

ample, function spaces in chapter 5 and homotopy and isotopy properties in chapter 2). This book is written for mathematically mature students, knowledgeable about basic logic, relations, cardinality, and the like. Quite abstract, it is intentionally shy on examples and illustrations. The student and the instructor must be prepared to provide these along with motivational discussion. The author justifiably prides himself on complete and clean-cut definitions and proofs of everything presented (for example, in chapter 6, "Fundamental groups," the group of a circle is rigorously determined, an uncommon feat in an elementary text).

In my opinion, the intelligibility striven for might be enhanced by leaving out some of the more repetitive details in simpler cases in favor of additional discussion or illustration in more difficult cases. The treatment of product maps could be improved by use of commutative diagrams, and definitions of continuity, exterior, interior, and boundary points simplified by making fuller use of the author's choice of definition of neighborhood. Amazingly, there appear to be practically no errors in the text, except printing errors which are largely confined to some careless typography in the first 25 pages and incorrect cross-references here and there. Interesting and valuable exercises of varying difficulty are abundant. Anyone who absorbs a major portion of the material presented will have an excellent grasp of basic topology.

D. E. SANDERSON

*Department of Mathematics,
Iowa State University, Ames*

Electro-optical Sciences

Principles of Optics. Electromagnetic theory of propagation, interference, and diffraction of light. Max Born and Emil Wolf. Pergamon, London; Macmillan, New York, ed. 2, 1964. xxviii + 808 pp. Illus. \$17.50.

A new optics is being born in the world of science, and, with the possible exception of its impact on technology, it probably has been largely unrecognized. During the last decade or two many of the most dramatic advances made in the field of optics were

directly stimulated by, or originated in, advances in electrical engineering, in its various branches of communication sciences, microwave electronics, and radio astronomy. The operational Fourier-transform treatment of optical image forming processes and of spectroscopy, the introduction of resonant structures and of optical feedback control, the remarkable simplicity of optical computing, communication systems and coherent-background (heterodyne) detection, the exploitation of the statistical and coherence properties of electromagnetic signals and radiations as well as polarization in interferometry and astronomy, the dramatic development of light amplification and control in optical masers and, more recently, the newly dramatic achievements in "lensless" photography and "automatic" character recognition, and nonlinear optics—these are some of the better known examples of the interdependence of theory and techniques throughout broad ranges of the electromagnetic domain: in astronomy, radio astronomy, physics, and electrical engineering. Skillful recognition and exploitation of basic similarities in pursuits throughout the entire electromagnetic domain are proving most fruitful in pinpointing new areas of research and of industrial applications in what may well be called the new field of "electro-optical science and engineering."

Perhaps the single most important element in the rapid development of the electro-optical sciences is the great experimental simplicity resulting from the deliberate use of sophisticated mathematical formulation. To paraphrase C. H. Townes (in *The Age of Electronics*, 1962, edited by C. F. J. Overhage), one may say that the recent dramatic developments in electro-optical science, including the maser, "epitomize the great change that has recently come" over the optics, optical computers, interferometric gratings, lensless photography, optical filters, and automatic "reading" systems, to mention only a few. These developments, which were predicted and worked out "almost entirely on the basis of theoretical ideas of a rather complex and abstract nature," are not inventions or developments "which could grow out of a basement workshop, or solely from the Edisonian approach of intuitive trial and error." They are rather creatures of our present scientific age which have come almost entirely from

modern theory in physics, communication sciences, and indeed in electro-optical engineering.

There is no single text which deals with all of these developments, or even with the "principles" involved. Born and Wolf's *Principles of Optics* was not written to even attempt to do this. In fact, there is hardly a text that on its own could serve as a point of departure for this vast new activity, which has recently attained a \$1 billion mark in the United States alone.

However, the reader who is looking for a masterful treatment of many of the *fundamentals* in *classical* optics, which are no doubt the basis of many of the sophisticated developments that are now at the focus of interest, is not likely to find a book that provides a more rigorous and exhaustive treatment. Another invaluable aspect of the book is the wealth of beautiful mathematical treatments accorded many aspects of optics: diffraction theory, optics of metals and of crystals, and several other subjects such as diffraction of light by ultrasonic waves, interference, and diffraction with partially coherent light. In the 14 chapters and 9 mathematical appendices, there are contributions by A. B. Bhatia, P. C. Clemmow, D. Gabor, A. R. Stokes, A. M. Taylor, P. A. Wayman, and W. L. Wilcock.

GEORGE W. STROKE

*Electrical Engineering Department,
University of Michigan*

On Encyclopedias

The Columbia Encyclopedia. William Bridgewater and Seymour Kurtz, Eds. Columbia University Press, New York, ed. 3, 1963. xii + 2388 pp. Illus. \$49.50.

The Columbia Encyclopedia, which has been in existence for 30 years, is one of our standard reference sources for ready information about a diverse number of subjects. It is especially useful for such information as dates and the principal works of people, names in the Bible, and miscellaneous geographical statistics. Scientists who desire to look up such things as Buddhism, manichaeism, free silver, the names and dates of Canadian prime ministers, minor literary figures, or the population of some inconsequential town will find this a useful reference.