

step, another generalization more sweeping than its predecessor. This is the form of progress, but it subsists upon those vital ingredients, the results of accurate observations. These come through the senses and by far the most of them come through vision. A one hundred fold increase in the keenness of vision has been achieved recently through the use of a new instrument. It is not surprising, then, that a great popular as well as scientific interest has been centered upon the electron microscope. It is fitting that a book describing the function and use of this new instrument be written by a scientist who has devoted many years to study in that field of investigation which involves both physics and biology.

This book, as the title indicates, is chiefly concerned with the use of the electron microscope. After a brief discussion of the various kinds of instruments now available here and abroad, and of their relative merits, there follows a chapter on the adjustment of the electron microscope in which features of design and function of the electromagnetic type of microscope and particularly of the types produced by RCA are described in considerable detail. Image formation and malformation are discussed with symptoms of the latter and therapy prescribed. The user hoping to obtain information on electric circuit function will, however, find nothing of this complex phase of microscope adjustment and maintenance. Adequate references are given to American and foreign literature on the subject.

Liberal space is given the subject of preparation of materials for electron microscopy. The advantage gained through the use of electrons is about 100-fold in resolving power over the light microscope but this requires, for full realization, quite new techniques of specimen preparation ranging through the fields of application of the microscope from metallographic studies to those involving the best method preparation of tissue sections in the laboratory of the pathologist. At this time it is the development of such techniques in each kind of work that is progressing with greatest rapidity. Nevertheless, a light microscopist, a bacteriologist for example, will be uncomfortably aware of the fact that the accumulated knowledge on the use of bacterial stains in light microscopy is now of no use to him in electron microscopy. He must use new procedures, and he will probably have to devise more, peculiar to his own field. This section of the book gives good coverage in several fields of application, including the examination of particulate material from paints to viruses, thin section work, surface films, and the manifold replica procedures so generally useful in the study of solid surfaces.

The technique of heavy metal shadow-casting which improves image contrast and adds three-dimensional effects to electron micrographs has added greatly to the usefulness of the microscope. Its application to the preparation of a wide range of subject materials is described in chapter five.

A little over half the book is given to results achieved with the electron microscope with various kinds of materials. It is copiously illustrated with electron micrographs taken by the author himself, and the descriptive material accompanying them is thus the result of firsthand observation. Surface replica work with metals, single crystals, bones, teeth, hair, etc., is shown. Under the head, "Electron Microscopy of Particle Suspensions", several representative pictures are shown, but the emphasis is upon biological subjects, chiefly bacteria. The thirty-two pictures of bacteria illustrate in an impressive manner the advances made possible with the electron microscope in this field. An eleven-page bibliography follows this section.

The final chapters which are perhaps the most interesting from the general point of view deal with the subject of photography of macromolecules. Here those interested in biology, physics, and biochemistry find a common interest. A kind of visual chemistry seems possible when one views directly the giant molecules of hemocyanin or the thread-like molecules of cellulose as they are shown lying in disarray and again forming bands and fibers. Some structural proteins of animal muscle are shown in striking detail. In muscle fibrils is seen the arrangement of the macromolecular constituents. Finally, there are the individual crystals of the tobacco necrosis virus, electron micrographs of which show clearly the three-dimensional symmetry of arrangement of the individual molecules. These pictures reveal directly the type of structure deduced earlier from x-ray analysis and give a kind of confidence in the results that only direct methods can give.

This book will be of general interest, but it will be of special value to one engaged in electron microscope investigation, for it contains the necessary detail described by an investigator who has done the work himself.

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How a Pile Reacts

Elementary Pile Theory. By Harry Soodak and Edward C. Campbell. 73 pp. John Wiley and Sons, Inc., New York, 1950. \$2.50.

During the academic year 1946-1947, Clinton National Laboratories (now Oak Ridge National Laboratory) held a Training School for mature scientists and engineers recruited both from academic institutions and from industrial laboratories. A high point of the Training School Program was the course on Elementary Pile Theory given by Dr. Soodak and written up by Dr. Campbell. The declassified and revised edition of these notes, contained in the present book, captures the spirit and content of the lectures, and serves as a course in the elementary theory of the nuclear reactor.

The level of the presentation is such that a reader with a knowledge of elementary physics and of elementary calculus will have no difficulty in comprehending the subject matter. On the other hand, the discussion is sufficiently accurate that a much more sophisticated reader will find it a suitable introduction to pile theory.

A brief introduction states the basic balance condition for a chain reactor to operate at a steady level of neutron density—"the rate of neutron loss is equal to the rate of neutron production."

The authors then introduce the concept of a cross section, in terms of which the probabilities of various processes involving interactions of neutrons and stationary matter are measured. Next treated is the problem of how a fast neutron, born as the result of a fission process, is slowed down till it reaches thermal energies—energies equal to the thermal agitation energy of stationary matter. This requires a study of the energy lost by a neutron in a collision.

Having treated the energy behavior of the neutrons, the authors attack the question of the spatial motion of the neutrons. This is needed to determine what fraction of the neutrons leak out of the pile. Here, almost immediately, the diffusion approximation is made. First the spatial distribution of monoenergetic neutrons is studied in the diffusion approximation and then the spatial distribution of slowing down neutrons is studied in the diffusion plus Fermi age

approximation. A discussion of the validity of the various approximations used is included.

Having spent over half of the seventy-one pages of text on these basic concepts, the authors consider the pile as a whole. They set up the basic balance equation and show how it is solved in the case of a pile of uniform composition. The treatment of the case of a pile with non-uniform composition is restricted to a pile with a reflector and is carried out on the basis of two-group theory.

