nature of the Egg", pointed out how complex is the structure of the eggs of birds and other vertebrates. In fact the embryo, which is eventually to develop into the new animal, only occupies a very small space within the whole egg. The remainder serves, in one way or another, to keep the organism alive until it is hatched. It is interesting to note that this is not the case among lower animals. The young octopus in its egg is not supplied by its mother with enough copper with which to make its blood pigment, but must obtain more for itself from the surrounding sea. Newts and frogs in their eggs also depend on the environment for water. Birds' eggs, however, represent a type of perfectly 'closed-box' structure which requires many ingenious devices in order to survive. One of these, by which the bird saves itself from being poisoned by its own by-products, is the fact that the developing embryo does not excrete nitrogen as ammonia or urea but in the form of uric acid, which is more easily deposited as crystals.

Dr. Ethel M. Cruickshank, of the Department of Agriculture, University of Cambridge, who spoke on the "Chemical Composition of the Egg", pointed out that the hen can be regarded as a physiological machine for turning raw materials into human food-stuffs. The amount of such human food that the hen can produce in a day depends on a number of factors, but to a large extent it is true to say that the bigger the hen the larger the egg. The number of eggs a hen lays in a year is a different matter; an

interesting point is the fact that high production has little or no detrimental effect on the quality of the eggs. In considering the composition of the egg one must divide it into three parts. The shell is principally made up of calcium carbonate, although small amounts of magnesium, phosphorus and organic matter are present. The 'white' is composed of at least four different proteins and can be divided into layers of thick and thin white. The proportion of thick to thin white influences the culinary value of the egg. Together, the proteins in the white contain all the essential amino acids for 'first-class' protein. Egg white contains minerals and also supplies valuable amounts of vitamin B₂. The yolk contains two proteins which are also found to be of 'first-class' quality. Besides protein the yolk contains 30-32 per cent fat. Numerous minerals are present, including relatively large amounts of easily assimilable iron. Vitamins A, D, B₁ and riboflavin are also present. The anti-rachitic vitamin D is of great significance in the diet. Dr. Cruickshank also discussed the factors in the diet of the hen which might give the yolk an unpleasant taste or a strange colour. Although the amount of fat, and hence the total food value of the egg, can only be influenced to a slight extent by the diet of the hen, the nature and flavour of the egg can be very strikingly altered by feeding mashes containing, for example, hemp seed or linseed oil. As to vitamins, it is essential that they should be abundantly present in the diet of the hen in order that her eggs may be of high nutritive value: and it is well known that a thin shell is obtained by feeding a hen a diet poor in calcium. However, the calcium contents of the yolk and the white are not affected. The amount of iodine in eggs is affected by the amount in the hens' food, although iron and copper appear to be independent of the amount present in the diet.

Dr. S. K. Kon, of the National Institute for Research in Dairying, Reading, spoke on the nutritive importance of eggs in the diet. He stressed that eggs share with milk the ability to cover nutritive requirements during the period of rapid development. The shortage of vitamin D and iron in milk is admirably supplemented by eggs; the deficiency of eggs in calcium is made good by their association with milk. The vitamins, minerals and 'first-class' protein in eggs make them one of the protective foods. In particular, eggs supplement very well the proteins present in cereals. Dr. Kon showed in detail how eggs contribute to the various factors of a good diet.

Dr. R. B. Haines, of the Low Temperature Research Station, Cambridge, spoke on the preservation of eggs. He pointed out that hens' eggs are in a state of rapid change. The aim of storage is to retard or stop this change and prevent the attack of outside agencies such as micro-organisms. Although storage only affects the nutritive value of eggs to a very minor degree, any loss of palatability and cooking quality is a clear indication that certain slight chemical changes have taken place. Dr. Haines mentioned three methods for the large-scale storage of eggs—cold storage, storage with the partial addition of carbon dioxide, and full gas storage. For other purposes, drying or freezing can be used. Problems connected with the storage of eggs lead to

the consideration of questions of production and handling. For example, 'thick white' is apparently due to the individual hen. Again, spoilage of eggs by the invasion of bacteria is influenced by the structure of the egg-shell, which may vary greatly in successive eggs from the same hen or by the 'washing' treatment which the eggs receive. Among many other topics upon which Dr. Haines touched were 'swollen' and 'flabby' yolks due to loss of moisture, 'watery whites', 'sunken' and 'sided' yolks due to chemical changes and eggs with 'whiskers' due to the growth of fungus on the shell.

Miss Mary Andross, of the West of Scotland College of Domestic Science, Glasgow, gave the final paper on the subject of "The Cooking of Eggs". Research in domestic science concerns itself with the effects such factors as temperature, time, rate of cooking, acidity, or the addition of salts may have on the nutritive properties of eggs which are boiled, poached, fried, scrambled or made into omelets, custards, mayonnaise, meringues, angel cakes, or sponge cakes. Another important factor which is the subject of scientific investigation is the effect of the age of the

egg in relation to its cooking qualities. Miss Andross presented the results of a large amount of her own original work on these points. She also discussed the waste of food value which may take place in different methods of cooking. In making a scrambled egg, for example, 13.5 per cent of the original food value is left behind in the various bowls and dishes used in cooking it. Miss Andross concluded by discussing the effects which different treatments may have on the digestibility of the food.

In the course of a general discussion a number of further points were considered. These included the 'too fresh' egg; the problem of sensitivity to egg white; coagulation of egg proteins during cooking; reconstitution of dried eggs; and many others.

If the following meetings of the series on other foods are as complete as the first, the collected papers will form a text-book of unrivalled excellence. It would only then remain to see whether the farmers, administrators, cooks and diners of England are availing themselves of the information thus collected to determine whether the plans of the Nutrition Panel have succeeded.

FUNDAMENTALS OF CLASSICAL ELECTRIC AND MAGNETIC THEORY

BY DR. G. BURNISTON BROWN

UNIVERSITY COLLEGE, LONDON

EVER since the Committee of the International Electrical Congress in 1932 was forced to resort to a majority vote in order to decide upon the introduction of the Oersted, the general uneasiness of physicists with regard to the difference between induction and force has been augmented rather than allayed; and all the more so when the secretary of the committee, Prof. Henri Abraham, maintained that there were at least six definitions of the permeability (μ), and that it is not possible either to show that they are the same or different¹.

A meeting of the Physical Society on May 3 was devoted to this problem and to a discussion of the presentation of the classical theory of electricity and magnetism in general. The discussion was opened by the present writer, who claimed to show that the first three definitions of μ , which are fundamental to electromagnetic theory, are equivalent. Abraham's last three definitions are concerned with magneto-optics and are not of the same importance.

In order to demonstrate this equivalence the author made use of a point of view which is gaining ground among writers on the philosophy of science, namely, that the ultimate meaning of any concept to which numbers are attached involves the consideration of an act of measurement either in an actual experiment or in a "theoretical-experiment". This may be looked upon as a special form of the general thesis put forward by Ogden and Richards in their book "The Meaning of Meaning"², that all meaning involves what they termed a "sign-situation". In the special form given above, it is the basis of Sir Arthur Eddington's philosophy of science, and he has called a sign-situation a "gesticulation"³.

If this principle is applied to the concepts of "force on a pole" and "force on a current element",

it can be shown that the former requires a rod-shaped cavity and the latter a disk-shaped cavity for the act of measurement, and thus the cavities of the classical treatment of Maxwell and Kelvin arise naturally instead of arbitrarily. Application of the same method to the theoretical-experiment in which the principle of the conservation of energy is used to show that the induced electromotive force is equal to the rate of change of magnetic flux, shows clearly that it is the rate of change of the normal induction which is involved and not the force. This is not often shown clearly in the text-books.

