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.

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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.

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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 grouping 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

large (easily measured) distances and small distances, for which one even has trouble giving an operationally defined basis for Euclidean geometry. Since this distance is about 0.005 centimeter at room temperature, this is a very odd result indeed. The slip amounts to confusing the temperature of the *source* of radiation used in measurement with the temperature of the object of interest and is pointed out here because it might bother the many students sure to use the book (and with profit).

The last four chapters comprise further applications to telecommunications (effects of noise, Tuller-Shannon formula), writing, printing and reading, the problem of computing, and a concluding general discussion of information, organization, semantic information, and some other topics. They are clear and well written and should be valuable to students. The fields of the last two chapters are moving rapidly, so much so that they are to be considered more or less introductory to current work rather than as an up-to-date picture.

To sum up, this book is one of the best available introductions to modern information theory and to some of its applications in physics (primarily) and other fields. It is recommended for practicing scientists, graduate students, and mature undergraduates.

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Atoms and Energy. H. W. S. Massey. Philosophical Library, New York, 1956. 174 pp. Illus. $4.75.

This is a book addressed to the layman who is interested in the developments of modern physics, and, although considerable space is devoted to a discussion of the release of nuclear energy, this is not the entire theme of the book. First are sketched the properties of the main building blocks of matter—the electron, the proton, and the neutron—and how these combine to form atoms. The second chapter discusses the combination of atoms and the release of chemical energy, either controlled or explosive, thus providing an analogy for the discussion of nuclear reactions and energy release. The third chapter is a brief description of nuclear physics to 1940, and Chapter 5 describes the large-scale release of atomic (nuclear) energy, including energy production in the stars. Chapter 6 is entitled "Atomic energy in the service of man." Here are discussed the possible applications in biology—for example, production of mutations, therapeutic and diagnostic applications, isotopic tracers—and in atomic power and atomic weapons. The final chapter deals with present research in high-energy physics, including mesons, neutrinos, and positrons, but, of course, none of the exciting events since 1952. The book is easy to read (not a single mathematical equation appears) and the necessary background is certainly not greater than high-school general science. It is, perhaps of necessity, rather sketchy in many places. The style is rather drab, and I failed to feel the excitement that I felt when I read Eddington and Jeans, but perhaps my appetite is now jaded with age. Massey writes from a thorough knowledge of the field, and this book is to be recommended to the reader of limited background in physics who wishes to know something of atomic and nuclear physics.

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Automata Studies. C. E. Shannon and H. McCarthy. Princeton University Press, Princeton, N.J., 1956. 285 pp. $4.

This book, which is a collection of papers on the general subject of automata, presents a picture of the state of research in the field as of 1953, when its contents were assembled. It is divided into three parts: "Finite automata," "Turing machines," and "Synthesis of automata." The papers in the first part show clearly the influence of data from neurological research, dealing mainly with the construction from basic elements, called "neurons," of machines designed to react to any set taken from a finite number of stimuli in any one of a finite number of ways. The papers of the second part represent advances in the now well-known theory of Turing machines. The first two papers deal with universal Turing machines, the third with the question of inversion of functions defined by Turing machines, and the fourth with the influence of unreliable elements on Turing computability.

Various simplifications are inherent in the studies of the first part: components of automata, rather than integrated machines, are studied; the possibility of infinite numbers of inputs and outputs is neglected; time, usually thought of as continuous, is taken to be discrete, the state of components being considered only at discrete moments; components are assigned fixed probabilities of misfiring, when in fact it is more likely that this type of misconduct is random.

These simplifications bear fruit for the studies of the third section, where these parts are combined into larger machines that can react to stimuli in a more complicated way. The first paper in this section considers the automaton as an amplifier that modifies the intelligence of its operator in much the same way that a crane would amplify the energy of its operator. The second paper considers ways in which a machine might be able to represent within itself data from the physical field within which it finds itself. The last two papers deal with conditioned reflexes and temporal and spatial patterns in relation to conditional-probability machines. The investigations of this section are concerned with the logical possibility of constructing given machines out of available parts, and hence exhibit some disregard for questions of economy of time and materials.

The papers in this volume seem appropriately chosen for various reasons. First, they are eminently readable, even to one unschooled in the terminology of the field. Most of the papers contain a good quantity of expository material in which it is explicitly stated what assumptions and what simplifications are being made, and in which is stated the point of view of the author concerning the relation of biology and mechanism. Second, the selection and order of the papers gives the reader insights into many different avenues of approach to the problem of automata. Third, the authors of many of the papers include discussions of the limitations of their work and indications of the numerous matters in which further investigation is needed. To be sure, making the reader aware of the vastness yet to be investigated is one of the book's greater accomplishments.

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Fluid Models in Geophysics. Proceedings of the first symposium on the use of models in geophysical fluid dynamics. Held at Johns Hopkins University, 1–4 Sept. 1953. Robert R. Long, Ed. Sponsored by the Office of Naval Research, Geophysics Research Directorate, and the U.S. Weather Bureau. Government Printing Office, Washington 25, 1956. 162 pp. Illus. $2.25.

Models are used more and more to study problems not easily solved by mathematical methods. In this book's section on "Dimensional analysis and similarity," S. Corrsin (pp. 1–17) summarizes fundamental data about dimensional analysis. G. W. Morgan (pp. 19–26) makes suggestions covering the subject in "Re-