have found many applications in other types of laboratories. The steroids pose special problems to the analyst, and there is probably no class of substances in which chromatography has been of greater importance in securing the advances that have taken place during the last 30 years with respect to our knowledge of their chemistry, biochemistry, and biology. These problems are not completely dispelled by the use of chromatography, however, so many technical details are somewhat different from those encountered in other fields, or are of greater importance in the achievement of satisfactory results. However, workers in other fields will find this book useful because many of the practical details are potentially of great use in the general field of lipids, and some of them in other fields as well.

Neher has done an excellent job in fulfilling the aims expressed in the preface—to provide a full and reliable guide to the practical problems encountered in the chromatography of steroids, but to include only the minimum amount of theory required to support the practical recommendations given. The book also includes a valuable and complete account of the newer methods that have been applied successfully to the steroids (for example, gas-liquid and thin-layer chromatography), and it is notable for the many excellent figures and diagrams with which technical and practical details are conveyed. The thoroughness and completeness with which the literature has been surveyed will also contribute to its value as a reference work, which it will undoubtedly become. The practical instructions will make it extremely valuable to a variety of research workers: those already working on problems of steroid biochemistry as well as newcomers to the field who find that their work demands that they undertake the estimation or separation of steroids. Newcomers, however, would be well advised to seek expert guidance with respect to their choice of methods because the author, in being so thorough, tends to offer a surfeit of possibilities and sometimes errs on the generous side in not suggesting preferences. This is not a serious defect, however, and in most cases useful preferences are suggested.

There are also a considerable number of new details of techniques and interesting results of investigations of existing techniques with which experienced workers may not be familiar, features which will make the book especially interesting to those already working in the field. There are occasional slips in syntax and some abbreviated forms that jar, but on the whole, the book is well written, clear, and very readable. Neher's colleagues will find this volume most useful.

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## Popular Astronomy

**The Flammarion Book of Astronomy.** Prepared under the direction of Gabrielle Camille Flammarion and André Danjon. Translated from the French edition (1955–60) by Annabel Pagel and Bernard Pagel. Simon and Schuster, New York, 1964. 670 pp. Illus. $19.95 until 25 Dec.; thereafter $22.95.

This enormous exposition of modern astronomy comes to us under a very strange banner indeed. The original version of Camille Flammarion's *Astronomie Populaire* appeared in 1880, the first of many successive editions by a man who was one of the 19th century's great engines of scientific popularization. Astronomy has advanced so far beyond Flammarion's time and so many hands have since revised the first edition, that one may question the wisdom of promoting this lavish volume in the name of it's original author. But then this is not quite the case either for, although the title page does not carry the name of an author, the reader is informed that the volume was prepared under the direction of Gabrielle Camille Flammarion, who, together with André Danjon, of the Paris Observatory, reedited the book.

Actually, there are eight subdivisions. The first four, on the earth, the moon, the sun, and the planets, were rewritten by Danjon, with the assistance of A. Dolfus, an expert on lunar and planetary physics, for part of the essay on the sun; the balance (on solar physics) was completed by R. Michard, director of solar research at the Centre National de Recherche Scientifique. Part 5, dealing with comets and meteors, is by F. Baldet of the Paris Observatory; part 6, on the sidereal universe, is by C. Fehrenbach, director of Marseilles Observatory; part 7, on the instruments of astronomy, is by A. Couder of the Paris Observatory; while the last part, on artificial satellites and space vehicles, brings back Danjon, with the assistance of P. Muller, another astronomer on the staff of the Paris Observatory. Finally, it has all been brought up-to-date and translated by Annabel Pagel and Bernard Pagel of the Royal Greenwich Observatory. The original Flammarion has surely disappeared beneath this sea of current effort. Would it not have been better to publish this volume under the names of so distinguished and so qualified a group of collaborators?

As a whole, this detailed, surprisingly complete essay on astronomy is well done. In it's geocentric discourse, the reader leaves the earth for the moon, sun, planets, and the study of the strays of the system—comets, meteors, and meteorites—before the great leap into the sidereal universe. A separate, but not unimportant, appendage is the last two "books," which are devoted to a discussion of astronomical instrumentation from telescopes to rockets and satellites. The illustrations are lavish and adequate enough for the expository task, and there are occasional ventures into the history of astronomy, but, for half the price, and in half the number of pages, Fred Hoyle's recent book (*Astronomy*, Doubleday, 1962) is more than double the value in every respect.

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## Mathematics

**Elements of General Topology.** Sze-Tsen Hu. Holden-Day, San Francisco, 1964. x + 214 pp. Illus. $8.75.

Choose *Elements of General Topology*, by Sze-Tsen Hu, if you wish a top-notch, one-semester, rigorous, and up-to-date presentation of the topological foundation important to serious students of mathematics. The emphasis on, and the excellent choice and effective use of theorems on, mappings, commutative diagrams, and topological identification contribute to the unification and unique utility of this text. Another distinction is the first readily accessible and elementary treatment of CW-complexes (cellular polytopes, in chapter 4). Other recent results previously available only in the literature are incorporated naturally and simply, creating a spirit of freshness (for ex-

ample, function spaces in chapter 5 and homotopy and isotopy properties in chapter 2). This book is written for mathematically mature students, knowledgable 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.

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## 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.

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## 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.