Geometrical Optics and Electromagnetic Theory

Electromagnetic Theory and Geometrical Optics. Morris Kline and Irvin W. Ray. Interscience (Wiley), New York, 1965. xii + 527 pp. Illus. $15.

This book is an outgrowth of work pioneered by Rudolf K. Luneburg and carried on by members of the Division of Electromagnetic Research of the Courant Institute of Mathematical Sciences at New York University and others. The object of this work was to develop geometrical optics entirely from electromagnetic theory. The work went further in that Luneburg's asymptotic solutions of Maxwell's equations not only gave geometrical optics as their leading terms but provided improvements on it as well.

A detailed history of geometric optics, including the efforts of previous authors since Maxwell to solve Luneburg's problem, is given in the introduction. Luneburg's basic idea lies in associating geometrical optical wave surfaces with surfaces of discontinuity in the electromagnetic field. Rays are defined as trajectories parallel to the direction of energy flow; for isotropic media they are orthogonal to the wave surfaces. Standard geometrical optical concepts such as Fermat's Principle, the eiconol equation, and Huygen's Principle are readily developed. The variation of the field discontinuities along rays are shown to satisfy ordinary differential equations (transport equations). This is an advance over classical geometrical optics and provides an easier method of solution than would be available from the full electromagnetic theory.

The book discusses geometrical optics in isotropic and anisotropic media. It discusses pulse and time-harmonic fields. The asymptotic series development is illustrated first with a dipole and then more generally. The asymptotic series depend on representing a general electromagnetic field, or specifically a time-harmonic field, in terms of integrals involving a pulse field. The series are obtained by integrating these by parts. The discontinuities in the pulse fields contribute to these series in the usual manner. The higher-order terms give corrections to the geometrical-optics fields and make it possible to discuss such nongeometrical-optics phenomena as diffraction. The theory is applied in several other directions, such as to the paraboloidal reflector and to the semi-infinite plane (Sommerfeld problem).

While clearly not a textbook, the book is very lucidly written and should be readily understood by graduate students and some undergraduates with a background in electromagnetic theory, who are specializing in mathematics, physics, or electrical engineering. The methods for improving on geometric optics should make possible some real advances in many problems now too difficult for a complete electromagnetic theoretic development.

EDMUND PINNEY
Department of Mathematics, University of California, Berkeley

Humanistic Scholarship in America

The Origins of American Humanistic Scholars. Robert H. Knapp. Prentice-Hall, Englewood Cliffs, N.J., 1964. xvi + 172 pp. $7.95.

The Origins of American Humanistic Scholars, by Robert Knapp, is a study of the formal educational origins of humanistic scholars. It provides information about undergraduate and graduate schools attended by persons who obtained a doctorate in one of the humanities, defined in this study to include history, English, languages and literature, philosophy, and music and fine arts. Emphasis was on inclusion of scholars rather than creative artists, although some of the doctoral recipients have contributed in both areas. This is a volume in the Princeton Studies of Humanistic Scholarship in America, which is sponsoring a number of volumes about the current status and prospects of humanistic scholarship. Knapp's book differs from most others in the series in providing a comprehensive view of recruitment to the whole field.

This book continues the pattern of studies conducted by Knapp and reported in *The Origins of American Scientists* and *The Younger American Scholar*. It utilizes the doctoral files of the National Academy of Sciences as its primary source of data and describes the schools where humanists got their bachelors degrees, schools where they got their doctors degrees, and the pattern of migration between them.

In his earlier study of scientists, Knapp formulated a "grass-roots" hypothesis to explain the diverse origins of scientists and the predominance of baccalaureate degree origins outside the private high-cost universities. In this newer study, the "Ivy League" hypothesis seems to fit the data best. Humanists are shown to be concentrated, both in their undergraduate training and in their graduate education, in a relatively small number of private liberal arts colleges and private universities located in the northeastern part of the country. Although other universities and colleges in other parts of the country contribute to the supply of humanistic scholars, the high rates of production are found among a relatively few selected liberal arts colleges and universities, mostly in the East.

