ions in dynamics, which were quite at variance with the ideas in the Problems, a gross historical distortion is hereby introduced.

Furthermore, I can think of no excuse—except in books for children—for using wholly imaginary portraits of scientific personages. I am not sure whether this is less excusable in the case of Newton and Galileo, of whom admirable portraits exist, or in the case of the Greeks, where the portraits do not exist at all. Yet here we find a full-page picture of Archimedes, looking like an aging Shakespearean actor, and a sketch of Euclid in a rabbinical cap and beard! All this jovial indifference to historical accuracy can only be defended on pedagogical grounds—Dr. Fraser is a "B. Paed."—with the assumption that it is proper to make a blood sacrifice of one field of knowledge in order to teach another. But even if this were true, which it decidedly is not, the method would defeat itself; for it is precisely the student for whom this book might be intended, the student with a flair for history or social studies but ignorant of physics, who will be disgusted with such childishness, and close the book without discovering its merits and its usefulness for him. The material is far too valuable, and the expositions of elementary science are much too good, for the book to be irreparably damaged by these avoidable and meretricious failings. If the book is successful enough to warrant a later edition, it would not be too difficult to eliminate these blemishes. When this is done, a bibliography and suggestions for further reading should by all means be included.

The "Readings in the Physical Sciences," edited by Professor Shapley and his associates, is likewise intended to promote the cause of general education in the field of science. It contains much interesting material, but it uses the spray or buckshot approach, and its lack of coordination makes it hard to see how it could be used systematically in a college course. The work includes a few lonely classic sources; some historical accounts, like Mr. Conant's admirable analysis of the work of Lavoisier; some good examples of scientific journalism by veterans like Watson Davis, George Gray, and Wolfgang Langewiesche; and some popular accounts of modern developments (President Lee DuBridge on microwaves and Linus Pauling on molecular architecture). There is even a section from David E. Lilienthal's admirable "TVA: Democracy on the March" and a condensation (!) of the Smyth Report. This compendium cannot teach much science or even give much idea of the tactics and strategy of investigation. It is a set of readings *about* science, chosen for their intrinsic, interest-catching appeal. But it is bait for the wholly indifferent, and therefore might be used as the first rung of the ladder. It could, for example, provide some of the first assigned readings in a general science course, and be consulted occasionally thereafter. For both teacher and students the extensive bibliography, divided into historical and technical lists, will certainly prove useful.

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Luminescence

PREPARATION AND CHARACTERISTICS OF SOLID LUMINESCENT MATERIALS (Symposium held at Cornell University October 24–26, 1946). Gorton R. Fonda and Frederick Seitz, editors. 459 pp. John Wiley and Sons, Inc., New York City, 1948. $5.00.

As a record of the first large symposium on luminescence since the 1938 Faraday Society Conference, this volume automatically achieves the status of the most important book on the luminescence of solids in recent years. It might have been an even greater contribution to the understanding of luminescent phenomena and to the advancement of research on this subject had it been possible to include more contributions from foreign workers—the British are represented by only one paper, and the excellent work of the Dutch is completely absent. The book is nevertheless to be highly recommended to workers both in and out of the field.

The general impression obtained from the book as to the present status of phosphor theory is well summarized by Seitz's recommendation in his introductory paper and in the final discussion: "We have only the most rudimentary knowledge of the mechanisms that operate in the various luminescent materials. . . . Practical development is far ahead of our basic knowledge and will remain so unless a larger fraction of the effort placed in the field is focused on the measurement of quantities which can be used in interpretative work . . . particularly if . . . carried out on the simplest materials." In general, this type of research is less compatible with the operation of laboratories devoted to the development of phosphors for various practical purposes than it is with academic research. The book contains ample evidence that university research groups have acquitted themselves nobly in the phosphor field during the war, and should constitute an invitation for more such groups to participate in this field of study.

The physical make-up of the book is good, and the numerous illustrations and graphs are excellent. A subject index might have added considerably to the value of the book as a reference source.

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History of Mathematics

MAKERS OF MATHEMATICS. By Alfred Hooper. 402 pp. Random House, New York City, 1948. $3.75.
MATHEMATICS: OUR GREAT HERITAGE. Edited by William L. Schaaf. 291 pp. Harper and Brothers, New York City, 1948. $3.50.

The purported series of biographies by Alfred Hooper is actually a mixture of biography, history, and conventional technical mathematics through the calculus. The technical material, which occupies at least a third of the book, is textbooky, repetitive of at least a dozen recent popular books on mathematics—two of them by Mr. Hooper himself—and loses the reader in a mass of details. For example over one hundred pages deal with the calculus but the central thoughts and the central contributions of Newton and Leibniz are never clearly stated. Fifty pages on Newton alone deal primarily with the me-

chanics of the calculus. The history throughout the book consists of standard material, much of it of questionable value for laymen. Despite the title, biography is a very small part of the book. Mr. Hooper's style is on the whole simple and readable.

