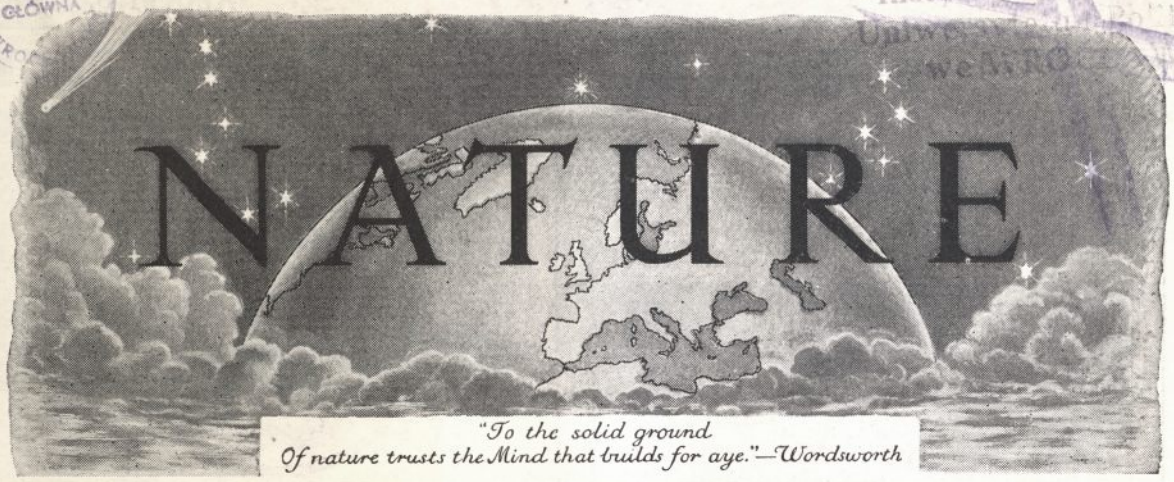
AG 107

SUPPLEMENT: INDEX TO VOLUME 145



Vol. 146, No. 3692 SATURDAY, AUGUST 3. 1940 TWO SHILLINGS

LANTERN SLIDES
FILM SLIDES & FILM STRIPS
ON ALL SUBJECTS

Catalogue issued in 10 sections

Over 200,000 Slides in Stock
Special Slides made to order

NEWTON & CO. LTD.
72 WIGMORE STREET, LONDON, W.1
MAKERS OF LANTERNS AND EPIDIASCOPES OF EVERY TYPE

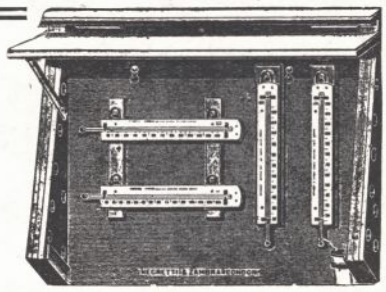
VITREOSIL QUALITY
in pure fused silica ware is known and appreciated in science and industry all over the world
THE THERMAL SYNDICATE LTD.
Head Office and Works: Wallsend, Northumberland
London Depot: 12-14 Old Pye Str., Westminster, S.W.1
Established over 30 years

C. BAKER 244 HIGH HOLBORN LONDON
ESTAB. 1765
USED and SHOP-SOILED
TESTING APPARATUS
for INDUSTRIAL or LABORATORY PURPOSES
Fully Guaranteed Optically and Mechanically

This department has over 3,500 items in stock and is worth your serious attention now that there is difficulty and delay in obtaining new apparatus. Many firms engaged on government contracts are equipping their testing and research departments from this stock.

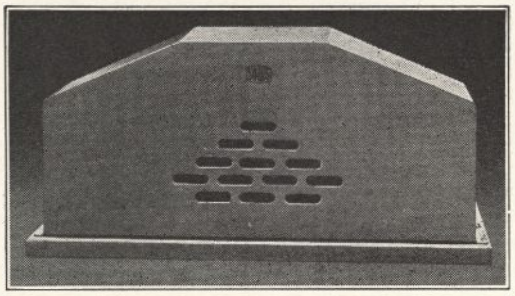
The variety of instruments is too numerous to mention here, and owing to restrictions on paper and other causes we are unable to print our usual edition of the catalogue of second-hand apparatus, we therefore invite you to let us know your requirements.

C. BAKER, 244 High Holborn, LONDON, W.C.1
Member Scientific Instrument Manufacturers' Assn. of Gt. Britain



Meteorological Instruments
NEGRETTI & ZAMBRA
38 Holborn Viaduct
LONDON

H.T. GENERATORS
for all purposes
X-RAY EQUIPMENT for CRYSTAL ANALYSIS, CABLE TESTING SETS, Etc.



A.C. STABILIZERS
OUR STANDARD SERIES include
3, 60, 120, 300, 450 watts
All these will maintain the output voltage within ± 1% despite mains fluctuation of ± 17%
Input Voltage 230 ± 40 volts 50~
Output Voltage 230 volts or as required

"SOLUS" Electrical Co., Ltd.
7, 9, 11, Stanhope Street, London, N.W.1

Reduction of Surplus Stock

WATCH SIZE ANEROID BAROMETERS

First-class British make, at about one third the usual price. In Morocco Snap Case

£1 : 10 : 0

Full particulars from :

JAMES J. HICKS
(Incorporated with W. F. Stanley & Co., Ltd.)
8, 9 & 10, HATTON GARDEN, LONDON

Please ask for particulars of
CHRONOGRAPH RECORDERS
*
BOMB CALORIMETERS
*
SPECIAL TESTING APPLIANCES

G. CUSSONS LTD.
The Technical Works
MANCHESTER

Meteorological Instruments
MERCURIAL BAROMETERS
THERMOMETERS
THERMOGRAPHS
HYGROGRAPHS
Supplied by Laboratory furnishers, Scientific Instrument dealers, etc.

F. DARTON & COMPANY LTD.
56-58 CLERKENWELL ROAD, LONDON, E.C.1

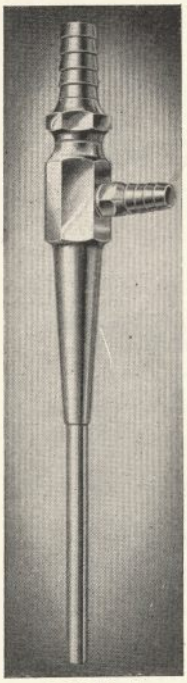
SECOND-HAND MICROSCOPES

by
SWIFT, BECK, WATSON, BAKER, ZEISS, LEITZ, REICHERT, HIMMLER, BAUSCH & LOMB, etc.

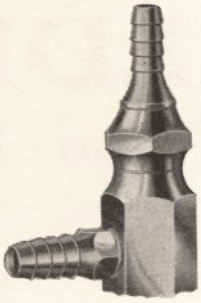
MICROSCOPES BOUGHT for CASH OR TAKEN IN EXCHANGE

A large selection of all kinds available. List on application.
CLARKSON'S, 338 High Holborn, LONDON, W.C.1
Opp. Gray's Inn Rd. Phone : HOLborn 2149. Estab. over a Century

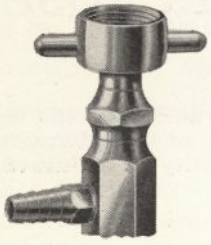
EDWARDS NEW METAL FILTER PUMPS



MODEL 1



MODEL 2



MODEL 3

- THE MOST EFFICIENT WATER JET PUMP AVAILABLE
- SUPERIOR JET DESIGN GIVING REMARKABLE EFFICIENCY
- BEST POSSIBLE VACUUM—FEW MMS. MERCURY
- HIGH SPEED AT ONLY 15 LBS. WATER PRESSURE
- UNBREAKABLE AND EASILY CLEANED
- TWO CONNECTIONS ON EACH PUMP

Let us send one for free trial

MODEL 1—½ in. Rubber Tube and ¼ in. (B.S.P.T.) Screw Connections **15/6**

MODEL 2—¼ in. Rubber Tube and ¼ in. (B.S.P.T.) Screw Connections **15/6**

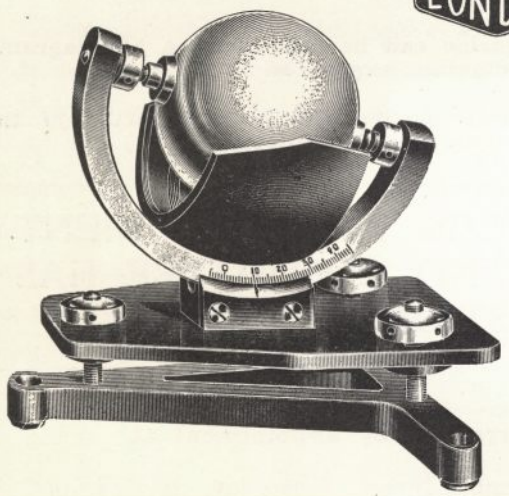
MODEL 3—¾ in. Union Cap for ½ in. Tap and ¼ in. (B.S.P.T.) Screw Connections **20/-**

Prices less 10% for 10

W. EDWARDS & COMPANY (LONDON) LTD. Allendale Works, Southwell Road, London, S.E.5

Telephone: BRIxton 1195 Telegrams: Edcohivac, Phone, London

CASELLA LONDON



SUNSHINE RECORDERS

AS SUPPLIED TO METEOROLOGICAL AUTHORITIES ALL OVER THE WORLD

C. F. CASELLA & Co. Ltd., Fitzroy Square, LONDON, W.1

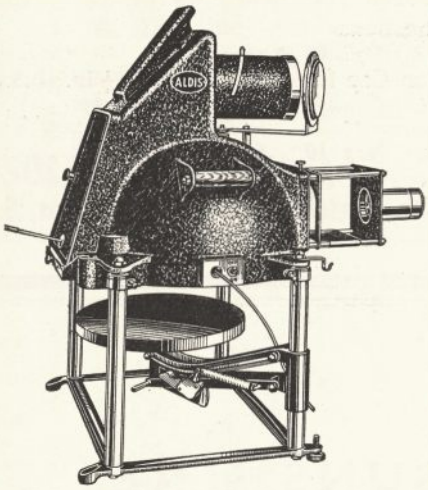
Members Scientific Instrument Manufacturers' Association of Great Britain

"GET AN ALDIS"

—the advice of those who know

The Aldis Epidiascope

DOMINATES BECAUSE . . . .



Normal use with the elevating table swung into position

- It will project :—
  - (a) Pictures, diagrams and solid objects, covering a circle of 9.4″ diameter, with outstanding fidelity in definition, colour and relief.
  - (b) Lantern slides with intense illumination.
  - (c) Ex-ray films and transparent objects up to 15 in. × 12 in. by means of a sub-illuminator.
- No other instrument compares for illumination. Only one 500W. lamp is used, yet, on test, instruments using a 1,000W. lamp have been proved to give less light.
- There is no trouble from overheating.
- Change over from diagrams to slides is swift and silent.
- A magazine can be used holding 50 diagrams from automatic exposures.
- A Micro-projection attachment worthy of the Aldis Epidiascope is available.

AN ALDIS EPIDIASCOPE IS AN INVESTMENT IN BRITISH EQUIPMENT NO COMMITTEE HAS EVER QUESTIONED

DEMONSTRATIONS can be arranged by appointment at

GRIFFIN & TATLOCK Ltd., Kemble Street, Kingsway, W.C.2, or

ALDIS BROTHERS Ltd., Sarehole Road, Hall Green, Birmingham, 28.

FREE. *Fully illustrated particulars may be obtained from either of the above addresses.*

NATURE

Vol. 146 SATURDAY, AUGUST 3, 1940 No. 3692

CONTENTS

PAGE

Potential and Real Scientific Man-Power 141

Animal Coloration and Natural Selection. By Sir Edward Poulton, F.R.S. . . 144

Water and all its Properties. By Prof. N. K. Adam, F.R.S. 145

History of the Power Station Industry. By Dr. A. Russell, F.R.S. 146

The Drift from the Land. By G. V. Jacks 147

Studies in Microbiology. By Prof. R. T. Hewlett 149

Co-operative Agricultural Research in the Americas. By The Hon. Henry A. Wallace . 151

Structure and Composition of Plant Cell Membranes. By Wanda K. Farr . . 153

Colour Vision and Chromaticity Scales. By Dr. W. D. Wright 155

Obituaries :

Mr. H. Guthrie-Smith. By Sir Arthur Hill, K.C.M.G., F.R.S. . . . 158

Dr. Phyllis M. Tookey Kerridge. By Prof. C. A. Lovatt Evans, F.R.S. . . 159

News and Views 160

Letters to the Editors :

Sulphanilamide as a Specific Inhibitor of Carbonic Anhydrase.—Dr. T. Mann and Prof. D. Keilin, F.R.S. 164

Temperature Coefficients and Acclimatization.—Dr. Kenneth Mellanby . . 165

Evidence of Demethylation in the Animal Body.—S. W. Stroud . . . 166

Resonance in the Chloroacetic Acids.—R. P. Bell 166

Mechanism of the Neutron Loss Reaction Produced by Deuterons.—M. Goldhaber . 167

Viscosity and Molecular Structure.—Dr. H. Mark and Dr. R. Simha . . . 168

Camouflage in War-Time.—C. H. Rowe. 168

Cobalt and Pine Disease—H. H. Corner and Dr. A. M. Smith 168

Research Items 169

The Royal Society of Canada 171

Culture *in vitro* of the Excised Embryo of an Ophiuroid. By H. Barraclough Fell . 173

Stereophonic Recordings of Enhanced Music 174

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 rate, Inland or Abroad, is £3 0 0, 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

THE CHEMICAL CONSTITUTION OF NATURAL FATS
By T. P. HILDITCH, D.Sc., F.I.C.
Royal 8vo. 452 pages, 11 figures and 113 tables.
35s. net

THE CALCULATION & DESIGN OF ELECTRICAL APPARATUS
By W. WILSON, D.Sc., B.E., M.I.E.E., M.A.I.E.E.
Second Edition, Revised.
Crown 8vo. 243 pages, 24 figures. **10s. 6d.** net

BEYOND THE CLINICAL FRONTIERS
A Psychiatrist views Crowd Behaviour
By EDWARD A. STRECKER
Crown 8vo. 210 pages. **9s. 6d.** net

STARCH AND ITS DERIVATIVES
By J. A. RADLEY, M.Sc., A.I.C.
Being Volume Eleven of a Series of Monographs on Applied Chemistry, under the Editorship of E. HOWARD TRIPP, Ph.D.
Demy 8vo. 356 pages, 61 Photomicrographs and 28 figures. **22s.** net

TELEVISION
The Electronics of Image Transmission
By V. K. ZWORYKIN, E.E., Ph.D., and G. A. MORTON, Ph.D.
Medium 8vo. 657 pages, 509 figures. **36s.** net

FORENSIC CHEMISTRY
By HENRY T. F. RHODES, Dip.Inst.C. (Lyon)
Demy 8vo. 222 pages. **12s. 6d.** net

THE MANUFACTURE OF COMPRESSED YEAST
By F. G. WALTER, A.A.C.I.
Demy 8vo. 262 pages, 29 figures. **15s.** net

THE TOOLS OF THE CHEMIST
Their Ancestry and American Evolution
By ERNEST CHILD
Demy 8vo. 220 pages, 107 illustrations. **21s.** net

PLANT PHYSIOLOGY
A Textbook for Colleges and Universities
By BERNARD S. MEYER, Ph.D. and DONALD B. ANDERSON, Ph.D.
Medium 8vo. 706 pages, 151 figures. **24s.** net

CHAPMAN & HALL, LTD., 11 HENRIETTA STREET, LONDON, W.C.2

Bausch & Lomb

The BAUSCH & LOMB range of microscopes has been designed by scientists who have known from their own experience just what is required of any given instrument. In consequence increasing numbers of laboratory workers are turning to BAUSCH & LOMB to supply instruments which will give

INCREASED EFFICIENCY

Detailed literature on request

Bausch & Lomb Optical Co. Ltd.
Africa House
KINGSWAY LONDON, W.C.2

B-S

Refractometers,
Polarimeters
and
Spectrometric Apparatus
are
Tools in the Empire's
Workshops

Advice
as to selection
of
suitable instruments
from

BELLINGHAM & STANLEY LTD.
71 Hornsey Rise, London, N.19
Phone: ARChway 2270

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

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, AUGUST 3, 1940 No. 3692

POTENTIAL AND REAL SCIENTIFIC MAN-POWER

THE various reports which have already been issued by the Select Committee on National Expenditure have afforded encouraging evidence of a more scientific outlook in the prosecution of our war effort, though there is still room for improvement in attempts to get the maximum utilization of scientific knowledge and resources in the elaboration of policy and in its execution. The eighth of these reports, which comes from the sub-committee on Home Defence Services, deals with matters with which scientific workers are themselves directly concerned.

The first and major of these subjects is the Central Register, which originated as a part of the National Service campaign, the establishment and working of which are critically reviewed. The Register was compiled through the medium of the professional and technical institutions, which circularized their members with an appeal issued on behalf of the Minister of Labour and National Service. In addition, individual applications for enrolment on the technical section of the Register were examined by the committees, and the volunteers were enrolled if found suitably qualified. Applications for enrolment on the administrative and business management sections of the Register were examined by the Department on the basis of standards laid down by the Administration and Management Committee.

Altogether about 50,000 individual applications for enrolment in the Register have been examined since the outbreak of war, of which somewhat less than half have been accepted. On May 20, the live section of the Central Register contained 97,044 names, sorted into 75 main classifications and 735 sub-classifications.

The Central Register is thus an essential part of the organization of the national effort. The report emphasizes, however, that it is not, as is often supposed, an organization for finding jobs for men but for finding men for the jobs. There are still many people of the highest qualifications who appear not to have realized this and have failed to register. The recent order of the Minister of Labour and National Service regarding the compulsory registration of professional engineers, while an indication that registration of engineers is incomplete, is not to be taken as implying greater backwardness on their part than with other scientific and technical workers. It was the first and essential prelude to any considerable use by the Minister of Labour of his wide powers of transference and placing of labour of all kinds, whether professional or otherwise. The order is expected to add about 30,000 to the 20,000 names already appearing in the engineering categories of the Register.

The subsequent extension of compulsory registration to chemists, physicists and quantity surveyors shows that the Minister of Labour has lost little time in acting on the sub-committee's recommendation that complete, and therefore compulsory, registration of persons in categories which are, or are likely to become, scarcity categories of the Central Register is essential. No organization of priority is possible without this foundation.

The report's major criticisms are indeed in respect of this question of priority and of the use made of the Central Register. In regard to the first point, there has until recently been no effective machinery for determining labour priority. Obviously the ultimate decision whether to release a man or woman of the Central Register standard from his or her appointment can no longer be left with the employer. Compulsory registration is a

first step to this end ; but the report also points out that the effective placing of scientific or technical staff in industries subject to the Undertakings (Restriction on Engagement) Order, 1940, can be exercised through the Central Register better than through the local office.

Hitherto the main use of the Central Register has been by Government departments and by such bodies as Chatham House and the British Council. This position has led to the erroneous belief that the Central Register is intended to divert highly qualified persons into the Departments rather than into vital war and export industries. The declared object of the Register is to supply additional war-time needs, whether in Government departments or elsewhere, and the sub-committee's recommendations in regard to wider use of the Register are designed to ensure that it plays much more effectively its essential part in the organization of the war effort.

The report recommends accordingly that industrial undertakings under Government control should be immediately and strongly recommended to recruit technical and professional staff from the Central Register. It further recommends that the rule that Government departments should recruit temporary staff of Central Register standards solely through that Register should be strictly enforced, except where it is urgent that the post be filled immediately and where the post to be filled is of a character requiring special qualifications and for which there is a limited field of choice. Even in regard to the latter reservation, it may well be held that use of the Central Register is the more appropriate method, particularly if professional institutions, which in normal times maintain their own appointments bureaux for the benefit of qualified members, maintained sufficiently close contact with the Central Register.

The report undoubtedly implies that more whole-hearted support should be given to the Central Register by individual scientific workers and their professional associations. More specifically, however, it urges that Government departments should assist the Central Register to function more effectively by presenting their demands for technical staff through a technical rather than an establishment officer, to secure the more precise formulation of their requirements. Similarly it is recommended that they should not require full technical qualifications for posts which are primarily administrative, and that they should not be too rigid in their requirements in regard to age. Expediting the notification of appointments is also urged as facilitating the work of the Register.

The report also comments on the inadequate salaries frequently offered and on the absence of any provision for registering firms of technical consultants, who might be willing to work together as a team. Such teams, accustomed to work together and possessing varied qualifications and experience, would often be likely to be more effective than a technical section of a Government department built up piece-meal. The sub-committee strongly recommends the careful exploration of this source of technical and professional skill at present untapped by Government departments and industries in the war effort.

Obviously a number of these recommendations and suggestions, although addressed primarily to Government departments, merit equally careful consideration by industry if the Central Register is to make its full contribution to our war effort. Moreover, many individual scientific workers are themselves occupying positions of responsibility which enable them to implement such findings, and it may well be hoped that the appearance of this report will lead them to consider very closely the possibilities of thus implementing the co-ordination of our resources of scientific and technical knowledge and skill.

The observations of the report on the neglect of the Central Register of Aliens appear at a time when renewed attention has been directed to the use generally of the services and special knowledge of friendly aliens and refugees in our midst. Both in the Houses of Parliament and in the general Press, the general internment of aliens has received strong criticism even from those who are most fully alive to the necessity of the policy of internment as such.

The question has come into prominence from two points of view ; first in view of its damaging effects on the war effort, and second, from its effect on opinion abroad, alike in providing material for enemy propaganda, in neglect to use those who could be of service to our own cause in that field, and as inconsistent with our traditions and the ideals for which we are fighting. It is, of course, with the first of these alone that the sub-committee's report is concerned.

The Central Register of Aliens has been compiled mainly through the medium of the Society for the Protection of Science and Learning and the refugee agencies dealing with professional classes. It is largely confined to the scarcity

categories of the main Central Register. The qualifications of these aliens are carefully examined, with the assistance of the chairmen of committees, before they are enrolled. The aliens registered are either friendly aliens or, if enemy aliens, those remaining in Category C (exempted from all restrictions), where they have been placed by the Home Office tribunals.

The sub-committee was informed that, in general, resort is only had to the Aliens Section of the Central Register to fill those vacancies for which aliens would naturally be expected to be useful, or vacancies in scarcity categories The sub-committee is satisfied that this Register could perform useful service. It contains a wealth of valuable material, including names of international repute. Demands on this section of the Register should not be hindered merely by the failure to devise such safeguards as may be required on grounds of security.

The hope thus expressed by the sub-committee will be echoed by every scientific worker. As pointed out in a recent leading article (NATURE, **145**, 796 ; 1940), any form of preferential treatment of alien scientific workers would carry with it a grave element of risk which could not be justified. While, however, general internment of alien men of science may have been necessary at the time it was carried out as a precautionary measure, neither in science nor in other fields have we such a superabundance of man-power or brains that we can neglect any source of assistance. This was visualized as a possibility in the same article in NATURE. Repeated instances have already been cited in Parliament and in the Press of the actual interruption of war-work through indiscriminate internment of friendly and anti-Nazi aliens, apart altogether from the refusal to accept offers of service from those only too eager to help.

There is little reason to doubt that the actual conditions in the internment camps will speedily be improved, but beyond this a definite aliens' policy is wanted, the absence of which is largely responsible for the worst mistakes or abuses. An aliens' board or commission under a responsible minister is required to supervise the whole problem, look after the welfare of aliens, examine and re-examine their credentials, and use to the full the abilities of those it finds trustworthy. Such an authority might well have prevented the scandals of recent weeks. It should prove the most effective means of implementing the recommendation of the report of the Select Committee and making available for the war effort here and in the overseas Empire the skill, knowledge and good will of many whose services are at present denied to us only by our own policy.

The vigour with which the Minister of Labour and National Service has already acted on other recommendations of the Select Committee, no less than the terms of the appeal addressed to the management of all the 9,000 firms working for the Government by the First Lord of the Admiralty, the Minister of Supply, and the Minister of Aircraft Production, will encourage the hope that this matter will not be overlooked. Sir John Anderson has now announced in the House of Commons on July 23, among other important changes in the treatment of enemy aliens, the formation of a small advisory committee to assist him in considering the question of enlarging the categories of exemption to include particularly those who could render services of special value or make a significant contribution to the war effort. This, with the transfer to the Home Office of the responsibility for managing internment camps, should go far to facilitate the rectification of mistakes, and the new policy has already been warmly welcomed.

Rapid progress should now be made in releasing those who have been wrongfully interned and in making life tolerable for those still confined. At the same time the new policy will still exclude numbers of potential workers, bitterly opposed to Hitler, and wholly on our side, against whom there is no reproach or suspicion. If the most urgent task is that of utilizing the specialist services as fully and quickly as possible, the traditions of Great Britain, and it may well be its ultimate security, will not permit us to rest content with any policy which does not avail itself to the maximum extent of the good will and services at our disposal.

The utilization of the willing services, which we ourselves urgently need, and which are only too anxious to be enrolled, means far more than the mere material accession to our war effort implied. Failure to evolve the necessary safeguards demanded would augur ill for our capacity to embark on the much larger task of establishing a new world order after the war. Integration of such services, skill and knowledge into our effort, on the other hand, will testify to a freedom from hysteria, a capacity for competent organization, and to a loyalty to the ideals and traditions of humanity worthy of the cause for which we contend.