Use can be made of Poisson's fictitious-layer theory to find the force in the cavities. Poisson's treatment rests solely on the inverse square law, and the assumption that the field of a polarized substance can be treated as consisting of the fields of a large number of doublets. If we take the number of doublets per cubic centimetre to be n and their polarizability α , then we readily find the relation with K , the dielectric constant, to be

$$K = 1 + 4\pi n\alpha.$$

This formula is derived directly from classical macroscopic theory and has the great advantage that it is independent of theories of molecular structure. It assumes that the polarization is proportional to the internal field but is independent of whether the polarization is due to separation of charges or rotation of doublets already present. It seems that Mossotti took the polarization to be proportional to the external field, and this causes his formula to differ from that given above. The formula of Clausius, since made great use of by Lorentz and Debye, would, however, seem to involve an unjustifiable mixture of macroscopic and microscopic considerations. One way of putting it briefly is this: a piece of

dielectric is placed in the field of a condenser and Poisson's fictitious-layers of charge are placed on its boundary; then a spherical portion (which is also large compared with molecular structure) is removed, but in this case Poisson's surface charge is omitted and it is considered from a purely microscopic point of view. The result is that there is difference between the formula of Clausius and that of Mossotti. This has been overcome by adopting the former, using a hyphen, and calling it the Clausius-Mossotti formula!

Another application of the epistemological principle already mentioned, namely, that a physical concept receives its precise meaning in an experiment or theoretical-experiment, is of great use in clearing the obscurity that surrounds the theory of dimensions. The dielectric constant K and the permeability μ do not, in some mystical way, tell us anything about the 'nature' of electricity and magnetism, or the difference between them. K and μ are symbols and mean just as much as their definition implies and nothing more. K is defined as the ratio of numbers obtained by the same conventional set of operations performed first on the material in question, and secondly on free space. It is easy to show that μ is exactly analogous to K . Consequently, both K and μ are dimensionless. In the determination of the ratio of the electrostatic to the electro-

magnetic system, it is usually forgotten that the conventional set of operations is different: in the case of the capacity of a condenser, for example, only a scale is required on the E.S. system, whereas on the E.M. system a clock is required in addition. The symbols representing the operation (the dimensions L and T) do not therefore cancel and the ratio is $c^2 \text{ cm.}^2/\text{sec.}^2$. In the expression for the velocity of

electromagnetic waves, $\frac{c}{\sqrt{K\mu}}$, it is c which has

dimensions.

In the discussion which followed, there seemed to be general agreement that the formulæ of Mossotti and Clausius are not free from errors in their derivation. Strong resistance was, however, shown to the attempt to deprive K and μ of their dimensions, and declarations of faith that B and H were 'really' different were made, including that of a former member of the International Committee. Other difficulties, such as that of providing a satisfactory proof of the expression for the energy involved in a hysteresis-cycle, were also discussed.

¹ Abraham, H., "A propos des unités magnétiques", *Bull. Nat. Research Council*, 93 (Washington, 1933).

² "International Library of Psychology, Philosophy and Scientific Method," Kegan Paul (1925).

³ *Proc. Roy. Soc., A*, 174 (1940).

GEOLOGY IN GREAT BRITAIN

REPORTS FOR 1936 AND 1937

PART I of the "Summary of Progress of the Geological Survey of Great Britain" for 1936¹ contains an appreciation of the work of the late Dr. Bernard Smith, who had held the office of director for less than a year at the time of his death in 1936. Pending the appointment of a new director, Dr. W. E. P. McClintock served as acting director and was in general charge of the Survey and Museum until the new director, Dr. E. B. Bailey, took up duty. The report gives the usual particulars of the routine work carried out during the year under review. Forty maps and ten memoirs were issued, some of which have already been reviewed (see *NATURE*, 141, 696; 1938).

Part II² contains a series of papers on subjects of special interest. The stratigraphy of the Upper Coal Measures of South Lancashire is described by R. C. B. Jones and compared with that of North Staffordshire and North Wales. W. B. Wright contributed an account of the *Anthrocomyas* of the Lancashire Coal Measures in a paper which claims to be the first serious attempt to show that the detailed Lancashire system of sub-zones has a stratigraphical significance elsewhere, notably in Scotland, where eight of the sub-zones have been detected in their appropriate sequence. C. J. Stubblefield places on record information concerning the availability of specimens of fossils figured in the 1848 memoir on the Malvern Hills and other Palæozoic districts. Borings are described by R. L. Sherlock (through a Keuper succession in Shropshire) and M. Macgregor (through Carboniferous strata in Lanarkshire). An investigation of underground water pressure in the Spilsby Sandstone of Lincolnshire is recorded by H. H. Swinerton. Structural features in the metamorphic rocks of parts of Shetland, notably the striations

known as 'lineation', are described by T. Robertson. Improvements in the Lawrence Smith method of alkali determination are suggested by C. O. Harvey.

In the "Summary of Progress" for 1937³ (no longer called Part I), the new director gives an interesting history of the changes in scope which the "Summary of Progress" has gradually undergone since its introduction in 1898 (for 1897) by Sir Archibald Geikie. Since 1927 the "Summaries" have been divided into two, or sometimes three, parts, the second and third parts being devoted to contributions on special topics, such as those referred to in the preceding paragraph. It has now been decided to issue papers or monographs of this kind in an independent publication to be called the *Bulletin of the Geological Survey of Great Britain*. The first two *Bulletins* have already appeared and are noticed below. It is also announced that it is intended to issue regional accounts of the ore deposits of particular districts. Devon-Cornwall and the South Pennines were selected for examination during 1938. Twenty-two maps and eight memoirs were published during 1937, and at the close of the year there were forty-four maps and six memoirs in the press. The "Summaries" for 1938 and 1939 are not yet available.

BULLETINS

Bulletin 1⁴ contains nine papers, of which six are concerned with the Carboniferous System. The discovery of a marine band with goniatites is announced by L. H. Tonks from the Middle Coal Measures of Co. Durham. R. Crookall reviews all the available evidence regarding Kidston's claim that an almost complete change in the recorded plant life of the Carboniferous occurs at a particular level in the Millstone Grit of Britain. The conclusion

is reached that only two plants have been satisfactorily proved to trespass from one side to the other of this so-called plant 'break'. An interesting account is given by M. Macgregor of old coal-workings encountered during excavation for hospital foundations at Cowglen, near Glasgow. Much new information is furnished regarding the freshwater mussels of the Coal Measures: in Yorkshire, by W. B. Wright; and in Lancashire, by W. Dewar.

A description of unusual palaeontological interest is given by F. W. Anderson of a Lower Carboniferous species of a rare group of echinoderms; although this particular species had not been previously recorded, thirty-three specimens are crowded upon a single small slab collected from the core of a boring in the Scremerston Series in Northumberland. Those interested in the Jurassic will find an important paper by L. F. Spath on the ammonites of the Warboys pit in the Oxford Clay of Huntingdonshire. C. O. Harvey contributes a description of a simple method for determining water in silicate analyses. The history and use of the petrographic term 'plagiophyre' are outlined by A. G. MacGregor, who proposes that in future it should be used only as a group-name. The *Bulletin* is effectively illustrated and has an adequate index.

Bulletin 2⁵ maintains the high standard of the first number and contains eight papers on subjects covering a much wider range of interest. A. F. Hallimond and J. T. Whetton demonstrate that a magnetometer survey can be usefully undertaken in search of hæmatite ore-bodies under considerable depths of cover. An account is given of a magnetic survey in South Cumberland and Furness. The difficulties of the method are critically considered. In another paper A. F. Hallimond describes magnetic observations on the Brockhill dolerite dyke of Worcestershire. Certain oil seepages in Lancashire, of which the most important occurs in peat near Formby, have been investigated by F. W. Cope; a biological report is added by Kathleen B. Blackburn. Both authors conclude that the oil is of underground origin and is not a derivative, as formerly supposed, from modern plants in the peat. J. E. Richey and W. Q. Kennedy describe in detail their recent researches on the Morar anticline with its Sub-Moine core and its envelope of Moines. The two series appear to be separated by a great unconformity.

