

# SCIENCE

VOL. 92

FRIDAY, SEPTEMBER 27, 1940

No. 2387

*Reactions Produced by Neutrons in Heavy Elements:*  
DR. ENRICO FERMI ..... 269

*Mental Health:* DR. ADOLF MEYER ..... 271

*Obituary:*  
Hans Zinsser: DR. RICHARD P. STRONG ..... 276

*Scientific Events:*  
*Pollution Investigations of the Fisheries Service;*  
*The Medicofilm Service of the Army Medical Li-*  
*brary; The Sealing of the Time Capsule; Scientific*  
*Lectures of the College of Physicians of Philadel-*  
*phia; The American Ornithological Union; The*  
*American Mathematical Society* ..... 279

*Scientific Notes and News* ..... 282

*Discussion:*  
*Rhesus Monkeys (Macaca Mulatta) for American*  
*Laboratories:* DR. C. R. CARPENTER. *Musca Do-*  
*mestica and Hippelates Flies—Vectors of Bovine*  
*Mastitis:* DR. D. A. SANDERS. *Evidences of Pleis-*  
*tocene Currents in Peninsular Florida:* DR. ROY E.  
DICKERSON. *The Use of the Terms Polygamy,*  
*Polygyny and Polyandry:* DR. DAVID E. DAVIS ..... 284

*Scientific Books:*  
*Statistical Mechanics:* PROFESSOR GEORGE E.  
UHLENBECK ..... 287

## Special Articles:

*The Autonomic Basis of Emotion:* PROFESSOR E.  
GELLHORN, R. CORTELL and J. FELDMAN. *The Ex-*  
*traction of a Carcinogenic Factor from Primary*  
*Human Mammary Cancer:* DR. JOHN F. MENKE.  
*Insect Life without Vitamin A:* DR. R. E. BOWERS  
and PROFESSOR C. M. MCCAY ..... 288

## Scientific Apparatus and Laboratory Methods:

*A Differential Metal Bellows Manometer for the*  
*Measurement of Blood Flow:* DR. HAMPTON LAW-  
SON ..... 291

*Science News* ..... 10

SCIENCE: A Weekly Journal devoted to the Advance-  
ment of Science, edited by J. MCKEEN CATTELL and pub-  
lished every Friday by

## THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal

Annual Subscription, \$6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Associa-  
tion for the Advancement of Science. Information regard-  
ing membership in the Association may be secured from  
the office of the permanent secretary in the Smithsonian  
Institution Building, Washington, D. C.

## REACTIONS PRODUCED BY NEUTRONS IN HEAVY ELEMENTS<sup>1</sup>

By Dr. ENRICO FERMI

PROFESSOR OF PHYSICS, COLUMBIA UNIVERSITY

THE nuclear reactions produced by neutron bom-  
bardment in heavy elements can be conveniently de-  
scribed, according to Bohr, with the assumption that,  
as soon as the bombarding neutron strikes the nucleus,  
it is incorporated into the nuclear structure with the  
formation of the so-called compound nucleus. This is  
a relatively stable system in the sense that its lifetime  
is very long compared with the frequencies of nuclear  
particles; in an absolute sense, however, the lifetime  
is very short, being sometimes of the order of  $10^{-12}$   
seconds and sometimes much less.

The ultimate result of the nuclear reaction depends

<sup>1</sup> Presented in a symposium on "Nuclear Physics," at  
the University of Pennsylvania Bicentennial Conference,  
September 19.

upon the way in which the compound nucleus further  
disintegrates. And this mode of further disintegra-  
tion depends in its turn, for any given nucleus, essen-  
tially upon the energy content of the compound  
nucleus. When the bombarding neutrons are slow the  
energy of the compound nucleus is equal to the bind-  
ing energy of the neutron in the nucleus. Apart from  
irregular fluctuations from nucleus to nucleus, this  
binding energy has a general variation with the atomic  
number and is a maximum for elements of atomic  
weight about 40 where it is in the average about 9 Mev.  
From there on it decreases more or less regularly up  
to the heaviest elements where it attains an average  
value of about 5 Mev. If the bombarding neutrons

sleeve was cut out as shown in the sketch, and fastened to the free face of each bellows with a small amount of solder. Maximum range is secured for the couple by mounting the bellows under minimum compression. The fulcrum which carries the recording lever is adjustable on the short rod *d*. The recording lever and its axle are shown only in the lateral view in Fig. 1.