ANIMAL COLORATION AND NATURAL SELECTION

Adaptive Coloration in Animals

By Dr. Hugh B. Cott. Pp. xxxii + 508 + 49 plates. (London: Methuen and Co., Ltd., 1940.) 40*s*. net.

THIS excellent work, eagerly awaited for many years, will be most welcome to naturalists, even, we may hope, to the few who have hitherto rejected the Darwinian interpretation which the author has here supported by a mass of additional evidence based on his own observations and those of very many others. Dr. Julian Huxley, in his introduction, refers to one of these critics, the American zoologist, A. F. Shull, who writes in contemptuous terms of the whole subject. To this Huxley replies: "Dr. Cott, in this important book, has turned the tables with a vengeance on objectors of this type. He has shown that it is they who are the armchair critics, or, one might say, the laboratory-bench critics. Had they taken the trouble to acquaint themselves with even a fraction of the relevant facts to be found in nature, they could never have ventured to enunciate such sweeping criticisms".

"Adaptive Coloration", following the author's preface, is divided into three parts: (1) concealment; (2) advertisement; (3) disguise, including mimicry (in cuckoos as well as insects and the relations between the two forms of resemblance); finally, a brief conclusion in which the cumulative effect of the facts and arguments is shown to "present a body of evidence which makes it appear that adaptive coloration is one of the chief attributes of the higher animals, and has been, indeed, one of the main achievements of organic evolution" (p. 427).

The immense amount of labour devoted to the production of this great work may be inferred from the 685 titles of original memoirs quoted in the bibliography (pp. 439–66). A brief inspection of the list will at once show how much we owe to the author for bringing together and discussing these scattered records of observations on adaptive coloration in animals and for their certain result, the stimulation of further researches along the same lines as well as others which are sure to be developed as the work proceeds. Special mention must be made of the illustrations. The coloured frontispiece, by the author, exhibits the warning coloration of eight Amphibia, while forty-eight monotone plates, chiefly reproduced from his admirable photographs of living species at rest in their natural surroundings, and eighty-four text illustrations, supply the help which is so absolutely necessary in this subject. Prof. Hale Carpenter, in a recent review, has referred to "the scattering of the plates at random through the pages" and the inconvenience of the references to some of them. I, too, felt something of a shock, in reading the extremely interesting pages on crabs and the stinging sea anemones, their welcome and invaluable guests, to be suddenly faced by the lovely plate 30 (opposite p. 236), displaying an East African hawk-moth at rest on a tree trunk at Beira. There can be no doubt that a second edition will soon be required, and we may hope that the arrangement of plates and the references to them will then be improved.

In the limited space available it is impossible to treat adequately the first and much the longest of the three sections into which the book is divided, namely, concealment. I must, however, direct special attention to the admirable and abundant plates and text figures and the excellent account of the whole subject and each of the ten heads into which it is divided, as clearly shown in the table of contents.

On the subject of Part 2, advertisement—aposematic or warning colours—I believe that every open-minded reader of pages 191–233, devoted, with the accompanying plates and figures, to the methods by which different animals are rendered conspicuous in Nature, will agree with the author's statement that the classes of evidence "all point to the conclusion that *aposematic appearances are adaptive*: that they tend to satisfy a vital need in the struggle for life, *the need for recognition by predatory enemies as something unwholesome, something unwelcome, and something to be avoided*" (p. 233).

The succeeding section, on adventitious warning coloration (pp. 234–44), describes many examples of "relatively defenceless and palatable animals . . . known habitually to associate themselves with others which are specially protected and conspicuous, and thus to share the protection from enemies which the latter enjoy" (p. 234). Instances of such partnership between crustaceans and sea-anemones or other unpalatable forms were recorded long ago—an interesting British example by P. H. Gosse in June 1859 and several observed by Walter Garstang at Plymouth, a few years later. Extremely interesting and remarkable as these and other early records certainly are, I do not remember meeting with any criticism or doubt of an interpretation based on adaptation which

was, I believe, offered by every observer. But the facts and their interpretation are so significant, and indeed arresting, that the admirable section in which the subject is brought up to date gave me special satisfaction and I hope it will be widely read, especially by those who are inclined to be critical of natural selection. A few of the many examples quoted by the author may be mentioned :

"The coral-haunting crab *Melia tessellata*, from Mauritius, invariably grasps two anemones, one in each claw—employing them both for defence and for feeding. Borradaile states that if the crab is assailed it thrusts the polyps towards the enemy and thus wards him off with their stinging tentacles; but if the polyps capture food, the crab takes the morsel from their grasp with one of its legs and transfers it to its own mouth" (p. 235). Other examples quoted are the damsel-fishes (Pomacentridæ) of the Indo-Australian Islands, which find protection among the stinging tentacles of certain large anemones and apart from these are unable to withstand the attacks of more active fishes (pp. 237–38).

Immediately following the account of associations observed in the life of the sea is a description of the nesting partnerships between birds and aggressive Hymenopterous insects, such as wasps, which Dr. J. G. Myers has carefully studied in South America and the West Indies (pp. 238–39). Dr. Cott concludes that the evidence as a whole "indicates that we have in these forest-dwellers a highly perfect and singular instinct correlated with the need for protection from enemies" and that it has its parallel "in the waters of coral reefs, where stinging anemones, rather than stinging aculeates, play the role of protector to the defenceless creatures who solicit their company" (pp. 239–40).

Dr. Cott has lightened and brightened his book by numerous admirably chosen quotations introduced into the text or appearing as headings to sections. Thus, referring in the preface (p. xiii) to the function of camouflage in aerial warfare, he points out that "we have lagged far behind nature, and have much leeway to make up before we can approach the efficiency attained by different forms of wild life in the field. We should do well, therefore, to follow advice from the Book of Job : 'But ask now the beasts, and they shall teach thee ; and the fowls of the air, and they shall tell thee . . . and the fishes of the sea shall declare unto thee' ". Another attractive and appropriate quotation, from Milton, supplies the heading (p. 290) to Section 9 : "Evidence of selective feeding by vertebrate enemies in a state of nature", containing abundant proof that the diet of many insectivorous animals is determined by palatability rather than availability, as some critics have urged. In the quotation the Archangel Raphael speaks to Adam of the "various living creatures" of the earth and air, and asks him :

"Know'st thou not
Their language and their ways ? They also know,
And reason not contemptibly."

It has been a very great pleasure to read Dr. Cott's fine work, to remember that it has been produced in this, the country of Charles Darwin, and that many excellent observations made in happier times by our present enemies are here described. May such happiness soon return !

E. B. POULTON.

WATER AND ALL ITS PROPERTIES

Properties of Ordinary Water-Substance in all its Phases

Water-vapor, Water and all the Ices. Compiled by N. Ernest Dorsey. (American Chemical Society, Monograph Series No. 81.) Pp. xxiv + 673. (New York : Reinhold Publishing Corporation ; London : Chapman and Hall, Ltd., 1940.) 90*s*. net.

IN this very remarkable book, Dr. Dorsey presents a series of nearly three hundred tables on the principal physical properties of water. The book continues the work commenced when the author was an associate editor of the International Critical Tables, for which he worked indefatigably. It is based, in respect of data obtained before 1923, mainly on these Tables ; for more recent data, the literature has been exhaustively searched, much more than a thousand references being given, and good use has been made of other tables and monographs. The breadth of knowledge and the conscientiousness with which this enormous mass of data has been digested and put into perspective compel profound respect.

All the ordinary physical properties of water are of course fully tabulated, for ice, water, and steam. Thermodynamic properties are fully given, including the data for the synthesis of water from its elements and for its dissociation. There are full tables of the spectroscopic and other optical

properties, also of the magnetic, magneto-optic, dielectric, and acoustic data. The results of the X-ray examination of ice and water are summarized and the sections on surface properties, as would be expected from the author's earlier contributions to the subject, are very good.

Much information that is not capable of quantitative tabulation is also given. There are excellent descriptions of the entrancing phenomena accompanying the formation of ice; indeed this book excels in its account of the various properties of ice, and of their importance in many directions, including meteorology and engineering. There are a few short sections dealing with miscellaneous topics, such as the preparation of dust-free water, and the composition of sea water. The term 'water-substance' means water as found on the earth, that is, having the usual isotopic ratio of about one part in 6,500 of deuterium oxide; but a good deal of information is included on sea water, in various places in the book. The solubility of gases in water, and the diffusion of gases through such solutions, are discussed; but wisely the solvent power of water for other substances is not treated.

This book is a monumental piece of industry, guided and inspired by learning and a breadth of interest far beyond that of most scientific authors. Naturally it is not a book to read through, though many parts of it are surprisingly readable. It should be on the shelves of every well-equipped library, where it will be consulted by workers in almost every branch of science. It provides, immediately, data of sufficient completeness and authority for all but very highly specialized work; and even those intending to pursue any special part of the subject farther than it is taken here will find this book an admirable and extremely well-balanced introduction.

N. K. ADAM.

HISTORY OF THE POWER STATION INDUSTRY

The Early Days of the Power Station Industry By R. H. Parsons. Pp. x + 218 + 24 plates. (Cambridge: At the University Press, 1940.) 15*s*. net.

THE author says in his preface that so rapid has been the growth of the industry and so profound the changes it has undergone, that few of its original features are now recognizable. He has done well to give an account of electricity supply as it was in the days when every enterprise was largely of a pioneering nature and its future could only be guessed at. This period closed near the end of last century. At that time the lines along which progress would take place were becoming evident.

The birth of the power station industry was foreshadowed by Faraday's discovery, in 1831, that electricity could be generated by mechanical means. The author points out that we may say that the development of the dynamo in its present form started in 1845, when Wheatstone and Cooke patented the use of electro-magnets in place of permanent magnets for the field. Machines were not made completely self-exciting before 1866, when the brothers C. and S. A. Varley, Dr. Werner Siemens and Sir Charles Wheatstone independently and practically simultaneously, discovered the principle of self-excitation. The production by Gramme, in 1870, of a dynamo with a ring-wound armature brought matters to a point when the industrial generation of electricity really became a practical question.

The first company to be formed for the exploitation of electric machinery was probably La Société Générale d'Electricité, of Paris. It was founded in 1853 to develop a machine designed by Prof. Mollet for the purpose of generating current for the electrolysis of water. The object was to produce hydrogen and oxygen for making lime-light. The project was not successful, but the machine was modified by Prof. F. H. Holmes and used for experiments in connexion with electric light. On December 8, 1857, the light produced by his second machine was thrown over the sea from the South Foreland Lighthouse.

Sir Humphry Davy showed in 1808 to the Royal Institution that a brilliant light could be produced by allowing an electric current to form an arc between a pair of carbon points, the current being obtained from a battery of 2,000 zinc-copper cells. For illumination, arc-lighting was the only way of utilizing electricity. In August 1878 six Lontin lamps were employed to illuminate the Gaiety Theatre; this was the first building in London to be lighted electrically. It was installed by French engineers.

The discovery of incandescent lamps by Edison and Swan and their wise agreement to amalgamate their interests in October 1883, so as to avoid litigation, was a great advance. If we confine ourselves to undertakings that have a continuous

existence to the present time, the honour of priority should be given to that of Brighton. The history of the Brighton undertaking can be traced back to December 1881, when Robert Hammond went to Brighton and staged an exhibition of the Brush arc-lighting system. The response was so good that the Hammond Co. gave a permanent supply of sixteen arc lamps in series carried on an experimental circuit for nearly two miles.

On looking through the book, one is struck by the versatility of many of the great pioneers of the mechanical and electrical power industries. Among others, we may mention Colonel Crompton, born in 1845, a world pioneer of D.C. dynamos directly coupled to high-speed Willans engines, and Sebastian Z. de Ferranti (1864–1930), who designed the high-voltage A.C. generating station at Deptford. He was the world pioneer of high-voltage transmission.

One of the greatest engineers was Charles A. Parsons, whose name is well known as the inventor of the steam turbine. The results of his efforts to provide the electrical industry with a better prime mover and dynamo, was the invention of the turbo-generator. The first machine of this type was constructed by him in 1884, and it now has an honoured resting place in the Science Museum at South Kensington. The fertility of Parsons as an inventor is shown by his list of British patents, which number more than three hundred. He founded several large engineering works. His invention of the steam turbine has made it possible for electricity to become almost a necessity of industrial and universal welfare, instead of a costly luxury.

This volume will be of great interest to every engineer. It contains a large number of excellent photographic reproductions of early power stations, the facts are well authenticated and the interest never flags. A. RUSSELL.

THE DRIFT FROM THE LAND

Proceedings of the Fifth International Conference of Agricultural Economists, held at Macdonald College, Canada, 21 August to 28 August 1938.
Pp. xiv + 436. (London: Oxford University Press, 1939.) 17*s*. 6*d*. net.

A STEADY decline in the agricultural population of every industrialized country is one of the most characteristic features of the present stage of civilization. The grave social consequences, if the decline continues, have frequently been portrayed, and some of them have already been experienced—even in countries which, like the United States, still have larger rural populations than can be accommodated under the prevailing economic system; for the decline is not only in numbers, but also in the strength of the bonds which tie the cultivators to the land. The cultivators are not so deeply rooted in the soil as formerly, and at any time an economic blast may blow them away.

The problem of the drift from the land is engaging the attention of sociologists and economists throughout Europe and North America. The solutions proposed to stem the drift do not include the return of sociologists and economists to the agricultural labours of their forefathers, and the recent failure of schemes for settling equally unsuitable material in the form of industrial unemployed on the land is leading to the abandonment of large schemes of rural resettlement. It is proposed, instead, to check the rural exodus by alleviating the lot of the dwindling minority which still remains tied to the soil—by substituting economic persuasion for the grim struggle for existence that Nature imposes on those who must sustain her challenge and hold the land for the use of mankind. There is, however, nothing in history to show that alleviating conditions for the front-line defenders of civilization either strengthens the defence against, or weakens the attack of, the antagonist who is always waiting to re-occupy the soil. But it is felt that something must be done to encourage the defenders, and it is up to those in the rear to do it.

In one form or another this problem was present in the minds of most of the speakers at the Fifth International Conference of Agricultural Economists. The four main sessions of the Conference discussed the social implications of economic progress in present-day agriculture; land tenure and social control of the use of land; farm labour and social standards; and international trade in relation to agricultural development. A dominant note in the Proceedings is struck by a widespread realization that the economic and political impacts of civilization are causing mankind to lose contact with the soil. A very high standard was maintained throughout the discussions, and it would be invidious to

select any of the seventy-odd contributions for particular mention.

Agriculture has lagged behind in the rapid economic development which industry has undergone in the last century. Industry is now a corporate affair whereas agriculture is still largely individual, and many of the economic strains to which agriculture is now subjected throughout the world may be traced to the inability of the individual to hold his own against the corporation. If this be so, the remedy would appear to lie in some form of co-operative agricultural organization, either voluntary or enforced by the State. Such organization has, indeed, already saved the farming community from complete economic ruin by industry in many countries, but in so far as the farmer abandons his individualism he loosens one of his most valuable contacts with the land—most valuable, that is, from the point of view of the society he supports. The farming community forms a biological link between the land and the otherwise detached industrialized societies living in sublime ignorance of the soil and of the latent power of Nature to eject them from it. As the link weakens, either by a bodily or a spiritual drift from the land, the delicately balanced superstructure of industrialized society begins to totter, and economists, sociologists and politicians bestir themselves to restore the equilibrium while there is still time.

We can observe them at work all around us to-day, the economists explaining the causes and seeking the cure for the small material reward the cultivator gets for his labours; the sociologists lauding the rigorous life of the countryside; the politicians currying the once neglected favours of the agricultural community. Earnestly they strive to distribute more equitably the burden of supporting civilization between the superstructure and the foundations. The farmer is to be assured a fair market and price for his produce; housing, sanitation, education, conditions of work and of leisure are to be improved; the rival attractions of the town are to be brought to the countryside; the countryman is encouraged to multiply his kind. If these economic and social measures fail to stem the drift from the land, political pressure can be brought to bear—as in Germany, where the recent *Erbhofsrecht* restricts the right of the peasant to alienate his land or to disinherit his son.

Nevertheless, it is noteworthy that in several countries within the last twenty years a marked improvement in the conditions of agricultural labour and in the amenities of country life has been accompanied by an accelerated drift from the land. The drift has been as strong in Germany, where men have thought, written and acted against it, as it has been in Britain, where men have thought—and occasionally written—about it, or in the United States where, until a few years ago, the individual farmer was left defenceless against the economic holocaust of the agricultural depression of the nineteen-thirties. It seems as though the economic and social antidotes which have been applied to the country have been taken in still greater measure by the towns, and the attraction exerted by the latter has increased rather than diminished. That, at least, is an impression one receives from the Proceedings of this economic conference, which was more concerned with elucidating the intricacies of the problem than with the superhuman task of formulating a solution.

The solution—if any—has, indeed, little or no relation to economics. America has a greater rural population than the land can profitably employ; but it is not suggested that her rural troubles—and especially her main trouble of erosion which aggravates all others—would be alleviated by a depletion of the rural population sufficient to give the remainder a satisfying share of the wealth of the soil. The trouble lies much deeper than economics. The farmer has no particular value to the community—except as a food producer, and machines can perform most food-producing functions equally well—unless he is tied by a spiritual bond to the land, a bond which is strengthened by making life not easier, but more difficult for him. The bond is the struggle with Nature for mastery over the land. When man's mastery over the land has been secured, as it has been in most countries of Western Europe, it is questionable whether any economic or social measures will suffice to prevent those who can from escaping from the slavery of the land, and enjoying some of the fruits of man's victory and the physical satisfaction of eating bread won in the sweat of another's face. Indeed, it is questionable whether in these circumstances an artificially maintained rural population has a social, or, under modern conditions of warfare, even a military value which is not possessed equally by an urban population. The love and understanding of the land characteristic of the cultivator while the issue of the struggle with Nature is still uncertain are liable to turn to indifference when men must be induced by what practically amounts to bribery to keep their roots in the soil. They probably will not stay on the land without inducement, but if they are induced to stay their chief value to the community at large is that they do not increase the congestion in the towns. Their social value as a stabilizing factor, and their biological or spiritual value as a

link between civilization and the rest of Nature are largely lost.

The bond with Nature, once broken, can only be mended by losing ground already won and then attempting to recover it. It is improbable that any people which has fought and won its battle will willingly retreat in order to fight again. The peoples of Western Europe hold their lands securely against the forests they have supplanted, and only a few men are now needed to protect the strong defences that have been erected against wild Nature. The bodily drift from the land may be stemmed, but the spiritual drift will go on. There is no longer any biological restraint to bind the great majority of men to the soil, and economic remedies are no substitute for the harsh bond of biological necessity that is now lacking. The pain and travail, the wind and rain in the fields, which are the essence of Nature's bond, are not for the economists and sociologists nor—if they can be avoided—for anybody else.

In America, on the other hand, the recently vaunted conquest of Nature by technocracy has been shown to be unreal. Desolation and destruction of the land have forced a retreat which can only be reversed by a people deeply rooted in the soil. The present drift from the land must be stopped and a spiritual bond forged between man and Nature. But the bond will be forged not by lightening the hard lot of the farmer, nor by otherwise encouraging a shallow-rooting human cover on the land, but by an unremitting struggle against the natural forces of adversity that mankind has released upon itself. Those forces are of biological and physical origin, and can be overcome—and the enduring fertility of the soil assured—only by biological and physical effort. The economics of the struggle with, and of the victory over, Nature are of great practical importance, particularly in these critical times, but they are not fundamental to the ultimate issue.

G. V. JACKS.

STUDIES IN MICROBIOLOGY

A Textbook of Microbiology

By Prof. Kenneth L. Burdon. Second edition of "A Textbook of Bacteriology". Pp. xv + 638. (New York: The Macmillan Company, 1939.) 14*s*. net.

SO far from being a text-book on general microbiology, as the title seems to imply, more than half this book is devoted to the medical aspects of the subject, little space being assigned to fermentation, soil microbiology and nitrification, micro-organisms in industry, and the like.

In the earlier portion of the book, some 150 pages, the fundamentals of microbiology are dealt with at some length, and an excellent account is given of the general properties and classification of micro-organisms, with chapters on the Protozoa, fungi and moulds, spirochætes and viruses, and the true bacteria. Part 2 is devoted to the laboratory study of micro-organisms—the microscope, culture media and culture methods, and isolation, with a section on disinfection. Under viruses and filterable micro-organisms, no explanation is given of the reason for their invisibility microscopically.

The remainder of the book gives an account of the relation of micro-organisms to disease, commencing with the sources and prevention of infection and aseptic technique. Chapters follow on resistance and immunity, anaphylaxis, and the practical use of vaccines and serums. Lastly, the microbiology of the chief infective diseases is considered. The treatment here is on somewhat novel lines, for the individual diseases are dealt with from the point of view of the regions of the body principally affected, the natural microbial flora of the region and the pathological conditions affecting the part being first considered, after which the micro-organisms responsible for these conditions, or likely to be present, are described.

The descriptions given throughout are clear and accurate and well up to date, and the treatment of the subject takes a middle course between an elementary text-book and an advanced treatise. We gather that the book has been designed as a general college course on the subject, rather than for the student of medicine and hygiene, and while serving as a useful outline for the medical student, it is scarcely full enough in many sections to be his only guide. As in many American text-books, review questions are appended to the various chapters, and the book concludes with appendixes on bibliography, formulæ, and suggested laboratory exercises.

The book is very readable and free from mistakes, is well produced and illustrated, and some portraits of pioneers of the subject add to its attractiveness.

R. T. HEWLETT.

The Physics of the Divining Rod

Being an Account of an Experimental Investigation of Water and Mineral Divining. By J. Cecil Maby and T. Bedford Franklin. Pp. xv+452+6 plates. (London: G. Bell and Sons, Ltd., 1939.) 21*s*. net.

THIS is a very ambitious book: its aim is to provide a much-needed physical explanation of dowsing and to improve its technique on scientific lines and, at the same time, to present a coherent mathematical theory. The greater part of the book is written by the first author and surveys the whole field of former investigations, describing many others made by himself and his co-workers. In his survey Mr. Maby shows a very uncritical acceptance of a number of claims either very insecurely established or already discredited. This has an unfortunate effect on the scientific reviewer, and his confidence is not increased by finding that there is not a graph containing points which indicate actual observations: all are smoothed means and consequently their value cannot be assessed. Measurements with Wynn-Williams ionization counters are described but not in sufficient detail to make critical comment possible. Atmospheric ionization is not an easy subject experimentally.

The theoretical section, by the second author, postulates some form of cosmic radiation resulting in electromagnetic waves of ten metres wave-length. There seems to be no direct evidence for such waves, and the author's discussion of their polarization cannot be justified on our present physical knowledge.

In presenting facts and theories to the scientific world, there is a well-accepted and necessary procedure. It is to be regretted that the authors have not followed this procedure, thus making the position of the scientific reviewer impossible.

Fossil Orthoptera Ensifera

By Frederick Eberhard Zeuner. Text. Pp. xiii+321. 15*s*. Plates. Pp. iv+80. 20*s*. (London: British Museum (Natural History), 1939.)

DR. ZEUNER has written a monograph which transcends the immediate purpose of a British Museum catalogue. He has made a study of fossil Orthoptera and allied insects side by side with the recent species and, in this way, he has enabled the reconstruction with reasonable probability of the evolution of the group Ensifera. This latter assemblage includes the Tettigoniidæ, or long-horned grasshoppers, the Gryllidæ, or crickets, together with various allied families. It is shown that the Ensifera may be traced back into Upper Carboniferous rocks. Their ancestors were Protorthoptera and are closely related to those of the Acridian group or short-horned grasshoppers.

Dr. Zeuner is an expert at his task and, unlike some insect palæontologists, he has the knowledge necessary to combine the evidence derived from recent and fossil forms to good purpose. Passing over the purely technical descriptions of genera and species, the premises upon which the main conclusions are based form interesting and instructive reading. The author's accounts of the venation and of the sound-receptor organs, for example, have involved a large amount of independent investigation the results of which aid in solving the phylogeny of the insects concerned. We hope that the British Museum (Natural History) will see its way in future to publish more monographs, of larger or smaller groups, involving, like the present work, conclusions of fundamental importance to our understanding of their origins and affinities.

Buschi

Vom Orang-Säugling zum Backenwülster. Von Prof. Dr. G. Brandes. Pp. v+135. (Leipzig: Quelle und Meyer, 1939.) 4.80 gold marks.

"BUSCHI" is a somewhat discursive account of the growth of a celebrated male orang-utan belonging to the Dresden Zoological Gardens, to which it went when an infant a few weeks old, and where it is apparently still living, a mature and powerful ape enjoying, judging by its photographs, even less in the way of good looks than is normally possessed by orangs. Records are given of the animal's increasing weight, of the times of eruption of its teeth, of its sexual maturation, and its development of secondary sexual characters; much of this information is of considerable interest to students of human evolution. Dr. Brandes has also gone to great trouble in acquainting himself with, and in illustrating, the individual characteristics of other captive orangs, and his observations on the great variability of this species of ape are not without interest in relation to the general question of racial differentiation, and in particular with the more specific question of the existence or non-existence of races among orangs. The book is lavishly illustrated, but it has no bibliography.

