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using

PHYSICS

by **J. S. MARSHALL** and **ELTON R. POUNDER**, McGill University

- frequent use of atomic theory to explain large-scale phenomena of physics
- description of heat as the mechanics of random motion, not as a separate discipline
- consistent use of specific applications to reflect changes and developments in physics
- well written with interesting well-chosen problems and illustrations supplementing the text

1957 906 pages, illus. \$8.50

The Macmillan Company
60 FIFTH AVENUE, NEW YORK 11, N. Y.

Matrix Calculus. By E. Bodewig. 334 pp. (North-Holland, Holland) Interscience Publishers, Inc., New York, 1956. \$7.50. Reviewed by Milton Abramowitz, National Bureau of Standards.

Various texts on linear algebra have appeared in the last several years devoted to the theoretical aspects of the subject. The present volume is a unified discussion of the practical application of matrices and presents many ideas which heretofore were only available in journals. The advent of electronic computers has emphasized the importance of the matrix approach to many problems and numerical analysts are well aware of the fact that matrix calculations are an everyday problem. Consequently more effective methods of dealing with matrices must be developed and tested. For this reason this volume fills a very important gap in the literature of numerical methods. Comparison with the now classical work of Frazer, Duncan, and Collar emphasizes the influence of electronic computers and an examination of the bibliography shows the intense efforts put forth by many people since 1945.

The volume is divided into five sections and although it is self-contained the prospective reader should have some knowledge of matrix theory to properly appreciate its content. The vector concept is used throughout and the ideas of determinants receive the minimum notice which they require. This approach simplifies many of the calculations and avoids the confusing complexities of operating with matrix elements. The first part entitled Matrix Calculus details the theoretical concepts important in the subsequent development. Special attention is given to those results which are of computational importance as exemplified by detailed description of the extremum properties and bounds for eigenvalues. The second section is concerned with the numerical solution of linear equations and several direct methods such as elimination, Gauss-Doolittle and Choleski are described and illustrated by numerical examples. The idea of ill-conditioned equations is illustrated and followed by a discussion of error estimates. The use of iterative methods is then considered and special attention is given to the criteria for convergence.

The method of steepest descent, and the gradient method are mentioned as iteration procedures suited for electronic computers. The discussion of inversion is referred to the equivalent problem of solution of linear equations. Special attention is given to the class of sparse matrices arising in geodesy. The final and deservedly longest chapter is devoted to eigenvalue problems. In addition to the standard "powering" methods there is a description of Jacobi's method and the useful modification due to Givens. A considerable portion of this section is devoted to a study of iteration methods from the points of view of computational technique and convergence conditions. In each case the advantages of each method are given and special attention is given to their feasibility for large scale computers. This is not only done here but throughout the volume. The short summaries and criticisms following each method are a

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very useful contribution and will be appreciated by all readers. They should serve to save time in selecting a particular method for programming. The only aspect in which the material seems dated is in the discussion of the use of standard punch card equipment. This volume is a welcome addition to the literature on matrix methods. It will probably become standard equipment in all computing laboratories.

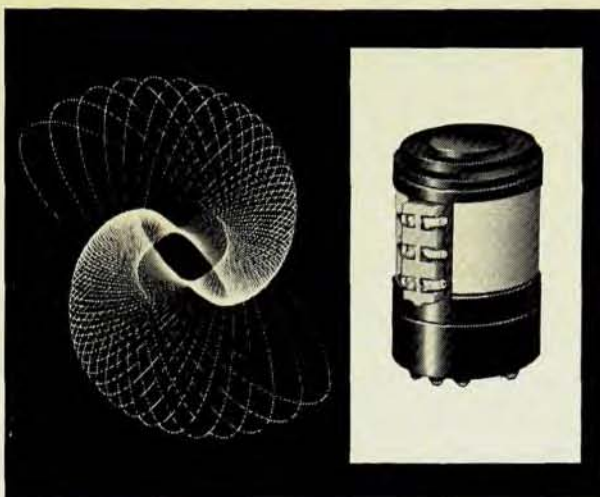
Introduction to Atomic Physics (4th Edition). By S. Tolansky. 435 pp. Longmans, Green and Co., Inc., New York, 1956. \$5.00. *Reviewed by William F. Meggers, National Bureau of Standards.*

First published in 1942, Tolansky's *Introduction to Atomic Physics* had its origin in a series of lectures given to second-year honors physics students at Manchester University. After the student has mastered classical physics he has to be introduced to modern (20th century) physics which is fundamentally more complex and powerful because all physical phenomena are regarded from an atomistic point of view. The student should become aware of certain shortcomings of classical physics, and of the brilliant successes of atomic and radiation physics, including the new quantum mechanics. To form a background for the student's final year of intensive study, this introduction to atomic physics should eschew difficult mathematical treatments, avoid giving too many details, but stress the qualitative description of phenomena and their interpretation. These specifications are admirably met by Tolansky's book.

The subject matter is, in general, presented in historical sequence, beginning with the conduction of electricity through gases, which led to the discovery of the electron, and ending with nuclear fission. The rapid and spectacular development of atomic physics makes it necessary frequently to revise and expand any treatment of the subject; the previous pages dealing with isotopes, heavy elements, cosmic rays, etc., have had to be rewritten and 21 chapters have been increased to 25 by adding four new chapters dealing respectively with (1) The Detection of Single Atomic Particles, (2) Mesons, (3) High-energy Particle Accelerators, and (4) Nuclear Reactors.

Atomic Physics now encompasses everything from elementary particles to solid matter, including energy and radiation of all kinds (waves or particles), and it is not easy to present the whole with balance and continuity. Molecular spectra and structures are excluded from Tolansky's book, although a chapter is devoted to the Structures of Crystals. A brief but adequate chapter on the Relativity Theory is included only because mass has been found to vary with velocity, and is equivalent to energy according to the now famous equation $E = mc^2$.

To this reviewer it seems that the chapter on Atomic Spectra and the Periodic Table could be expanded somewhat since it was the principal proving ground for quantum theory and wave mechanics. For example, the



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