The last ten pages of the book are concerned with the problem of pile control and the transient behavior of a pile.

On the whole, this volume is a clear, concise presentation of elementary pile theory with emphasis on large thermal piles. Its most visible lack is a set of references. A further need is a few examples of pile designs. The reader is led to understand how a pile operates, but would have little concept from reading this book of how to design and build a pile.

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Age of the Earth

Report of the Committee on the Measurement of Geologic Time (1948-49). 139 pp. Division of Geology and Geography, National Research Council, Washington, D. C., 1950. \$1.00.

This compilation by a special committee of the NRC reviews the scientific background of the problem of the earth's age and covers all relevant scientific material bearing on the question. Work in progress in various laboratories on measurements of radioactivity, chemical composition, and isotopic composition of minerals is discussed, including both W. F. Libby's carbon-14 method for dating recent geologic time and the measurements made by G. L. Davis on meteorites, dunites, and other natural materials of very low radioactivity. The importance of low activity work in theories of the earth's thermal history is emphasized. A review of the "age of the ocean" problem points out the divergent results obtained by measuring ions in solution if it is assumed that all ocean minerals were first carried by rivers. A record of Japanese analyses of radioactive minerals, 1936-46, appears as an appendix. Also included is a comprehensive bibliography of articles related to the measurement of geologic time.

Books Received

PHOTOGRAPHY IN ASTRONOMY. By E. W. H. Selwyn. 112 pp. Eastman Kodak Company, Rochester, N. Y., 1950. \$2.75.

SOME APPLICATIONS OF NUCLEAR PHYSICS TO MEDICINE. By W. V. Mayneord. Supplement No. 2, British Journal of Radiology. British Institute of Radiology, London, 1950.

HIGH-SPEED COMPUTING DEVICES. By the staff of Engineering Research Associates, Inc., Supervised by C. B. Tompkins and H. H. Wakelin, Edited by W. W. Stifler, Jr. 451 pp. McGraw-Hill Book Company, Inc., New York, 1950. \$6.50.

PHYSICAL CHEMISTRY. By Walter J. Moore. 592 pp. Prentice-Hall, Inc., New York, 1950. \$5.00.

THE CLINICAL USE OF RADIOACTIVE ISOTOPES. By Bergram V. A. Low-Beer. 414 pp. Charles C. Thomas, Springfield, Illinois, 1950. \$9.50.

SOME RELATIONS BETWEEN VISION AND AUDITION. By J. Donald Harris. 56 pp. Charles C. Thomas, New York, 1950. \$1.50.

FIRST PRINCIPLES OF ATOMIC PHYSICS. By Richard F. Humphreys and Robert Beringer. 390 pp. Harper and Brothers, New York, 1950. \$4.50.

AN INTRODUCTION TO PROBABILITY THEORY AND ITS APPLICATIONS. VOLUME I. By William Feller. 419 pp. John Wiley and Sons, Inc., New York, 1950. \$6.00.

THE ACCELERATION OF PARTICLES TO HIGH ENERGIES. (Physics In Industry Series) 58 pp. Institute of Physics, London, England, 1950. 10s. 6d.

FOURIER SERIES. By Werner Rogosinski. 176 pp. Translated by Harvey Cohn and F. Steinhardt. Chelsea Publishing Company, New York, 1950. \$2.50.

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SCIENTIFIC RESEARCH: ITS ADMINISTRATION AND ORGANIZATION. Edited by George P. Bush and Lowell H. Hattery. 190 pp. American University Press, Washington, D. C., 1950. \$3.25.

PHYSICS. By George Shortley and Dudley Williams. 1,271 pp. (In two volumes.) Prentice-Hall, Inc., New York, 1950. VOLUME I. \$6.00. VOLUME II. \$7.35.

PHYSICAL MECHANICS. (2nd Edition) By Robert Bruce Lindsay. 451 pp. D. Van Nostrand Company, Inc., New York, 1950. \$5.00.

INTRODUCTION TO THE TRANSFER OF HEAT AND MASS. By E. R. G. Eckert. 284 pp. McGraw-Hill Book Company, New York, 1950. \$4.00.

NATURE OF PHYSICAL THEORY. By P. W. Bridgman. 138 pp. Dover Publications, New York, 1949. (Princeton University Press, Princeton, New Jersey, 1936) \$2.25.

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SUMMARY OF CONTEMPORARY RESEARCH ON LIGHT, VISION AND VISUAL ENVIRONMENT. 15 pp. Illuminating Engineering Society, New York, 1950. No charge.

TABLE OF POWERS OF COMPLEX NUMBERS. By Herbert E. Salzer. 44 pp. U. S. Government Printing Office, Washington 25, D. C., 1950. \$0.25.

THERMAL EXPANSION OF SOLIDS. 29 pp. U. S. Government Printing Office, Washington 25, D. C., 1950. \$0.20.

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INTERNATIONAL RADIO TUBE ENCYCLOPEDIA. Edited by Bernard B. Babani. 410 pp. British Industries Corporation, New York, 1950. \$6.50.

PROCEEDINGS OF THE FIRST NATIONAL AIR POLLUTION SYMPOSIUM. 149 pp. Sponsored by Stanford Research Institute, California Institute of Technology, the University of California, and the University of Southern California. \$2.50.

WAVE MECHANICS. ELEMENTARY THEORY. (1st American Printing of Oxford University Press 2nd Edition, 1936) By J. Frenkel. 312 pp. Dover Publications, Inc., New York, 1950. \$3.50.

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