Knapp has a readable style and presents his statistical information in a manner that should be palatable to nonquantitative humanists among his readers. Unfortunately, there is some sacrifice of clarity and precision of expression in the interests of readability. Some of the comparisons that are important to the understanding of the process of recruitment to the humanities are missing, even though the data necessary for the comparison are readily available. For example, there is a good deal of discussion of the decline in the percentage of persons majoring in the humanities at the undergraduate level, but no information about the long-time trend in the percentage of all doctoral degrees awarded in the humanities. (Doctorates in the humanities have declined from about 20 percent of all doctoral degrees in the 1922 to 1947 period to about 14 percent in the 1948 to 1962 period.)

Knapp's previous studies have been criticized because they did not examine the effects of differences in average student ability in explaining the differences in the productivity of undergraduate schools. His study of the academic origins of humanists is subject to the same limitations, and it is unfortunate that he could not assemble more information about the characteristics and abilities of the students who later became humanists to add to the information about the schools that

were important at the undergraduate and graduate level as producers of humanists. The processes of educational selection and educational and occupational choice are very complex. Knapp has done a good job in presenting one part of the picture in a readable fashion. It would be a more valuable study if he had been able to analyze more of the variables that are important in the process of becoming a humanist. It may seem unfair to criticize a study for something it did not attempt, but the importance of variables like socio-economic background, ability level, and institutional quality have been demonstrated in other research. Failure to include them in this study limits to a considerable degree the importance of the findings.

JOHN FOLGER
Florida State University, Tallahassee

Nuclear Engineering

Numerical Methods of Reactor Analysis. Melville Clark, Jr., and Kent F. Hansen. Academic Press, New York, 1964. xiii + 340 pp. Illus. $10.50.

Numerical Methods of Reactor Analysis is a noteworthy addition to the list of textbooks available for use in educational programs in nuclear engineering. This excellent book, which assumes an intermediate-level familiarity with nuclear reactor analysis and a basic knowledge of differential equations, develops those aspects of numerical analysis most frequently encountered in reactor analysis and discusses specific applications. Emphasis is placed on problem-solving techniques and numerical methods commonly used in the application of digital computers to the solution of problems in reactor physics.

The first three chapters are devoted to matrix theory and numerical analysis. These chapters are sufficiently comprehensive and detailed to provide a self-contained course of study for the nonspecialist. Later chapters describe multigroup diffusion theory, transport theory, and the Monte Carlo method. The Boltzmann transport equation, velocity relations for nuclear events, the moments method for neutrons, and special functions are described in useful appendices. Each chapter is provided with problems that illustrate the material covered or extend the breadth and depth of the coverage. The individual chapters are well referenced. In addition, succinct comments that accompany the reference lists direct the reader's attention to the most fruitful sources for specific topics.

The book is written in a crisp, lucid style that should appeal to the engineer who is interested in the practical aspects of reactor analysis. In general, the material is well chosen and the presentation is factual and objective. One exception is the chapter on Monte Carlo techniques. Here, in my opinion, the discussion of limitations, though appropriate, is overly severe.

Numerical Methods of Reactor Analysis should serve admirably as the principal text for an intermediate-level course in reactor analysis or as a supplementary text for an advanced course in reactor physics. In addition to its usefulness as a textbook, the volume will provide an informative survey for the practicing engineer or an introduction to the field for the would-be specialist in reactor computation.

GEORGE H. MINTON
Reactor Physics and Mathematics Section, Westinghouse Atomic Power Division, Pittsburgh

Book Award

Kirtley F. Mather's *The Earth Beneath Us* (Random House, New York, 1964) has been awarded the Thomas Alva Edison Foundation's tenth Edison award for the best science book for young people. This book was reviewed in *Science* [**147**, 852 1965)].