When coupled in this fashion, the elongation of each bellows for a given rise in pressure is reduced by one half, pressure in the other member of the pair remaining constant. Thus, with the diameter and flexibility given above the volume change for a pressure rise of 100 mm Hg is approximately 0.87 cc. Under most conditions the time required for the displacement of

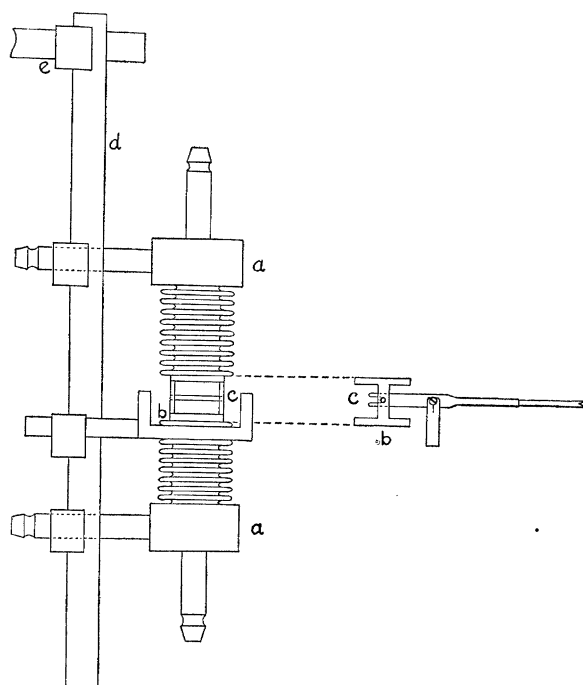


FIG. 1

this volume of fluid does not constitute a serious error. Unless pressures high enough to produce lateral deformation are employed, the behavior of the firmly joined apposed faces resembles that of a single elastic membrane, in response to pressure differences in the two members of the couple. Equal pressure increases in either member, pressure in the other remaining constant, will produce equal and opposite movements of the writing point from the zero line, regardless of differences in the separate flexibility of the two bellows. Furthermore, since fluid displacement for a given pressure change is equal in the two members, resistance to flow anywhere in the system has the same effect as resistance anywhere else.

The use of this type of manometer as a flow-meter for arterial blood flow was described in the earlier report. Water is used for filling the bellows and tub-

ing, rather than citrate solution, as the latter corrodes the metal bellows. After cannulation and filling of the apparatus is complete, 5 per cent. chlorazol fast pink solution is injected into the cannulae and adjacent tubing as an anticoagulant. In filling the lower bellows, air is evacuated by rotating the couple on the rod *d* in the clamp *e* until the lower bellows is uppermost.

With arterial pressure acting on both bellows, there is usually a fairly wide swing of the writing point with each pulse wave, due to delayed arrival of the wave at the lower cannula. Up to a frequency of about 40 per min. in hydrostatic systems, equal but asynchronous pulsating pressures in the two bellows produce equal oscillations of the writing point about the true mean. With higher frequencies, such as occur in the arteries, there may be an error as great as 2 mm Hg in reading the true mean.

When the constricting clamp is placed on the artery between the two cannulae to permit the use of the apparatus as a flow-meter, the pulse wave as well as mean pressure in the lower bellows is reduced, and the now weakly opposed waves in the upper bellows produce large oscillations of the pointer. The legibility of the record may be improved by damping these with a screw clamp applied to the tubing leading to the upper bellows. The reading of the mean pressure difference is not affected by such damping.

The force acting at the apposed faces is approximately 5.85 gm for a pressure difference of 1 mm Hg. This permits the use of magnifying recording levers, giving 50-100 times magnification on the record. With a light lever giving a magnification of approximately 100 times, the apparatus in use has a period of 0.3 sec. Since this is of the same order as the natural period of most mercury manometers, the apparatus can indicate flow changes with such cyclic circulatory phenomena as can be recorded with a mercury manometer. The accuracy with which it records these is about the same as the accuracy of the usual laboratory mercury manometer in indicating pressure changes.