E. B. Bailey reviews the Caledonian structural elements of Skye; he confirms, with some modifications, Clough's reading of a tectonic window near Ord. New reasons are given for regarding the Tarskavaig 'Moines' as Torridonian. Rocks of the Moine Series are also described by T. Robertson, these being in and near the Garry-Ericht water-tunnel of the Grampians. Special attention is given to structural features, including lineation. In south-west Cornwall the Meneage Crush-Zone has long withstood satisfactory stratigraphical analysis. C. J. Stubblefield now records the presence of Lower Devonian strata at two localities and throws considerable doubt on former identifications of alleged Ordovician and Silurian fossils. R. Crookall describes plant remains in a red sandstone regarded as probably of Lower Carboniferous age.

MEMOIRS

The volume on Area I of the "Economic Geology of the Central Coalfield" of Scotland⁶ completes a series of nine memoirs on this important region. It describes in detail the mineral resources of the

Kilsyth-Kirkintilloch district, an area of 66 square miles mainly in Stirlingshire and Dumbartonshire. Along the north are the steep slopes of the Kilsyth Hills and Campsie Fells. The through valley that has formed a natural line of communication between the Forth and Clyde throughout the centuries stretches across the area. The south-eastern part is undulating drift-covered moorland, relieved by hills and crags where dolerite sills come to the surface. Apart from superficial deposits, which provide good building sand and gravel, and a small inlier of Old Red Sandstone, the rocks described are of Carboniferous age. The Limestone Coal Group, around which centres the chief economic activity of the district, has long yielded coal and ironstone. In recent years anthracite has been successfully exploited. Such products as limestone, building stone, moulding sand and fireclay are provided by other strata, and large quantities of road metal are obtained from the well-known quartz-dolerites of Kilsyth. Special chapters are devoted to the structure of the area and to more systematic descriptions of the various economic products.

The memoir describing the geology of the "Shrewsbury District"⁷ deals with some of the most geologically attractive parts of Shropshire, including the Longmynd, Caer Caradoc and the Wrekin, where Pre-Cambrian rocks appear boldly at the surface; and Wenlock Edge, made famous by Murchison in his pioneer work on the Silurian System. The district is remarkable for the great variety of its rocks and fossils and for the immense range of time which they represent. As a result many geologists have here received their first training in field work, and some of them have returned to repay their debt by detailed research. The Survey geologists have done full justice to a classic area of unrivalled interest. Successive chapters deal with the Pre-Cambrian, Cambrian, Ordovician and Silurian rocks; the Carboniferous formations of the Coalbrookdale coalfield and the minor fields near Shrewsbury; the Bunter sandstones and pebble beds; and the superficial deposits, mainly glacial, which lie across the outcrops of all these 'solid' formations. Mineral products and water supply form the subjects of the final chapter. A series of appendixes includes two of special interest: "Fossil and Fossil Locality Lists" and "Age-Determinations by the Helium Method". The latter records the ages of the Clee Hills and Little Wenlock basalts as 240 and 260 million years, respectively, and so confirms the Carboniferous age now assigned to them.

The "Wigan District"⁸ is mainly occupied by the productive Coal Measures of the western half of the South Lancashire Coalfield. In the west and south-east these lie below a covering of Triassic sandstones, while to the north-east the Lower Coal Measures and Millstone Grit rise to form a high moorland that merges into the Pennine uplands. Over the lower ground lies a widespread mantle of glacial deposits which in turn are partly hidden in the west by wind-blown sands and peat-mosses. The memoir records important additions to our knowledge of the Coal Measures. Zonal correlation by freshwater faunas has been extended well into the area from the adjoining Manchester sheet. Many new features of tectonic interest have become apparent and are recorded in a valuable chapter on structure and faulting. The Upper Coal Measures are found to be unconformable on the Middle Coal Measures, certain folds in the latter having been formed prior to the deposition of

the former. Fossiliferous Permian marls discovered in the south of the area are of economic importance in regard to the exploration of the coalfield concealed beneath them. Special chapters deal with this topic, and with the palaeontology of the Coal Measures, the economic products, and the glacial geology.

REPORTS ON MINERAL RESOURCES

The report on gypsum, anhydrite, celestine and strontianite⁹ is now in its third edition. Since the second edition appeared in 1917, anhydrite, which was then a waste product, has become a valuable raw material in the manufacture of ammonium sulphate and sulphuric acid. The gypsum industry has greatly expanded as a result of the development of gypsum plasters and cement. Celestine and strontianite are the only sources of strontium compounds. These are used in the beet-sugar industry, as fillers in special paints and gramophone records, and for red flares in pyrotechny. The report gives details of the geology, mode of occurrence and distribution, mining and quarrying, uses and treatment, and reserves and statistics of these four minerals.

The report on the "Granites of Scotland"¹⁰ brings together in compact form accounts of the distribution, mode of occurrence and leading characteristics of the principal Scottish granites, intended primarily for the use of those engaged in the granite industry. The first three chapters deal in succession with the development of the industry, with the mineralogical, chemical and physical properties of granite, and with the distribution and age-relationships of the

occurrences. Later chapters provide details of the granites of north-east Scotland, of the Galloway district in the south-west, and of the Western Highlands. These include all the most important centres. Special attention is given to granites at present being wrought, and an account is given of the methods of working in active use. Other occurrences of granite throughout Scotland are also briefly described. A list of the quarries in operation during 1938 is appended.

¹ "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1936". Part I. Pp. viii+90. 1936. 1s. 6d. net.

² "Summary of Progress". Part II. Pp. viii+83+1 plate. 1938. 1s. 6d. net.

³ "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1937." Pp. viii+109. 1938. 2s. net.

⁴ *Bulletin of the Geological Survey of Great Britain*, No. 1. Pp. xi+108+7 plates. 1939. 2s. 6d. net.

⁵ *Bulletin*, No. 2. Pp. xi+96+6 plates. 1939. 2s. net.

⁶ "The Economic Geology of the Central Coalfield: Area I (Kilsyth and Kirkintilloch)." By T. Robertson and D. Haldane. Pp. viii+169+2 plates. 1937. 3s. 6d. net.

⁷ "Shrewsbury District, including the Hanwood Coalfield (One-inch Geological Sheet 152, New Series)." By R. W. Pocock, T. H. Whitehead, C. B. Wedd and T. Robertson, with contributions by D. A. Wray, C. J. Shiblefield, T. C. Cantrill and W. M. Davies. Pp. xxi+297+8 plates. 1938. 5s. net.

⁸ Wigan District (One-inch Geological Sheet 84, New Series)." By R. C. B. Jones, L. H. Tonks and W. B. Wright. Pp. xvi+244+9 plates. 1938. 5s. net.

⁹ Special Reports on the Mineral Resources of Great Britain. 3, "Gypsum and Anhydrite", by R. L. Sherlock and B. Smith; and "Celestine and Strontianite", by R. L. Sherlock. Third edition by R. L. Sherlock and S. E. Hollingworth. Pp. x+98. 1938. 2s. 6d. net.

¹⁰ Special Reports on the Mineral Resources of Great Britain, 32, "The Granites of Scotland", by J. G. C. Anderson, with a contribution by M. Macgregor. Pp. 70+4 plates. 1939. 2s. 6d. net. London: H.M. Stationery Office.

