Books

Classical Mechanics (second printing). By Herbert Goldstein. 399 pp. Addison-Wesley Press, Inc., Cambridge, Massachusetts, 1951. $7.50.

Until recently, the modern course in analytical dynamics was often a poorly motivated, loose collection of special topics. The instructor bemoaned the lack of a suitable text, assigned one of the more formidable and somewhat archaic treatises as a base, and attempted to indicate applications to modern physics by enlisting anywhere from ten to thirty auxiliary volumes. He assigned four to eight chapters in as many books each week as collateral reading to "familiarize the student with the literature", and attempted to tie these together in classroom discussion. While this procedure left something to be desired, particularly since dynamics is usually taken as the first advanced graduate course of a physics curriculum, the only alternative was for the instructor to write his own text; many of them did in fact prepare rather comprehensive sets of mimeographed notes. Although a large number of exhaustive (and usually exhausting) treatises existed for various aspects of the subject, no modern introductory or general text was available.

Within recent years, several serious attempts have been made to fill this need: to present a more-or-less-self-contained, unified treatment of more-or-less-classical mechanics from the vantage point of modern physics. Goldstein's *Classical Mechanics*—or *The Geometrical Optics of Wave Mechanics,* as he suggests in the text—is, in our conviction, the most successful of these and the one we would have welcomed most strongly as a student. Finding Olympian detachment difficult, and not wishing to prejudice the reader by a too sophomoric eulogy, we pirate Goldstein's preface. His thesis needs no comment:

"An advanced course in classical mechanics has long been a time-honored part of the graduate physics curriculum. The present-day function of such a course, however, might well be questioned. It introduces no new physical concepts to the graduate student. It does not lead him directly into current physics research. Nor does it aid him, to any appreciable extent, in solving the practical mechanics problems he encounters in the laboratory.

"Despite this arraignment, classical mechanics remains an indispensable part of the physicist's education. It has a twofold role in preparing the student for the study of modern physics. First, classical mechanics, in one or another of its advanced formulations, serves as the springboard for the various branches of modern physics. Thus, the technique of action-angle variables is needed for the older quantum mechanics, the Hamilton-Jacobi equation and the principle of least action provide the transition to wave mechanics, while Poisson brackets and canonical transformations are invaluable in formulating the newer quantum mechanics. Secondly, classical mechanics affords the student an opportunity to master many of the mathematical techniques necessary for quantum mechanics while still working in terms of the familiar concepts of classical physics.

"Of course, with these objectives in mind, the traditional treatment of the subject, which was in large measure fixed some fifty years ago, is no longer adequate. The present book is an attempt at an exposition of classical mechanics which does fulfill the new requirements. . . ."

The tortuous byways and pedantic minutiae that usually clutter this course have been replaced by logical extensions of mechanics into other fields. The principles and techniques most useful in modern physics have been stressed, and "modern mathematics" is introduced early and skillfully for elegance and compactness:

". . . . For example, the discussion of central force motion has been broadened to include the kinematics of scattering and the classical solution of scattering problems. Considerable space has been devoted to canonical transformations, Poisson bracket formulations, Hamilton-Jacobi theory, and action-angle variables. An introduction has been provided to the variational principle formulation of continuous systems and fields. As an illustration of the application of new mathematical techniques, rigid body rotations are treated from the standpoint of matrix transformations. The familiar Euler's theorem on the motion of a rigid body can then be presented in terms of the eigenvalue problem for an orthogonal matrix. As a consequence, such diverse topics as the inertia tensor, Lorentz transformations in Minkowski space, and resonant frequencies of small oscillations become capable of a unified mathematical treatment. Also, by this technique it becomes possible to include at an early stage the difficult concepts of reflection operations and pseudotensor quantities, so important in modern quantum mechanics. A further advantage of matrix methods is that 'spinors' can be introduced in connection with the properties of Cayley-Klein parameters. . . ."

In addition, velocity-dependent potentials are introduced from the outset, and a chapter is devoted to special relativity.

