tial theory, including much original work, pertinent to three major methods of effecting asymptotic representations—as rooted in the one-sided and two-sided Laplace transforms and in the complex inversion integral—and various exemplifications of this theory, especially as it can be used to effect asymptotic solutions of boundary-value problems that would be difficult to solve by conventional classical procedures. Other applications range over mathematical topics as diverse as the Gaussian error integral and the prime number theorem and over physical topics as different as current distribution in electric cables and the wave functions of the continuous spectrum of the hydrogen atom.

Part II, "Convergent developments," embraces a short "Introduction" (pp. 201–202) and two chapters: "Gamma-function series" (pp. 203–235) and "Special series" (pp. 236–254). The first-named series play an important role in the solution of difference-equations, numerical analysis (especially in connection with modern, high-speed automatic digital computers), and the asymptotic representation of a major class of Laplace-transforms. The special series treated encompass developments of the Laguerre polynomials and confluent hypergemetric functions in terms of Bessel functions; series developments in terms of Laguerre polynomials, Hermitean polynomials, and confluent hypergemetric functions; and other kindred topics that are of prime interest in numerous branches of classical and modern mathematical physics.

Part III, "Ordinary differential equations," is made up of four chapters: "Ordinary differential equations with constant coefficients in a one-sided infinite interval under prescribed initial conditions" (pp. 255–344); "Ordinary differential equations with constant coefficients in a two-sided infinite interval under prescribed initial and boundary conditions" (pp. 345–363); "Ordinary differential equations with variable coefficients in the domain of the original variable of the Laplace transform" (pp. 363–385); "Ordinary differential equations with variable coefficients in the domain of the transform variable of the Laplace transform" (pp. 386–404).

These chapters comprise a good exemplification of the Laplace-transform for the solution of both ordinary linear differential equations with constant and (certain types of) variable coefficients under prescribed initial or boundary conditions and of systems of such equations. A very desirable conciseness and elegance of treatment of systems of equations is achieved by use of matrix notation, in recognition and support of the rapidly increasing use of such in modern engineering analysis. Illustration of application of this theory is drawn largely from two areas of electrical engineering: basic feedback systems theory (which affords an area for evidencing the usefulness of asymptotic and convergent developments in investigating the stability of both ordinary and dead-time control systems) and ladder-connections of four-terminal networks (which afford excellent opportunity for evidencing the utility of the conjunction of matrix notation with Laplace transform analysis). These applications are complemented by a brief, but excellent, account of the theory of the impulse function in its modern rigorous formulation on the basis of Laurent Schwartz's distribution theory. Since the impulse function plays a central role in modern theoretical physics (under the guise of Dirac's δ-function) and in various branches of engineering (electric network analysis and synthesis, information theory, mechanical vibration theory, and so forth) this section of the text should prove of especial interest to those physicists and engineers who are dissatisfied with the usual sketchy and vague treatments of the δ-function given in most textbooks.

The major context is rounded out by a preface, a short appendix on "Lagrange-Burmänn's theorem," a lengthy "Literatureal and historical commentary" comprising pertinent critical remarks relative to various points of the content, a subject index, and a list of emendations to volume I. A detailed bibliography is not given in this volume; references are keyed to the lengthy alphabetically arranged list of articles and books in volume I and to an additional list which will close out volume III.

The physical aspects of the volume are of superior order: a high-quality paper; sturdy board covers and attractive green cloth binding; superlative typography; well-displayed equations; finely executed line drawings; and a convenient size of page. The textual content is covered in a lucid, easy style that enables rapid grasp of theoretical development and of illustrative example. Finally, the accuracy of theory and completeness of treatment evidence the broadness of knowledge, depth of mathematical originality, and command of exemplification to be expected of the foremost European authority on Laplace transform theory and its application.