RADIO FREQUENCY WAVE GUIDES

WITH the continuous extension of radio research to increasingly higher frequencies, it is not surprising to find occasionally that radical changes in technique and equipment occur. Such changes are already envisaged in the practical application of decimetre and centimetre electric waves, that is, the wave-length band from 1 cm. to 100 cm. So long ago as 1897, Lord Rayleigh gave a mathematical analysis of the propagation of electric waves along hollow tubes of either circular or rectangular cross-section, and showed that this type of transmission could take place only when the wave-length was of the same order as, or less than, the cross-sectional dimensions of the tube. Consequently this subject attracted little attention until about 1935, when suitable methods of generating these very high frequencies had been developed. Since this date the matter has been investigated in some detail in the United States, notably in the Bell Telephone Laboratories and the Massachusetts Institute of Technology, and also to a lesser extent in France and Germany.

A good review of the investigations conducted in the past few years was given by Dr. J. E. Houldin in a paper read on February 19 before the London Students' Section of the Institution of Electrical Engineers. It has been shown by analysis and verified experimentally that several types of waves can exist within the tube, but particular attention has been devoted to four of these. As is to be expected, there is a critical free-space wave-length above which no transmission along the tube takes place. Tubes having diameters of the order of 10 cm. appear to

be practically convenient for use in the wave-length band 10-30 cm. By filling a copper or bakelite tube with water, the effective wave-length in the tube is reduced, with certain practical advantages for experimental work.

The velocity of propagation and attenuation of the waves depend upon the type of wave used, the wave-length and cross-sectional dimensions of the tube and the nature of the dielectric with which the tube is filled. It has been shown that at wave-lengths of 10 cm. and below, the hollow metal tube has an attenuation per unit length smaller than that of a co-axial cable of zero dielectric loss and the same external diameter. Owing to the omission of the central conductor and its dielectric supports, the hollow metal tube is simpler and cheaper to construct.

If an open-ended metal tube be excited with oscillations of suitable wave-length, the waves travel towards the open end and are radiated into space. Such radiation may be either vertically or horizontally polarized, or a combination of these, depending upon the type of waves set up in the tube. This radiation is transmitted predominantly forward, and by the use of a suitable flared horn on the open end of the tube, a well-defined beam is obtainable.

Experiments with various horns and tubes have shown that the gain of energy transmitted in the desired direction over that given by an omnidirectional radiation is comparable with that obtained in the practical use of antenna arrays on the wave-lengths of 10-100 metres used in the beam system of short-wave communication. R. L. S-R.

SEVENTY YEARS AGO

NATURE, vol. 2, May 19, 1870

Scientific Education

THE leading article, under this title, discusses the facilities for training in the sciences available in Great Britain, with special reference to the Royal Commission recently appointed to consider Government aid to science. Referring to the Science and Art Department, it has been questioned whether this scheme has fulfilled the purpose for which it was originated. While the advantages of the scheme have been great, in that it is under the direction of men of the highest eminence, it is contended that the scheme operates mainly for the benefit of the technical schools founded by Government, and thereby forces an official plan of education upon the country. "To such we would remark, that the quantity of Science taught is so small, that it is not wise to attempt in any way to reduce that quantity; but it is certainly to be wished that the Commission should carefully inquire whether this method is one calculated to extend a sound Science education over the whole country".

A plea is made for consideration of the claims of such independent institutions as University College, London, King's College, London, and Owens College, Manchester.

Intellect and Size of Brain

ACCORDING to the *British Medical Journal*, the weight of the late Sir James Simpson's brain, including the cerebellum, was 54 ounces. While, as is well known, the ratio between intellect and size of brain is by no means close, yet there can be no doubt that it is very important. Most of our great men have had large crania. The male brain ranges between 46 and 53 ounces, its average being 49½ (Quain and Sharpy). That of Cuvier is stated to have weighed 64 ounces, and that of the late Dr. Abercrombie 63 ounces, but it is possible that some error may have crept in through the use of weights of different standards. If not, Sir James's brain, whilst much above the average, did not nearly reach those of the celebrated men we have mentioned; but at the same time, the convolutions were remarkably numerous; they were, says a correspondent, "twisting and turning round on each other as if they could not find room within the head. The island of Reil was very wonderful".

AN interesting application of photography to legal evidence has just taken place. The Spanish Government having refused to give up the *Tornado*, an English vessel captured some time since, or to give compensation to the owners, our own Government has acquiesced in the decision, a photographic copy of the private instructions given to the captain by the owners having proved conclusively the more than doubtful character of the vessel.

CORRESPONDENCE on the "Strange Noises heard at Sea off Grey Town" continues. Charles Kingsley relates his own experiences and suggests that Drum fish (Pogonias) are responsible; Staff Capt. F. J. Evans, F.R.S., also quotes his own experiences and suggests "musical fish or shells"; H. P. Mallet suggests the presence of gas-bubbles rising from a mud containing much vegetable matter.

FORTHCOMING EVENTS

[Meetings marked with an asterisk are open to the public.]

Monday, May 20

ROYAL GEOGRAPHICAL SOCIETY, at 5 p.m.—Prof. O. T. Jones, F.R.S.: "Oceanic Shelves".

Tuesday, May 21

CHADWICK LECTURE (at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1), at 2.30 p.m.—Prof. S. P. Bedson, F.R.S.: "Human Virus Infections of Animal Origin, their Mode of Spread and Control".*

ROYAL INSTITUTION, at 5.15 p.m.—Dr. L. H. Lampitt: "The Manufacture, Preservation and Distribution of Food".*

Thursday, May 23

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP) (at the Waldorf Hotel, Aldwych, W.C.2), at 6.45 p.m.—Twenty-first Annual General Meeting.

Friday, May 24

ROYAL ASTRONOMICAL SOCIETY, at 4.30 p.m.—Discussion on "River Flow". (Opening paper by Capt. W. N. McClean.)

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (in the Lecture Hall of the Science Museum, South Kensington, S.W.7), at 5 p.m.—Discussion to be opened by Dr. L. Newcombe on "The Accessibility of Thesis Literature". Discussion by Dr. J. N. Goldsmith on "Errata and Corrigena".

ROYAL INSTITUTION, at 9 p.m.—Prof. L. C. Martin: "Ultra-Violet and Electron Microscopy".

Saturday, May 25

BRITISH PSYCHOLOGICAL SOCIETY (at 55 Russell Square, W.C.1), at 3 p.m.—H. W. Durant: "A Critical Account of Public Opinion Measurement".

At 5.30 p.m.—J. G. W. Davies: "Individual Differences between Psychological Workers".

At 6.15 p.m.—Alec Rodger and Patrick Slater: Report on "Some New Non-verbal Tests".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT LECTURER IN MATHEMATICS—The Principal, Science Department, Technical College, Kingston-upon-Thames (May 21).

HEADMISTRESS of the County School for Girls, Gravesend—Mr. W. A. Clench, Bank Chambers, Windmill Street, Gravesend (May 25).

LECTURER IN PLANT PATHOLOGY AND ZOOLOGY—The Principal, Horticultural College for Women, Swanley, Kent (May 31).

ASSISTANT INSTRUCTRESS IN DOMESTIC FRUIT AND VEGETABLE PRESERVATION—The Secretary and Registrar, Department of Agriculture and Horticulture (University of Bristol), Long Ashton (May 31).

PRINCIPAL of St. Mary's College (for Women) (University of Durham)—The Secretary, Durham Colleges' Office, 38 North Bailey, Durham (May 31).

ADMINISTRATIVE ASSISTANT—The Director of Education, Lindsey Education Office, County Offices, Lincoln (June 1).

HEADMASTER OF WELLINGBOROUGH COLLEGE—The Clerk to the Governors, 1 High Street, Wellingborough (June 1).

LECTURERS (two) IN CIVIL AND MECHANICAL ENGINEERING subjects, and a LECTURER IN ELECTRICAL ENGINEERING subjects—The Secretary, Northampton Polytechnic, St. John Street, E.C.1 (June 10).

