

# SCIENCE

VOL. 73

FRIDAY, JUNE 19, 1931

No. 1903

<i>The Uncertainty Principle:</i> PROFESSOR CHARLES GALTON DARWIN .....	653
<i>Serial Literature Used by American Geologists:</i> PROFESSOR P. L. K. GROSS AND PROFESSOR A. O. WOODFORD .....	660
<i>Obituary:</i>	
<i>Memorials; Recent Deaths</i> .....	664
<i>Scientific Events:</i>	
<i>Botanical Research Stations in Africa; The Reforestation Program; The Guatemala Expedition; Appropriations for Grants-in-aid by the National Research Council</i> .....	665
<i>Scientific Notes and News</i> .....	667
<i>Discussion:</i>	
<i>New Ostracoderms from Oesel:</i> PROFESSOR WILLIAM PATTEN. <i>The Occurrence of Old Meadow Sod under the New Jersey Beaches:</i> HORACE G. RICHARDS. <i>Twisted Trunks of Apple Trees:</i> PROFESSOR BERTRAM T. BUTLER. <i>Early Utilitarian Application of Twist in Trees:</i> DR. LLEWELLYN N. EDWARDS. <i>Panaman:</i> DR. CARLETON R. BALL. <i>Cure for Formalin Poisoning:</i> VESTA HOLT. <i>Barro Colorado Island Biological Station:</i> DR. W. C. CURTIS .....	671
<i>Quotations:</i>	
<i>The Capper Award</i> .....	676
<i>Societies and Academies:</i>	
<i>The Illinois Academy of Sciences; The Tennessee Academy of Science</i> .....	677

*Scientific Apparatus and Laboratory Methods:*  
*A Transparent Elastic Glue Used in Making Chambers for Insertion in the Rabbit's Ear:* B. B. VARIAN. *Cellophane Covers for Petri Dishes for Keeping out Contaminations and Studying the Effects of Ultra-violet Light:* FRANK H. JOHNSON 678

*Special Articles:*  
*The Effects of Breed on Growth of the Embryo in Fowls and Rabbits:* DR. W. E. CASTLE and PROFESSOR P. W. GREGORY. *The Effect of Diet on Hookworm Infestation in Dogs:* A. O. FOSTER and DR. W. W. CORT. *Further Studies on the Adrenal Cortical Hormone:* DR. G. A. HARROP, DR. J. J. PRIFFNER, DR. A. WEINSTEIN and DR. W. J. SWINGLE ..... 680

*Science News* ..... 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. McKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal  
Lancaster, Pa. Garrison, N. Y.  
Annual Subscription, \$6.00 Single Copies, 15 Cts.

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

## THE UNCERTAINTY PRINCIPLE<sup>1</sup>

By Professor CHARLES GALTON DARWIN

UNIVERSITY OF EDINBURGH

WE have seen that direct experimental evidence pointed to electrons being waves, in the sense that when we send a stream of them through two holes, we can only explain the result by supposing that, like a wave, each electron goes through both holes. We saw, moreover, that if a patch of wave-disturbance in a medium never encounters small obstacles it keeps together as it travels, and behaves in this way like an individual, which is what we think the characteristic of a particle. So we might at first sight be tempted to think that we had got a quite satisfactory and complete view of the character of an electron merely as being a wave of very short wave-length. But a little consideration shows that this will not do.

In the first place we have seen that though a patch of disturbance travels along as an individual with the

<sup>1</sup>The fourth of the series of lectures on "The New Conceptions of Matter," delivered at the Lowell Institute on March 27, 1931.

definite group-velocity, there is always a region round its edges where the disturbance is slowly spreading. There is no way in which a wave can escape this gradual diffusion, and it means that ultimately it will become spread all over space. The rate of diffusion is smaller the larger the volume over which the waves are spread, so that it would be very slow for matter in bulk, and such waves would keep together a considerable time, but still they would not do so forever. Even if we regarded the world as originally created in well-defined "wave-packets," they would certainly by now have spread indefinitely. We may say that the existence of fossils which have preserved their form unchanged for several hundred million years disproves the adequacy of the wave theory.

But the matter is worse than this, since we can do other experiments which seem immediately to disprove the validity of the wave-theory. There exist substances which have the property of *scintillation*

## BOSTON UNIVERSITY SCHOOL OF MEDICINE

ORGANIZED IN 1873

### ANNOUNCEMENT

may be obtained by application to

THE REGISTRAR

80 East Concord Street

Boston

Massachusetts

## CARNEGIE INSTITUTION OF WASHINGTON

Publications of the Institution present in monographic form the results of its own research activities, and include a few books on other subjects.

Nearly 600 volumes have been issued, representing studies in the following fields:

Archaeology	History
Anthropology	Literature
Astronomy	Mathematics
Biology	Nutrition
Botany	Palaeontology
Chemistry	Palaeography
Ecology	Philology
Economics	Physics
Embryology	Terrestrial Magnetism
Genetics	Zoology
Geology	

Descriptive lists and prices may be obtained by addressing:

**CARNEGIE INSTITUTION OF WASHINGTON**  
WASHINGTON, D. C.

## School of Medicine and Dentistry University of Rochester

Medical School, Strong Memorial Hospital, School of Nursing and Out-Patient Department of the University of Rochester and the Municipal Hospital of the City of Rochester, all under one roof. Medical, Surgical, Obstetric, Pediatric, Dental, Contagious and Neurological patients admitted. Unusual opportunities for school and hospital coöperation in medical and graduate dental teaching.

### Admission

Medical candidates must have completed three years of college work with special requirements in chemistry, physics and biology. The entering class will not exceed 50, men and women being admitted on equal terms.

### Tuition

Charge for tuition will be \$400 per annum, payable in equal installments at the beginning of each semester.