Monograph of the South American Weevils of the Genus Conotrachelus

By Karl Fiedler. Pp. iv+365. (London: British Museum (Natural History), 1940.) 15*s*.

THIS work, the text of which is written in German, deals with a single genus of weevils that is extremely numerous in species. It is entirely devoted to descriptions of the South American members and the majority of these refer to new species. The genus includes a number of forms that are pests of cacao, custard apple, guava, together with certain Leguminosae and such fruits as plums, apricots, etc. The monograph is illustrated by one plate and various text figures.

Statistical Method from the Viewpoint of Quality Control

By Dr. Walter A. Shewhart, with the editorial assistance of Dr. W. Edwards Deming. Pp. x+156. (Washington, D.C.: Graduate School, Department of Agriculture, 1939.)

FOR many years Dr. Shewhart has concerned himself with the development of statistical methods in the practical business of quality control in mass production. This latest publication covers old ground and provides a didactic foundation rather than any new extensions of his previous ideas. R. A. F.

CO-OPERATIVE AGRICULTURAL RESEARCH IN THE AMERICAS*

By the Hon. Henry A. Wallace,
United States Secretary of Agriculture

THE Governments of the American countries look to men of science, on one hand, for sound appraisals of their hemisphere resources and, on the other, for scientifically sound judgments as to the methods under which these resources can best be utilized in order to promote the general welfare and raise the standard of living of all American peoples.

In this connexion, special emphasis must be placed on agriculture for a number of reasons. One is that agriculture plays a very vital part in the economies of all the countries of the Western Hemisphere, especially those of Latin America. Another is that at present these countries produce much the same types of agricultural commodities. A third reason lies in the fact that export trade is vital to the welfare of these countries, and it so happens that agricultural items represent very significant portions of either the export or the import trade of each of them.

As things stand to-day, the lines of production in the Americas and the nature of the merchandise exchanged between the republics present definite handicaps to a substantial trade expansion. This emphasizes the need of exploring the possibilities for greater agricultural production in Latin America of tropical or semi-tropical products that the United States needs and can readily import in substantial quantities. Developing agricultural production along these lines would provide a sound basis for complementary trade relations and place the trade between the two areas on a solid foundation. As a consequence, it would increase the buying power of Latin American countries for the wide variety of products that they want from the United States but which, in present circumstances, they are unable to buy here. Finally, the development and expansion of production of complementary, non-competitive products would furnish the spearhead of co-operative efforts designed to give practical significance to the idea of Pan-American solidarity.

The tropical and semi-tropical products include such articles as rubber, cinchona, abaca, kapok, rotenone, and other insecticides, tea, cocoa, camphor, and tropical hardwoods. Hundreds of millions of dollars are spent by the United States each year for such commodities as these, imported for the most part from distant areas outside of the Western Hemisphere. Experiments and investigations already undertaken by private concerns and under co-operative arrangements of American Governments have revealed some encouraging possibilities by way of developing profitable production in tropical areas of Latin America. Recently the United States have co-operated in four important agricultural surveys in Haiti, Paraguay, Ecuador, and Colombia at the request of their Governments. Members of the United States Department of Agriculture who made the surveys gained a knowledge both of the problems and possibilities in Western Hemisphere agriculture. Their experience should be most helpful in work on the specific projects that must be undertaken in the future.

In this connexion, it has been found that some limited facilities exist in the Americas for research in tropical agriculture. But, for a long-term programme that would call for continuing research designed, on one hand, to develop and promote tropical agriculture on a scientific basis, and on the other hand, to train the agricultural leaders of the future in this field, more adequate facilities than now exist are indispensable. For such a purpose some thought has been given to the possibility of establishing an institute of tropical agriculture in some Latin American country where facilities for tropical research are suitable.

It is our sincere belief that the establishment of an institute of tropical agriculture is vital if Western Hemisphere agriculture is to develop as it should. This proposal, which we in the Department of Agriculture have been considering for a couple of years, has been endorsed by President Roosevelt's Interdepartmental Committee on Co-operation with the American Republics. The Institute would serve as a symbol of amity and of the economic and cultural relations between the Americas. It would lead to a better balanced agricultural economy in the Western Hemisphere. It would be in a position to present comprehensive data on the vital agricultural problems of all the American republics. It would develop a broad knowledge of pests and diseases common to the great tropical region. In bringing together students in agricultural science, it would promote a mutual under-

* Substance of a paper prepared for delivery at the session devoted to agriculture and conservation, Eighth American Scientific Congress, on May 11.

standing between these future leaders in agriculture. Through co-operative research it would work towards the solution of serious problems in crop and animal production such as the Sigatoka disease of banana, witch broom and Monilia rot of cacao, and animal parasites.

The Institute would not only provide technical training but also an opportunity to acquire a knowledge of the languages and the varied business methods, standards of ethics, and points of view of the Western Hemisphere.

Research on rubber production should meet with the approval of all those interested in or responsible for Western Hemisphere policies. Rubber is the most important of all tropical agricultural products. Although indigenous to South America, rubber is not grown there commercially to any extent. Indications are, however, that it could be and should be an important product of this hemisphere. The Goodyear Company, with its plantings in Costa Rica and Panama, and the Ford Company, with its plantings in the Amazon region of Brazil, have been pioneers in the plantation-production of rubber here. Research should be undertaken on modern production methods, such as soil management and the developing of high-yielding disease- and insect-resistant strains which can be used in bud-grafting. Such research would doubtless lead to the economical production of rubber.

It is our feeling that an institute of tropical agriculture cannot be established unless, in the beginning at least, the bulk of the necessary funds are subscribed by private foundations or individuals. Governments of the American Republics could participate directly by sending students to study in the Institute, assigning problems to the Institute for solution and perhaps furnishing part of the faculty. The problems assigned to the Institute would be of a kind that Governments would find it cheaper to pass on to the Institute for solution. The Institute, of course, would be equipped to work on large and important agricultural problems, at less cost and with greater certainty of solution than elsewhere.

Discussions of the Institute always bring up the question of location. It is our feeling that it should be located in a Latin American Republic under good environmental living conditions ; but, at the same time, be so situated as to be easily accessible to places having conditions favourable for the development of tropical crops like rubber, abaca and vegetable oils. Some Governments have indicated a desire to have such an institute in their countries, and a willingness to furnish sites for its location.

The fusing of agriculture and conservation in this section of the Eighth American Scientific Congress is entirely logical. If, in its truest sense, agriculture means the science and art of wresting vital human needs from the soil and the resources dependent upon it, it is essential that we should think simultaneously of conservation. Agriculture and conservation must progress hand in hand. The former could not long exist without the latter. The Americas have resources yet untapped.

Having gone through a long period of exploitation, coincident with settlement of the continent, we in the United States are now striving to reverse the trend and move as rapidly as we can toward the conservation of our resources in order to ensure sustained use. Conservation of natural resources is the pronounced policy of our Congress, and the executive branches of Government, in co-operation with individuals, co-operative groups, and corporations, are carrying on constructive programmes in this direction.

In undertaking to protect our natural resources for permanently sustained use, however, we promptly discovered several formidable gaps in our knowledge. We were aware, for example, that soil erosion was wasting our soil and its fertility at an incredibly rapid rate. But we had no precise knowledge of the extent of erosion in our country, and we had no extensive knowledge of the varying rates of erosion on different types of soil and under varying kinds of ground cover.

In recent years we have devoted an increasing amount of time and energy to gathering basic facts about our agricultural plants. This kind of inventory, in my opinion, is indispensable to the intelligent conduct of agricultural programmes. How can we hope to conserve our resources for the continuous use and maximum long-time benefit of our citizens unless we know what resources we have, as well as their quality and quantity ?

In 1934, we made a reconnaissance to find out just how extensive and severe erosion of the soil had become in the United States. We learned that much of the land of the United States had been damaged to some extent and that not a single State had escaped. We learned that great areas had been ruined or severely impoverished. We learned where erosion is most severe, the types of erosion that had caused the most damage, and got some idea of the relative effectiveness of our major crops in protecting the soil or exposing it to the elements.

In the Americas, I believe, we have an obligation to ourselves and to the world. It is to develop our resources for the maximum benefit of mankind, yet, while developing them, to ensure to posterity their prolonged usefulness. Depending on our choice, we can exploit our resources, exhausting them completely, or we can draw steadily on them as requirements demand, preserving the source for future generations.

STRUCTURE AND COMPOSITION OF PLANT CELL MEMBRANES

By WANDA K. FARR,

DIRECTOR, CELLULOSE LABORATORY, BOYCE THOMPSON INSTITUTE FOR PLANT RESEARCH, YONKERS, NEW YORK

HISTORICAL CONCEPTION OF MEMBRANE COMPOSITION

THE complex structure and chemical composition of plant cell membranes were indicated in the reports of the earliest study of cells as biological units. Before 1850 the work of Payen[1] had shown that different proportions of carbon, hydrogen, and oxygen were obtained from some of the separable membrane constituents. During succeeding years, considerable progress was made in correlating chemical analyses with observed microscopic structural features of various types of membranes.

The observations of these early botanists and chemists were carefully reviewed by Mangin[2] in his memoirs on the pectic compounds published in 1891–92. A constituent, almost universally present in plant cell membranes, which was very resistant to ordinary chemical and physical treatment, they had named 'cellulose'. From the point of view of orderly molecular arrangement, as indicated through observations in polarized light, this material was seen to be fundamentally crystalline and, in many cell membranes, in the form of diminutive fibrils varying in length and arrangement. In intimate association with the cellulose they found other substances of carbohydrate nature which definitely fell into the colloidal group in Graham's classification of chemical substances. To this group of carbohydrates as a whole they gave the name 'pectic substance'. Mangin concluded that pectic substance exists in cell walls along with cellulose from the earliest stages of formation of the membrane. He also suggested that various phenomena associated with cell wall modification, such as gelatinization and liquefaction, are due to the transformation of pectic materials.

MODERN CONCEPTIONS OF MEMBRANE COMPOSITION

This earlier work, indicating a heterogeneous composition of the plant cell wall, including the cotton fibre, has been generally disregarded during more recent years by leading workers in the field of cellulose chemistry. Instead, attempts have been made to explain reactions of the cotton fibre by analogy with the behaviour of pure substances the molecules of which are in the form of long chains. The conclusion has been drawn that variations in viscosity produced by the fibre mass can be accounted for upon the basis of variations in the degree of polymerization of the cellulose molecules. The behaviour of dispersions of derivatives of cellulosic materials has been interpreted in a similar manner. The direct application of this concept, even to the behaviour of purified cotton fibres, assumes chemical homogeneity in the fibre mass.

Along with this growing tendency to interpret the behaviour of the cotton fibre membrane in terms of a single organic chemical, data concerning individual fibre reactions which are incompatible with this conception have continued to accumulate. A membrane which can be shown to contain as much as 90 per cent cellulose in the form of spirally arranged fibrils, exhibits colloidal behaviour of various types not in keeping with the known chemical stability of this substance. Many of these reactions, if carefully controlled, are reversible, leaving the fibre apparently unchanged. While the techniques of microscopy and X-ray diffraction have established the fundamental crystalline nature of cellulose, the single fibre and the fibre mass in many types of reagents behave as a colloidal system. These various types of information have served to increase the uncertainty concerning the physical structure of cell membranes and the chemical nature of the membrane constituents.

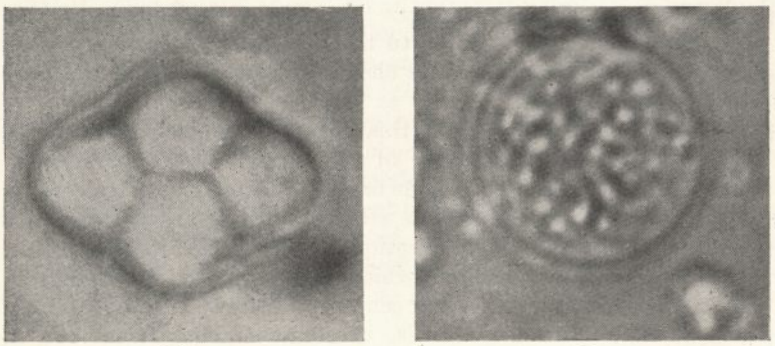
CURRENT OBSERVATIONS OF MEMBRANE COMPOSITION

In 1934, after a five-year period of study by means of microscopy, X-ray diffraction, and chemical analyses, the universal presence in cell membranes from all parts of the plant kingdom of a uniform-sized cellulose crystallite was established[3]. This paved the way for a clearer understanding of the variable reactions which had been observed in cell walls. These crystallites are remarkably stable physically, and although diminutive in size ($1{\cdot}5\mu \times 1{\cdot}1\mu$), lend themselves to separation from the other membrane constituents and to both optical and microchemical analyses. They are

definitely doubly refractive in polarized light ; the refractive indexes of dry particles from the cytoplasm of a living cotton fibre are 1·565 lengthwise and 1·530 crosswise ; they react in a manner characteristic of cellulose in the presence of sulphuric acid and iodine ; and their elementary analysis is :

	Theoretical value	Found
Carbon, per cent	44·4	44·34 ; 44·30
Hydrogen, per cent	6·17	6·31 ; 6·29 (no ash)

Their X-ray diffraction pattern is that of native cellulose, and when treated with 18 per cent sodium hydroxide they give the pattern of mercerized cellulose. In other words, these ellipsoidal particles show the characteristic properties of cellulose and were designated by us 'cellulose particles'.



(*A*) (*B*)

(*A*) STARCH GRAINS IN THE PROCESS OF FORMATION IN A PLASTID FROM THE LIVING PROTOPLASM OF A COTTON LEAF CELL. (× 2500).

(*B*) CELLULOSE PARTICLES IN THE PROCESS OF FORMATION IN A PLASTID FROM THE LIVING PROTOPLASM OF A COTTON FIBRE. IN THE GROWING PLASTID RINGS OF EQUAL THICKNESS AND VARYING DIAMETER ARE FORMED SUCCESSIVELY AT THE INTERFACE OF THE PLASTID PLASMA AND THE PLASTID MEMBRANE. THESE RINGS FRAGMENT DIRECTLY TO FORM THE UNIFORM-SIZED CELLULOSE PARTICLES SHOWN IN THE INTERIOR OF THE PLASTID. (× 1500).

During the period of wall formation, the cellulose particles appear in the outer regions of the cytoplasm arranged end-to-end in orderly single rows. The fibrils thus formed can be removed from the living cells for more careful study. It then becomes clear that each particle in the fibril is coated with a viscous substance which functions as a cementing material, holding the particles together to form the fibril, and the fibrils, layer upon layer, to form the membrane lamellæ. The heterogeneous composition of the membrane is therefore clearly visible in the form of a system having a continuous colloidal phase and a discontinuous crystalline phase. The crystalline phase is made up of the cellulose particles in various forms of orientation in the different types of membranes. The colloidal phase is chemically complex in any membrane and varies widely in chemical make-up as well as relative proportion to the crystalline phase in different types of membranes.

Membranes of moist cotton fibres from the unopened boll can be disintegrated into fibrils and particles by mechanical treatment alone. The membranes of mature, dried fibres require controlled treatment with chemical reagents to bring about a similar degree of membrane disintegration[4]. As the reaction proceeds, the material surrounding the particles is observed microscopically to swell and, in so doing, to push the particles farther apart. Long-continued treatment brings about the removal of the cementing material. The significant fact is that complete membrane disintegration is thus brought about without indication of change in the physical state of the cellulose particle. The characteristics of the colloidal substances which are removed in the process of this disintegration are, in general, those described by botanists of the last century as pectic substances. It is not implied that all of these constituents of the membrane will meet the requirements of the modern chemical concept of pectic material. In our own laboratories, in addition to pectic acid[5] we have two separable constituents of the inter-particle phase not yet fully identified. There are probably more fractions than these, even in a cementing substance so comparatively simple as that of the cotton fibre. In lignified and suberized membranes many new constituents in this phase of the membrane make the problem increasingly complex.

Microscopic analyses show that the cellulose particles in the membrane of the cotton fibre are not completely freed from all traces of the cementing material until after complete fibre and fibril disintegration has taken place. These observations indicate the possibility that an intimate physical, rather than a chemical, union between the diminutive crystallites and the thin surface coating of colloidal material may more nearly explain the observed properties of the membrane. In the final analysis both types of bondage may be found to be in operation. In any event, a satisfactory interpretation of the behaviour of the cotton fibre must take into consideration all the components which go to make up its intricate fibrillar and lamellate structure. Standard purification treatments frequently show little measurable effect upon the more general physical properties of the fibre.

Techniques are not yet available that will indicate finally which, if any, of the fractions of the cementing material can be removed without producing complete disintegration of the membrane.

The heterogeneous chemical nature of these plant cell membranes is not clearly in evidence in many of the experimental procedures now in common laboratory usage. Under the specific conditions employed, the conception of chemical homogeneity is frequently adequate for the final interpretation of data. The discovery of the cellulose particle, the observation of its intimate association with the cementing material, and the reactions of this two-phase system in different types of reagents do not conflict with the results obtained by other workers who have studied the reactions of plant cell membranes, assuming them to be pure cellulose[6]. Rather they represent a more detailed consideration of many of the experimental techniques now commonly used. The uniform shape and diminutive size of the cellulose particles, along with their even distribution in the colloidal material, tend to produce those reactions of the membrane long observed by workers who considered it a single-phase rather than the two-phase system which we have found it to be.

In the course of these first observations of the formation and structure of plant cell membranes, by cellulose particles and cementing material elaborated in the protoplasm of living plant cells, no clue was obtained as to the mechanism of formation of the cellulose particles themselves. During the past few months living cells of tropical marine algæ have proved to be excellent material for the solution of this problem. As the plastid enlarges, upon the inner surface of the chloroplast membrane are formed successively rings of varying diameter but equal thickness. These rings fragment directly to produce the uniform-sized cellulose particles.

In the cotton fibre and many other types of higher plant cells, colourless plastids produce cellulose particles by essentially the same mechanism. In chlorophyll-containing cells of the higher plants, the sugar and starch are manufactured in the chloroplasts and the cellulose in separate colourless plastids within the same cell. Starch formation in plastids of living cells was described before 1850. Cellulose formation has been more elusive and the mechanism which we now find in operation in many types of cells has been hitherto undescribed.

[1] Payen, A., "Mémoire sur les développements des végétaux". (Paris 1842.)
[2] Mangin, L., "Étude Historique et Critique sur la Présence des Composés Pectiques dans les Tissues des Végétaux", *J. Bot.*, **5**, 400, 440 (1891); **6**, 13 (1892).
[3] Farr, Wanda K., and Eckerson, Sophia H., "Formation of Cellulose Membranes by Microscopic Particles of Uniform Size in Linear Arrangement," *Contrib. Boyce Thompson Inst.*, **6**, 189–203 (1934).
[4] Farr, Wanda K., "Certain Colloidal Reactions of Cellulose Membranes", *J. Phys. Chem.*, **41**, 987–995 (1937).
[5] Harris, Stanton A., and Thompson, H. Jeanne, "Pectic Acid from the Cotton Fiber", *Contrib. Boyce Thompson Inst.*, **9**, 1–5 (1937).
[6] Farr, Wanda K., "The Microscopic Structure of Plant Cell Membranes in Relation to the Micellar Hypothesis", *J. Phys. Chem.*, **42**, 1113–1146 (1938).

COLOUR VISION AND CHROMATICITY SCALES

By Dr. W. D. Wright,
Imperial College of Science and Technology, London

Colour Vision

IT is no easy matter to assess the value of recent additions to our knowledge about colour and colour vision. So much fundamental information had been recorded twenty-five or fifty years ago by König, Abney, Helmholtz, v. Kries, Hering and other pioneers, that modern work appears at first sight to consist largely of filling in gaps here and there, and of improving the accuracy of the data by taking advantage of improved apparatus and photometric technique. This is especially true in regard to colour mixture and colour discrimination data, while on such questions as colour contrast, after-images, colour fatigue and the like, an enormous amount of quantitative work still remains to be done.

One most important feature of modern research, however, is that there exists a marked disinclination to make extensive theoretical deductions that have no adequate experimental backing. Earlier, highly ingenious and involved theories of colour vision were developed on the flimsiest of foundations, and burning controversies would be waged as to their relative merits; all this, in spite of the fact that very little was known about even the first reaction that takes place when light enters the cones, the colour perception mechanism in the retina. Perhaps only subconsciously, but none the less definitely, it has at last become recognized that the assault on the mysteries of the retina and brain is not going to be carried by a *Blitzkrieg*, either theoretical or experimental; there can be no short-circuiting of an immense amount of patient and laborious investigation.

Nevertheless, there has been progress. On the purely physiological side, a great deal of very valuable information has been accumulated about visual purple and its derivatives. This is, in a sense, only a preliminary to an examination of the colour perception mechanism, since visual purple is essentially associated with the rods, and the marked difference between rod vision and cone vision suggests that any photochemical substance occurring in the cones is likely to be very different from that in the rods. Further, with the aid of modern amplifier equipment, physiologists can now record the electrical impulses sent out along a nerve fibre from a single receptor in the retina of an excised eye, following stimulation by light. Investigations have already been started to measure the variation in the response with wave-length, and in the near future we may hope to learn whether or no three types of receptor sensitive to different parts of the spectrum do exist. This may perhaps be the most important single step forward since visual purple was isolated.

Subjective investigations have also, during the past few years, broken fresh ground. The data about the different types of colour-defective observer are now very much more complete, especially as regards luminosity, colour mixture and colour discrimination. Again, very remarkable effects have been observed by varying the angle of incidence at which a narrow pencil of light strikes the retina, and they have led to suggestive ideas regarding the operation of the light-sensitive layer in the retina. A third type of investigation is that in which adaptation changes have been recorded quantitatively by a method of binocular matching, in which one eye is kept in a constant state of adaptation and used as a reference against which changes induced in the other eye can be recorded. By this means, photochemical and electrical reactions that would be most difficult to record by any direct physiological method can be followed with comparative ease.

In spite of this steadily increasing volume of information, it is doubtful whether workers on colour vision would be prepared at the moment to say more than that there is a photochemical reaction in the cone, and that at some stage, almost certainly in the retina, the response divides into three components. How this division occurs, how the three types of response that we may for convenience label red, green and blue, are transmitted separately to the brain, and how they are identified when they arrive, are questions that cannot yet be answered.

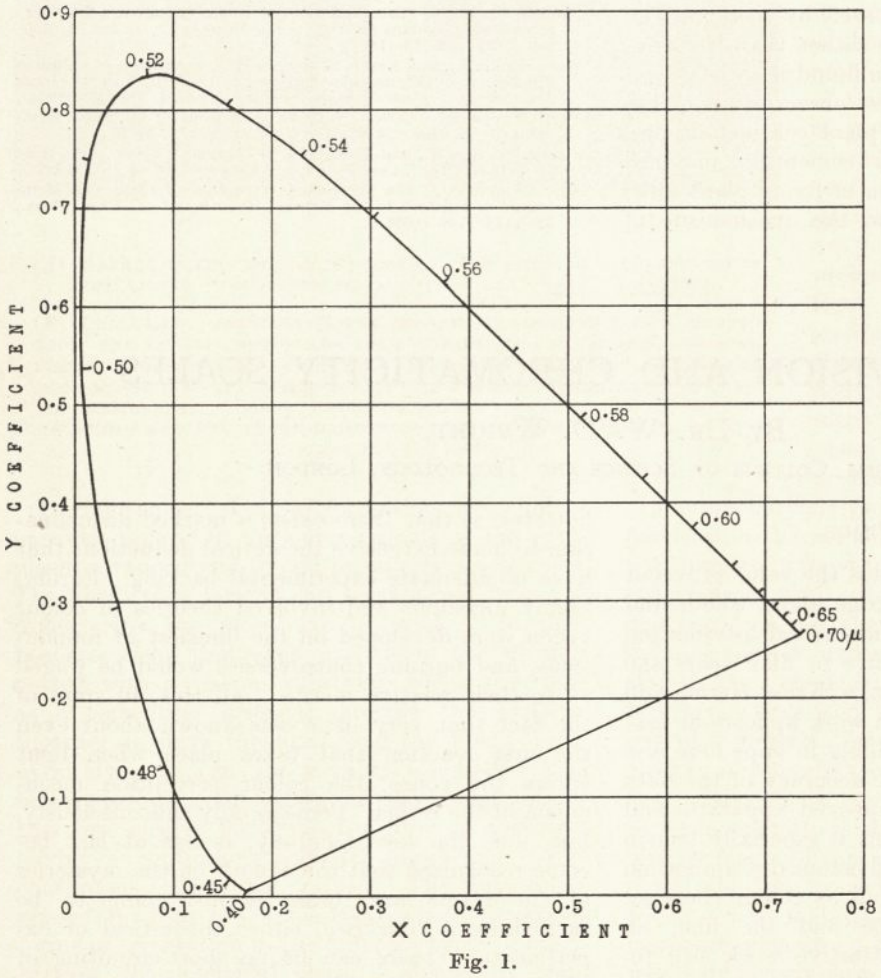


Fig. 1.