LECTURER IN BOTANY at the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 29).

TEACHER OF PHYSICS at the Rugby College of Technology and Arts—The Principal and Organizer of Further Education in Rugby, 61 Clifton Road, Rugby.

DIRECTOR OF EDUCATION—The Town Clerk, Town Hall, Salford 3. ENGINEER for the Malayan Postal Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9113).

CHARGE ENGINEER for the Electrical Department of the Federated Malay States—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9018).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 11, No. 3, December 1939. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+199-304. (London: H.M. Stationery Office.) 4s. 6d. net. [104]

Reports of the Council and Auditors of the Zoological Society of London for the Year 1939. Pp. 48. (London: Zoological Society of London.) [154]

Thirty-seventh Annual Report, 1938-1940, of the Imperial Cancer Research Fund. Pp. 43. (London: Imperial Cancer Research Fund.) [154]

Lecture on A Century of Chemistry: "From Boyle to Priestley". Compiled by Richard B. Pilcher. Pp. 43. (London: Institute of Chemistry.) [154]

Brompton Hospital Reports: a Collection of Papers recently published from the Hospital. Vol. 8, 1939. Pp. iv+248+52 plates. (London: Brompton Hospital.) 5s. [154]

Empire Cotton Growing Corporation. A Review of the Work of the Experiment Stations, Seasons 1938-39. By W. Nowell; with a Note on the Entomological Work, by Dr. J. W. Munro. Pp. 18. (London: Empire Cotton Growing Corporation.) 1s. 6d. [184]

The Journal of the Institute of Metals. Vol. 65. Edited by S. C. Guilan. Pp. 479+60 plates. (London: Institute of Metals.) [224]

Annual Reports on the Progress of Chemistry for 1939. Vol. 36. Pp. 458. (London: Chemical Society.) 13s. net. [234]

The Nematode Parasites of Plants catalogued under their Hosts. By Dr. T. Goodey. Pp. iii+80. (St. Albans: Imperial Bureau of Agricultural Parasitology.) 10s. [234]

Imperial Bureau of Horticulture and Plantation Crops. Technical Communication No. 13: Vegetative Propagation of Tropical and Sub-Tropical Plantation Crops. Compiled by G. St. Clair Feilden. Drawings of Propagation Methods and accompanying Descriptions by R. J. Garner. Pp. 99. (East Malling: Imperial Bureau of Horticulture and Plantation Crops.) 3s. 6d. [234]

Proceedings of the Physical Society. Vol. 52, Part 1, No. 289: Report of a Conference on Internal Strains in Solids, held at the H. H. Wills Physical Laboratory, University of Bristol, July 11th, 12th and 13th, 1939. Pp. viii+178. (London: Physical Society.) 7s. net. [244]

Hull Bulletins of Marine Ecology. Vol. 1, No. 1: Ecological Investigations with the Continuous Plankton Recorder—Object, Plan and Methods. By Dr. A. C. Hardy. Pp. 68. 5s. Vol. 1, No. 2: Ecological Investigations with the Continuous Plankton Recorder—Summary List of Records, 1932-37. Pp. 59-72. 1s. Vol. 1, No. 3: Ecological Investigations with the Continuous Plankton Recorder—The Phytoplankton in the Southern North Sea, 1932-37. By C. E. Lucas. Pp. 73-170+64 plates. 12s. (Hull: University College.) [15]

Proceedings of the Royal Society of Edinburgh, Session 1939-1940. Vol. 60, Part 1, No. 3: Observations on the Oestrous Cycle of the Guinea Pig. By Dr. P. Bacsich and Dr. G. M. Wyburn. Pp. 33-39. 6d. Vol. 60, Part 1, No. 4: On the Independence of Linear and Quadratic Forms in Samples of Normally Distributed Variates. By Dr. A. C. Aitken. Pp. 40-46. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [15]

Other Countries

Statens Meteorologisk-Hydrografiska Anstalt. Meddelanden. Serien Uppsatsor, No. 29: Beräkning av medeltemperaturen vid svenska stationer. Av H. Modén. Pp. 13. 1 kr. Meddelanden, Serien Uppsatsor No. 30: Hydrologisk bibliografi, år 1938, Sverige, årgång 5. Pp. 14. 1 kr. Meddelanden, Serien Uppsatsor No. 31: Current Meter Discharge Measurements for the Testing of Hydraulic Turbines. By Gustaf Slettenmark. Pp. 9. Årsbok, 19, 1937. iii. Vattenstånd vid Rikets kuster. Pp. 24. 2 kr. Årsbok, 20, 1938. v. Hydrografiska mätningar i Sverige. Pp. 12. 3 kr. Årsbok, 21, 1939. v. Hydrografiska mätningar i Sverige. Pp. 12. 3 kr. (Stockholm: P. A. Norstedt and Söner.) [114]

Indian Forest Records (New Series). Utilization, Vol. 1A: The Comparative Strengths of some Important Indian Timbers and their Uses. By V. D. Limaye. Pp. iv+28. (Delhi: Manager of Publications.) 12 annas; 1s. [154]

U.S. Department of the Interior: Geological Survey. Bulletin 906-C: The Mizpah Coal Field, Custer County, Montana. By Frank S. Parker and David A. Andrews. (Contributions to Economic Geology, 1938-39.) Pp. v+85-134+plates 16-40. 1.50 dollars. Bulletin 906-D: Geology of the Searchlight District, Clark County, Nevada. By Eugene Callaghan. (Contributions to Economic Geology, 1938-39.) Pp. iv+135-188+plates 41-52. 40 cents. Bulletin 910-B: Platinum Deposits of the Goodnews Bay District, Alaska. By J. B. Merthie, Jr. (Mineral Resources of Alaska, 1937.) Pp. iii+115-146+plate 2. 15 cents. Bulletin 916-B: Transit Traverse in Missouri. Part 2: South-Central Missouri, 1908-37. Pp. x+125-296+xi-xiv+1 plate. 25 cents. (Washington, D.C.: Government Printing Office.) [164]

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 845: Water Levels and Artesian Pressure in Observation Wells in the United States in 1938. Pp. iv+724. 75 cents. Water-Supply Paper 861: Surface Water Supply of the United States, 1938. Part 11: Pacific Slope Basins in California. Pp. vii+374+1 plate. 40 cents. (Washington, D.C.: Government Printing Office.) [164]

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 130: Chemical Investigations on the Fleeces of Sheep. By Martin R. Freney. Pp. 52. Bulletin No. 131: Black End and Anthracnose of the Banana, with Special Reference to *Gloeosporium musarum* Cke. and Mass. By J. H. Simmonds and R. S. Mitchell. Pp. 63+2 plates. Pamphlet No. 92: The Density of Australian Timbers. 2: Air-dry and Basic Density Data for 172 Timbers. By W. L. Greenhill and H. E. Dadswell. (Division of Forest Products: Technical Paper No. 33.) Pp. 75. Pamphlet No. 94: Some Effects of Alkaline Reagents on Wool. 1: Chemical Studies, with Special Reference to Felting and Shrinkage, by M. R. Freney and M. Lipson; 2: Preliminary Notes on the Physical Properties of Alkali-treated Wools, by E. H. Mercer and M. R. Freney. Pp. 28+11 plates. Pamphlet No. 95: Australian Apples; a Guide to Picking for Export or Local Storage and to the Best Shipping Periods for Export Varieties. Compiled by W. M. Carne. Pp. 55. (Melbourne: Government Printer.) [184]

Memoirs of the Commonwealth Solar Observatory, Mount Stromlo, Canberra. No. 8: Potential Gradient Observations at Mount Stromlo during 1933-1938. By Dr. C. W. Allen. Pp. 34. (Canberra: Government Printer.) [184]