New Books

Biological and Medical Sciences

Advances in Protein Chemistry. vol. 20. C. B. Anfinsen, Jr., M. L. Anson, John T. Edsall, and Frederic M. Richards, Eds. Academic Press, New York, 1965. 389 pp. Illus. $14.50. Four papers: "Thrombosthenin, the contractile protein from blood platelets and its relation to other contractile proteins" by M. Bettex-Galland and E. F. Lüscher; "Hydrolysis of proteins" by Robert L. Hill; "The unusual links and cross-links of collagen" by John J. Harding; and "The chemistry of keratins" by W. G. Crewther, R. D. B. Fraser, F. G. Lennox, and H. Lindley.

Advances in Radiation Biology. vol. 1. Leroy G. Augenstein, Ronald Mason, and Henry Quastler, Eds. Academic Press, New York, 1964. 295 pp. Illus. $11. Six papers: "Recent research on the radiation chemistry of aqueous solutions" by Harold A. Schwarz; "Physical mechanisms in photosynthesis" by Gordon Tollin; "Effects of intracellular irradiation with tritium" by Donald E. Wimber; "Effects of small doses of ionizing radiations" by Arne Forssberg; "The radiation chemistry of amino acids" by J. Liebster and J. Kopoldová; and "The relative roles of ionization and excitation processes in the radiation inactivation of enzymes" by Leroy G. Augenstein, Tor Brustad, and Ronald Mason.

Advances in Tracer Methodology. vol. 2. A collection of papers presented at the sixth (New York, November 1962); seventh (Los Angeles, March 1963); and eighth (Chicago, November 1963) symposia on tracer methodology plus other selected papers. Seymour Rothchild, Ed. Plenum Press, New York, 1965. 329 pp. Illus. $12.50. Thirty-four papers: Methods for Labeling Compounds (6 papers); Special Analytical Techniques (9 papers); Biochemical Applications (5 papers); Clinical Applications (13 papers); and Health Physics (1 paper); and a paper on the early history of carbon-14.

Bacterial and Mycotic Infections of Man. René J. Dubos and James G. Hirsch, Eds. Lippincott, Philadelphia, ed. 4, 1965. 1039 pp. Illus. $14.50.

Biochemical Aspects of Neurological Disorders. John N. Cumings and Michael Kremer, Eds. Davis, Philadelphia, Pa., 1965 (second series). 336 pp. Illus. $11. Eighteen papers contributed by J. M. Barnes, John N. Cumings, G. Curzon, P. C. Gautier-Smith, R. W. Gilliatt, R. A. Henson, Michael Kremer, Walpole Lewin, Brian McArdle, Vincent Marks, D. M. Matthews, R. J. Pennington, R. T. C. Pratt, Derek Richter, J. A. Simpson, Eliot Slater, R. H. S. Thompson, and John N. Walton.

Biology. Alfred M. Elliott and Charles Ray, Jr. Appleton-Century-Crofts (Meredith), New York, ed. 2, 1965. 895 pp. Illus. $8.50.

The Biology of Tissue Transplantation. Paul S. Russell and Anthony P. Monaco. Little, Brown, Boston, 1965. 217 pp. Illus. $6.75.

The Biosynthesis of Macromolecules. Vernon M. Ingram. Benjamin, New York, 1965. 239 pp. Illus. Paper, $3.95; cloth, $8. Biology Teaching Monograph Series.

Cell Biology. John Paul. Stanford Univ. Press, Stanford, Calif., 1965. 207 pp. Illus. $4.75.

Chemotaxonomie der Pflanzen. vol. 3, *Dicotyledoneae: Acanthaceae-Cyrillaceae*. R. Hegnauer. Birkhauser, Basel, Switzerland, 1964. 743 pp. Illus. F. 123.

Clinical Phonocardiography. Dennis C. Deuchar. Van Nostrand, Princeton, N.J., 1965. 144 pp. Illus. $3.75.

Cold Spring Harbor Symposia on Quantitative Biology. vol. 29, *Human Genetics*. Biological Laboratory, Long Island Biological Assoc., Cold Spring Harbor, N.Y., 1964. 506 pp. Illus. $15. Forty-five papers given at the symposium; the topics included: Population Studies (13 papers); Genetics of Somatic Cells and Cells in Culture (13 papers); and Human Proteins (19 papers).

(Continued on page 554)