THE C.I.E. COLOUR CHART PLOTTED WITH RECTANGULAR CO-ORDINATES, SHOWING THE LOCUS OF THE COLOURS IN THE SPECTRUM.

COLOUR MEASUREMENT

Because colours can be matched by an additive mixture of three radiations (generally, but not necessarily, a red, green and blue are chosen), it is possible to specify a colour in terms of the amounts of the three radiations required to match it. For measurements to have a recognized meaning, a number of factors have to be

Recent books from METHUEN

Physico-Chemical Methods

By JOSEPH REILLY
Professor of Chemistry, University College, Cork,
and
WILLIAM NORMAN RAE
Professor of Chemistry, Royal College of Surgeons in Ireland

Third edition, enlarged and divided into two parts: Vol. 1, *Measurement and Manipulation*; Vol. 2, *Practical Measurements*.
In 2 volumes, 1,236 pages, 846 diagrams, £4 4s. net the set.

Electrocapillarity

The Chemistry and Physics of Electrodes and other Charged Surfaces

By J. A. V. BUTLER
Lecturer in Chemistry in the University of Edinburgh.
Demy 8vo. 12s. 6d. net.

Theoretical Physics

Volume III
Relativity and Quantum Dynamics; Einstein—Planck

By W. WILSON, F.R.S.
Hildred Carlile Professor of Physics in the University of London, Bedford College.
Demy 8vo. 21s. net.

Adaptive Coloration in Animals

By H. B. COTT
Lecturer in Zoology and Strickland Curator in the University of Cambridge.

"Perhaps the most satisfactory book yet written on adaptation. . . . In many respects the last word on the subject."—From Dr. Julian Huxley's *Preface*.
Wide royal 8vo, with 124 illustrations, £2 net.

Outlines of Structural Geology

By E. SHERBON HILLS
Lecturer in Geology in the University of Melbourne.

An outline of those sections of structural geology most likely to find practical application in the field of the laboratory. Many references and illustrations are given.
Crown 8vo, with over 100 diagrams, 6s. 6d.

Advanced Calculus

By C. A. STEWART
Lecturer in Mathematics in the University of Sheffield.

The complete subject-matter of a first honours course in calculus is given, including chapters on Partial Differentiation, Multiple Integrals, Functions of a Complex Variable, Convergency, Bernoulli and Gamma Functions, Vectors and Tensors.
Demy 8vo, with 153 diagrams, 25s. net.

Methuen & Co. Ltd., 36 Essex St., W.C.2

Fundamentals of

BIOLOGY

By ARTHUR W. HAUPT
Associate Professor of Botany
University of California at Los Angeles

443 pages, 9 × 6, 288 illustrations, 20/- net, Third Edition

(McGraw-Hill Publications in the Zoological Sciences)

LIKE previous editions of this standard text, the present revision deals with the basic principles common to all living things, with emphasis on those aspects of biology which seem to be of greatest value in contributing to a liberal education. Thus the text is intended to serve as the basis for an orientation course and to give, from a cultural rather than a technical viewpoint, a broad perspective to the vast field of modern biology.

In the new third edition the general plan of the book—its method of approach, objectives, and organization of material—has been retained. The principal change involves a shift of emphasis towards the animal side of biology, but without affecting the well-balanced treatment that characterized earlier editions.

New material has been added to many chapters, especially those dealing with protoplasm and the cell, unicellular organisms, lower animal groups, and the vertebrates.

The topics of chief animal tissues, metabolism in animals, and co-ordination in animals have been so greatly expanded that each now forms a separate chapter. Also, additions have been made to the sections dealing with dietary requirements, digestion, absorption, respiration, circulation, excretion, nerve control, reflex action, and chemical co-ordination. The discussions of vitamins, hormones, immunity to disease, and organs of special sense have been considerably enlarged. In connexion with the physiological processes of animals, which are now discussed chiefly as they occur in man, there is a more extended description of the human digestive, respiratory, excretory, and nervous systems.

Many changes have been made in the illustrations, and eighty new figures have been prepared for this edition. Two-thirds of all the illustrations in the book are original.

Contents

Preface
Introduction
Protoplasm and the Cell
Unicellular Organisms
The Lower Plant Groups
Vegetative Organs of Seed Plants
Reproduction in Seed Plants
Metabolism and Imitability in Plants
The Lower Animal Groups
The Higher Invertebrates
The Vertebrates
Chief Animal Tissues
Metabolism in Animals
Co-ordination in Animals
Reproduction and Development in Animals
Physical Basis of Heredity
Mendelian Laws of Heredity
Application of Hereditary Principles
Adaptation
Saprophytism, Parasitism and Symbiosis
The Facts of Evolution
The Life of the Past
The Causes of Evolution
The Evolution of Man
Appendix
Index.

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

MACMILLAN'S NEW BOOKS

The Neuroses in War

By Several Authors under the Editorship of EMANUEL MILLER, M.A.(Cantab.), M.R.C.P., D.P.M.(Cambs.)

With a concluding chapter by H. CRICHTON-MILLER, M.D., F.R.C.P.

Dr. Emanuel Miller, the Editor of this volume, is an authority on neurosis. Other contributors are also known for their authority on the special angle of the subject on which they write. Neurosis is reviewed from every point of view and the result is a book which will be invaluable at the present time. 10*s.* 6*d. net.*

Berkeley Moynihan: Surgeon

DONALD BATEMAN
With a Preface by LORD MOYNIHAN

Berkeley Moynihan: *Surgeon* is an account of the life of the first Baron Moynihan of Leeds, the most famous English surgeon of his day.

The book does not purpose to recount the surgical work of Lord Moynihan in any detailed manner. Nor does it attempt biographical comprehensiveness. It is an effort to evoke, within the pages of a small volume, a picture of Berkeley Moynihan the man, of the tasks he undertook, and of the heights to which, from modest origins, he climbed.

8 *page plates.* 12*s.* 6*d. net.*

Religion in Science and Civilization

SIR RICHARD GREGORY, Bart., F.R.S.
formerly Editor of Nature

A Study of the interwoven threads of Religion and Science in the History of Human Civilization

Among the subjects of the twenty-eight chapters of this book are the civilization of Babylonia and Assyria, sacred books and doctrines, religion as a social force, influence of primitive faiths, monotheism and the doctrine of the 'fall' of man, the Eastern world and the Christian era, epochs of European civilization, biological and cultural aspects of the war, evolution of ideas of God, liberation of life and thought, and science and social ethics. 380 *pages. With* 16 *pages of illustrations.* 12*s.* 6*d. net.*

Animal Behaviour: Impulse, Intelligence, Instinct

DR. JOHANN A. LOESER
With a Foreword by L. J. F. BRIMBLE, B.Sc., F.L.S.
and Illustrations by ERNA PINNER

Dr. J. A. Loeser, formerly of the University of Berlin, made a long series of observations on animal behaviour, and from these, together with the observations of other students of animal behaviour, developed certain concepts, most of which proved revolutionary. In October, 1938, he came to Great Britain as a political refugee, and since his views were little known in this country, he was persuaded to publish them in English. This book is the result of his work, and is partly a translation of the original German work, but modified in places in view of more recently acquired knowledge. 10*s.* 6*d. net.*

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

EARLY PUBLICATIONS

of the

Carnegie Institution of Washington

A Few Copies Now Available at Reduced Prices

Pub. No.

5 BURNHAM, S. W. **General Catalogue of Double Stars within 121° of the North Pole.** 2 volumes. $5.00 set, paper; $6.00 set, cloth.

32 DEAN, BASHFORD. **Chimaeroid Fishes and Their Development.** $2.00 paper; $2.50 cloth.

46 ADAMS, F. D., and E. G. COKER. **An Investigation into the Elastic Constants of Rocks, more especially with reference to Cubic Compressibility.** $1.00 paper; $1.50 cloth.

59 DORSEY, G. A. **The Pawnee: Mythology.** $1.00 paper; $1.50 cloth.

79 DURAND, W. F. **Researches on the Performance of the Screw Propeller.** $0.25 paper; $0.50 cloth.

110 JONES, HARRY C., and J. A. ANDERSON. **Absorption Spectra of Solutions.** $1.50, cloth only.

The Carnegie Institution of Washington, Washington, D.C., has published some 750 volumes covering the wide range of its researches. Orders may be placed direct or through regular dealers. Advise subjects in which you are interested, and catalogue will be sent upon request.

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

HEFFER 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.

The Faraday Society

CONTENTS

JULY, 1940

The Electrical Double Layer—
General Discussion on papers published in the January 1940 issue.—Dr. M. H. Gorin, Prof. G. S. Adair, Prof. H. A. Abramson, Dr. J. J. Bikerman, Prof. A. Frumkin, Dr. J. Powney and Dr. L. J. Wood, Dr. S. R. Craxford, Dr. A. J. Ham, Prof. R. A. Gortner, Prof. A. J. Rutgers, Prof. R. Audubert, Prof. L. S. Moyer, Dr. E. A. Guggenheim, Dr. J. W. Wrzeszinski, Dr. E. J. W. Verwey, Dr. A. S. McFarlane, Dr. S. Levine, Prof. B. Derjaguin.

A Thermodynamic Study of Bivalent Metal Halides in Aqueous Solution—
Part I. The Activity Coefficients of Magnesium Halides at 25°. By R. A. Robinson and R. H. Stokes.
Part II. The Activity Coefficients of Calcium, Strontium and Barium Chloride at 25°. By R. A. Robinson.
Part III. The Activity Coefficients of Potassium and Cadmium Iodide at 25°. By R. A. Robinson and (Miss) Jean M. Wilson.
Part IV. The Thermodynamics of Zinc Chloride Solutions. By R. A. Robinson and R. H. Stokes.

The Crystal Structure of Conjugated Hydrocarbons at Low Temperatures: (1) Butadiene. By C. J. Birkett Clews.

Kinetics of the Reaction of Iodine with Hypophosphorous Acid and with Hypophosphites. By R. O. Griffith, A. McKeown, and R. P. Taylor.

Kinetics of the Reaction of Iodine with Phosphorous Acid and with Phosphites. By R. O. Griffith and A. McKeown.

The Interaction between Nitrogen Molecules. By J. Corner.

The Explanation of a Rule for Critical Temperatures. By J. Corner.

Measurements of the Pressures due to Monolayers at Oil-Water Interfaces. By Frederick Anderton Askew and James Frederick Danielli.

AUGUST, 1940

The Duhem-Margules Equation and Raoult's Law. By C. R. Bury.

The Infra-Red Spectrum of Dimethyl Zinc. By H. W. Thompson, J. W. Linnett and F. J. Wagstaffe.

The Infra-Red and Raman Spectra of Ethylene Sulphide. By H. W. Thompson and D. J. Dupré.

The Infra-Red Spectrum of Methyl Mercaptan. By H. W. Thompson and N. P. Skerrett.

A Relation between the Activation Energies of Reactions in Solution and the Dielectric Constants of the Media. The Measurement of Activation Energies in Solution. By D. P. Evans and H. O. Jenkins.

Wood-Water Relationships. V. The Hydrostatic Compressibility of the Wood-Water Aggregate. By W. W. Barkas.

The Iso-Electric Point of Gelatine. By E. C. E. Hunter and A. J. Turner.

The Effect of Certain Potassium Salts on the Electrophoretic Mobility of Cetyl Acetate Emulsions, and on the Interfacial Tension between Cetyl Acetate and Water. By W. Dickinson.

A Surface Interaction between Ferric and Manganese Oxide. By H. R. Thirsk and E. J. Whitmore.

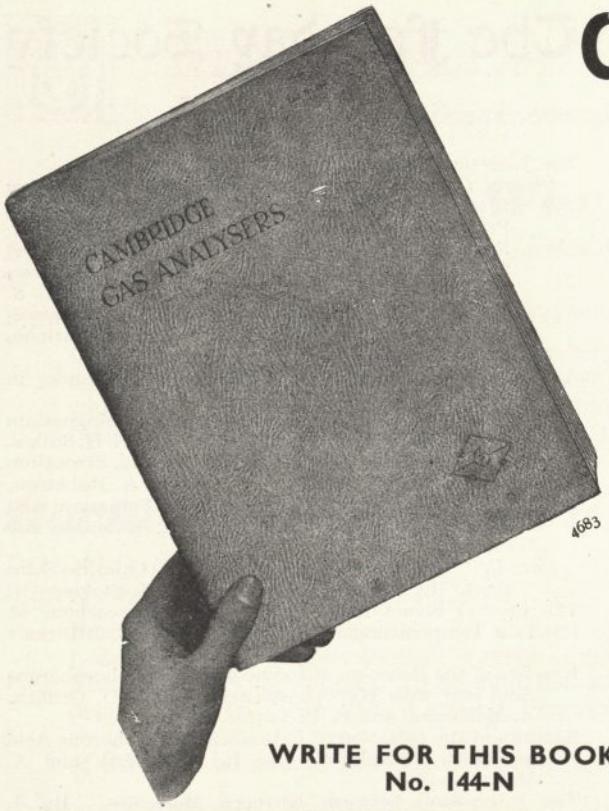
Magnetism and Valency; Manganese Compounds. By N. Goldenberg.

On the Energy and Entropy of Liquid Surfaces. By H. Campbell and D. D. Eley.

The Electrolytic Growth of Ionic Crystals. By A. R. Ubbelohde.

The Interaction of OH Radicals and of Similar Free Radicals. By J. Weiss.

Copies of these issues of the Transactions may be obtained from the Society's publishers: Messrs. Gurney & Jackson, 98 Great Russell Street, London, W.C.1.



CAMBRIDGE GAS ANALYSERS

This book contains a technical treatise on the thermal-conductivity method of gas analysis, and deals with

Fixation of Atmospheric Nitrogen.
Liquid Air Industry.
Measurement of Sulphur Dioxide.
Measurement of Organic Vapours.
Measurement of O_2 in Feed Water.
The Cement Industry. Aeronautics.
The Rubber Industry.
Measurement of CO_2 in Fruit Stores.
Physiological Applications.
Measurement of H_2 in Submarines.
Measurement of Humidity.
Other Applications.

If you have any problem of a similar nature, we should be pleased to assist you.

WRITE FOR THIS BOOK
No. 144-N

CAMBRIDGE
INSTRUMENT CO LTD
LONDON & CAMBRIDGE *Head Office & Showrooms* :— 13 GROSVENOR PLACE LONDON. S.W. 1

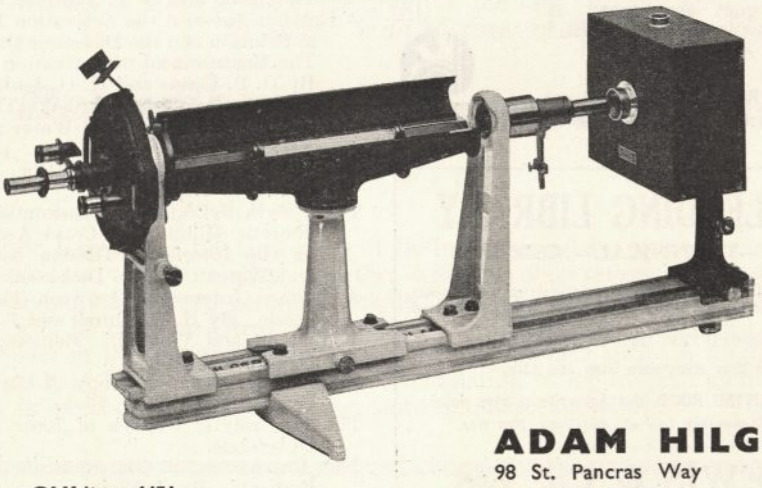
93

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

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

standardized. Modern colorimetry dates from 1931, when the Commission Internationale de l'Éclairage (C.I.E.) standardized the colour mixture data of a 'normal' eye and introduced a standard framework in which any colour could be specified.

In the C.I.E. system a colour is expressed in terms of the three co-ordinates X, Y and Z by an equation of the type

$$C = x.X + y.Y + z.Z.$$

X may here be regarded as the red co-ordinate, Y as the green and Z as the blue. Since the colour is governed only by the relative proportions of the three components, no loss of generality in the colour specification is introduced if the coefficients

$$x + y + z = 1.$$

In this case the amount of colour represented by such a unit equation is known as '1 trichromatic unit' and since, with this restriction, there are now only two independent variables, any colour can be represented by its position on a two dimensional diagram. Thus the locus of the spectrum colours in terms of the C.I.E. co-ordinates is given by the curve in Fig. 1, and this diagram may be regarded as the C.I.E. colour chart, the distribution of colours in the chart being governed by the particular choice of the reference colours X, Y and Z and their units.

The stage was thus set for the development of a practical system of colorimetry, but although this standardization was a necessary preliminary to the actual business of making standard colour measurements, much remained to be done.

The measurements can be made either visually or by means of a photo-electric device. In either case the accuracy of the measurement may have to be very high, because when two samples of considerable area are compared side by side the eye is extremely sensitive to quite small colour differences. In a visual colorimeter, the matching field has to be small owing to the structure of the eye, so that matches may not be possible to the accuracy demanded by the customer. Again, unless the matches are recorded by an eye that has the same characteristics as the standard eye, there will in general be a residual error from this cause. Difficulties of this kind can to a considerable extent be overcome by the extensive adoption of substitution methods. There is nothing illegitimate in doing this—substitution methods are continually in use in photometry—but it undoubtedly adds to the complexities of colorimetry.

It is not difficult to design a photo-electric colorimeter that has, in most cases, sufficient sensitivity, but it is very difficult indeed to produce an instrument that will give the right answer. For this purpose, three photo-cells are required that have spectral sensitivities corresponding to the X, Y, Z distribution curves through the spectrum, or linear transformations of these curves. This result might be obtained by one cell and three colour filters, or three cells and three filters, the filters being either normal gelatine or glass filters, or more probably spectrometer systems with a suitable template in the plane of the spectrum. A very considerable amount of development work still remains to be done before a satisfactory instrument on these lines is available for industrial purposes.

A more indirect approach is to measure the energy distribution through the spectrum of the light from the sample. When this is known, the calculation of the colour co-ordinates from the standard C.I.E. data is perfectly straightforward. This method, which only involves matches between two halves of a field of identical physical composition, has the outstanding merit that the spectral sensitivity of the eye or cell that is used has no effect on the result. It is, however, either very

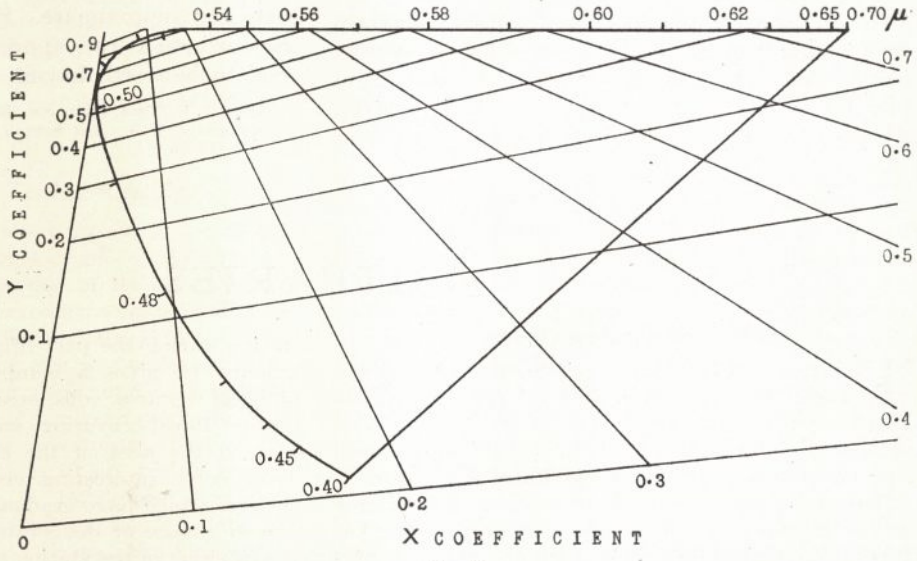


Fig. 2.

THE SPECTRUM LOCUS PLOTTED ON AN OBLIQUE PROJECTION OF THE C.I.E. COLOUR CHART TO GIVE A MORE UNIFORM COLOUR DISTRIBUTION.

laborious or, if a recording spectro-photometer is used, very costly in equipment and operating personnel. It is a question for the industrialist to decide whether the cost is justified. The decision should, however, be made in the light of the fact that the spectrophotometric curve has other uses than just the calculation of the colour co-ordinates of any particular sample ; in the case of dyes, for example, it provides the essential data from which the colour of a mixture of dyes can be derived, and thus enters into the very heart of the dyeing industry. It is not to be expected that an elaborate device such as the photo-electric spectrophotometer will at first be able to compete economically with the experience of the craftsman acquired through many decades in industry, but there is no doubt whatever that here is a tool which should in time prove to be of the greatest possible value.

CHROMATICITY SCALES

It is of interest to consider whether, after a testing period of nine years, the system of colorimetry recommended in 1931 is free from criticism. Inevitably a few minor points have arisen that have called for further discussion, but it may be said that as a means of colour specification the system has proved entirely satisfactory and is being very widely adopted. It is from a somewhat different point of view that the system has proved less satisfactory. It has already been suggested that the diagram in Fig. 1 is not only a graphical means of expressing a numerical result, but also has to perform the additional functions of a colour chart. A good colour chart is characterized by a uniform grading of colours from one part of the chart to another, but in this the C.I.E. diagram fails, and fails in no small degree. What is required is a 'uniform chromaticity diagram', to use a term popular in the United States, in which a given distance always corresponds to an equivalent colour difference, in whatever part of the diagram and in whatever direction the distance is measured.

A uniform distribution of colours is not desirable for any pictorial virtues that it might possess, but for very material considerations of convenience when expressing colour tolerances and when estimating the importance of errors in matching, say, a number of dyed samples. An arbitrary re-distribution of the colours in the C.I.E. diagram is not possible because, on the trichromatic system, there is a definite algebraic relation between different points in the colour field. By certain linear transformations a new oblique projection of the present diagram could be used, and by this means a closer approximation to a uniform distribution can be obtained. At the moment further experimental data on colour discrimination are required before a final decision can be reached as to the projection that will give the most uniform distribution.

The disadvantages of using a fresh diagram are that either a new system of co-ordinates must be adopted, or else a specially prepared colour diagram must be used in which the X, Y and Z co-ordinates are no longer rectangular. Fig. 2 shows a diagram of this type due to Holmes[1], in which the colour field has been distorted to the shape required to give the uniform chromaticity scale proposed by Breckenridge and Schaub[2]. A change in the co-ordinate system itself is certainly to be deplored unless unavoidable ; not only would it cause a great deal of inconvenience, but also it would tend to discredit colorimetry in the eyes of the industrialist. If a diagram such as Fig. 2 is ultimately adopted, it will always have to be borne in mind that the uniformity of colour distribution is at best only approximate. Further observations will show whether the approximation is sufficiently good to be worth having.

[1] Holmes, J. G., *Proc. Phys. Soc.*, **52**, 359 (1940).
[2] Breckenridge, F. C., and Schaub, W. R., *J. Opt. Soc. Amer.*, **29**, 370 (1939).

OBITUARIES

Mr. H. Guthrie-Smith

THE death of Mr. H. Guthrie-Smith, fellow of the Royal Society of New Zealand, recorded in *The Times* on July 8, is a very sad loss. Not only was he one of the most observant and learned of Dominion naturalists, but also a man of great kindness and charm.

Tutira, his homestead, between Napier and Wairoa in the Hawke's Bay Province of New Zealand, has become a classic from his fascinating book, "Tutira—The Story of a New Zealand Sheep Station" (1920 ; second edition, 1926), which gives a full history of all the changes that have taken place day by day on the station during the past fifty or more years. In this account he gives a comprehensive picture of the physical features, soils, erosion and surface slips, the former forest covering and the vegetation which covered the area of the station before settlement. Then come interesting chapters dealing with the changes which have gradually or rapidly taken place due to chance or deliberate plant introductions and the stocking of the station with sheep, and later with cattle and goats, in order to check the insidious blackberry, which has brought such havoc on Tutira ; getting a hold during the War of 1914–18 when labour

was scarce, it has spread like a devouring plague. In a letter to me a few years ago, after referring to the devastation of the rare native vegetation of the Kermadec Islands by goats which had recently been liberated there, he wrote :

"Reverting to goats where the blackberry is worst the cocksfoot grass holds best, its crown just sufficiently protected from the nibbling sheep—we have therefore the curious paradox of the more blackberry the better sward !"

Guthrie-Smith refers to the great increase of sparrows, starlings, blackbirds and thrushes, which all help to spread the blackberry, but points out that the goat, which certainly helps to keep it down, unfortunately eats everything else that comes in its way.

Guthrie-Smith had an intimate knowledge of the native New Zealand flora and of the introduced and naturalized plants, and his knowledge of the fauna was equally extensive, as readers of "Tutira" will well remember. His last book, "Sorrows and Joys of a New Zealand Naturalist" (937), records his wanderings over many parts of the mainland and to the uninhabited islands, both to the north and south, to watch and study the birds. This, like "Tutira", is written in a very pleasant literary style, illuminated by the humour and imagination which made him so delightful a companion.

His earlier book on New Zealand birds, "Bird Life on Island and Shore" (1926), equally pleasantly written, contains vivid descriptions of species new to European readers. Other books were "Crispus a Drama" and "Mutton Birds and Other Birds".