India Meteorological Department. Scientific Notes, Vol. 8, No. 85: A Note on Some Measurements of Cloud Heights at Poona, Bombay and Madras. By K. P. Ramakrishnan. Pp. 17-22+3 plates. (Delhi: Manager of Publications.) 8 annas; 9d. [184]

Twenty-second Annual Report of the National Research Council of Canada, 1938-39. (N.R.C. No. 866.) Pp. 22. (Ottawa: National Research Council of Canada.) [224]

Report and Accounts of the National Botanic Gardens of South Africa (and the Karoo Garden, Whitehill) for the Year ending 31st December 1939. Pp. 24. (Kirstenbosch: Botanic Gardens of South Africa.) [224]

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 13: Studies in Tropical Fruits, iv. Methods in the Investigation of Respiration with Special Reference to the Banana, vii. Notes on Banana Fruits in relation to Studies in Metabolism. By C. W. Wardlaw, E. R. Leonard and H. R. Barnell. Pp. 27-42+845-860. (Trinidad: Imperial College of Tropical Agriculture.) [224]

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft 1939. Pp. 350. (Aarau: H. R. Sauerländer et Cie.) [224]

University of California Publications in American Archaeology and Ethnology. Vol. 38: Cultural and Natural Areas of Native North America. By A. L. Kroeber. Pp. xi+242. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 3 dollars. [224]

Revue Internationale des Industries agricoles. No. 1. Pp. 248. (Paris: Commission Internationale des Industries agricoles.) [224]

Mazoe Citrus Experimental Station. Report for the Year ending 31st December 1937. (British South Africa Company Publication No. 7.) Pp. xiii+62+4 plates. (Mazoe: Mazoe Citrus Experimental Station.) [224]

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1939. (Publication 3586.) Pp. iv+96. (Washington, D.C.: Smithsonian Institution.) [224]

Proceedings of the U.S. National Museum. Vol. 88, No. 3083: New Genera and Species of Ichneumon-Flies, with Taxonomic Notes. By R. A. Cushman. Pp. 355-372. (Washington, D.C.: Government Printing Office.) [224]

U.S. Department of Agriculture. Technical Bulletin No. 719: Prevention of Damage by the Seed-corn Maggot to Potato Seed Pieces. By W. J. Reid, R. C. Wright and W. M. Peacock. Pp. 38. (Washington, D.C.: Government Printing Office.) 10 cents. [224]

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 15: Clinical Organization for Child Guidance within the Schools. By Elise H. Martens. Pp. vi+78. 20 cents. Vocational Division Bulletin No. 202 (Occupational Information and Guidance Series No. 2): Minimum Essentials of the Individual Inventory in Guidance. By Giles M. Ruch and David Segel. Pp. vi+83. 15 cents. (Washington, D.C.: Government Printing Office.) [224]

A Living Coelacanthid Fish from South Africa. By J. L. B. Smith. (Reprint from the *Transactions of the Royal Society of South Africa*, Vol. 28, Part 1.) Pp. 106+44 plates. (Cape Town: Royal Society of South Africa.) [244]

Ministry of Public Works, Egypt: Physical Department. The Nile Basin. By Dr. H. E. Hurst and the late Dr. P. Phillips. Second Supplement to Vol. 2: Measured Discharges of the Nile and its Tributaries in the Period 1933-1937. (Physical Department Paper No. 38.) Pp. vii+362. P.T. 50: 10s. Meteorological Report for the Year 1934. Pp. xiv+235. P.T. 40. (Cairo: Government Press.) [264]

Lucknow University Studies: Faculty of Science. No. 1: The Theory and Construction of Non-Differentiable Functions. By Dr. A. N. Singh. Pp. vii+110. 1 rupee. No. 2: Recent Advances in Indian Paleobotany. By Prof. B. Sahni. Pp. viii+100. 1.2 rupees. No. 3: Parasitic Worms and Disease; Lectures on Certain Aspects of Helminthology. By Dr. Gobind Singh Thapar. Pp. vi+46. 9 annas. No. 4: Three Lectures on Photochemical Process. By Prof. P. S. Macmahon. Pp. iv+68. 1.2 rupees. No. 5: Saltation in Fungi. By Dr. S. N. Das Gupta. Pp. vi+84. 13 annas. No. 7: Liesegang Rings and the Influence of Media on their Formation. By Dr. A. C. Chatterji. Pp. iv+30. 10 annas. No. 9: Nitrogen Fixation and Alkali Soil Reclamation. By Prof. N. R. Dhar. Pp. iv+40. 12 annas. No. 10: The General Field Theory of Schouten and Van Dantzig. By Prof. N. G. Shabde. Pp. iv+56. 1.2 rupees. No. 11: Boundary Problems in Non-Linear Partial Differential Equations. By Prof. M. R. Siddiqui. Pp. xiv+136. n.p. No. 13: Two Dimensional Potential Problems connected with Rectilinear Boundaries. By Prof. B. R. Seth. Pp. vi+122. 2.12 rupees. (Lucknow: Lucknow University.) [15]

Ontario Research Foundation. Report for the Year 1939. Pp. 36. (Toronto: Ontario Research Foundation.) [15]

"POSTLIP"
(No. 633 Mill)
ENGLISH FILTER PAPERS

Manufactured in
ANNUALLY INCREASING QUANTITIES
for upwards of 50 years.

White and
Grey Plain,
Antique,
Crinkled,
and
Embossed.



All sizes in
Squares,
Circles, and
Folded
Filters.
Rolls made
to order.

**Pure Filterings for Laboratory
Work and in quantities for all
industrial purposes.**

★ See Report of TESTS made by The
National Physical Laboratory, a copy
of which will be sent on application,
together with free samples if required.

Postlip Filterings are stocked by all the leading
Wholesale Laboratory Dealers.

EVANS, ADLARD & CO., LTD.
POSTLIP MILLS
WINCHCOMBE, CHELTENHAM, ENGLAND

Life assurance in war time

Under most of our schemes we
grant policies at normal rates
with a reduction in benefits
on death during hostilities

Ask for particulars

**The Equitable Life
Assurance Society**

(founded 1762)

19, Coleman Street, London, E.C.2
Sir William Elderton, Actuary and Manager

No shareholders

No commission

ILFORD
"Q" PLATES

THESE are special Laboratory products designed and manufactured for scientific work in the far ultra-violet. In these plates the silver halide grains actually project from the surface of the emulsion, by which device the absorption of ultra-violet by the gelatin layer is reduced to a minimum. The 'Q' Plates are more robust than those of the Schumann type and, compared with typical oiled plates, which are commonly used for this work, they show in many cases a very considerable increase in speed. The difference between the two types is least in the neighbourhood of 400 Å, where the absorption of gelatin is at a maximum. At this point a layer as thin as 10^{-6} cm. is sufficient to cause some absorption. The 'Q' emulsions are by far the most satisfactory yet devised for work in the extreme ultra-violet as far down as 120 A.U. They also are the best material for recording atomic bombardments, e.g. in isotope research.

References.

- F. W. Aston. Proc. Roy. Soc. A., **163**, 391 (1937).
A Second Order Focusing Mass Spectrograph and Isotopic Weights by the Doublet Method.
- F. W. Aston. Proc. Roy. Soc. A., **132**, 487 (1931).
The Isotopic Constitution and Atomic Weights of Selenium, Bromine, Boron, Tungsten, Antimony, Osmium, Ruthenium, Tellurium, Germanium, Rhenium, and Chlorine.
- Johnson and Hancock. J. Sci. Instr., **10**, 339 (1933).
Characteristic curves of some Photographic Plates in the Ultra Violet.
- Hunter and Pearse. Nature, **133**, 37 (1936).
Sensitivity of Photographic Plates in the Region 2500-2100A.
- Hunter and Pearse. Proc. Phys. Soc., **50**, 256 (1938).
Sensitivity of Photographic Plates in the Region 2500-2000A.