For information address

**THE DEAN**  
School of Medicine and Dentistry  
Crittenden Boulevard, Rochester, N. Y.

## THE WISTAR INSTITUTE BIBLIOGRAPHIC SERVICE

A condensed summary of each paper appearing in the journals listed below is issued prior to publication of the article in full. This distribution of abstracts enables a biologist to familiarize himself with *contemporary research* in a minimum of time, and to select the articles which he wishes to purchase in reprint form. To receive these abstracts he may subscribe to the Advance Abstract Sheets or to the Bibliographic Service Cards.

The Advance Abstract Sheets are issued twice a month, each sheet containing ten or more abstracts, together with the price per reprint. Subscription rate is \$3.00 per year.

The cards also are issued twice a month. In addition to the abstracts, the cards provide subject headings and complete bibliographic reference. The cards are convenient for filing and library records. Price, \$5.00 per year.

At regular intervals the abstracts are assembled and published in book form with complete analytical index. Price, \$5.00 per volume.

**Journal of Morphology and Physiology**  
**The Journal of Comparative Neurology**  
**The American Journal of Anatomy**  
**The Anatomical Record**  
**The Journal of Experimental Zoology**  
**American Anatomical Memoirs**  
**American Journal of Physical Anthropology**  
**Folia Anatomica Japonica** (Tokyo, Japan)  
**Physiological Zoology** (Chicago, Illinois)  
**Stain Technology** (Geneva, New York)  
**Ecological Monographs** (Durham, North Carolina)

**The Wistar Institute of Anatomy and Biology**

Thirty-sixth Street and Woodland Avenue  
Philadelphia, Pa., U. S. A.

## Latest McGraw-Hill Books

### Recording Sound for Motion Pictures

Edited by LESTER COWAN for the Academy of Motion Picture Arts and Sciences. 404 pages, 6 x 9. \$5.00.

The material for the courses at the Academy of Motion Pictures, Arts and Sciences has been expanded and revised and is now offered in book form. The book includes discussions of sound recording equipment, the film record, the technique of studio acoustics and sound reproduction.

### Lohmann's Principles of City Planning

By KARL B. LOHMANN, Professor of Landscape Architecture, University of Illinois. 395 pages, 6 x 9, 153 illustrations. \$4.00.

A carefully organized discussion of the elements and principles of the various branches of city planning. The book takes up the scope of such work, its importance, its possibilities and means of accomplishment.

### Newton's Opticks: or a Treatise of the Reflections, Refractions, Inflections and Colours of Light

By SIR ISAAC NEWTON. Reprinted from the fourth edition. With a Foreword by PROFESSOR ALBERT EINSTEIN, Nobel Laureate, and an Introduction by PROFESSOR E. T. WHITTAKER. *A Whittlesey House Publication.* 414 pages, 4½ x 7½, 57 illustrations. \$2.50.

This book is an exact reprinting of the corrected fourth edition of *Opticks*, published in London, England, in 1730, three years after Newton's death.

### East's Biology in Human Affairs

Edited by EDWARD M. EAST, Professor of Genetics, Harvard University. *A Whittlesey House Publication.* 399 pages, 6 x 9. \$3.50.

A series of twelve relatively non-technical discussions, by twelve leading scientists, of the present conditions of several of the more important sub-divisions of biology, emphasizing recent advances and expressing a few conservative predictions as to probable future trends.

### Emmons' Geology of Petroleum—*New Second Edition*

By WILLIAM HARVEY EMMONS, Professor and Head of Department of Geology and Mineralogy, University of Minnesota; Director, Minnesota Geological Survey; Formerly Geologist, Section of Metalliferous Deposits, United States Geological Survey. Second edition. 736 pages, 6 x 9, 435 illustrations. \$6.00.

This book is intended as a textbook and manual of the geology and deposits of oil-bearing areas. Essentially all of the world's oil fields are covered, with references to the important literature.

*Send for copies on approval*

**McGRAW-HILL BOOK COMPANY, Inc.**

Penn Terminal Building

370 Seventh Avenue

New York

## Announcing Two New Wiley Books ► IN PHYSICS ◀



### Fundamentals of Electricity and Magnetism By Leonard B. Loeb

*Professor of Physics, University of California*

This volume is designed as a textbook in undergraduate courses in the subject. Emphasis is laid on the fundamental concepts of electricity as developed in the organization of the material around a system of fundamental concepts, three fundamental and three derived, and defining electrical units of measurement in terms of the three systems, electro-magnetic, electro-static, and practical. The book contains an excellent

historical treatment of the development of electricity, and except for the last chapter all equations and formulas are clearly explained. A chapter on the fundamental physics of the photo-electric and thermionic effect is added in order to meet the demand for fundamental knowledge of these subjects. The book contains a set of illustrative problems giving practice in the application of the laws.

432 pages

6 by 9

Price, \$4.00



### The Nature of a Gas By Leonard B. Loeb

This is an exceptionally clear presentation of the essential facts covering atomic and gaseous structure. The volume is brief and concise but gives all the necessary data on the breakdown of solid and liquid dielectrics. The book is developed in an interesting and logical manner and is the only compilation of reliable data on electrical properties of gases. It will appeal to physicists, chemists, electrical engineers and all those who work with electrical problems in

which a gas is either used as insulator or conductor or where its presence modifies the main phenomenon.

This volume is the first of a series of monographs to be published under the auspices of the Committee on Electrical Insulation of the Division of Engineering and Industrial Research, National Research Council, with J. B. Whitehead, Dean of Engineering at Johns Hopkins University, as Chairman.

134 pages

6 by 9

Price, \$2.50



► John Wiley & Sons, Inc. ◀  
440 Fourth Avenue, New York City