Guthrie-Smith was born at Helensburgh in 1861, and was the son of Mr. John Guthrie-Smith of Mugdock Castle, Stirlingshire. Very soon after he left Rugby School, he went to New Zealand, where he acquired Tutira, some 20,000 acres, and made it his home. His carefully recorded observations of the changes which have taken place due to human interference, are of the greatest value, and he will be remembered with gratitude by scientific workers and naturalists both now and in years to come.

ARTHUR W. HILL.

Dr. Phyllis M. Tookey Kerridge

BY the death, after a short illness, of Dr. Phyllis Margaret Tookey Kerridge, on June 22, the subject of physiology loses one of its ablest women workers, and several circles mourn a valued friend and colleague. The only daughter of Mr. William Alfred Tookey, of Bromley, Kent, she was educated at the City of London School for Girls, and at University College, London. Most of her post-graduate years were spent at the latter institution, first in the Department of Chemistry, in which subject she had taken an honours degree in 1922, and afterwards in the Department of Physiology, in which she was a lecturer at the time of her death. She also worked for various periods of time at the London School of Hygiene and Tropical Medicine, the Marine Biological Association Laboratory at Plymouth, the Carlsberg Laboratories at Copenhagen, and the Medical Unit of the London Hospital. While acting as a lecturer in the Department of Physiology at University College she studied medicine at University College Hospital, qualifying in 1933, and obtained the M.R.C.P. in 1937.

Dr. Kerridge contributed to the advance of science in several directions, covering a wide field. Her earliest work was in physical chemistry, from which she passed to the applications of that subject to problems of biology, her most distinguished work in that direction being the introduction and perfection of the glass electrode for the measurement of hydrogen ion concentrations of body fluids and tissues. This work won her an international reputation. After qualification in medicine she turned to the applications of physics, chemistry and physiology to practical requirements of medicine, and here again she distinguished herself, first in connexion with the perfection and investigation of the mode of action of the Bragg-Paul pulsator for the performance of artificial respiration, and secondly, in the many problems connected with the use of hearing aids for the deaf, and the study of the incidence of deafness in children. In this work her human sympathies found expression and her love of music gave it interest and value. For none of this clinical work, so greatly appreciated by the large number of deaf people whom she served so gladly, would she ever take a fee of any kind. The work was afterwards extended to embrace the study of speech in deaf-mutes, and had already achieved notable results. She also carried out, in collaboration with various colleagues, a number of researches of more academic interest—on buffering in tissues, on the conditions for albuminuria, and in several other directions.

All her investigations illustrated her wide acquaintance with methods, and a sure grasp of the experimental approach to a problem. As a teacher also, Dr. Kerridge will long be remembered by the many students who profited by contact with her fine and stimulating personality. Often she would encourage them to participate in her investigations, and to go round with her during their vacations on visits to Special Areas and slums in search for factors in the etiology of deafness in school-children.

Immediately on the outbreak of war, Dr. Kerridge joined the staff of an Emergency Service Hospital, where she and her colleagues fitted up an improvised laboratory for use in pathological and blood transfusion work. While this was in progress, and in the subsequent weeks and months, her cheerful personality and zeal did much to encourage all with whom she came into contact.

Dr. Kerridge was a keen musician, and a lover of the country and all that it brings to make life worthwhile, a capable botanist and ornithologist, and always a most cheerful, loyal and helpful colleague. The passing of so gallant a spirit will leave a gap in many places, and if the world of science is the poorer for her loss, it is the richer for the achievements she leaves behind after a relatively short, but very full, life. She was thirty-eight years of age.

C. LOVATT EVANS.

NEWS AND VIEWS

War Seventy Years Ago

JUST seventy years ago the Franco-German War broke out. It is interesting in this connexion to quote extracts from a leading article entitled "War" published in NATURE at the time:

"The dogs of war are again let loose, and in the two most highly civilised countries of Europe, where, a week ago, science, education, and commerce were in full sway, all the arts of peace are already neglected, and in prospect have gone back a quarter of a century. This journal, of course, has nothing to do with Politics: the function of Science is to unite the whole human family, whereas the function of Politics seems to be, both in the case of the human family and of each nation, to create parties and to emphasise them as much as possible, the object in each case being place for the partisans—whether that place be an income of a few thousands a year in one case or increased territory in the other. But although we cannot discuss politics, we may point out that as Science advances such policies will be overridden—that when Science and Education have taken their proper position—when the sword has given place to brain—when more of the best men of each nation take part in each nation's counsels, the dreadful thirst after blood will give way to something better; monarchs will see the folly of being surrounded merely with empty helmets and uniforms, or at all events if they do not, others will; and much will have been done when the pampering of armed men shall cease."

"If England is to prepare for war, the abnormal condition, so let it be; but surely, *a fortiori* she should *prepare for peace*, the normal one, as well. This has never struck her ministers, and the reason is not far to seek. But this is not all; the same disregard for science, arising from the ignorance of science among our rulers, has probably placed us in another position of disadvantage. While France and Prussia have been organising elaborate systems of scientific training for their armies, a recent Commission has destroyed what little chance there was of our officers being scientifically educated at all. As there is little doubt that a scientific training for the young officer means large capabilities for combination and administration when that officer comes to command, we must not be surprised if the organisation of our army, if it is to do its work with the minimum of science, will, at some future time, again break down as effectually as it did in the Crimea, or that our troops will find themselves over-matched should the time ever come when they will be matched with a foe who knows how to profit to the utmost from scientific aids."

"While, therefore, the Continent is being deluged with blood, let us *prepare for peace* as well as for war; let us prepare ourselves for victories in the arts, conquests over nature; let us, by means of a greater educational effort, more Science Schools, a truer idea of the mode in which a nation can really progress, fit ourselves to take our place among the nations when peace returns."

A Tax on Learning

WHILE speaking in the debate on July 24 in the House of Commons on the Budget resolutions, Mr. A. P. Herbert took up the question of the proposed sales tax in its application to books, which have been placed in the category subject to 12½ per cent tax. It will be remembered that the subject was discussed at length in NATURE of May 11, p. 719. As one of the representatives of the University of Oxford, and himself an author of distinction, it was wholly appropriate that Mr. Herbert should identify himself with the movement for treating books as a commodity apart and entitled to special consideration. As he pithily remarked, he was "not speaking so much of pennies as of principle. The taxes on knowledge were finally wiped out between 1850 and 1870, and the principle was established that we would not put a tax on things of the mind." For the sake of the £500,000 which it is estimated that the tax on book sales will produce, we are being committed "to do this barbarous thing".

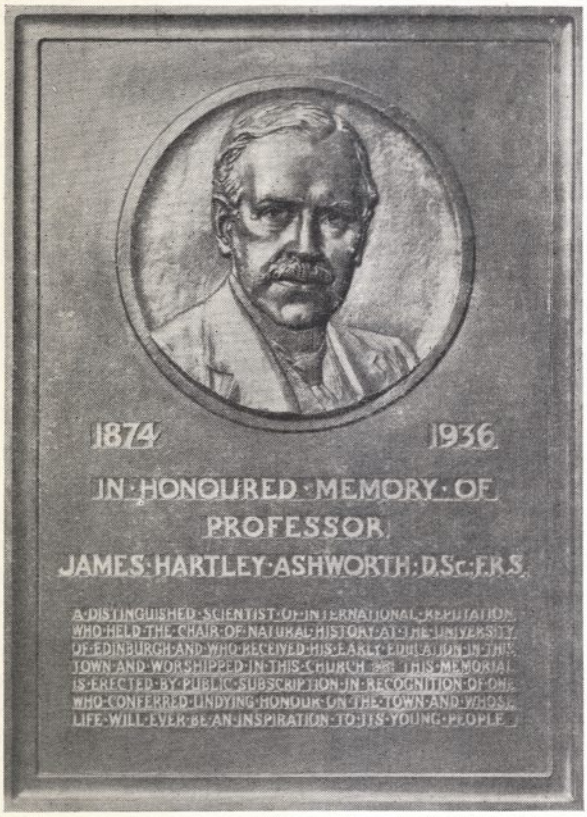
Lord Wolmer replied to Mr. Herbert on behalf of the Government; he said that the whole purpose of the sales taxes was to curtail consumption, and that no case had been made for regarding books differently from other commodities. No one will wish to quarrel with the general views expressed by Lord Wolmer, but we still insist that books should be exempted from this impost. The general shortage of paper and other material must lead to a reduction in quantity of publications in any event, and, as Mr. Herbert pointed out, if one new thought is held back from publication by the tax, then, on the long view, the tax is bad. To this we may add that mathematical and scientific works are notoriously expensive to produce, and that their publication frequently depends on the indirect subsidy afforded by more popular books. There is also another aspect of book sales, a short-term view, which might receive more emphasis; that is, the position of export sales. It is not sufficiently realized how large a proportion of the books produced in Great Britain are sold overseas. The export trade must be maintained, and to this end a healthy home trade is essential, for in no industry more than in book production does final cost depend on the total number of items produced at one working; prospective sales of an edition of 5,000 as against a possibility of disposing of 4,000 copies of a book may enable a publisher to make a substantial reduction in its selling price.

Camouflage in Modern Warfare

SINCE the publication in NATURE of June 22 of the leading article under this title, correspondence has revealed the interest which has been aroused. On p. 168 a letter on the subject, written from the point of view of the artist, demonstrates that scientific workers are not alone in their criticism of the official methods of dealing with camouflage. In this

connexion, it is worth while directing attention to an article in the July issue of the *Nautical Magazine*, in which Sir John Graham Kerr discusses camouflage in its application to ships at sea. The article includes a reprint of the original letter drafted by Prof. Graham Kerr, as he then was, and circulated by the Admiralty to the Navy on November 10, 1914, on the use of paint camouflage for diminishing the visibility of ships at a distance. Effective camouflage, whether on land or sea, depends on two fundamental principles: compensative or counter-shading, and parti-colouring or disruptive pattern. The effect of imitative colouring, the basis of the artist's technique, is entirely overborne by the effects of light and shadow.

Sir John points out that complete invisibility by the use of paint camouflage is out of the question. In bright light and a clear atmosphere, it is impossible to hide a large object such as a ship at sea, but in conditions of poor visibility, properly devised camouflage can make it extremely difficult to 'pick up' a ship and can disguise effectively its character, size and course. The trial or adoption of Sir John's suggestions were left to individual flag officers, and this may have accounted for the very indifferent results obtained. In 1917 a modification of these proposals was adopted, under the guidance of Mr. Norman Wilkinson (now president of the Royal Institute of Painters in Water Colours), to which the American biological term 'dazzle' was given, and was widely used for the mercantile marine, American destroyers and certain British war-vessels. As we have already pointed out, present-day methods of paint camouflage are largely ineffective, due in part to lack of co-ordination of the various departments concerned and to lack of scientific direction.



Memorial to Prof. J. H. Ashworth

THE bronze memorial plaque to the late Prof. J. H. Ashworth, a reproduction of which appears on this page, set in Yorkshire monumental stone, was unveiled at Salem Congregational Church, Burnley, by Mrs. Ashworth on June 25. Prof. Ashworth was a Burnley man, and although he spent the last twenty-five years of his life at Edinburgh, he never allowed the link with his birth-place to be broken. As professor of natural history in the University of Edinburgh, he achieved an international reputation, and by his death at the early age of sixty-one on February 4, 1936, the world lost a distinguished zoologist; NATURE lost a valued contributor whose services had extended over many years.

After the unveiling ceremony, at which the Mayor of Burnley presided, addresses were given by, among others, Prof. H. Graham Cannon, professor of zoology in the University of Manchester, and the Rev. T Ormerod, chairman of the Memorial Committee; Dr. W. Howarth, director of education at Burnley and honorary secretary of the Memorial Committee, read tributes received from Sir Thomas Holland, principal of the University of Edinburgh, Sir George Adam Smith, formerly principal of the University of Aberdeen, Sir Richard Gregory, president of the British Association and former editor of NATURE, and others. Prof. Ashworth was a great friend, a great zoologist, and a great teacher and administrator. He was the first in Great Britain to introduce a course of medical zoology, and when the time came to re-organize and build a new department of natural history in the University of Edinburgh, his powers were shown to the full. The building there which now bears his name is a lasting and worthy memorial in the community of his adoption.

Prof. W. P. Alexander

PROF. WILLIAM P. ALEXANDER has been awarded the Cornelius Amory Pugsley Medal of the Buffalo Museum of Science, for his work as a conservationist and naturalist. The medal, established by Chester D. Pugsley of Peekskill, N.Y., in honour of his father, bears the inscription: "Awarded to William Prindle Alexander for his distinguished work as a pioneer of outdoor education in state parks". Prof. Alexander, who is Hayes professor of natural history at the Buffalo Museum of Science, is widely known as a lecturer, writer, and teacher of natural history subjects. He was the originator of the Nature trail idea, his first trail having been planned in the Allegany State Park in 1921; it is now an established institution in many State and Federal parks. Prof. Alexander

is a conservationist, not in the sense that he seeks to protect wild life out of season, so that the mute and helpless creatures of wood and field can be indiscriminately maimed and slaughtered 'in season', but as a protector and preserver of all wild life in every season. In addition to being the author of numerous articles on natural history, he has had published several novels.

Dr. Tweedie John Todd

DR. TWEEDIE JOHN TODD, physician and naturalist, was born at Berwick in 1789, the son of the borough treasurer. He studied medicine at Edinburgh and for several years served as a surgeon in the Navy, chiefly in the East Indies and at the Cape of Good Hope, where he made some experiments on the electric ray (Torpedo), which were afterwards published in the *Philosophical Transactions*. He retired from the Navy in 1816, and after spending some years in Italy settled in Brighton, where he soon acquired an extensive practice. He was the author of several papers on natural history which were published in the *Philosophical Transactions* and the *Journal of Science and Arts*, such as "The Regeneration of Parts in the Aquatic Salamander" and "The Luminous Power of Some of the Lampyrides". His contribution to medical literature consisted of "The Book of Analysis. A New Method of Experience", in which he endeavoured to apply Baconian induction to medicine and the other natural sciences. For many years he was engaged in a series of microscopical researches on living animals illustrative of different parts of physiological and pathological science and especially of the processes concerned in the healing and regeneration of wounded and lost parts. He left a large collection of microscope slides at the time of his death, which took place on August 4, 1840.

University Students and Compulsory Service

DR. RAYMOND PRIESTLEY, vice-chancellor of the University of Birmingham, in the course of a circular letter addressed to head masters of a number of schools in the Midlands, has pointed out that the age at which undergraduates will be called up for military service has been fixed by the Government at twenty years. This will enable many men to complete their university training before entering the Services. With the object of enhancing the value of such men to the national effort, it has been decided by the University of Birmingham that all future entrants will be required to choose one of the following options as part of their university course: (1) compulsory physical education for one year; or (2) two years service in the University contingent of the O.T.C. Those who choose the latter will be accepted for the O.T.C. only if they are approved by an interviewing board set up by the Military Education Committee, the main criteria being personality and power of leadership (latent or developed). Training in the O.T.C. will be carried out with the view of developing powers of leadership rather than training technical experts, and should prove of great interest and value to all who join, in whatever walk of life they may afterwards find themselves. The advantages of this general military training apply equally to those taking medical and dental courses, since the military background essential to an R.A.M.C. officer can be adequately acquired in this way. Those who obtain War Certificates A and B will have definite advantages when they are called up for military service; the scheme should go far towards ensuring that the best use is made of all those suitable as officers.

Fire Risk from the Smashing of Filament Lamps

EXPERIMENT shows that it is difficult to cause ignition of combustible material by means of smashing a filament lamp embedded in it. But the lamp-holder of a large lamp may rise to a fairly high temperature, high enough to explode certain compounds used for military purposes. It is well known that sudden breakage of a glass bulb may occur during heavy gunfire in a battleship or cruiser. It could also happen in a submarine when depth charges are exploding near it. This explains the interest now being taken in the United States Navy in fluorescent lighting for magazines and in other parts of a warship where explosives are handled. It is very difficult to set fire even to cotton-wool by smashing a lighted fluorescent lamp reposing on it.

A useful feature of the mercury fluorescent lamp is that it can easily be so graded as to emit the tone of blue light that is preferred for darkening a ship when in action at night. At present this reduced lighting effect is obtained by shading tungsten filament lamps and using a blue glass bulb, or one which has been sprayed in that colour. The *Electrical Times* of July 4 states that the U.S. Navy is having a series of experiments made with fluorescent lighting, and if it is found that this type obviates the danger due to filament lamps overheating in tropical atmospheres or when they are smashed by heavy gunfire, the mercury discharge type with fluorescent effect may find an extensive use in warships and elsewhere. It is also being recommended for mines, gasworks, petrol and benzine factories, hydrogen plant and all other places where the air is charged with explosive vapours or dust.

Daylight Observation of Venus and Jupiter

DR. A. L. PECK, of Christ's College, Cambridge, writes: "In view of the astronomical notes in NATURE of July 27, p. 128, it may be of interest to record that two planets were picked out here with the naked eye on July 28, at 9.40 a.m. B.S.T.—Venus (daylight observation of which is, of course, nothing unusual) and Jupiter. Observation of the latter was made possible by its proximity to the moon, with which it had been in conjunction a few hours before."

British Museum (Natural History): Acquisitions

THE Zoological Department has received as a donation from Admiral Sir Sidney Bailey, a series of mounted heads of North American ungulates, including a very fine moose and some exceptionally good wapiti and caribou. The collection also contains a head of a Rocky Mountain goat. Another interesting

gift to the same Department is a series of ten skulls with horns of African antelopes from the Dinder River District of the Sudan, presented by Mr. T. W. H. Dore. This collection contains, among other specimens, some skulls of Soemmerring's gazelle and of the Sudan race of the roan antelope. The Department of Geology has acquired from the Committee of the Royal Literary and Scientific Institution, Bath, a collection of ninety-nine invertebrate fossils from the Mesozoic of Australia, including a number of type and figured specimens. The Trustees appreciate this recognition of the importance of housing type-specimens, other than those of local interest, in the National Collection.

Beit Memorial Fellowships for Medical Research

A MEETING of the Trustees of the Beit Memorial Fellowships for Medical Research was held on July 17. Prof. A. J. Clark, professor of materia medica in the University of Edinburgh, was appointed to the Advisory Board in succession to Prof. W. Bulloch, who resigned after twenty-nine years service. Dr. Paul Fildes was appointed honorary secretary on the resignation of Prof. T. R. Elliott from that post after ten years service. Out of the twenty-seven present fellows, nine have already been seconded from their fellowships at their own request for more direct service during the War.

The following elections were made, all with permission for each fellow to be seconded at any time for war duties: *Senior Fellowship* (£700 a year): T. A. H. Munro, to continue his studies of inheritance in mental disorders, at the Royal Eastern Counties Institution, Colchester; *Fourth Year Fellowships* (£500 a year): J. G. Chalmers, to continue his chemical studies of polycyclic hydrocarbons in experimental cancer formation, at the Research Department of the Glasgow Royal Cancer Hospital; Dr. T. R. R. Mann, to extend his work on intracellular metallo-protein compounds, especially of red blood cells, at the Molteno Institute of Biology, University of Cambridge; *Junior Fellowships* (£400 a year): M. Abercrombie, junior research fellow, Queen's College, Oxford, to study amputation neuromata and the degeneration and regeneration of mammalian nerves, at the Department of Zoology, University of Oxford; Dr. D. A. K. Black, research student of the Medical Research Council, to study metabolic and bone marrow changes in the repair of severe anæmias, at the Nuffield Department of Medicine, Oxford; Dr. G. C. Butler, 1851 Exhibition science research scholar, to study the purification and properties of gonadotrophic hormone from the pituitary gland, at the Department of Pathological Chemistry, University College Hospital Medical School, London; Dr. J. L. Madinaveitia, honorary research fellow in chemistry, University of Manchester, to study diffusing factors in bacterial filtrates and snake venoms, at the Department of Chemistry, University of Manchester; Dr. S. M. Partridge, Lister Institute student in biochemistry, to study the chemical nature of the antigen of Shiga dysentery bacteria, at the Lister Institute of Preventive Medicine, University of London; D. Whitteridge, demonstrator in physiology, Oxford, to study electrical records from brain after concussion or severe injury, at the Nuffield Department of Surgery and the Department of Physiology, University of Oxford; P. C. Williams, research grantee of the Medical Research Council, to study pituitary hormones and their excretion in clinical pathological conditions, at the Courtauld Institute of Biochemistry, Middlesex Hospital, London.

Announcements

THE Minister of Supply stated in the House of Commons on July 25 that due regard will be had to the provision of reasonable amounts of paper for educational, scientific, and technical publications.

ACCORDING to *Science* of June 28, Prof. Peter Debye, of Berlin-Dahlem, has been appointed professor and chairman of the Department of Chemistry at Cornell University. Prof. Debye has been George F. Baker visiting lecturer in chemistry at Cornell University during the past term. His son, Peter Paul Debye, will be associated with Prof. Debye in research in the Baker Laboratory of Chemistry at Cornell. Prof. Jacob Papish, who has been chairman of the Department, will continue as vice-chairman. Dr. Bruno Rossi, formerly professor of physics in the University of Padua, research associate at the University of Chicago, has been appointed associate professor of physics at Cornell.

IT is announced that the Pétain Government has dismissed M. Huismans, director-general of fine arts, M. Julien Cain, administrator of the Bibliothèque Nationale, M. Laugier, director of the national centre for scientific research, and M. Longchambon, director of scientific research, who are said to have abandoned their posts under the previous French Government without justification.

THE Council of the University of Birmingham has instituted a scheme for family allowances for members of staff whose salaries do not exceed £700 per annum. The allowance, for salaried members, is at the rate of £25 per annum for each child. The wage-earning staff receive an allowance of 2*s.* 6*d.* per week for each child less than sixteen years of age. The scheme takes effect as from February last.

IN 1920, Miss L. Jones-Bateman of Cae Glas, Abergele, presented to the Royal Horticultural Society a valuable silver-gilt replica of the Warwick Vase to be used for the encouragement of fruit production. It is accordingly decided to offer it triennially for original research in fruit culture. Candidates should submit accounts of their work by October 31. The work dealt with should have been mainly carried out by the candidate in the United Kingdom, and mostly during the past five years.

ERRATUM. NATURE, July 20, p. 101, col. 2, paragraph on "Precautions against American Foul Brood in Bees", line 13, for "American" read "European".

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.

Sulphanilamide as a Specific Inhibitor of Carbonic Anhydrase

CARBONIC anhydrase which catalyses the reversible reaction $H_2CO_3 \rightleftarrows CO_2 + H_2O$ is present in large concentrations in the red blood corpuscles and some cells of gastric mucosa of mammals. This enzyme plays an important part in accelerating the carbon dioxide output in the lungs; it appears also to promote the formation of hydrochloric acid by the parietal cells of gastric mucosa[1].

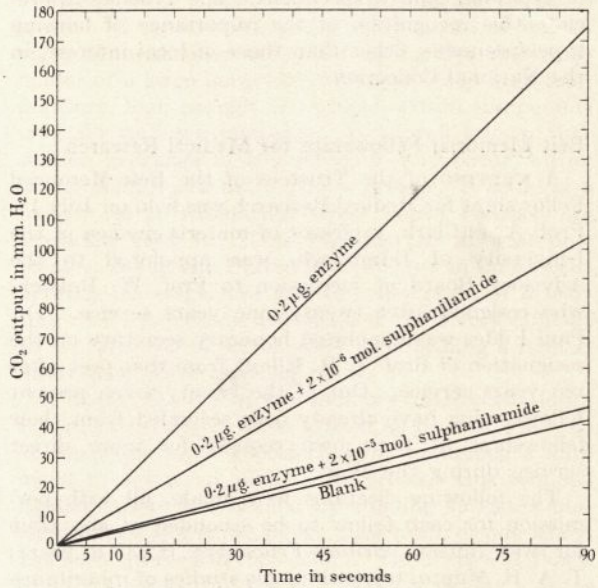
Having isolated carbonic anhydrase in a pure state, we have been able to show that this enzyme is a zinc-protein compound, where zinc forms an essential part of its prosthetic or active group[2,3]. The activity of this enzyme is very strongly and reversibly inhibited by potassium cyanide, hydrogen sulphide and sodium azide. These inhibitors, however, are not specific for carbonic anhydrase, as they are shared also by other metallo-protein enzymes such as catalase, peroxidase, cytochrome oxidase and polyphenol oxidase.

The main object of this investigation was the discovery of new and more specific inhibitors of carbonic anhydrase, as they will certainly be of great assistance in the study of several problems connected with the physiology of this enzyme. The existence of such inhibitors was revealed by the study of some drugs belonging to the class of sulphonamide compounds. The demonstration of the therapeutic efficiency of prontosil and other sulphonamide drugs in treatment of bacterial infections was followed by numerous investigations resulting in an extensive literature dealing with pharmacological and physiological properties of these compounds[4,5]. The repeated references in this literature to the fact that the administration of some sulphonamide compounds is followed by a fall in the carbon dioxide combining power of blood[6,7] suggested the possibility that some of these compounds may have an inhibitory effect on carbonic anhydrase.