HAMPDEN LAWSON

UNIVERSITY OF LOUISVILLE  
SCHOOL OF MEDICINE

## BOOKS RECEIVED

- CURTMAN, LOUIS J. and SYLVAN M. EDMONDS. *Calculations of Qualitative Analysis*. Pp. vii+156. Illustrated. Macmillan. \$2.00.
- JONES, H. SPENCER. *Life on Other Worlds*. Pp. x+299. Illustrated. Macmillan. \$3.00.
- MERRILL, PAUL W. *Spectra of Long-Period Variable Stars*. Pp. ix+107. 6 plates. University of Chicago Press. \$2.50.
- STAIG, ROBERT A. *The Fabrician Types of Insects in the Hunterian Collection at Glasgow University. Part II*. Pp. x+164. 59 colored plates. Cambridge University Press, Macmillan. \$7.60.

## 2 OUTSTANDING SCIENCE DICTIONARIES

### *An Immediate Success* GERMAN-ENGLISH SCIENCE DICTIONARY

By LOUIS DE VRIES  
Professor of Modern Languages, Iowa State College  
With the Collaboration of Members of the  
Graduate Faculty

473 pages, 5 x 7. \$3.00

Widely praised by teachers everywhere, this highly successful dictionary contains 48,000 terms in the agricultural, biological, and physical sciences. Many literary expressions needed by the student in science are included.

#### *Praise for the Book*

"I feel certain that it will meet satisfactorily a definite need in the profession."

Professor WALTER MULFORD  
School of Forestry  
University of California

"This is the sort of publication that we need in our Scientific German courses, even if most of the textbooks have vocabularies. . . . The author, collaborators, and publisher are to be congratulated."

Professor ADOLPH N. BENSON  
Department of Germanic Languages  
Yale University

"I never expected it of any dictionary, but this one is a popular success here—a best seller! It is extremely well liked by students and faculty members, and I should like to repeat my congratulations."

Professor FRITZ MOORE  
Department of Modern Languages  
Kansas State College

"De Vries' German-English Science Dictionary, compiled by specialists in all fields of science under the direction of a competent linguist should find an immediate reception among all scientific workers."

Professor FRANK E. E. GERMANN  
Department of Chemistry  
University of Colorado

### *Just Published* FRENCH-ENGLISH SCIENCE DICTIONARY

By LOUIS DE VRIES  
With the Collaboration of Members of the  
Graduate Faculty

546 pages, 5 x 7. \$3.50

This dictionary of 43,000 entries is, like the German-English Science Dictionary, the first of its kind to include terms of the agricultural, biological, and physical sciences in one compact and handy volume. Intended for students in chemistry, geology, physics, biology, and agriculture, the dictionary contains a wealth of terms pertaining to every branch of these studies, as well as many literary terms. One of the unique features of the dictionary is the inclusion of some 500 common idioms, together with many forms of the present, past, and future tenses, as well as the past participle, with at least one meaning, and the infinitive form in parentheses in case other meanings are desired.

"... the author has done an excellent piece of work ..."

W. N. SPARHAWK, in the  
*Journal of Forestry*

"The work is a real triumph."

Professor FREDERICK GROVER  
Department of Botany  
Oberlin College

"There has been a crying need for just such a volume ..."

Professor HAROLD K. FINK  
California Institute of Technology,  
in *Science*

"It appears to be well suited to its purpose, and should be a boon to the graduate student and researcher alike."

*Ohio Journal of Science*

*Send for copies on approval*

## McGRAW-HILL BOOK COMPANY, INC.

330 West 42nd Street, New York, N. Y.

Aldwych House, London, W.C.2

# NEW WILEY BOOKS

Published Fall 1940



## FUNDAMENTAL CHEMISTRY

By **HORACE G. DEMING**, *Professor of Chemistry, University of Nebraska.*

An elementary textbook which is intended for college undergraduate courses. The important chemical principles are presented in logical order, progressing from the simple to the complex. The purpose of the book is to reveal the spirit of modern chemistry and to give a brief survey of its achievements.

756 pages

6 by 9

\$3.50

## POULTRY BREEDING

By **MORLEY A. JULL**, *Head of Poultry Department, University of Maryland.*

The many advances in breeding methods, rearing, feeding and kindred subjects are reflected in the completely revised second edition of this comprehensive book. Numerous new sections have been included to cover these recent developments, and much of the content has been rewritten.

Second Edition

484 pages

6 by 9

\$4.00

## ATLAS OF OUTLINE DRAWINGS OF THE DOGFISH SHARK, THE NECTURUS, AND THE CAT, FOR VERTEBRATE ANATOMY

By **SAMUEL EDDY**, *Associate Professor of Zoology*; **CLARENCE P. OLIVER**, *Associate Professor of Zoology*; and **JOHN P. TURNER**, *Assistant Professor of Zoology*; all at the *University of Minnesota*.