Naturally, this book will prove of greatest interest to mathematicians—especially those interested in analysis or applied mathematics, or both. By virtue, however, of the power and usefulness of the Laplace transform for the solution of problems or the development of general theory in all branches of modern-day physics and engineering (as manifested by the illustrative applications drawn from such diverse domains as wave mechanics, vibration theory, information theory, spectral theory, electric network and transmission-line theory, automatic control theory, oscillator and amplifier theory), this volume merits a careful study by all physicists and engineers who wish to keep abreast of the advances in mathematical analysis that underlie the analytic foundations of their own areas of professional work.

Thomas J. Higgins
University of Wisconsin

Topological Dynamics. American Mathematical Society Colloquium Publications, vol. XXXVI. Walter H. Gottschalf and Gustav A. Hedlund. American Mathematical Society, Providence, R.I., 1955. 151 pp. $5.10.

A flow consists of a space X together with a one-parameter group T of transformations of X into itself. Historically, the study of flows arose from the consideration of systems of ordinary differential equations. Poincaré was the first to study such dynamical problems using topological methods; later G. D. Birkhoff undertook a systematic study of the dynamics of flows.

In the present book there is given the first systematic treatment of the work of the last 20 years in topological dynamics. The primary concern in topological dynamics is with "recursive" properties of flows, and of transformation groups in general. In the case of a dynamical system, the study of a particular recursive property arises when one specifies how often a point comes back, as time passes, into any specified neighborhood of the point. Thus there are the periodic points, the almost periodic points, the recurrent points, and so forth.

The book is divided into two parts, the first of which gives the general theory. A feature of this portion is its striking generality. The general framework is that of a (topological) transformation group T operating on a space X. The authors are able to build a theory that generalizes the classical theory and in which T is not only necessarily a one-parameter group, but not even abelian. After preliminary work, in Chapter III the authors define and study the fundamental concept of recursion. There follow specializations of recursion to yield theories of almost periodicity, regular almost periodicity, and recurrence. Next the concept of incompressibility is treated, and its relation to recursive properties is studied. The theory concludes with chapters on transitivity, asymptoticity, and function spaces.

The second part of the book gives the examples. The role of examples in a treatment of topological dynamics is particularly important, since any useful example is not a thing to be studied by casual geometric inspection, but rather by a deep and detailed analysis. There is a detailed study of the symbol spaces of symbolic dynamics, the geodesic flows on manifolds of constant negative curvature, and of cylinder flows.

The general theory portion of the book is undoubtedly hard to read. This is probably inevitable, for the authors have been able to place the theory in an exceedingly general setting; in so doing, they have had to overhaul the vocabulary of dynamics and place the subject in a considerably more abstract setting. Their account of modern topological dynamics should provide a new area of problems for the future development of the subject.

E. E. Floyd
University of Virginia

Histologie und Mikroskopische Anatomie des Menschen. W. Bargmann. Georg Thieme Verlag, Stuttgart, ed. 2, 1956. (Order from Intercontinental Medical Book Corp., New York 16.) 796 pp. Illus. $16.55.

In this second edition, Bargmann has thoroughly revised his well-known textbook of histology and has brought it up to date. The general part on living matter and the tissues opens with a presentation of the methods of investigation, ranging from those applied to living material to those serving for the study of fine structures. In the chapter on the cell, a very good way of introducing the student to the complex structure of cytoplasm was found by dividing the material into cell organelles, paraplasm, metaplasm, and hyaloplasm. One wonders whether the surface and permeability of the cell should not have been given more special consideration in this chapter.

In his presentation of mitosis, the author adopted, to my satisfaction, the distinction between the two types of the spindle and the distinction between metakinesis and diakinesis as the first and second movements of the chromosomes. Statics, kinetics, metabolism, and irritability of the cell are dealt with under the heading of functional morphology. This way of approaching function within the histologist's own domain is one of the characteristic features of the entire book.