This supposition was confirmed experimentally by testing the effect of sulphanilamide on the catalytic activity of carbonic anhydrase in blood, in gastric mucosa and in pure enzyme preparations. The results of these experiments summarized in the figure clearly show that sulphanilamide acts as a very powerful inhibitor of carbonic anhydrase, exhibiting marked effect even in a concentration so low as 2×10^{-6} mol.

In order to determine which portion of the sulphanilamide molecule (*p*-aminobenzene-sulphonamide [$NH_2C_6H_4.SO_2NH_2$]) is responsible for the action on the enzyme, the effects of a number of other compounds belonging to the sulphonamide group have been tested and the results of these tests can be summarized as follows:

(1) The amino-group of sulphanilamide, which is essential for the therapeutic properties of this compound, is not responsible for the inhibition of the carbonic anhydrase. In fact, its loss as in benzene-sulphonamide [$C_6H_5SO_2NH_2$], its acetylation as in acetylaminobenzene sulphonamide [$CH_3CONHC_6H_4SO_2NH_2$] or its shift to *ortho-* or *meta-*positions do not affect in the least the properties of these compounds as inhibitors of carbonic anhydrase.



EFFECT OF SULPHANILAMIDE ON THE ACTIVITY OF CARBONIC ANHYDRASE (TESTED BY MELDRUM AND ROUGHTON METHOD AT 0° C.).

(2) The sulphonamide group appears to be directly concerned with the inhibitory effect of these drugs since the replacement of both hydrogen atoms, or even one in the amido-group, causes a complete loss of the inhibitory property; thus while substances like prontosil [$(NH_2)_2C_6H_3.N{=}N.C_6H_4.SO_2NH_2$], benzyl-sulphanilamide [$C_6H_5.CH_2NH.C_6H_4.SO_2NH_2$], pyridine-3-sulphonamide [$C_5NH_4.SO_2NH_2$] and amino-naphthalene-sulphonamide [$NH_2C_{10}H_6.SO_2NH_2$] are acting as inhibitors, substances like benzene-sulphonchloride [$C_6H_5.SO_2Cl$], sulphanilic acid [$NH_2.C_6H_4.SO_2OH$], sulphanil-acetamide [$NH_2.C_6H_5.SO_2NH.COCH_3$], Diseptal A [$NH_2C_6H_4.SO_2NH.C_6H_4.SO_2N.(CH_3)_2$], Diseptal B [$NH_2C_6H_4.SO_2NH.C_6H_4.SO_2NH.CH_3$], Rodilone [$CH_3CO.NHC_6H_4.SO_2.C_6H_4.NH.COCH_3$], sulphapyridine (M. & B. 693) [$NH_2C_6H_4.SO_2NH.C_5NH_4$], pyridine-3-sulphonic acid [$C_5NH_4.SO_2OH$] and sulphathiazol [$NH_2C_6H_4.SO_2NH.C_4NH_4$] do not interfere with the activity of carbonic anhydrase. This enzyme therefore appears to be an exceptionally sensitive biological test capable of detecting a few micrograms of an unsubstituted sulphonamide compound.

(3) Sulphamic acid [NH_2SO_2OH] and sulphamide [$NH_2SO_2NH_2$] inhibit the activity of carbonic anhydrase to a much smaller extent, however, than benzene-sulphonamide or sulphanilamide.

As to the mechanism of the inhibition of carbonic anhydrase by these compounds, it is conceivable that the sulphonamide group reacts directly with the zinc-containing prosthetic group of the enzyme. This appears to be supported by the following considerations. The inhibition by sulphonamide compounds does not require a period of incubation, on the contrary it is immediate even at low temperatures, it is also very strong and completely reversible. In this respect it shows great resemblance to inhibitions produced by reagents such as potassium cyanide, hydrogen sulphide and sodium azide which are known to react with metals. Both sulphamic acid and sulphamide are known to form compounds with metals. Moreover, benzene-sulphonamide, like some other acid amides, reacts with alkaline metal-amide compounds including zinc-amide[8,9].

The experiments which we have carried out in order to determine the effect of sulphonamide compounds on other enzymes have shown that even in concentrations as high as 10^{-2} mol. they have little or no effect on enzymes such as catalase (purified preparation from liver), peroxidase, cytochrome oxidase, polyphenol oxidase, xanthine oxidase, uricase, urease and carboxylase.

The inhibitory effect of sulphonamide compounds on carbonic anhydrase appears to be highly specific. These inhibitors therefore make it possible to abolish the activity of carbonic anhydrase in cells and organisms without affecting the activity of other known catalytic systems.

For the gift of several substances used in this investigation we wish to thank Dr. H. King, Dr. T. A. Henry, Dr. H. McIlwain, Dr. W. J. C. Dyke of the Evans Biological Institute, May and Baker, Ltd., and Schering, Ltd.

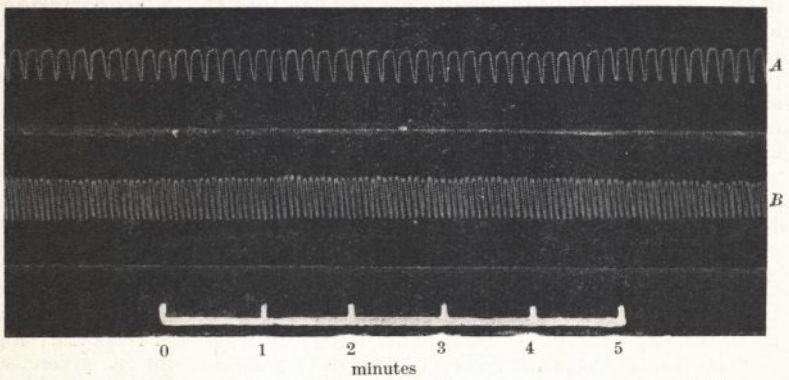
Molteno Institute,
University, Cambridge.
July 11.

T. MANN.
D. KEILIN.

[1] Davenport, H. W., *J. Physiol.*, **97**, 32 (1939).
[2] Keilin, D., and Mann, T., NATURE, **144**, 442 (1939).
[3] *ibid.*, *Biochem. J.* (in the press).
[4] Findlay, G. M., "Recent Advances in Chemotherapy" (London, 1939).
[5] Marshall, E. K., *Physiol. Rev.*, **19**, 240 (1939).
[6] Southworth, H., *Proc. Soc. Exp. Biol.*, **26**, 58 (1937).
[7] James, G. W., *Biochem. J.*, **34**, 633 (1940).
[8] Franklin, E. C., *et al.*, *Amer. Chem. J.*, **23**, 277 (1900); **28**, 83 (1902) *J. Amer. Chem. Soc.*, **37**, 2279 (1915).
[9] Audrieth, F. L., *et al.*, *Chem. Rev.*, **26**, 49 (1940).

Temperature Coefficients and Acclimatization

CERTAIN biologists (especially Crozier[1] and his school) have formulated theories on the effects of changing temperatures on protoplasm. The numerical value of the temperature coefficient ($= Q_{10} = \frac{\text{velocity at } (t+10)^\circ \text{C.}}{\text{velocity at } t^\circ \text{C.}}$ of a biological reaction is believed to afford a clue to the nature of the controlling physical or chemical changes. I consider that theories based on such evidence may often be misleading.



RATE OF HEART-BEAT OF THE CRESTED NEWT, BOTH ANIMALS AT 0° C. *A*, ACCLIMATIZED TO 30° C.; *B*, ACCLIMATIZED TO 10° C.

I showed recently[2,3] that the position of the chill coma temperature (that is, the highest temperature at which immobilization occurs) for insects and Amphibia is not rigidly fixed but may be altered many degrees by first acclimatizing the animal—and acclimatization is usually complete within as short a period as twenty-four hours—to a high or a low temperature. Not only is the chill coma temperature affected, but the reactions of some tissues may be modified also. In the case of the crested newt, *Triton cristatus*, animals from stock were acclimatized to 10° C. and 30° C. by exposure to these temperatures for twenty-four hours, they were then immersed in water at 0° C. or 10° C. and the rate of heart-beat determined. Results are given in the table. In the accompanying figure tracings from two newts differently acclimatized and then both cooled to 0° C. are shown.

NUMBER OF HEART-BEATS OF THE CRESTED NEWT PER MINUTE.

	Acclimatized to 10° C.	Acclimatized to 30° C.
At 0° C.	14	6
At 10° C.	25	16

If all these results are considered, and the fact that some of the animals were differently acclimatized is, for the moment, neglected, four values of the temperature coefficient may be obtained, namely, 1·1, 1·8, 2·7, 4·2. The two extreme values (1·1, 4·2) are mainly of interest because certain other workers have not ensured that all their animals came from identical conditions; the results of such experiments will be difficult to interpret. The other values of the temperature coefficient of the newt's heart over the range between 0° C. and 10° C. show that the acceleration for an animal acclimatized to 10° C. ($Q_{10} = 1{\cdot}8$) might be assumed to be controlled by a physical 'master reaction', while that in the one acclimatized to 30° C. ($Q_{10} = 2{\cdot}7$) the controlling reaction would be thought to be of a chemical nature.

Such explanations appear to me unsatisfactory. The reasons for the increase in velocity of almost any biological reaction with an increase in temperature are very imperfectly understood; these observations on acclimatization may eventually help in the formulation of a satisfactory explanation.

At every temperature some acclimatization is probably going on in a living tissue, the extent of the acclimatization depending partly on the length

of the exposure. This appears to me to mean that at any particular temperature there may be no absolute rate for a biological process, and that all conditions previously experienced by the animal must be considered. Otherwise any theory based on the speed of a reaction must be treated with great caution.

KENNETH MELLANBY.

The University,
Sheffield, 10.
July 10.

[1] Crozier, W. J., *J. Gen. Physiol.*, **7**, 189 (1924).
[2] Mellanby, K., *Proc. Roy. Soc.*, B, **127**, 473 (1939).
[3] Mellanby, K., *J. Physiol.* (in press) (1940).

Evidence of Demethylation in the Animal Body

DURING the course of work on the metabolism of synthetic œstrogenic compounds[1] undertaken at this Institute, attention has been directed to the methyl ethers of some of the synthetic œstrogenic phenols. Preliminary experiments have been carried out on 4 : 4′-dimethoxy diphenylether and 4-methoxy diphenyl ; 4 : 4′-dihydroxy diphenylether having been shown to produce full œstrous response when injected at a dose of 100 mgm. into ovariectomized rats, and 4-hydroxy diphenyl shown to have no œstrogenic activity at a dose of 100 mgm.[2]

3 gm. of 4 : 4′-dimethoxy diphenylether, dissolved in sesame oil, were injected into two female rabbits over a period of three weeks, the urine being collected during this period and for a further week after the last injection. From the 'free' and 'combined' phenolic extracts prepared from the urine a crystalline phenol was obtained by repeated extraction with boiling water, 47 mgm. occurring in the 'free' state and 22 mgm. in the 'combined' state. After several recrystallizations from petroleum ether this phenol melted at 90° C. and was shown to be 4-methoxy-4′-hydroxy diphenylether.

3 gm. of 4-methoxy diphenyl were injected into two rabbits in the same way as above, and a crystalline solid obtained from the 'free' and 'combined' phenolic extracts prepared from the urine, 203 mgm. occurring in the 'free' state and 43 mgm. in the 'combined' state. After several recrystallizations from benzene 30 mgm. of a crystalline phenol m.p. 268° C. were obtained and shown to be identical with 4 : 4′-dihydroxy diphenyl m.p. 272° C. From the benzene mother liquors 111 mgm. of another crystalline phenol m.p. 162° C. were obtained and shown to be identical with 4-hydroxy diphenyl, m.p. 163° C.

These results show that demethylation definitely occurs in the animal body and gives support to the suggestion made by Westerfeld[3] that œstrone methyl ether is metabolized in the body to œstrone.

Work on the metabolism of the methyl ethers of the highly active synthetic œstrogenic phenols is now in progress.

S. W. STROUD.

Courtauld Institute of Biochemistry,
Middlesex Hospital Medical School,
London, W.1.
July 3.

[1] Stroud, S. W., *J. Endocrin.*, **1**, No. 2, 201 (1939) ; **2**, No. 1, 55 (1940).
[2] Dodds, E. C., and Lawson, W., *Proc. Roy. Soc.*, B, **125**, 222 (1938).
[3] Westerfeld, W. W., *Biochem. J.*, **34**, 51 (1940).

Resonance in the Chloroacetic Acids

IN a recent letter[1], H. O. Jenkins has made the interesting suggestion that the high acid dissociation constants of di- and tri-chloroacetic acids are largely due to the possibility of a resonance structure in their anions. It is the purpose of this note to indicate a possible means of testing this hypothesis.

The strengths of acids or bases are in general a good measure of the velocity with which they will lose or gain protons. This is shown by the wide validity of relations of the form $k = GK^{\alpha}$, where k is the velocity of a catalysed reaction, K the strength of the catalysing acid or base, and G and α constants for a given solvent, temperature and reaction[2]. However, this parallelism will break down if the acid and base involved in the equilibria used for defining acid-base strengths have different electronic structures. The extreme case of this behaviour is met with in pseudo-acids, where the charge on the anion may reside on an atom other than that from which the proton has been removed (for example, $CH_3NO_2 \rightarrow CH_2 : NOO^- + H^+$). This point was realized by Brönsted when he first proposed quantitative relations of the above type, and it was in fact shown that in the decomposition of nitramide the ions of pseudo-acids had a much smaller catalytic effect than would be predicted from their dissociation constants[3].

The same type of argument applies in general to cases where resonance structures occur in only one member of an acid-base pair. In the case of dichloroacetic acid, let the 'normal' molecule and ion be denoted by HA and A^-, and the resonance structures $\mathrm{Cl_2}\!\!\diagdown\!\!\overset{+}{\mathrm{C}}\mathrm{H.COOH}$ and $\mathrm{Cl_2}\!\!\diagdown\!\!\overset{+}{\mathrm{C}}\mathrm{H.COO^-}$ by HR and R^-. Let us suppose for the sake of simplicity that the molecule exists almost entirely as HA, and the ion almost entirely as R^-. The best measure of the tendency of HA to lose a proton is given by the constant $[H^+]\,[A^-]\,/\,[HA]$, which is much smaller than the observed dissociation constant $[H^+]\,[R^-]\,/\,[HA]$: hence the dichloroacetic acid molecule will be a less powerful acid catalyst than would be expected from its dissociation constant. Similarly, the tendency of R^- to pick up a proton is represented by $[HR]\,/\,[H^+]\,[R^-]$, which is smaller than the observed constant $[HA]\,/\,[H^+]\,[R^-]$: hence the dichloroacetate ion will be a less powerful basic catalyst than would be expected from the dissociation constant of the acid. In a catalytic reaction involving dichloroacetic acid or its ion, the transition state will actually be intermediate in structure between A and R, but the same qualitative conclusions will apply.

There is a certain amount of experimental evidence for the existence of this effect. Thus in the iodination of acetone[4], the catalytic effect of dichloroacetic acid is about 30 per cent lower than the value calculated from an equation based on seven other carboxylic acids (average deviation 8 per cent). Similarly, in the decomposition of nitramide[3,5,6], the catalytic effect of the dichloroacetate ion is 35 per cent lower than the calculated value (based on twelve other anions : average deviation 4 per cent). There appear to be no other cases for which sufficiently full or accurate data are available.

These results lend some support to the view that a resonance structure plays a part in the dichloroacetate ion. On the other hand, the effects observed

are smaller than might be expected if resonance is a major cause of the thirty-fold increase of dissociation constant in passing from $CH_2Cl.COOH$ to $CHCl_2.COOH$.

R. P. BELL.

Physical Chemistry Laboratory,
Balliol College and Trinity College,
Oxford.

[1] Jenkins, NATURE, **145**, 625 (1940).
[2] For a summary, see Bell, *Trans. Farad. Soc.*, **34**, 229 (1938).
[3] Brönsted and Pedersen, *Z. phys. Chem.*, **108**, 185 (1924).
[4] Results of Dawson *et al.*, *J. Chem. Soc.* (1913–29) in some cases recalculated.
[5] Pedersen, *J. phys. Chem.*, **38**, 581 (1934).
[6] Bell and Baughan, *Proc. Roy. Soc.*, A, **158**, 464 (1937).

Mechanism of the Neutron Loss Reaction Produced by Deuterons

IN a recent letter in NATURE, Krishnan and Banks[1] reported an interesting new type of nuclear transformation. Copper, consisting of two stable isotopes 63 and 65, was bombarded with deuterons, and the radioactive isotope Cu^{62} (10·5 min.) was obtained. The transformation was found to have a threshold at a deuteron energy of about 7 Mev. By analogy with the well-known reaction

$$Cu^{63}\ (n-2n)\ Cu^{62}, \qquad (1)$$

Krishnan and Banks suggested that a new kind of neutron loss reaction might explain their results, either

$$Cu^{63}\ (d-d, n)\ Cu^{62}\ (2), \quad \text{or} \quad Cu^{63}\ (d-p, 2n)\ Cu^{62}\ (3)$$

From some further observations they concluded that reaction (3) was more probable. In a similar way they interpreted previous results of Krishnan and Gant[2], who had found that Ag^{107} could be transformed by 9 Mev. deuterons into Ag^{106} (26 min.). For this case, however, the threshold energy has not yet been determined.

Recently, in the course of an investigation of the radioactivity produced when beryllium is bombarded by deuterons, a different type of neutron loss reaction was established in this laboratory[3], namely, the reaction

$$Be^{9}\ (d-H^3)\ Be^{8}.$$

It seemed, therefore, worth while to examine the possibility that the effect reported by Krishnan and Banks might be due to the analogous reaction

$$Cu^{63}\ (d-H^3)\ Cu^{62} \qquad (4)$$

If we denote by E (D^2), E (H^3) and E (Cu^{63}) the energies necessary to remove a neutron from D^2, H^3 and Cu^{63} respectively, and by $E_1, \ldots E_4$ the threshold energies of reactions (1) . . . (4), we obtain the following simple relations.

$E_1 = E_2 = E\ (Cu^{63})$, $E_3 = E\ (Cu^{63}) + E\ (D^2)$, $E_4 = E\ (Cu^{63}) - E\ (H^3)$.

The threshold energy of reaction (1) has been measured by Sagane[4], who found a value between 12 and 13 Mev. His work has been confirmed by Salant and Ramsey[5], who find a value close to 12 Mev. We shall adopt for the following the value $E_1 = 12$ Mev. The binding energy of the deuteron is known, $E\ (D^2) = 2{\cdot}2$ Mev. $E\ (H^3)$ can be easily calculated from the masses of H^3, D and n. We find, using Barkas' compilation of masses[6], $E\ (H^3) = 6{\cdot}2$ Mev.

With these values we obtain for the threshold energies of reactions (2, 3, 4)

$$E_2 = 12 \text{ Mev.}, \quad E_3 = 14{\cdot}2 \text{ Mev.}, \quad E_4 = 5{\cdot}8 \text{ Mev.}$$

It appears that the $(d-H^3)$ reaction (4) can best account for the observed threshold of about 7 Mev.

If we assume that a $(d-H^3)$ process takes place according to the 'compound nucleus' model of nuclear reactions developed by Bohr, it appears difficult to understand why the reaction is observable with a nucleus of so high an atomic number as $Z = 29$ (Cu) or even $Z = 47$ (Ag). For, with deuteron energies below 9 Mev.[1,2], the H^3 particle will be emitted with an energy considerably below the top of the potential barrier, and consequently, once the highly excited compound nucleus is formed, the probability of emission of an H^3 article will be quite negligible compared with the probability of emission of a neutron or proton. It would seem preferable, therefore, to picture the $(d-H^3)$ reaction without postulating the formation of a compound nucleus. We would then have to assume that a deuteron with an energy exceeding the threshold could capture a neutron in a collision with the nucleus without entering it. Near the threshold, the Coulomb force between the final nucleus and the H^3 particle would lead to a very small probability of the $(d-H^3)$ reaction. This might account for the fact that the lowest deuteron energy at which the production of Cu^{62} was observed[1] is higher than the calculated threshold of reaction (4).

M. GOLDHABER.

Department of Physics,
University of Illinois,
Urbana, Illinois.
June 20.

[1] Krishnan and Banks, NATURE, **145**, 777 (1940).
[2] Krishnan and Gant, NATURE, **144**, 547 (1939).
[3] O'Neal and Goldhaber, *Phys. Rev.*, **57**, 1086 A (1940).
[4] Sagane, *Phys. Rev.*, **53**, 492 (1938).
[5] Salant and Ramsey, *Phys. Rev.*, **57**, 1075 A. (1940).
[6] Barkas, *Phys. Rev.*, **55**, 691 (1939).

Viscosity and Molecular Structure

TABLE 2 of our recent article in NATURE on "Viscosity and Molecular Structure"[1] contains some molecular weights of nitrocellulose and cellulose acetate estimated from viscosity measurements. One sentence of the text referring to this table runs: "in this case no experimental data from the ultracentrifuge were available".

Dr. E. O. Kraemer has been so kind as to direct our attention to the fact that (although the samples to which reference is made in the table have not been directly investigated by the ultracentrifuge) a number of other nitrocelluloses and cellulose acetates have been investigated by him[2] and by R. Signer[3] with the aid of the ultracentrifuge. We are greatly indebted to Dr. Kraemer for this comment, and wish to correct the remark in our article by adding: Ultracentrifuge measurements by E. O. Kraemer[2] gave, for cellulose acetate and nitrocellulose, molecular weights between 50,000 and 250,000 and between 102,000 and 160,000 respectively. It is also of importance to add that Dr. Kraemer, Dr. Signer and

their collaborators have measured methyl and ethyl cellulose and have found values of 14,000–38,100 and 125,000 respectively.

Concerning the shape of proteins, data and formulæ presented by J. W. Mehl, J. L. Oncley and R. Simha[4,5] give better agreement between results obtained by viscosity measurements and those provided by the ultracentrifuge than that shown in Table 1.

Finally, we owe to Dr. Kraemer the information that the viscosity behaviour of gelatin at 34° investigated by Sanigar, Krejci, and Kraemer[6] is irreconcilable with the sedimentation constants, if the gelatin particles are assumed to be solvated spheres. The necessary degree of solvation would practically eliminate the difference between the densities of particle and medium.

H. MARK.
R. SIMHA.

c/o Nordeman Publishing Co., Inc.,
215 Fourth Avenue,
New York.

[1] NATURE, **145**, 571 (1940).
[2] Kraemer, E. O., *Ind. Eng. Chem.*, **30**, 1200 (1938).
[3] Signer, R., and Tavel, P. v., *Helv. chim. Acta*, **21**, 535 (1938). Comp. also Signer, R., and Liechti, J., *Helv. chim. Acta*, **21**, 530 (1938), and the data given in Svedberg and Pedersen's "The Ultracentrifuge" (Oxford, 1940), pages 416 and 431.
[4] Simha, R., *J. Phys. Chem.*, **44**, 25 (1940).
[5] Mehl, J. W., Oncley, J. L., and Simha, R., *Science* (in the press).
[6] Sanigar, E. B., Krejci, L. E., and Kraemer, E. O., *J. Amer. Chem. Soc.*, **60**, 757 (1938).

Camouflage in War-time

THE article on camouflage in NATURE of June 22 provides ample evidence of incompetence in this subject, but the writer has turned his guns in the wrong direction. His attack on artists has little relation to fact, in that the vast mass of 'camouflage' visible in all its glorious futility on army vehicles and buildings is not the work of artists.

A few weeks after the declaration of war a fellow artist, Mr. F. S. Manner, and I submitted a memorandum to the War Office camouflage authorities which covered all the criticisms mentioned in the article and a great many more. We are aware of at least one other memorandum on similar lines also submitted by an artist. We stressed the importance of biological study which, I am afraid, we called "Nature study", while pointing out the many occasions when it would be quite inapplicable. We also gave what we consider a practical solution to the whole question of co-ordination and control.

We also approached a Government contractor in relation to structural camouflage, and after some inquiry, he informed us that much of the work was in the hands of the Paint Manufacturers' Association. If this is so, it may be one of the reasons why khaki and green lozenges, of equal tone value, appear like a rash on everything that moves or stays in the military field. The artists at the Camouflage Research Station are probably equally sceptical about the situation, but what artist since the dawn of time has not obeyed the voice of the Philistine or said good-bye to his wage packet? There is a strong case for employing display and exhibition artists rather than those accustomed to landscape and other forms of painting, because the former are used to designing structurally, and experts in getting almost any effect with the minimum material.

The artist should not be blamed for the present situation, however, because he is only too willing to co-operate with the biologist; indeed he is no mean naturalist himself. Leonardo da Vinci, a great artist and scientist, pointed out Nature's use of protective colouring before Thayer was born. Artists before and since have been fully aware of the principles of 'countershading', 'coincident pattern', 'disruption', and 'deflection', only they have been called in art schools since the time of Rembrandt such other names as 'counterchange', 'discord and harmony', 'atmospheric and solid perspective'. Indeed, it is impossible to paint a picture without using these principles. Incidentally, no mention is made of the importance of aerial photography, which by using special film nullifies the virtue of colour, whether put on by naturalist or artist.

Let men of science turn their righteous indignation (an emotion impossible to the twisted cynicism of the artist) in the direction of the bureaucrats responsible for the control of camouflage. They will find the artists dour warriors in the same cause.