Outline drawings to accompany the authors' manual "A Guide to the Study of the Anatomy of the Shark, the Necturus and the Cat." The "Atlas" is noted for the excellent details of the skeleton, its arrangement according to animal forms rather than systems, and the large number of drawings included.

69 sheets

8½ by 11

\$1.50

## THE CHEMICAL CONSTITUTION OF NATURAL FATS

By **T. P. HILDITCH**, *Campbell Brown Professor of Industrial Chemistry, University of Liverpool.*

In this volume the natural fats are considered as a group of natural organic compounds and are treated primarily from the standpoint of their chemical constitution. The fats are classified on a biological basis because of the close connection between their component acids and their biological source.

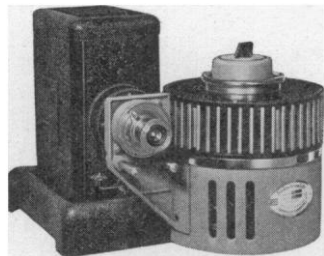
438 pages

6½ by 10

\$6.50

# JOHN WILEY & SONS, INC.

440 FOURTH AVENUE, NEW YORK, N. Y.



## Laboratory Selectroslide

*Projects Your Film Slides Perfectly  
By REMOTE CONTROL*

**F**OR laboratory or lecture room, Selectroslide, automatic slide changer, projects your 35mm natural color or black-and-white film slides up to any size. Change slides automatically by remote control. No assistant is necessary. Error in projection impossible. Your slides projected in clear, sharp detail.

*Write for descriptive catalogue*

**SPINDLER & SAUPPE, INC.**

86 Third Street, San Francisco, Calif.

Branch Office: 811 West 7th St., Los Angeles

## NEW BOOK AND INSTRUMENT CATALOGUES

**APPLETON-CENTURY COMPANY, D.**, New York. *Fall Books, 1940.* Pp. 56.

**DUPONT DE NEMOURS AND COMPANY, E. I., INCORPORATED**, Wilmington, Delaware. *The Neoprene Notebook 25; Facts About Neoprene for the Engineer.* Pp. 105-112. Illustrated.

**HARVARD UNIVERSITY PRESS**, Cambridge, Massachusetts. *Announcements of Harvard Books for the Autumn of 1940; Preliminary Edition, July 22, 1940.* Pp. 36.

**INTERNATIONAL NICKEL COMPANY, INCORPORATED.** *Inco, Vol. 17, No. 2.* Pp. 37. Illustrated.

**MACMILLAN COMPANY**, New York. *Fall, 1940; New Books, Final List.* Pp. 194.

**MONSANTO CHEMICAL COMPANY**, St. Louis. *Monsanto Magazine, September, 1940.* Pp. 35. Illustrated.

**OXFORD UNIVERSITY PRESS**, New York. *New and Forthcoming Books, Fall, 1940.* Pp. 69. *New Books, September, 1940.* Pp. 24.

**YALE UNIVERSITY PRESS**, New Haven. *Autumn, 1940; New and Recent Books.* Pp. 28.

*Readers are requested to mention SCIENCE when they write for catalogues.*



## For Covering Histological Sections on Slides

These superior media are inert, high-melting, water-white synthetic resins having many advantages over Canada balsam and gum damar. Clarites have proper refractive indices and adhesion to glass, and will neither become acid nor discolor with age. Clarites are pure, uniform, perfectly transparent, and will not cause stains to fade with age because they are absolutely neutral and remain so.

*Clarite and Clarite "X" Resins are available in lumps or ready-to-use solutions.*

Send for booklet "Neville Clarite Mounting Media"

**THE NEVILLE COMPANY**

PITTSBURGH • PA.

## "POSTLIP"

(No. 633 Mill)

## ENGLISH FILTER PAPERS

Manufactured in  
ANNUALLY INCREASING QUANTITIES  
for upwards of 50 years

White and  
Grey Plain,  
Antique,  
Crinkled,  
and  
Embossed



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

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

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

**EVANS, ADLARD & CO., Ltd.**

POSTLIP MILLS,

WINCHCOMBE, CHELTENHAM, ENGLAND.