The second part, which deals with organs and systems, begins with a significant discussion of growth, differentiation, functional adaptation, and other topics in relation to microscopic anatomy. M. Heidenhain's theory of histiosystems is given its rightful place in this context. The chapter on the salivary glands, usually a somewhat dry subject, is an example of Bargmann's mastery in correlating architecture, vascular pattern, innervation, and functional mechanism of organs. Almost half of the illustrations are taken from studies of the author and his coworker. In selecting electron micrographs, Bargmann correctly refrained from going too far in a book designed for students who have yet to learn how to employ the light microscope, but a few more such illustrations—demonstrating, for example, the fine structure of muscle (H. E. Huxley, who is referred to in the text) and of bone (Robertson and Watson)—would be welcome. In bibliographies at the end of each chapter, both domestic and foreign publications are listed. An index of 20 pages facilitates the use of the book.

Bargmann deserves special thanks for stimulating interest in the history of histology. Portraits of Leeuwenhoek, Schwann, Virchow, Nägeli, Kölliker, Aschoff, Cajal, and Held serve this purpose and are an additional ornament to a book that does much credit also to the publisher. Bargmann's clear, straightforward use of the German language makes for good reading. This is the kind of textbook we like to see in the hands of students in medicine and biology; as the work of a leading histologist and an excellent teacher, it will be appreciated and enjoyed by the expert.

F. Wassermann
Argonne National Laboratory

Science and Information Theory. Leon Brillouin. Academic Press, New York, 1956. 320 pp. Illus. $6.80.

The large and still rapidly growing literature of information-communication-cybernetics now includes hundreds of papers and a number of books. Many of the latter are symposia proceedings in which many specialized contributions, more or less independent of one another, are brought together in one binding. Sometimes there is a grouning about some major central theme, for example, information theory in biology or psychology. Others are engineering textbooks or specialized monographs. Leon Brillouin's book has the merit of combining a unified logical development, such as one hopes for in a textbook, with the breadth of coverage heretofore found in the less coherent, collective kind of compilation. Many of his own contributions are incorporated in the general treatment. The novice will rejoice, and the specialist will sometimes be disappointed, that the presentation is at a mathematical level readily understood by the average physicist or engineer; this entails the omission of a number of advanced topics (for example, most of filter and prediction theory, stochastic processes, ergodic theory).

The book's 20 chapters fall roughly into three parts. The first eight define and apply the concepts of information, redundancy, and channel capacity, give a good treatment of coding problems (including error detecting and correcting codes), and discuss signal analysis (Fourier methods, sampling theorem, Wiener-Khintchine formula, and so forth). Together with Chapter 17, of the third part (in which the effects of noise on channel capacity are discussed), they give a fine presentation of the standard results used in communication theory.

The next eight chapters are concerned with aspects of scientific interest. After three introductory chapters on thermodynamics, thermal agitation, Brownian motion, and noise in electric circuits, two are devoted to the connection between information and entropy, and the problem of Maxwell's demon. The former is called the "negentropy principle of information" and is applied in the last three chapters of this group to general problems of physical measurement, limits of observation, and a discussion of the interactions between informational and quantal limitations on measurement. Many "thought experiments" and physical examples are included. Much of the discussion represents original work by the author. These chapters are at once significant, stimulating, tantalizing, and a little disappointing in that the discussion often concludes when one's interest has been aroused to a high pitch.

The author has carefully avoided questions with much of a philosophic tinge, preferring to discuss concrete physical situations. In my opinion the book would have been more satisfying with more attention given to semantic and methodological questions closely related to the information concept and the operational viewpoint (although perhaps it is unfair to reproach a scientist for not being more of a philosopher).

Many sections should be viewed as posing questions for further investigation and subject to possible future revision. The use of a characteristic length, Δx_T for temperature T, given by hc/kT (approximately $1.44/T$ centimeters) seems to be misapplied occasionally via a semantic slip. It originates (p. 207), in essence, from considering the precision in length measurement obtainable using radiation from a resonator at temperature T. It is then stated (pp. 232–233) that this length is the boundary between