C. H. ROWE.

41 Camden Square,
London, N.W.1.

Cobalt and Pine Disease

IN a recent communication[1] Stewart and Ponsford have questioned the justification for our claim regarding the value of cobalt in the control of pine disease in sheep. We have examined the results which they have published[2], but find no evidence that they effect the validity of our conclusions.

It is unnecessary to go into details here, for a summary of the work carried out on the Scottish side of the border appeared last year[3] and shows that the use of cobalt for curative and preventive purposes has been widely adopted in the south of Scotland and in other areas with highly successful results. On farms where the treatment has been introduced on a systematic scale pine disease has been abolished. We have treated more than three hundred pining sheep by oral administration of cobalt on many different farms and the rate of recovery has been 97 per cent. The same treatment has been given by stock owners on the farms concerned with similar results. Sheep to which cobalt chloride has been administered have been kept for two years on pining land without a change of pasture and have remained entirely healthy.

Whatever may be the cause of this disease known as 'pining' on the Scottish borders, there now seems to be ample evidence that small doses of cobalt can cure or prevent it. It is possible that the experiments carried out by Stewart and Ponsford in Northumberland have been conducted under conditions which have become abnormal and have led to complications so that the use of cobalt alone is unavailing.

H. H. CORNER.
A. M. SMITH.

Edinburgh and East of Scotland
College of Agriculture,
13 George Square,
Edinburgh.

[1] NATURE, **145**, 1023 (1940).
[2] *Vet. Rec.*, **52**, 379 (1940).
[3] *Agric. Prog.* **16** 181 (1939).

RESEARCH ITEMS

Amerindian Religious Reactions to Cultural Impact

In a study of the ghost dance, which appeared among the Indians of Oregon and California in 1870, Cora Du Bois points out that it is a minor phase of a recurrent series of Messianic or revivalistic movements which have arisen among the weaker peoples throughout the world as reactionary waves to the crushing impact of European culture (*Anthrop. Rec.*, **3**, 1; 1939. California Univ. Press). The ghost dance cult originated among the Paviotso of Walker Lake in Nevada in 1869–70; and from it developed a complicated series of cults during the sixty years beginning in 1871. The early manifestation consisted largely of doctrinal stress on the return of the dead and the end of the world, which in some vague supernatural way would entail the elimination of the white people. The ghost dance proper had two main strands of diffusion. Among the Wintun and Hill Patwin a further development was what is known as the earth lodge cult from its most characteristic feature. This cult stressed the end of the world. The faithful were to be protected from the catastrophe by the subterranean houses which they built for the purpose. Like the original ghost dance, this cult had two main strands of diffusion. An elaboration was the Bole-Maru, which abandoned the doctrines of imminent world catastrophe and stressed instead a concept of the after life and of the supreme being. Ceremonially its highest development occurred among the Patwin and Pomo. Each local dreamer had his own revelations and supernatural authority, which determined the form his cult activities should take. A probable dating indicates the origin of the ghost dance in 1869–70, diffusion beginning 1871, earth lodge cult 1871–72, Bole-Maru in its first form 1872, persisting, though in a state of flux, down to the present day.

Shrine and Market in Morocco

The saintly shrine of Sīdī l-Yemām, a few miles south-east of Azila on the Laraiche-Tetuan road, typical of many in the countryside of Morocco described by Walter Fogg in *Man* of July, has a close relation to the nearby tribal market. The saint is said by tradition either to have come to Morocco with the founder of the first Mohammedan dynasty, or to have been a fighter against the infidel. Though his body lies in the grave, he is thought also to be alive. He is the patron of the countryside, and every year after the wheat harvest and threshing an important festival is held at the shrine in his honour, when much dancing, powder-play and feasting take place. Around the shrine is a large grove of old olive trees, each of which has much *baraka* (literally 'blessing', a wonder-working force). On certain of the trees fragments of clothing are tied as a means of placing *ar* on the saint, that is, the conditional curse which serves as a means of securing the fulfilment of a wish. The grove is also a haven of refuge. The spring is a 'haunted' and also a 'safe' spring, as opposed to a spring haunted by evil spirits. The tortoises, leeches and eels of the spring were 'holy', while the frogs, though not holy, might be inhabited by good spirits. Sacrifices were made at the spring as well as at the shrine itself, which was also the place at which solemn oaths were taken either between individuals or the representatives of two tribes after an inter-tribal war. In addition to the general significance of the shrine in relation to tribal life, which affected the market also, it had a particular reference for the latter. Not only was the spring the water supply of those attending the market—and holy at that; but also the market was under the special blessing of the saint, who walked about in the form of a visitor, or invisible, and his *baraka* protected buyer and seller alike. Everything bought at the market contained much *baraka* and might increase greatly in quantity after being stored, while the health and happiness of those attending will become greater from the influence of the saint.

Anti-Pernicious Anæmia Principle in Urine

In normal gastro-hæmopoiesis at least three unidentified factors appear to be involved. These are: (1) the 'intrinsic' factor of Castle or the 'hæmopoietin' of Wilkinson and Klein, which has enzyme-like properties and is present in the mucous membrane and secretion of the stomach and pylorus and reacts with (2) the 'extrinsic' factor of Castle such as beef protein, producing (3) the anti-pernicious anæmia principle absorbed from the intestine and stored chiefly in the liver. J. F. Wilkinson *et al.* (*Biochem. J.*, **34**, 698; 1940) have now shown the anti-pernicious anæmia principle may be isolated from normal male urine or from urine of treated patients with remitting pernicious anæmia but not from urines of untreated relapsing cases of pernicious anæmia. The extracts, active by intramuscular injection, were obtained by either concentrating the urine by evaporation and precipitating inert material with alcohol or by adsorption of the active material on norite at *p*H 5. It is pointed out that if an accurate chemical or biological test for the anti-pernicious anæmia principle becomes available, by which relatively small amounts of urine can be assayed, then such a test may be of great value in the early diagnosis of the disease, since absence of the principle from the urine should be one of the first signs long before the blood picture becomes characteristic. It seems reasonable to suppose that the principle present in the urine is identical with the liver principle, and represents that which has been removed via the kidneys from the blood.

Corals of the John Murray Expedition

Vol. 6, No. 5 of the *Scientific Reports of the John Murray Expedition*, 1933–34, British Museum (Natural History), 1939, is noteworthy in having a special part (B) on the ecology of the solitary corals by J. Stanley Gardiner, besides Part A on the Madreporaria, excluding Flabellidæ and Turbinolidæ previously described, by the same author with Peggy Waugh. It is seldom that so full a statement is available of the difficulties which are encountered by the systematist when the group dealt with is subject to such extreme variation and so many environmental factors are involved. To determine the specific and even generic characters of these corals is a heart-breaking task, but one which has been much helped in the present instance by the large number of specimens of certain

forms in the collection and a fair series of many, allowing a study of environmental variation in the species and a determination as to the characters which may be regarded as specific. Thirty-six species and sixteen genera are represented. Stress is laid on the fact that we do not yet know how the corallum is formed and the urgent need of this knowledge. A plea for the closer collaboration between geologist and biologist closes this interesting, if pessimistic, essay.

Taxonomy of the Actinomycetes

Two papers by E. Baldacci, relating to the systematic positions of ray fungi or Actinomycetes, have recently appeared in *Mycopathologia*. The first ("Introduzione allo studio degli Attinomiceti", vol. 2, fasc. 2, July 1939) is a comprehensive study of the whole family. A historical review of classification within this group reveals the need for a modern taxonomic framework to accommodate the research findings of recent years. This is met by a new classification, where the Actinomycetales are divided into two families with amended range, namely, Mycobacteriaceæ and Actinomycetaceæ. The former is further subdivided into Leptotrichioideæ and Proactinomycoideæ. Prof. Baldacci also proceeds to the finer divisions of classification in a further paper (vol. 2, fasc. 3; March 1940), where ten species of the genus Actinomyces are considered critically in the light of morphological and cultural behaviour. Subdivision into species has formerly been carried to excess, and several species described as new are now shown to be really strains of well-established specific conceptions.

Variegation in *Nicotiana Tabacum*

AMONG the monosomics (23II + 1) of *N. Tabacum*, the haplo-*C* type has been found to produce new types of the form 23II + C_1 + a fragment. These fragments are translocation products of the *P* and *C* chromosomes. The flower colour gene *Wh* is situated on the *C* chromosome. In an exceptional plant with flowers variegated carmine and white some cells contained 23II + C_1 + a fragment, while in others the fragment was missing. By propagating parts of the plant by the aid of hetero-auxin, K. R. Stino (*J. Hered.*, **31**, 19–24; 1940) was able to show that the fragment was a ring-chromosome. Different cells contained rings of different sizes, or more than one ring. The behaviour of the ring-chromosomes appears to be, in general, similar to that of McClintock. The carmine-white variegation, therefore, is presumed to result from the loss of the *Wh* gene by breakage and deletion during the division of the ring-chromosome and sometimes to elimination of the ring-chromosome during mitosis. Sometimes the carmine sections were more intense than normal; this may be due to the presence of a double dose of the *Wh* gene. It is interesting to note that Clausen has now shown that the fragment in the classical case of the carmine-coral variegation is ring-shaped.

Colchicine Treatment of Daphnia

H. Howard Durham and A. M. Banta (*Genetics*, **25**, 310–328; 1940) treated parthenogenetic eggs of a control line of *Daphnia longispina* with dilute solutions of colchicine. 60 unusual individuals occurred in 1748 treated eggs. Of these, 33 showed no ovarian activity, 20 produced parthenogenetic eggs which failed to hatch, while seven gave rise to mutant clones. Three of these mutant clones reverted to normal after several parthenogenetic generations. None of the eggs hatched from one line which was induced to reproduce sexually. There was no evidence of polyploidy, and the nature of the changes brought about by colchicine in Daphnia await further elucidation.

Temperature Distribution in the Lower Stratosphere

A DISCUSSION entitled "Distribution of Temperature in the Lower Stratosphere" by M. W. Chiplonkar deals with the increase of temperature with height that has been observed in India between heights of about 18 and 25 kilometres (*Proc. Ind. Acad. Sci.*, **11**, No. 1, Sec. A; 1940). The India Meteorological Department has been very successful in obtaining observations of temperature at great heights, and the author had for his purpose ten soundings from Poona (latitude 18°) and sixteen for Agra (latitude 27°). All except four of these twenty-six ascents were made during the period November–April, and many at such a time that the sun was probably below the horizon when the balloon passed into the stratosphere. These last must therefore have been unaffected by solar radiation. It appears that no other country can show a comparable number of very high soundings free from this only too likely source of error. The increase of temperature between 18 and 25 kilometres over Poona is largest around 21 kilometres, where it amounts on an average to between 4° and 5° C. per kilometre. It appears to be a permanent feature of the stratosphere over tropical India. Comparison is made with Munich (48° N.) and Abisko (68° N.), where an analogous rise is shown; but one which begins at a lower level, is much smaller, and is confined to the summer half of the year. The view is taken that in those European ascents that were made with the sun above the horizon the variation of temperature with height was probably little affected, although the level of temperature probably was affected. A short summary of some present-day views about the causes of the distribution of temperature within the stratosphere is added.

Investigation of the Period of RW Sagittarii

P. M. RYVES has discussed his observations of RW Sagittarii since 1923 (*Mon. Not. Roy. Astro. Soc.*, **100**, 6; April 1940). Ryves suggested in 1923 (*Mon. Not. Roy. Astro. Soc.*, **84**, 34; 1923) that it was a variable star of long-period type and small amplitude, the extreme range being 2·1 magnitudes and period 188 days. Although a large portion of his observations from 1923 is inaccessible owing to the international situation, it has been found possible to discuss some provisional data. From a re-examination of the earlier work in conjunction with some of the later observations, it seems that the period of 188 days satisfies the observations up to 1926 or 1927. After 1926 the observed dates of minima commenced to lag behind the calculated dates by increasing quantities, and a period of 191 days satisfied the later observations, but greater precision will not be attempted nor will the light-curve be fully described until all the observations can be used. The change of period appeared to have been effected abruptly about cycle 30 or 31 (1925–26), and about this time the light-curve showed peculiar irregularities, including indications of a second wave or inflection with a period of about 172 days, and a superimposed short-term variation, period 22 days.

THE ROYAL SOCIETY OF CANADA

ANNUAL MEETING

THIS year the fellows of the Royal Society of Canada were the guests of the University of Western Ontario in London, for their annual meeting during May 20–22. The attendance was not so large as last year; but representatives from all parts of Canada attended and presented papers. The University buildings, situated in beautiful spacious grounds outside the city, presented a peaceful contrast to the present conditions in Europe.

The presidential address, "A Study of the Organization and Work of the Royal Society of Canada", was delivered by Dr. H. M. Tory, following a complimentary dinner tendered the fellows, their wives and guests, by the City of London on May 20. The president stated that the Royal Society of Canada differs in one respect from the similar Society in England, in that it includes under its organization all the intellectual movements which were deemed worthy of recognition. Thus with the Natural Science Sections III, IV and V are associated the Literary Sections including philosophy, literature, history and economics. After outlining the various contributions of the older sciences and literary fields of knowledge to our present Western society, Dr. Tory concluded with the suggestion that they should at their annual meeting each year have a major symposium dealing in some form with the relations existing between the various sections. Two typical topics suggested were the effect of science upon literature in the last hundred years and the present state of controversy between science and philosophy.

On May 21, Dr. R. W. Boyle received the Flavelle Medal of the Society for distinction in scientific subjects, in recognition of his researches, particularly on the development of 'Asdics' and his work on ultrasonics. The presentation of the medals was followed by a scholarly lecture delivered by Dr. F. Cyril James, principal of McGill University, on "Science and Society", in which he traced the changes in Western society brought about in the four centuries between 1475 and 1875 due to the impact of scientific discovery. He pointed out that the primary function of the social sciences is the charting for society of a course that is most appropriate in the light of the existing fund of human knowledge. Apparently the impact of science on society has not been wholly beneficial; the ethos of Western society has not responded to the changes in its material environment, but if we are willing to face the major problem of deciding upon our ideals, the forces that science has placed at our disposal are sufficient to make the attainment of those ideals a practical possibility.

Section III (Chemical, Mathematical and Physical Sciences) was held under the presidency of Prof. J. A. Gray, who delivered the presidential address on "Studies in Beta and Gamma Rays", in which he outlined the early work done in Rutherford's laboratory at Manchester and the subsequent development of the theory of scattering and softening of the γ-rays on passing through matter. Recent experimental results on the beta-ray spectra and the gamma-rays from uranium X were presented by Dr. Gray. Five new fellows were elected to the Section: Dr. A. N. Campbell, Prof. P. E. Gagnon, Prof. Gordon Pall, Dr. R. M. Petrie and Prof. H. Grayson Smith.

Of the eighty-four papers presented to Section III, twenty-five were by title. Dr. S. A. Hodgson described the seismograph installation at the Lake Shore Mines, Kirkland Lake, Ont., and the results obtained in investigating the possibility of forecasting the rock bursts which are prevalent in that mine. The results of experiments on the vibrations in aircraft, described by Dr. D. C. Rose, indicated the possibility of improvement in the design of such craft. Dr. J. S. Foster reported that he and his associates had obtained some new results in the Stark effect, using copper, nickel, mercury, zinc, cadmium, and lead, and fields from 100 to 250 kv./cm. R. G. Elson, Grayson Smith and J. O. Wilhelm described a new type of calorimeter for determining the specific heats of materials at liquid hydrogen temperatures. Among the results communicated, it was stated that the variation with temperature of the specific heat of manganese can be expressed by a Debye function with a characteristic temperature of 410° and a linear term $0{\cdot}0042\,T$.

A very interesting investigation on the validity of the Ferry-Porter law in normal, enhanced and depressed states of visual sensibility, and the influence of stimulation of the senses of vision, hearing, taste and smell upon the sensibility of the organs of vision were reported by Dr. Frank Allen. It appears that stimulation of one sense causes a periodic rise and fall in another, the results confirming and extending the work of Kravkov. For example, stimulation of the ear by sounds makes red colours appear dimmer and green brighter when no rest interval is allowed, but after a rest interval of three minutes, the red appears brighter and the green dimmer. A number of papers on meteorology by the staff of the Meteorological Office were communicated by the director, John Patterson, who exhibited a new *radio-sonde* instrument by R. C. Jacobsen, now being used by the Service. Dr. L. Gilchrist described geophysical results of electrical drill hole coring carried out with the assistance of A. R. Clark, and Dr. D. A. Keys gave the results of a magnetic survey on Calumet Island. Dr. D. K. Froman described a 12-inch cloud chamber used in a magnetic field for the study of cosmic-ray mesotrons.

Among the fourteen mathematical papers read, Dr. Buchanan spoke on second genus crossed orbits, in which he considered a special case of the restricted three-body problem. Dr. R. L. Jeffery gave a paper on the integration of functions in a complete normed sector space, in which he set forth a theory equivalent to that of G. Birkhoff.

Dr. Gordon Pall delivered a paper on "Simultaneous Representation in Quadratic and Linear Forms", and among several papers read by Prof. Synge attention is directed to a new electromagnetic energy tensor. A direct application of the laws of conservation of energy and momentum leads to the equations of motion given by the Lorentz ponderomotive force, without the radiation term. Dr. W. L. G. Williams communicated the results of an investigation on hyperbolic trigonometry.

In the Chemistry Section, Dr. E. W. R. Steacie and his students presented five papers on photo-sensitized reactions, in which the polymerization of

ethylene was investigated using different wave-lengths in the ultra-violet, and an estimate of the strength of the C–H bond was determined. Dr. P. Gagnon described the synthesis of some new hydrocarbons in the indene series, and Dr. R. H. F. Manske described the structure of hunnemanine. A large number of papers were read by Dr. R. H. Clark and his students. An examination of the phenolic constituents of the water-soluble ethanolysis products of western red cedar, Douglas fir and western hemlock was made, and the oil isolated from the phenolic constituent in each case on methylation with diazomethane yielded a white crystalline compound with the same melting point as that from spruce and maple woods. Another paper described a method for the synthesis and isolation of glycuronic acid.

Prof. Otto Maass was elected president of Section III and Prof. J. K. Robertson secretary.

The feature of the meetings in Section IV (Geological Sciences) was the excellent address of the president, Prof. J. J. O'Neill, on "The Exploitation and Conservation of Mineral Resources in a Balanced Development of Canada". He urged that while the mines are active in Canada's north, bringing men and money into the country, is the time to take preliminary steps toward permanent settlement; otherwise when mines are exhausted the settlements will be deserted and become 'ghost towns'. Each district will have to be considered as an individual problem, and study of these problems should be begun at once. Agriculture in the few areas possible, reforestation to be followed eventually by scientific lumbering, and the development of manufacturing industries near sources of power were some of the possibilities suggested.

Among the twenty-eight papers presented, special mention may be made of one by P. M. Hurley, C. Goodman and R. D. Evans on the investigations of the helium method of age determination. They show that the agreement between the results obtained using samples of pyroxene from specimens is much better than that obtained from determining the age from felspar. It is suggested that pyroxene retains its helium and is more suitable for such age determinations. Dr. A. E. Gill directed attention to the unsatisfactory state of fault nomenclature and suggested certain improvements. As a result, a committee was appointed to study the question and report at the next meeting. J. T. Wilson summarized the results of a study of air photographs covering a large belt of the North-West Territories. The investigation showed this part of the Canadian Shield to be a mosaic of fault blocks, some having horizontal movements as much as eighteen miles.

The presidential address of Section V (Biological and Medical Sciences), entitled "The Causes of Hybrid Sterility and Incompatibility", was delivered by Prof. W. P. Thompson, of the University of Saskatchewan, and stressed particularly the time in the life-cycle at which the causes may operate.

A notable feature of the meeting was the group of papers on fish (and particularly on salmon). Prof. A. G. Huntsman described the habits of Atlantic salmon and discussed deaths due to high-water temperatures in the rivers of eastern Canada, while Prof. E. M. Walker presented the work of K. C. Fisher and P. E. Elson on temperature preference in Atlantic salmon and speckled trout. W. A. Clemens reported A. L. Pritchard's work on the age of coho and spring salmon of British Columbia and his own work on sockeye salmon in the same region. Attempts to explain the origin of kokanee (a variety of sockeye salmon) were made in a paper by W. E. Ricker, reported by R. E. Foerster. The close affinities of the Coregine fishes of Canada with Siberian species were dealt with by J. R. Dymond.

Desiccation in southern Ontario, as reflected in the decreasing mileage of streams, was the subject of a paper by A. F. Coventry, read by J. R. Dymond. This lead to an animated discussion as to the causes of desiccation.

Botanical papers included one by Prof. R. B. Thomson on the study of sporelings in the vascular cryptogams as a basis for the interpretation of seedling organization, another by H. B. Sifton on the development of the air spaces in the leaf of Labrador tea, and two by Prof. E. H. Moss on interxylary cork in Artemisia. Prof. G. W. Scarth summarized work on frost- and drought-resistance carried out with J. Levitt, B. Siminovitch and others and described the changes in the physical state of protoplasm associated with hardening.

James Miller discussed the parts played by the basal and prickle layers of the epidermis in regeneration and neoplasia, and M. L. Barr described the effect on the synapse of axon reactions in motor neurones. C. C. Macklin demonstrated that after over-inflation of the excised lung the internal septa and sheaths of the pulmonary blood vessels are similarly pneumatized. Dr. Benjamin Kropp brought forward much material to demonstrate that in spontaneous and therapeutic abortions structural abnormalities were present in the villus capillaries and villus epithelium. H. Wasteneys, B. F. Crocker and P. Hamilton reported that deuterium-labelled proteins are useful for the study of digestion in the dog. Madge Thurlow Macklin gave evidence that tumours in man have a genetic basis, and Lionel Penrose presented studies on the grandchildren of consanguineous unions. Dr. D. A. Scott discussed the structure of insulin crystals prepared from bison and human pancreases in comparison with those previously prepared from other sources. Dr. Leslie Young described his synthesis of aryl hydrogen sulphates *in vitro*.

Drs. Clark, Cleghorn, Ferguson and Fowler demonstrated that adrenal insufficiency results in a decrease in extracellular fluid and in plasma volume, that the percentage decrease of the former is less than the latter and that the decrease in plasma was not sufficient to account for circulatory collapse. Dr. Bram Rose presented evidence to show that in various types of shock there is a decrease in blood histamine. Dr. N. W. Roome advanced further evidence tending to dissociate the sympathetic nervous system from shock due to hæmorrhage. Prof. F. R. Miller demonstrated the local effects of eserine and acetylcholine on the electrogram of the cerebellar cortex. Dr. P. J. Maloney presented further evidences of the influence of bile salts on the flocculation of toxin. Prof. G. B. Reed described a semi-synthetic medium for the production of gas gangrene and tetanus toxins.

E. Horne Craigie described the area of distribution of the middle cerebral artery in birds and the form of the capillary bed of the central nervous system in Dermophis. J. McDunnough discussed some marine Coleophoridæ, and C. McLean Fraser described hydroids of the Pacific coast.

Other papers dealt with genetics of size (J. W. MacArthur) and the structure of homotypic and somatic chromosomes (L. C. Coleman).

Principal R. C. Wallace, of Queen's University, was elected president of the Society for the ensuing year.

CULTURE *IN VITRO* OF THE EXCISED EMBRYO OF AN OPHIUROID

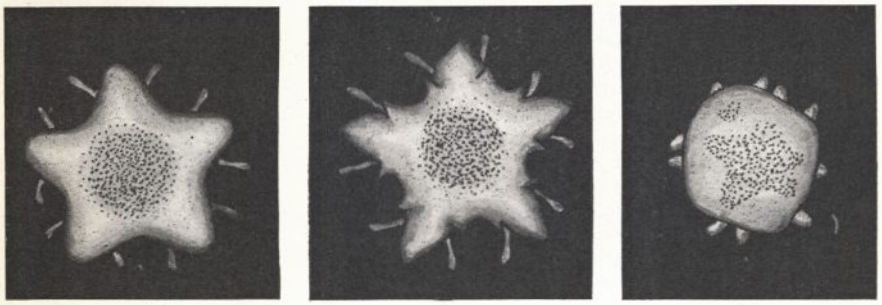
By H. BARRACLOUGH FELL,
DEPARTMENT OF ZOOLOGY, UNIVERSITY OF EDINBURGH

EXCISED embryos of the viviparous ophiuroid *Amphipholis squamata* have been successfully cultured *in vitro* by the method described below. It has been developed in the course of a study of the embryology of the species, and involves a modification of the watch-glass technique of Strangeways as described by Honor B. Fell and Robison[1]. As the culture medium Föyn's "Erdschreiber" has been used; this fluid has been employed previously by Dr. F. Gross for culturing the post-embryonic stages of fish, and various larvæ, and I am indebted to him for suggesting its use in the present instance.

