

Books

Experimental Designs. By W. G. Cochran and G. M. Cox. 453 pp. John Wiley and Sons, Inc., New York, 1950. \$6.50.

Statistical Design and Analysis of Experiments for Development Research. By Donald Statler Villars. 455 pp. Wm. C. Brown Co., Dubuque, Iowa, 1951. \$6.50.

During the past twenty years there has been a great extension in the use of statistics to analyze experimental results. It has been shown that statistics is useful not only in analyzing a large mass of data but also in analyzing what may seem to be an inadequate amount of data. In fact, statistical theory has become so powerful that it has proved useful to design experiments so that the maximum amount of information can be obtained from them by statistical means. These two books provide a guide to the experimenter by which he can so design his experiments.

The need for such books can be understood when it is realized that in experiments where little is known about the type of variability that may be present, unexpected biases can occur from some innocuous rule about the order in which the experiment is conducted. For example, to test which of two calculating machines is the faster, similar computations may be done on each machine in turn. Now, if one machine is always used first, this may introduce a bias in favor of the second machine since, because of the repetition, the operator may be more familiar with the computation the second time. Of course, this source of bias may be eliminated by using each machine first half the time. This is a very simple illustration of experimental design.

The book by Cochran and Cox is essentially a handbook listing the possible types of design, such as randomized blocks, Latin squares, split plots, etc. Each design is illustrated by an example of its use in agricultural experiments; the proper use of statistics in treating the data obtained is explained; and, finally, the advantages and disadvantages of the proposed design are discussed. This book should prove very useful to an experimenter. It must be remarked, however, that it assumes the knowledge of a good introductory course in statistics including analysis of variance and that it is fairly difficult reading.

On the other hand the book by Villars demands a minimum of statistical knowledge. It is the outgrowth of a course of lectures given at the University of Delaware, the General Foods Corporation, and the United States Naval Ordnance Test Station. The author, writ-

ing from the standpoint of a research chemist, first points out the necessity of the use of statistics in industrial experiments because the experimental results obtained are so highly variable. The variability results from the poor reproducibility in setting up experiments as well as from the error in measurement. Next, the author shows how statistics can be used to analyze the experiments; finally, he discusses how the experiments should be set up so that the experimental errors may be minimized.

Besides the theory of experimental designs, the author also discusses the use of control charts and of sequential analysis. This book may be recommended as an introduction to the use of statistics in industry.

B. Friedman
New York University

Conformal Mapping. By L. Bieberbach (translated by F. Steinhardt). 234 pp. Chelsea Publishing Company, New York, 1953. \$2.25.

This is a translation of one of Professor Bieberbach's well-known texts and shares the virtues and drawbacks of his more famous *Funktionentheorie*. This book is compact, a bit difficult for the complete novice at complex variables, not complete enough for the advanced student, but quite useful for reference or restudy by one who has once had a course in complex variables but who uses it only occasionally. The first chapter contains a general survey of the subject and a discussion of the transforms represented by linear functions; the second chapter is devoted to those for rational functions; the third chapter returns to general theory. The fourth chapter has a discussion of the transforms represented by $(z + z^{-1})$, by the exponential, by trigonometric functions, and by the elliptic functions. The fifth chapter, making up more than half of the book, is an introduction to the problem of mapping of various regions onto the interior of a circle or onto the upper half of the complex plane (Schwartz-Christoffel formula). A number of the simpler examples are worked out. There is a short but adequate index.

Philip M. Morse
Massachusetts Institute of Technology

Classical Mechanics. By H. C. Corben and Philip Stehle. 388 pp. John Wiley & Sons, Inc., New York, 1950. \$6.50.

According to its authors, *Classical Mechanics* "is intended to be a modern book on an old subject". As a result this book is not just an exposition of classical mechanics as an end in itself but rather a discussion of the material with the intention of introducing to the reader concepts and mathematical techniques which, while useful and in some cases basic in classical mechanics, nevertheless find their greatest application in quantum theory. This awareness of the imminent exposure of the student of classical mechanics to

quantum concepts and a desire to minimize the abruptness of the transition are manifested throughout the book. For example, Corben and Stehle discuss the quaternion representation in connection with the motion of rigid bodies and introduce the Pauli spin operators and their properties there. An entire chapter is devoted to the theory of real linear vector space, with the eigenvalue problem and the diagonalization of symmetric matrices being covered. In addition, such modern applications of classical theory as the motion of particles in high-energy accelerators are treated. While in some respects perhaps unsuited to the traditional graduate course in classical mechanics, this book will certainly find a welcome reception for its fresh outlook on and elegant presentation of its subject.