ILFORD LIMITED,
ILFORD, LONDON

Manufacturers of sensitized materials for all photographic work, including
Selo and Selochrome Roll Films.

OFFICIAL ANNOUNCEMENTS

THE INSTITUTE of CHEMISTRY of GT. BRITAIN & IRELAND

(Founded 1177)

(Incorporated by Royal Charter, 1885)

APPOINTMENTS REGISTER

A Register of Chemists (Fellows, Associates and Senior Registered Students) who are available for appointments or who are seeking to improve their positions, is kept at the office of the Institute. The facilities afforded by this Register are available (free) to Companies and Firms requiring the services of chemists, and to Universities, Colleges and Technical Schools requiring Teachers of Chemistry and Technology. A list of Laboratory Assistants is also available.

Particulars of the Regulations and Examinations of the Institute can be obtained (free), on application to the Registrar.

All communications to be addressed to The Registrar, the Institute of Chemistry, 30 Russell Square, London, W.C.1.

BRIGHTON SUMMER SCHOOL IN ANIMAL BIOLOGY

AUGUST 2 to 15, 1940

The course is intended as an introduction to Biology and as a refresher course for teachers of the subject. Laboratory and field work. Director: Prof. L. E. S. Eastham, M.A., M.Sc., Professor of Zoology in the University of Sheffield, assisted by specialists. Prospectus of F. H. Toyne, Education Officer, 54 Old Steine, Brighton.

SUDAN GOVERNMENT

The Director of Education invites applications for the following posts:

1. MATHEMATICAL TUTOR in the Khartoum Secondary School (late Gordon Memorial College). Candidates should have a University Degree in Mathematics, Physics or Engineering.

2. LECTURER IN CHEMISTRY in the School of Science, Khartoum. Candidates should have a University Degree in Chemistry.

Candidates for both these appointments should be under the age of 30 and unmarried, but older candidates may be considered. Some teaching experience is desirable. The appointments will be on contract, with an initial salary of £E.480 per annum, though a higher initial salary may be offered in recognition of age, experience and qualifications (£E.1=1 0s. 6d.). At present no income tax is payable in the Sudan. The selected candidates will be required to take up their posts in the Sudan on or about January 1, 1941; but it may be possible, if circumstances so warrant, to advance this date by a period of not more than 2-3 months.

Further particulars are obtainable from the University Appointment Boards, and from the Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1, to whom applications should be submitted not later than June 15, 1940. Selection will be made during July. Envelopes should be marked "Mathematical Tutor" or "Lecturer in Chemistry."

SUNDERLAND EDUCATION COMMITTEE, THE TECHNICAL COLLEGE

Principal: F. H. REID, B.Sc., Wh.Ex., M.I.Mech.E.

APPLICATIONS are invited for the post of FULL-TIME LECTURER in BIOLOGY, duties to commence in September 1940.

Candidates should possess a good honours degree in Botany and Zoology. Previous teaching experience and research desirable.

Salary in accordance with the Burnham (Technical) Scale. After three years' service an additional allowance may be made to the salary scale under clause 5(c) of the Burnham Award in respect of "special work of an advanced nature."

Further particulars and Forms of Application may be obtained (stamped, addressed foolscap envelope) from the Secretary, The Technical College, Sunderland, Co. Durham.

Applications should reach the undersigned on or before Monday, June 3, 1940.

W. THOMPSON,
Director of Education.

Education Offices,
15 John street,
Sunderland.

**UNIVERSITY OF CAPE TOWN
LECTURER IN BOTANY**

The University of Cape Town invites applications for a lectureship in Botany, vacant from March 1, 1941. Special qualifications in plant physiology will be a recommendation.

The normal commencing salary of a lecturer is £400 per annum, and, subject to paragraph 4 of the conditions of appointment, rises by annual increments of £25 to £600, or in certain cases may rise to £750.

Applications (four copies) must reach the Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (from whom forms of application and further particulars may be obtained), not later than June 29, 1940. Applicants, in addition to submitting copies of testimonials, must give the names of three referees.

**NORTHERN POLYTECHNIC,
HOLLOWAY, LONDON, N.7**

The Governors of the above Polytechnic invite applications for the post of full-time Lecturer (Male) of Physics.

Candidates must possess a good honours degree of a British University; some teaching experience is essential, and preference will be given to a candidate having experience in research.

The salary will be in accordance with the Burnham Scale (£276-£15-£528), less 5 per cent for Superannuation.

The Lecturer will be required to take up his duties on September 9, 1940.

Forms of application, together with full particulars, will be forwarded on receipt of a stamped, addressed foolscap envelope. Forms must be returned not later than June 3, 1940.

R. H. CURRELL,
Clerk.

**SWANLEY HORTICULTURAL COLLEGE
FOR WOMEN, SWANLEY, KENT**

Required in September, a Lecturer in Plant Pathology and Zoology who can teach these subjects to students taking the course leading to the University of London Degree of B.Sc. Horticulture (Zoology to Intermediate stage only), and students reading for the College Diploma and Certificate.

Full particulars may be obtained from the Principal, to whom applications should be submitted before May 31, 1940.

Secretary-Librarian required by important City

Company. Good knowledge Chemistry and some business experience essential. Age not over 35.—Write full particulars Box 714, T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4.

Consulting Chemist. For disposal, equipped labora-

tory, office, etc., coal, building materials.—Box 715, T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4.

Scientific Intelligence Service.

Reports and bibliographies of scientific literature—from a single abstract to a complete monograph. Current reports. Bibliographical researches. Any language. Accuracy and completeness. Chemistry, Biochemistry, Physics, Geology, Botany, Biology.—LEWKOWITSCH BIBLIOGRAPHICAL BUREAU, Barn House, Barn Hill, Wembley Park, Middx.; ARN 3956

GLASS BLOWING

(PYREX, SODA, LEAD and SILICA QUARTZ)

For Scientific, Experimental, and Research Work.

High Vacuum Work for Electrical Research, Etc.

**G. C. AIMER & CO., 15 FITZROY STREET
TOTTENHAM COURT ROAD, W.1**

"NATURE" Advertisement Rates

| | £ | s. | d. |
|--------------------------|----|----|----|
| Page | 8 | 8 | 0 |
| Half-page | 4 | 8 | 0 |
| Quarter-page | 2 | 6 | 0 |
| Eighth-page | 1 | 4 | 0 |
| Sixteenth-page | 12 | 6 | |

Special rates for Series upon application

**T. G. SCOTT & SON, LTD.
63 Ludgate Hill, London, E.C.4**

**HEFFER'S BOOKSHOP for
SCIENTIFIC & TECHNICAL BOOKS**

The staff of our Scientific Books Department is skilled in the supply of books on every aspect of science and technology. Our stock of new and secondhand books is very large, and classified catalogues are issued at frequent intervals - are you on our mailing list?



W. HEFFER & SONS, LTD.
BOOKSELLERS - CAMBRIDGE

LEWIS'S LENDING LIBRARY
(SCIENTIFIC—TECHNICAL—MEDICAL)

NEW BOOKS and EDITIONS are added immediately on publication, as the demand requires, delay or disappointment thus being prevented.

ANNUAL SUBSCRIPTION from ONE GUINEA.

Subscriptions may commence from any date.

READING AND WRITING ROOM (for Subscribers) open daily
Prospectus with Bi-monthly List of Additions, post free.

H. K. LEWIS & Co. Ltd.
136 Gower Street, London, W.C.1

Metro. Railway Euston Square Stn. All Tube Railways: Warren St.