William L. Schaaf's book contains seventeen essays, most of them written by mathematicians and dealing with five subjects: mathematics as an art, the origins of mathematical ideas, the nature of mathematical truth, the relationship of mathematics to science, and the humanistic bearings of mathematics. The essays are very uneven in several respects. Some of the authors are competent to speak for mathematics; others can do no better than quote from people whose knowledge of mathematics and history is to say the least suspect. The literary worth of the essays also runs a wide gamut; the best, in the opinion of the reviewer, are those by J. W. N. Sullivan, G. H. Hardy, and George Sarton. Quite a few of the essays discuss mathematics in such general terms or proffer such advanced concepts by way of illustration that one must question their value to laymen. The various authors repeat each other a good deal. On the whole the collection has rather little to say and reflects either too limited a search or a deficiency of able essayists on mathematics.

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Books Received

FUNDAMENTALS OF PHYSICAL SCIENCE. Second edition. By Konrad Bates Krauskopf. 676 pp. McGraw-Hill Book Company, Inc., New York City, 1948. $4.50.

THE ESSENTIALS OF ORGANIC CHEMISTRY. By C. W. Porter and T. D. Stewart. 394 pp. Ginn and Company, Boston, 1948. $4.00.

PRINCIPLES OF MATHEMATICAL PHYSICS. Second edition. By William V. Houston. 363 pp. McGraw-Hill Book Company, Inc., New York City, 1948. $4.50.

NUCLEAR RADIATION PHYSICS. By R. E. Lapp and H. L. Andrews. 487 pp. Prentice-Hall, Inc., New York City, 1948. $4.50.

MECHANICS. Second edition. By John W. Breneman. 144 pp. McGraw-Hill Book Company, Inc., New York City, 1948. $2.50.

THEORY OF EXPERIMENTAL INFERENCE. By C. West Churchman. 292 pp. The Macmillan Company, New York City, 1948. $4.25.

THE COLLECTED WORKS OF J. WILLARD GIBBS. Two volumes. Reprint. 925 pp. Yale University Press, New Haven, Connecticut, 1948. $8.00.

THE MATHEMATICAL BASIS OF THE ARTS. By Joseph Schillinger. 696 pp. Philosophical Library, New York City, 1948. $12.00.

RADIO AT ULTRA-HIGH FREQUENCIES. Volume II (1940–47). Edited by Alfred N. Goldsmith, Arthur F. Van Dyck, Robert S. Burnap, Edward T. Dickey, and George M. K. Baker. 485 pp. RCA Review, Princeton, New Jersey, 1948. $2.50.

NEWS and VIEWS

Xerography

A new dry method of photography and printing by electrostatics was demonstrated by R. M. Schaffert and Joseph C. Wilson at the annual meeting of the Optical Society of America in Detroit. The process, called xerography, substitutes powders for ordinary developers and ink, and involves no chemical reaction. It was invented by Chester F. Carlson and developed by Battelle Memorial Institute, and the Haloid Company has arranged to use and license it.

In the photographic operation, a sheet of aluminum, or some other electrical conductor, is coated with a photoconductive insulating material and passed under a corona spray which creates an electrostatic surface charge and makes the plate sensitive to light. When this plate is exposed in a camera—or in a contact printing frame—it can be made to reproduce an image because the charge leaks from the photoconductive layer into the aluminum backing wherever light strikes it. Developer powder (a mixture of a coarse carrier material and a very fine resinous material, electrically charged through friction) is then passed over the plate and its oppositely charged particles stick to the image pattern. The plate, which is a negative, can then be printed by putting a piece of paper (or some other material) over it and charging the paper with the corona spray so that it attracts the powder image away from the plate. The resulting print is fixed by heating, which fuses the powder to the paper.

A laboratory model printing machine used in the demonstration printed by xerography at a rate that compares favorably with that of the best newspaper presses. The printing plate may be prepared by the technique just described, by ordinary photomechanical means, or possibly by typing through carbon paper coated with the electrically insulating material. This plate is fastened to a cylinder, which as it turns carries the plate successively through a corona spray, a developing chamber, and under paper (fed into the machine by standard means). Then paper and plate are both charged and the printed paper is sent through a heating unit or a fixative spray.

Mr. Wilson, president of the Haloid Company, emphasized the fact that the process is still incomplete. As its first application, Haloid hopes to bring out a duplicating machine for office use within the next few months. Future plans include a camera that will produce a finished print within a few seconds, and many applications in the graphic arts industry.

Gaseous Electronics

Probably no phenomenon studied by physicists has contributed more to knowledge about the nature of atoms and molecules than electrical discharge in gases. Yet how many readers have a clear conception of the mechanisms in, say, the corona, glow, or arc discharge? In spite of all that has been learned about individual processes, when many are simultaneously active, as in a discharge, the