Arthur Beiser
New York University

Fatigue and Fracture of Metals. A Symposium held at the Massachusetts Institute of Technology, June 1950. Edited by William M. Murray. 313 pp. The Technology Press of MIT and John Wiley and Sons, Inc., New York, 1952. \$6.00.

This collection contains 14 papers. Those of the authors who are listed in *American Men of Science* include one physicist, three metallurgists, and four engineers. It is interesting to compare these numbers with the corresponding ones for a 311-page collection published in 1948 by the American Society for Metals. That collection, entitled *Fracturing of Metals*, contained 19 seminar papers presented in October 1947. For it, the numbers were: six physicists, six metallurgists, and three persons concerned with engineering or mechanics. It might be inferred that engineers are now successfully applying concepts and methods developed for them, earlier, by physicists; but the inference would be wrong. The ideas about basic phenomena presented in the earlier book are almost completely absent from this one, and so are any applications of them. I will illustrate this with three examples.

First, in the 1947 papers the dislocation concept was used to elucidate the micromechanisms of fracture and of fatigue; both the familiar schematic drawing and the bubble model were shown and discussed. In the 1950 papers the dislocation concept is scarcely mentioned; the drawing is presented (p. 288) only for the purpose of contrasting "what the physicist imagines" with "what the metallurgist sees"—and with no evidence of admiration for the physicist's imagination.

Second, in 1947 Griffith's theory of fracture was discussed critically and extended quantitatively by several authors. In 1950 neither it nor any substitute for it receives attention, except in Orowan's paper; he presents briefly the general ideas he has discussed more fully in Vol. 12 (1948-49) of *Reports on Progress in Physics*, with one new ingredient added.

Third, in 1947 there was interest in the details of stress distributions about notches; for it was recognized

that these details must be known in order to proceed from experiments to inferences about the necessary conditions for fracture. Once the yield point has been exceeded somewhere, the determination of the stress distribution requires a difficult and tedious calculation. But during the last few years, electronic calculators have been built that are designed to do difficult and tedious calculations. Have they been applied to this problem? Not so far as I know. In this book, except on a few isolated pages, the analysis of stress distributions consists in merely classifying the specimens as "notched" or "unnotched."

Thus the book leaves almost unmentioned those aspects of fracture that are of interest to a physicist. It contains many experimental results, mostly taken under field conditions or under the arbitrarily standardized conditions of engineering tests. The applications emphasized are to airplanes, ships, and machinery. There is quite a bit of fitting to formulas, all of the formal empirical type, with no attempt at physical interpretation. There is much unquantitative verbiage. In this respect there is no noticeable change from 1947.

A person active in the field of fracture will need this book for the data and references it contains. A person interested in learning about the field had better begin somewhere else: for instance, with the 1948-49 review by Orowan already cited.

William Fuller Brown, Jr.
Sun Oil Company

Isotope Catalog and Price List

The current catalog of the Oak Ridge National Laboratory listing the isotopes and services available may be purchased from the Radioisotope Sales Department of the Laboratory, Post Office Box P, Oak Ridge, Tennessee at the price of one dollar. In convenient loose-leaf form, the publication includes useful information on the various stable and radioactive isotopes and on their handling.

Mathematical Tables

Two new publications in the National Bureau of Standards Applied Mathematics Series have been announced, *Tables of Chebyshev Polynomials $S_n(x)$ and $C_n(x)$, $n = 2(1)12$, $x = 0(.001)2$* , and *Table of Bessel-Clifford Functions of Orders Zero and One*. The volume on Chebyshev polynomials (161 pages) contains an introduction by Cornelius Lanczos that gives a comprehensive survey of their important properties and applications, with their use in the solution of ordinary differential equations being well illustrated by numerical examples. It is available from the Government Printing Office, Washington 25, D. C. for \$1.75. An introduction to the basic properties of the Bessel-Clifford functions by M. Abramowitz is provided along with the tables in the volume devoted to them (72 pages), which can be obtained from the Government Printing Office for 45 cents.