Booksellers to the World

FOYLES
QUICK, EFFICIENT POSTAL SERVICE

New and second-hand books
on every branch of Science

Enrolments taken for the Scientific Book Club.
Members buy books published at 7/6, 8/6, 10/6 & 12/6
for only 2/6 each

113-125 CHARING CROSS RD., LONDON, W.C.2
Telephone: Gerrard 5660 (16 lines)

SECOND-HAND MICROSCOPES

FINEST SELECTION IN LONDON

- Watson Edinburgh "H" Outfit, 2/3", 1/6", 1/12" o.i. £30
- Zeiss E.S.C. Outfit, 2/3", 1/6", 1/12" o.i. £27/10
- Reichert, with mech. stage £25/10
- Spencer, " " £27/10
- Beck London 29, 2/3", 1/6" £14/10

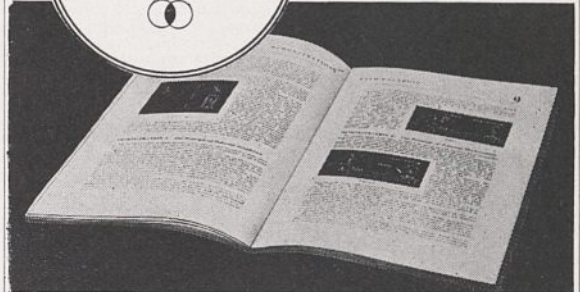
6 gross Rock Section Slides, by well-known makers, 1/- each, 10/- per dozen

Send stamps for lists of Telescopes, Microscopes, Binoculars

BROADHURST, CLARKSON & CO. LTD.

Note name & address: 63 Farringdon ROAD, London, E.C.1
(3 minutes from Farringdon Street Metro. Station)

SEND FOR
this
Useful Handbook



of Important Interesting Experiments with Polarized Light

"Suggestions for the Use of Polaroid* Light Controls" is a 20-page handbook, giving full instructions for performing twenty-one experiments with Polaroid filters in the classroom or laboratory. It includes the brilliant classical experiments of Malus, Arago, Biot and Brewster—together with dramatic demonstrations of the applications of Polaroid light con-

trol now occurring in sun-glasses, glare-free illumination, 3-dimensional pictures, photography, machine design, etcetera.
Write Division 9 . . . for the Handbook and a Survey of this new field of applied science.



POLAROID CORPORATION
721 Main Street, Cambridge, Mass.



Trade



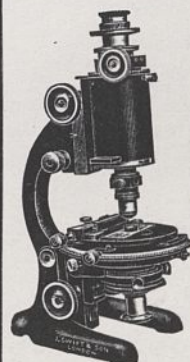
Mark

This immersion oil is suitable for all makes of Oil Immersion Objectives and has been in constant use in numerous laboratories for many years.

See Catalogue S.N. of Stains, Chemicals and Reagents. Post free.

Sole makers:

FLATTERS & GARNETT LTD.
309 Oxford Road Manchester, 13



An entirely New Series of
MICROSCOPES

for

Technical & Industrial Investigation

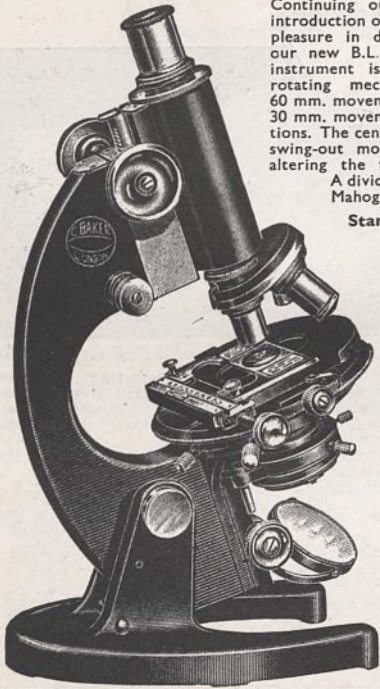
Analytical Research, Biochemistry, Observation with Incident Polarised Light, etc.

Send for list "Tech 188" free on request

JAMES SWIFT & SON, Ltd.

Makers of the highest grade Microscopes and Accessories

81 Tottenham Court Road
LONDON, W.1, ENGLAND

Estab.] **C. BAKER'S** [1765**B.L.M. 3A MICROSCOPE**
An Entirely New Model

Continuing our announcement of the introduction of our new models, we have pleasure in describing and illustrating our new B.L.M. 3A Microscope. This instrument is fitted with a circular, rotating mechanical stage, having a 60 mm. movement in the horizontal, and 30 mm. movement in the vertical directions. The centring substage has a special swing-out movement operated without altering the focus of the condenser. A divided draw tube is also fitted. Mahogany case. £27 0 0

Stand as above in Case with achromatic condenser and iris, triple nosepiece, eyepieces 2 and 4, objectives $\frac{3}{8}$ ", $\frac{1}{2}$ " and $\frac{1}{1.25}$ " o.i., N.A. 1.30, magnifications 53-900 £48 7 0

Stand in Case. Achromatic condenser and iris, triple nosepiece, No. 2 eyepiece, orthoscopic eyepieces 19 and 12.5 mm.; objectives 2", $1\frac{1}{2}$ ", $\frac{3}{4}$ ", $\frac{1}{2}$ ", $\frac{1}{1.25}$ " o.i., N.A. 1.30, dark ground condenser micrometer eyepiece, divisions to rotating stage, magnifications 14 to 1600 £62 0 0

Quotations for other outfits on application.

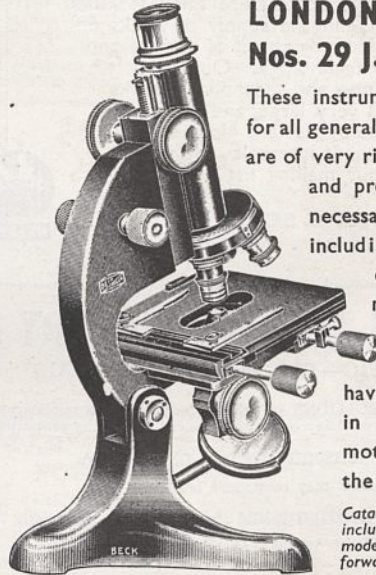
All prices subject to war advance of 5%.

Ask for abridged list N.1.

244 High Holborn
LONDON, W. C. 1

BECK
MICROSCOPES**LONDON MODELS**
Nos. 29 J. K. L. & M.

These instruments are suited for all general purposes. They are of very rigid construction and provided with the necessary adjustments including adjustable draw-tube. The mechanical stage is of the built-in type, having travel of 3 in. in the horizontal motion and 1 in. in the vertical motion.



Catalogue giving full details including all other Beck models and accessories forwarded on application

R. & J. BECK LTD.
69 MORTIMER STREET, LONDON, W.1

Members Scientific Instrument Manufacturers' Association of Gt. Britain

**TEMPERATURE CONTROLS**

are used by
GOVERNMENT,
UNIVERSITY and INDUSTRIAL
LABORATORIES
throughout the Empire

You must have many problems
which these instruments could
help to solve

Write for our leaflet N.2

SUNVIC CONTROLS LTD.,
NUMBER ONE, KINGSWAY, LONDON, W.6.2**B.D.H.**
CULTURE MEDIA

for bacteriological use

Liquid and solid media are prepared in the B.D.H. Bacteriological Laboratories for the use of workers who find it convenient to purchase their requirements in forms which are ready for immediate use.

The B.D.H. Culture Media are supplied in three different types of containers, i.e., in test-tubes, in screw-capped vials, and in bulk containers. Every batch is controlled for sterility and for growth-promoting properties.

Further particulars and prices from
THE BRITISH DRUG HOUSES LTD.
GRAHAM STREET LONDON N.1