The pregnant adult is anæsthetized by subjection to a solution of menthol in sea water. The embryos are excised from the bursæ and pipetted through several washings of sea water which has been sterilized. Each embryo is then placed in a small watch-glass (5 cm. diameter) and covered by 2–3 c.c. Erdschreiber medium, prepared as described by Gross[2] (p. 754). The watch-glass is set in a larger Petri dish, together with a sterile swab of wet cotton wool to keep the contained air humid, thus minimizing changes in the density of the culture medium through evaporation. The whole 'set-up' is surrounded by a bath of flowing tap water to keep the temperature reasonably constant. In practice, the medium has been renewed every fourth day, but a longer interval can be allowed. Aseptic technique must be used throughout, as the embryos are very susceptible to bacterial toxins. Embryos treated in this way have continued to grow and to differentiate in the usual way as if still within the bursæ of the parent, but with the advantage that the developmental changes can be observed in sequence.

The value of Erdschreiber as a medium for the culture *in vitro* of explanted embryos is demonstrated by the behaviour of controls cultured in the same way, but using as the culture medium sterile sea water which has been allowed to regain its normal oxygen content and *p*H value after sterilization. Freshly explanted embryos so treated appeared healthy and active until the sixth day, when it was observable that the yolk-mass, which is normally confined to the mesendoderm region, was assuming an irregular distribution through the tissues. The movements of the podia were feebler. On the seventh day the embryos had withdrawn the arm-buds and begun to assume a spherical form. Feeble movements of the podia still occurred, but they were shrunken and no longer capable of being used as organs of progression. By the eighth day one of the embryos had assumed the form of a ball of undifferentiated cells from which the vestiges of the podia protruded. In another embryo the cells of the disk had begun to grow out independently as in an ordinary tissue culture, and this condition persisted to the sixteenth day, when death occurred. On the other hand, embryos which had been placed in Erdschreiber at the beginning of the experiment had by the eighth day undergone considerable differentiation, and were moving about actively on the floors of the watch-glasses.

An embryo which had undergone retrograde development in sterile sea water was placed in Erdschreiber on the eighth day. The tissues, however, failed to redifferentiate, and after a period of uncoordinated cell-division, death occurred.



A *B* *C*

A. EMBRYO WHEN REMOVED FROM THE BURSA. *B*. SAME EMBRYO AFTER EIGHT DAYS CULTURE IN ERDSCHREIBER, SHOWING GROWTH AND DIFFERENTIATION OF THE ARMS. *C*. RETROGRADE DEVELOPMENT OF ANOTHER EMBRYO AFTER EIGHT DAYS IN STERILE SEA WATER, HAVING BEEN AT THE SAME STAGE AS *A* WHEN REMOVED FROM THE BURSA.

The development of the embryo will be described later elsewhere. It may, however, be stated here that a comparison of the results of culturing embryos in Erdschreiber and in sterile sea water shows that the embryo is unable to develop on its own yolk material alone, requiring the addition of other substances to the medium. These substances, whatever they may be, are contained in Erdschreiber (an aqueous extract of earth by autoclaving, plus sodium nitrate and disodium hydrogen phosphate). Therefore, we are justified in concluding that the wall of the bursa secretes a nutrient substance which is directly absorbed by the embryo within. This deduction is in agreement with the fact that the bursal wall contains numerous sinuses. In the absence of the necessary substance or substances, the embryo remains for a while apparently healthy, and then undergoes a retrograde development, resulting finally in an amorphous mass of cells. The fact is interesting in that it indicates the closeness of the interrelationship that can exist between parent and embryo in the echinoderms.

[1] Fell, Honor B., and Robison, R., "The Growth, Development and Phosphatase Activity of Embryonic Avian Femora and Limb-buds Cultivated *in vitro*", *Biochem. J.*, **23**, 4 (1929).

[2] Gross, F., "Notes on the Culture of some Marine Plankton Organisms", *J. Mar. Biol. Assoc.*, **21**, 2 (1937).

STEREOPHONIC RECORDINGS OF ENHANCED MUSIC

DEMONSTRATIONS of the stereophonic reproduction of music and speech were given at the Carnegie Hall in New York City on April 9 and 10. This was the culmination of a long series of researches by Bell Telephone Laboratories. The first step in this achievement was demonstrated in 1933, when a symphony concert produced in Philadelphia was transmitted over telephone wires to Washington and there reproduced stereophonically and with enhancement before the National Academy of Sciences. Subsequent researches by Dr. H. Fletcher and his colleagues at the Bell Laboratories have supplied the equipment and technique for recording such a production on film.

With the co-operation of Leopold Stokowski and the Philadelphia Orchestra, the Tabernacle Choir and organists in Salt Lake City, and of Paul Robeson and other artists, their music and drama was recorded both in Philadelphia and in Salt Lake City. At a later audition, the director or artist was able to vary the recorded volume and to change the tonal colour of the music to suit his taste. He could soften it to the faintest pianissimo or amplify it to a volume ten times that of any orchestra without altering its tone quality, or he could augment or reduce the high or low pitches independently. While he was thus enhancing the music which he himself had directed, his interpretation was being re-recorded on film as a permanent record.

Selections for reproduction, chosen to demonstrate the full capabilities of this system, were given. From the choral numbers, vocal solos, organ, drums and grand opera reproduced at Carnegie Hall, the audience gained an idea of the versatility of the stereophonic system. A stirring climax for the programme was provided by the closing scene of the "Götterdämmerung". Dr. Stokowski took full advantage of the tenfold increase of sound over that of the largest orchestra, and effectively used the individual control to make the soloists' voice clearly heard above the orchestra. Dr. Stokowski has shown a full grasp of the possibilities of the new system.

In the *New York World Telegraph* of April 10, L. Biancolli describes a new effect demonstrated at Carnegie Hall. When the light went out all that one saw was a gossamer veil hung across the stage, with a soft red glow playing on it. Then a flute sounded thinly from the distance; a crowd bellowed thunderously; horses galloped by; thunder rumbled; a man talked as he walked from one end of the stage to the other. Then the whole width, breadth and depth of a symphony orchestra went into action. It sounded real, spread out in space. But it all came from a set of sound boxes and horns each functioning separately and in unison. "Dogged research in electricity, acoustics, dynamics had shown one more miracle—spread-out sound coming straight from the source, with no hint of crowding. Drums were at one end, flutes at another and in between other instruments were heard clearly across the stage. There was no blurring, no congestion. Pianissimi were the merest hush and fortissimi had the impact of a cannonade. The trick of giving orchestral music 'position' in recordings and weaving in nuances between nuances is now a perfected fact."

APPOINTMENTS VACANT

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

CIVIL ENGINEERING ASSISTANT—The Waterworks Engineer, Town Hall, Wakefield (August 8).

TEACHER OF MECHANICAL ENGINEERING at the Smethwick Municipal College—The Chief Education Officer, 215 High Street, Smethwick.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Experimental and Research Station, Nursery and Market Garden Industries Development Society, Ltd., Cheshunt. Twenty-fifth Annual Report, 1939. Pp. 60. (Cheshunt: Nursery and Market Garden Industries Development Society, Ltd.) [97

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 799, Vol. 239: The Friction of Lubricated Metals. By F. P. Bowden and L. Leben. Pp. 27+5 plates. 8*s*. 6*d*. Series B: Biological Sciences. No. 571, Vol. 230: On the Evolution of the Mammalian Palate. By F. R. Parrington and Dr. T. S. Mestoll. Pp. 305–355. 8*s*. (London: Cambridge University Press.) [117

Other Countries

Bulletin of the American Museum of Natura History. Vol. 77, Art. 2: A Supplement to the American Land and Fresh-Water Isopod Crustacea. By Willard G. Van Name. Pp. 109–142. (New York: American Museum of Natural History.) [87

Proceedings of the United States National Museum. Vol. 87, No. 3076: Catalog of Human Crania in the United States National Museum Collections—Indians of the Gulf States. By Aleš Hrdlička. Pp. 315–464. (Washington, D.C.: Government Printing Office.) [87

Report for the Year 1939 of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty. Pp. 10. (Cape of Good Hope: Royal Observatory.) [107

Union of South Africa: Department of Agriculture and Forestry. Pamphlet No. 215 (Chemistry Series No. 161): The Bambarra Groundnut or Njugo Bean. By J. M. Holm and Dr. B. W. Marloth. Pp. 10. (Pretoria: Government Printer.) 3*d*. [107

Survey of India. General Report 1939, from 1st October 1938 to 30th September 1939. Pp. xii+83+8 plates+7 maps. (Calcutta: Survey of India.) 1·8 rupees; 2*s*. 6*d*. [117

Triennial Programme of Work for the Forest Research Institute, Dehra Dun, for 1939–42. Pp. 32. (New Delhi: Government of India Press.) [117

Smithsonian Miscellaneous Collections. Vol. 99, No. 4: A Check-List of the Fossil Birds of North America. By Alexander Wetmore. (Publication 3587.) Pp. ii+81. Vol. 99, No. 5: The 11-Year and 27-Day Solar Periods in Meteorology. By H. Helm Clayton. (Publication 3589.) Pp. ii+20. (Washington, D.C.: Smithsonian Institution.) [117

U.S. Department of Agriculture. Circular No. 568: Factors Influencing the Use of some Common Insecticide-Dispersing Agents By Lynn H. Dawsey. Pp. 10. 5 cents. Yearbook Separate No. 1718 Feeding Requirements of Gallinaceous Upland Game Birds. By Ralph B. Nestler. Pp. 893–924. (Washington, D.C.: Government Printing Office.) [117

U.S. Department of the Interior: Office of Education. Know Your School Leaflet No. 53: Know how your Schools are Financed. By Timon Covert. Pp. iii+17. 5 cents. Pamphlet No. 89: Opportunities for the Preparation of Teachers in the use of Visual Aids in Instruction. By Katherine M. Cook and Florence E. Reynolds. Pp. iii+13. 5 cents. Pamphlet No. 90: Opportunities for the Preparation of Teachers in Conservation Education. By Katherine M. Cook and Florence E. Reynolds. Pp. iii+13. 5 cents. Vocational Division Bulletin No. 205 (Business Education Series No. 12): Co-operative Part-Time Retail Training Programs; Supervision, Co-ordination and Teaching. By Kenneth B. Haas. Pp. vii+96. 15 cents. (Washington, D.C.: Government Printing Office.) [117

New York Zoological Society. Report of the Director of the Aquarium. Pp. 30. (New York: New York Zoological Society.) [117

Tanganyika Territory: Department of Tsetse Research. Tsetse Research Report, 1935–1938. Pp. 88. (Dar es Salaam: Government Printer.) 5*s*. [117

Some Problems of the New World Order. By Dr. G. H. Scholefield (Cawthron Lecture, 1939.) Pp. 29. (Nelson: Cawthron Institute.) [117

Trinity College Bulletin. Vol. 37, New Series, No. 2: A List of Books for a College Student's Reading. Edited by Prof. Harry Todd Costello. Third edition, rewritten. Pp. 125. (Hartford, Conn.: Trinity College.) [117

University of Washington Publications in Anthropology. Vol. 8, No. 2: Coos Myth Texts. By Melville Jacobs. Pp. 127–260. (Seattle, Wash.: University of Washington.) [127

University of Illinois: Engineering Experiment Station. Bulletin No. 321: Summer Cooling in the Research Residence with a Condensing Unit operated at Two Capacities. By Prof. Alonzo P. Kratz, Prof. Seichi Konzo, Prof. Maurice K. Fahnestock and Edwin L. Broderick. Pp. 70. 70 cents. Bulletin No. 322: An Investigation of Rigid Frame Bridges, Part 3: Tests of Structural Hinges of Reinforced Concrete. By Ralph W. Kluge. Pp. 34. 40 cents. (Urbana, Ill.: University of Illinois.) [157

"Its accuracy combined with quick reading astounds me," says another user.

The calculating facilities of the Otis King are equivalent to a 66-inch Slide rule, yet it closes up to fit the pocket.

Write for free descriptive pamphlet.

Otis King's Patent POCKET CALCULATOR

CARBIC LIMITED
(Dept. CJ)
51 HOLBORN VIADUCT, LONDON, E.C.1

22/6

LABORATORIES
WITHOUT A SUPPLY OF GAS

should write for particulars of the Mansfield Oil-Gas plant which produces gas in a simple manner from heavy oil, such as paraffin.

The gas produced has a calorific power of about 1,300 B.T.U.'s per cubic foot, and gives perfect oxidising and reducing flames.

The Mansfield plant may be seen in operation in many of the principal laboratories in the British Empire which are out of the reach of a supply of town's gas.

Write for particulars to

MANSFIELD & SONS
9 REDCROSS STREET, LIVERPOOL, 1

INCLINED EYEPIECE
for use with the
MICROSCOPE
Combining Comfort with Efficiency
Full particulars on request.

JAMES SWIFT & SON, Ltd.
Makers of the Highest Grade Microscopes and Accessories
81 Tottenham Court Rd. LONDON, W.1, England

We give good terms for annuities on lives over age 70, e.g. at age 75, £15:8:2% for men, and £12:18:1% for women.

Write 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

PRIORITY

WHY RED CROSS APPEAL TAKES PRECEDENCE

The Red Cross brought order out of chaos on the battlefield. It established that the wounded were to be respected and cared for, that military hospitals were not to be fired on, that nurses and doctors were to be protected and the lives of prisoners spared.

The Red Cross arranges for the exchange of prisoners, traces missing men, repatriates the badly wounded, visits and reports on internment camps and arranges communication between prisoners and relatives.

During and as a result of the last War it spent over £21,000,000. Encourage everybody to support The Lord Mayor's Fund, and send donations to The Mansion House, London, E.C.4, or to the Prisoners of War Fund, St. James's Palace, London, S.W.1.

OFFICIAL ANNOUNCEMENTS

UNIVERSITY COLLEGE OF SWANSEA
(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES)

Principal: C. A. EDWARDS, D.Sc., F.R.S.

APPLIED SCIENCE DEPARTMENTS
METALLURGY

Professor: (Vacant).
Lecturers: R. HIGGINS, Ph.D. (Glasgow); R. GRIFFITHS, M.Sc. (Wales).
Assistant Lecturer: T. B. WILKINSON, Ph.D., B.Eng. (Liverpool).

ENGINEERING

Professor: FREDERIC BACON, M.A. (Cantab.), A.M.Inst.C.E., M.I.Mech.E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, M.Sc.(Bristol), B.Sc.(Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. FORDHAM, Ph.D.(Lond.), A.M.Inst.C.E., M.I.Struct.E.
Lecturer: J. SELWYN CASWELL, M.Sc.(Wales), A.M.I.Mech.E., A.M.Inst.C.E.
Assistant Lecturer: W. E. J. FARVIS, B.Sc.(Bristol).

The College offers a number of exceptional advantages to students who aim at entering upon professional careers in Metallurgy or in Engineering. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The Manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the Works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to works of practical educational value to the students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (*a*) Metallurgy; (*b*) Metallurgical Engineering; (*c*) Civil Engineering; (*d*) Mechanical Engineering; (*e*) Electrical Engineering; and (2) for Diplomas of the College in (*a*) Metallurgy; (*b*) Civil Engineering; (*c*) Mechanical Engineering; (*d*) Electrical Engineering.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College classes provided they satisfy the authorities of the College that they are qualified to benefit by such classes.

Entrance Scholarships will be offered for competition in April, 1941.

Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW,
Registrar.

Singleton Park,
Swansea.

UNIVERSITY OF MANCHESTER
CHEMISTRY COURSES

A Prospectus containing full particulars of the LECTURES and LABORATORY COURSES qualifying for the Degrees in Chemistry will be forwarded on application to the REGISTRAR. Applications for admission to the Research Laboratories should be made to the DIRECTOR of the Chemical Laboratories.

The Session commences on Thursday, September 26.

Wanted—Assistant for research department of

Chemical Plant Manufacturers, to undertake development work of national importance in distillation and allied fields. Really sound knowledge of physical and chemical principles and an aptitude for mathematics essential; research and works experience desirable. Attractive opening for enterprising man.—Write, giving qualification and salary required, to Box 725, T. G. SCOTT & SON, LTD., 63 Ludgate Hill, London, E.C.4.

Lewkowitsch Bibliographical Bureau

(Director: J. Lewkowitsch, B.Sc., A.R.C.S.), Barn House, Barn Hill, Wembley Park, Mddx. (ARN 3956). Abstracts of papers, summaries of literature. bibliographies. Periodical reports of current literature. Bibliographical researches. Chemistry, Biochemistry, Physics, Geology, Botany, Biology. Any language. Accuracy and completeness. Moderate Terms.

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM
The Laboratory, Plymouth

The following animals can always be supplied, either living or preserved, by the best methods:

Sycon; Clava; Obelia; Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Pleurobrachia (preserved); Leptoplana; Lineus, Amphiporus, Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus, Salpa (preserved), Scyllium, Raia, etc.

For prices and more detailed lists apply to:
Biological Laboratory, Plymouth. THE DIRECTOR.

MAN **An illustrated monthly record of Anthropological Science, 2s. net per part, 20s. a year, post free anywhere.**

CONTENTS OF AUGUST ISSUE

An unusual Snake Vessel from South-Central Africa (*with Plate and Illustrated*). The Genetic Relation of the Bark Canoe to Dug-outs and Plank-Built Boats. Gesture, Magic and Primitive Art. Some Notes on a Hungarian Copper Axe-Hammer. (*Illustrated*). Reviews, Correspondence.

THE ROYAL ANTHROPOLOGICAL INSTITUTE
21 Bedford Square **London, W.C.1**

DO YOU READ TECHNICAL or SCIENTIFIC BOOKS ?

HERE IS YOUR "FIRST AID" TO TECHNICAL TERMS.

Your enjoyment in your general reading and intensive study will be increased tenfold by the certainty of understanding which CHAMBERS' TECHNICAL DICTIONARY will afford you.

Every contributor is a university expert and the scope of the Dictionary covers every important branch of science and technology (including):—

ASTRONOMY
BIOLOGY
BOTANY
ELECTRICITY
GEOLOGY
AERONAUTICS
HEAT
LIGHT
MINERALOGY
ZOOLOGY, etc.

CHAMBERS'
TECHNICAL DICTIONARY

980 PAGES.
OVER 45,000 DEFINITIONS.

15/- cash with order, or can be obtained by Globe Easy Payment Terms (at slightly increased cost).

WRITE TO-DAY
for FREE PROSPECTUS and particulars:

To THE GLOBE PUBLISHING CO., Ltd.,
112, Strand, London, W.C.2.

Please send me descriptive folder of CHAMBERS' TECHNICAL DICTIONARY.

Name .....

Address .....

.....

Use Block Capitals.
Unsealed Envelope 1d. stamp.

N.85

NOTICE TO ALL CHEMISTS

and particularly to those earning up to £420 per annum

Under the NEW INSURANCE ACT all Chemists earning up to £420 per annum will be compulsorily insured by deductions from salaries. One reason is given by "The Times" of July 5th, 1940: "much of the security enjoyed by salary earners has been undermined by the war, and the duration of this instability is quite uncertain." If you should unfortunately become unemployed, you can, as a member of the BRITISH ASSOCIATION OF CHEMISTS, retain your professional status, get the benefit of the employment service, the full assistance of your fellow chemists towards obtaining another satisfactory position, and during the period of your unemployment receive your unemployment allowance by cheque from your professional organisation instead of from the Labour Exchange.

The BRITISH ASSOCIATION OF CHEMISTS acts as the agent of the Ministry of Labour for this new service for chemists.

Please remember

there is no competition between the B.A.C. and the three chartered bodies—The Chemical Society, Society of Chemical Industry, and the Institute of Chemistry—on the contrary, every member of the B.A.C. is urged to support these Societies.

The B.A.C. concerns itself—when the Council is satisfied that you are a competent chemist—only with your economic needs—its solicitor will advise you on your Agreement for service—its LEGAL AID FUND and long experience are at your service to settle disputes—its EMPLOYMENT SERVICE will assist in finding suitable and properly paid employment and its UNEMPLOYMENT FUND WITH A RESERVE OF £21,000 will administer the compulsory unemployment service on behalf of the Ministry of Labour, and, in addition, pay the added benefits for which every member contributes.

For a payment of £6 10s. 0d. per annum paid by National Insurance Stamps (£2 3s. 4d. by the contributor, £2 3s. 4d. by the employer, £2 3s. 4d. by the State) you receive unemployment allowance of £1 per week.
For every multiple of £1 10s. 0d. per annum paid to the B.A.C's Unemployment Fund you receive 17s. 6d. per week (£1 per week after five years) during unemployment in addition to the Government allowance, and to members the Government allowance is paid by cheque direct from the B.A.C. The B.A.C. Fund is open also to those earning more than £420 and those now earning less can continue in the B.A.C. Scheme, even when by salary increase they have become ineligible for the Government Scheme.

YOU OWE IT TO YOURSELF—TO YOUR DEPENDANTS—TO YOUR PROFESSION TO

JOIN the B.A.C.

President—Prof. F. G. Donnan, C.B.E., D.Sc., F.R.S., F.I.C. *Hon. Registrar—Prof. E. C. C. Baly, C.B.E., F.R.S., F.I.C.*

ADMINISTERED BY CHEMISTS FOR CHEMISTS

To C. B. Woodley, F.C.R.A., F.C.I.S., General Secretary
THE BRITISH ASSOCIATION OF CHEMISTS
Empire House, 175, Piccadilly, London, W.1

Please send me details of the B.A.C. Unemployment Insurance Fund.

Name ..... *Degrees*.....

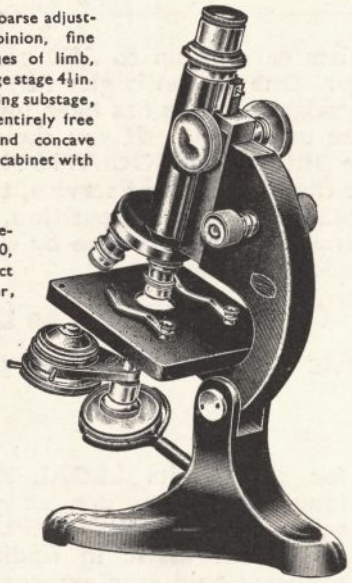
Address .....

.....

BECK
LONDON MICROSCOPE
Model No. 29B

Large and heavy stand, coarse adjustment by rack and pinion, fine adjustment on both sides of limb, adjustable draw-tube, large stage 4½in. square, spiral screw focusing substage, of a very heavy design entirely free from flexure, plane and concave mirrors, contained in oak cabinet with lock and key.

Outfit consisting of:
Stand in cabinet, 2 eyepieces, × 6 and × 10, ⅔ in. and ⅙ in. object glasses, Abbe condenser, iris diaphragm, triple nosepiece,
£15 19 0



Outfit as above with addition of 1/12 in. oil immersion object glass and mechanical stage,
£26 19 6

Full descriptive price list on application

R. & J. BECK, LTD., 69 Mortimer St., London, W.1

Members Scientific Instrument Manufacturers' Association of Gt. Britain

REPAIRS

TO

MICROSCOPES
AND OBJECTIVES
MICROTOMES
OPTICAL PROJECTION
AND OTHER APPARATUS

EXPERIMENTAL APPARATUS
MADE TO REQUIREMENTS

ESTIMATES SUBMITTED

HAWKSLEY & SONS, LTD.
17 NEW CAVENDISH ST., LONDON, W.1

Telephone: WELbeck 3859
Telegrams: Diffract, Wesdo, London

W. WATSON & SONS, LTD.
MANUFACTURERS OF MICROSCOPES FOR ALL PURPOSES and ALLIED APPARATUS

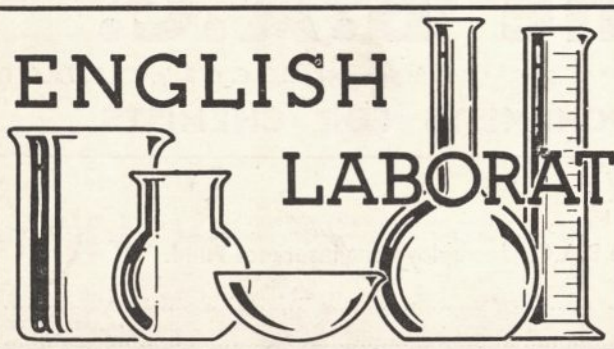
for every form of Scientific Investigation, Manufacturing Control, etc.

OPTICAL ELEMENTS AND OPTICAL SYSTEMS.
ALL OPTICAL AND SCIENTIFIC INSTRUMENTS.

TEMPORARY HEAD OFFICE to which enquiries should be addressed :—
14, HADLEY GROVE, HIGH BARNET, HERTS.

Cables : Optics, Barnet. Telephone : Barnet 2568.

ENGLISH LABORATORY GLASSWARE



REGISTERED TRADE-MARK

HIGH-RESISTANT BEAKERS AND FLASKS OF FIRST QUALITY.
SCIENTIFICALLY CALIBRATED VOLUMETRIC GLASSWARE.
THE WIDEST RANGE OF BRITISH MANUFACTURE.
SOLE AGENTS FOR INDIA: ADAIR, DUTT & CO. LTD., CALCUTTA, BOMBAY, MADRAS.

ESTABLISHED 1828

E. SYKES

WOOD BROS. GLASS CO. LTD. BARNSLEY.

Printed in Great Britain by FISHER, KNIGHT & CO., LTD., The Gainsborough Press, St. Albans, and published by MACMILLAN & CO., LIMITED, at St. Martin's Street, London, W.C.2, and THE MACMILLAN CO., 60-62 Fifth Avenue, New York—Saturday, August 3, 1940.