homology theory is assumed given on triangulable spaces; the classical algorithms for computing the homology groups of a complex are then derived from the axioms, and using these, the axioms are shown to be categorical for homology theories on triangulable spaces.

Chapter 4 presents the concepts of category and functor. Chapter 5 makes the step from chain complexes to homology groups. Chapter 6 gives the classical homology theory of simplicial complexes, while in Chapter 7 the singular homology theory is defined and shown to satisfy the axioms. In Chapter 8, direct and inverse systems of groups and their limit groups are considered, as an algebraic preliminary to the development of the Čech homology theory given in Chapter 9; additional properties of the latter are set out in Chapter 10, where it is seen that the addition of a single new axiom characterizes the Čech theory on compact spaces. Two additional homology theories are constructed which are extensions of the Čech theory on compact spaces.

Chapter 11 gives classical applications of homology theory, including the Brouwer fixed-point theorem, invariance of domain, and the fundamental theorem of algebra. The authors state that a second volume is in preparation. The book is excellently written from the axiomatic point of view. R. G. COOKE

Description of a Magnetic Drum Calculator

By the Staff of the Computation Laboratory. (Annals of the Computation Laboratory of Harvard University, Vol. 25.) Pp. xi+318. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1952.) 52*s*. net.

THE publication of complete design information about a large automatic computing machine is something of a problem, partly because of the speed at which the subject has developed in the past decade and partly because of the magnitude of the task. As a result all too few computers are as fully documented as those designed and built at the Harvard Computation Laboratory. Four Harvard machines are now in existence. Mark I, also known as the Automatic Sequence Controlled Calculator, was completed in 1944 and is still in use at the Laboratory. Mark II was completed in 1948 and has since been in operation at the U.S. Naval Proving Ground, Dahlgren, Virginia. Mark III, which forms the subject of this volume, was the first of the series to make use of electronic techniques; it began to operate on a production basis at Dahlgren in 1951. Since that time development has continued and a further machine, Mark IV, has been built and is now working at Harvard.

Much of the logical design of Mark III matches the distinctive pattern established by its two predecessors. The decimal scale is used, and numbers are stored quite separately from instructions. This was one of the earliest machines to employ magnetic drums for internal storage and to exploit the possibilities of magnetic tape as an input/output medium. The nine drums were carefully engineered and use a rather conservative pulse density. A certain amount of checking equipment is built into the machine, which uses a word length of sixteen decimal digits.

Most of this book is devoted to details of the logical design, engineering and circuits of the machine. These are very fully covered and well illustrated. A description of how problems are prepared and presented to the computer is also given, together with some simple examples. E. N. MUTCH

Typical Means

By Prof. K. Chandrasekharan and Prof. S. Minakshisundaram. (Tata Institute of Fundamental Research Monographs on Mathematics and Physics, 1.) (Published for the Tata Institute of Fundamental Research, Bombay.) Pp. xi+140. (London: Oxford University Press, 1952.) 35*s*. net.

OF the numerous methods devised for dealing with oscillatory series, one of the most important is by the use of M. Riesz's 'typical means'. The first systematic account of what Prof. G. H. Hardy described as "his beautiful theory" appeared in Hardy and Riesz's Cambridge Tract "The General Theory of Dirichlet's Series" in 1915. Since that time the subject has developed considerably. The book under review gives a comprehensive account, including a good deal of material hitherto available only in research periodicals and even some still unpublished when the book appeared. The first and second chapters deal with the general theory, including theorems of consistency and Tauberian theorems. The third chapter applies this theory to Dirichlet's series. The fourth chapter applies it to Fourier series, starting with a theorem due to S. Bochner on multiple Fourier series and including several results due to Prof. Chandrasekharan himself. A valuable feature of the book is the supplementing of each chapter by extensive bibliographical notes.

H. T. H. PIAGGIO

Stochastic Processes

By Prof. J. L. Doob. (Wiley Publications in Statistics.) Pp. vii+654. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1953.) 80*s*. net.

THIS text is important for at least two reasons. It meets a long-felt need for a systematic account of a subject which has grown rapidly during the past 20–30 years; and it is an account in English of a subject which has developed largely outside the English-speaking world. Readers for whom the Russian language is a closed medium will find here accounts of contributions by Gnedenko, Khintchine, Kolmogorov, Krein and other Russian authors.

There is an introductory chapter on elementary definitions and theorems in probability theory, but, as Prof. Doob points out, "there has been no compromise . . . probability is simply a branch of measure theory . . . and no attempt has been made to sugar-coat this fact". This attitude, indeed, sets the flavour. The reader who is not a specialist in measure theory will find the going heavy in places, but he may be consoled by the fact that there is a supplement on measure theory. After three chapters dealing with stochastic processes in general there come two chapters on Markov processes. In the first of these there is a lucid account of finite-dimensional Markov chains with an application to card shuffling. In the second there are applications to diffusion equations, including the Fokker–Planck equation occurring in various physical problems. Next comes a long chapter on martingales with an application to games of chance. Later, there are chapters on stationary processes, and the book ends with a chapter on linear least-squares prediction.

It is perhaps worth emphasizing that the present work is mathematical rather than applied in character, in the sense that mathematical formulation and method take precedence over the details of applications. L. S. GODDARD