The book begins with a survey of elementary principles at the level of a reader who has been exposed to an undergraduate course in theoretical physics. It proceeds with a comprehensive close-knit exposition of the subject which amply fulfills the writer's thesis; in addition, it is an extremely readable and *interesting* account. The development is clear and incisive. The language is simple, often colloquial, and the asides and humor are not forced. The examples and exercises are illustrative and realistic extensions of the subject matter; there is nothing of the physical cook book or mathematical game book about this text. The fact that a great many of these extensions transcend the boundaries of the subject and range over modern physics, electromagnetics, thermodynamics, and acoustics is a significant aid to the student in acquiring perspective and maturity; but not only in this regard does the author take cognizance of the learning problem. The choice of material and its presentation throughout is characterized by sympathetic insight of the needs of student and teacher. Although we choose to emphasize the pedagogical merits of the work, it is more than the introductory text it purports to be—the treatment of various topics is distinctly original. Particularly outstanding are the sections on kinematics of rigid bodies, on geometrical optics and wave mechanics, and on the variational formulation of systems and fields. The book will be welcomed by all physicists as a valuable contribution to the theoretical literature.

There is perhaps one thing in the book that might puzzle the reader—the symbols appended to the preface. This abbreviation, employed since antiquity by Hebrew scholars to indicate humility and gratitude at the completion of a task, may be translated somewhat freely as "it is finished and completed; praise be to the Lord, the Author of all works."

While the book has been enthusiastically received, it is possible that some would have preferred amplification of certain topics and the explicit inclusion of other topics in the text rather than in the exercises. One reader may ask for the treatment of impulse problems; another, for a detailed discussion of the multiple roots of the secular equation; or, following the preface, for the inclusion of the stress-energy tensor, microscopic equations of continuity, momentum space representations, etc. Mature differences of opinion in this regard are, of course, no reflection on the book as it stands; but Goldstein's treatment of additional topics, which he implies will appear in a future edition, would be welcomed. As long as we're digressing, we would also welcome the completion of his companion texts on electromagnetics and quantum mechanics.

A textbook greatly increases its utility by indicating supplementary reading for the various topics. The best of these employ footnotes, or cite references and their appropriate sections at the end of each chapter—occasionally with a line of comment; the more usual practice is to include a bibliography at the end of the book; but it is not at all uncommon to find a textbook which presumably sprang full grown from the author's head (rather more like Sin than Athena). Goldstein's method is very effective and worthy of emulation; the references at the end of each chapter receive rather detailed evaluation. Consider a few sample lines from his candid reviews and try to guess the texts:

". . . . A formidable treatise which often manages somehow to make the elegant simplicity of vector and tensor methods appear quite complicated and repellant. . . ."

". . . . This monumental work on the theory of the top, in four volumes, has all the external appearances of the typical stolid and turgid German 'Handbuch'. Appearances are deceiving, however, for it is remarkably readable. . . ."

". . . . The development is marked, regrettably, by an apparent dislike of diagrams (of which there are only four in the entire book) and of vector notation, and by a fondness for the type of pedantic mechanics problems made famous by the Cambridge Tripos examinations. . . ." (This one is too easy.)

". . . . The style is pleasantly discursive and the writing is less formal and more physical than in Whittaker, and consequently more intelligible. . . ." (This one is too hard.)

The reader may have gathered that Whittaker's *Analytical Dynamics* was the reviewer's base text as a student. Fortunately, this classic treatise, which is still the best reference for many topics and whose concise treatment makes it singularly appropriate for a mathematician, need no longer be foisted on the tyro as an introductory or general text.

We recommend Goldstein's work to all physicists.

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Laplace Transformation. By William T. Thomson. 230 pp. Prentice-Hall, New York, 1950. $5.00.

This is a good introductory text on the application of the Laplace transformation to mechanical engineering problems. The illustrations and exercises are well chosen for those interested in learning to use this tool, but the text is somewhat detracting. The engineer will be grateful for the absence of mathematical rigor and will not be particularly concerned with the looseness of the discussion or the failure to properly define the mathematical labels and concepts involved; the physicist will be stimulated to seek a supplement in the more rigorous literature (e.g., Doetsch, Dover Publications, New York. $1.90).

V. T.

Briefly Noted

Science and Nonscientists

The difficulties of communication between scientists and laymen, and even between specialists in different sciences, are discussed in *General Education in Science* (edited by I. Bernard Cohen and Fletcher G. Watson; Harvard University Press, Cambridge, Mass., 1952; 217 pp.; $4.00), a collection of papers originally presented at Harvard's workshop in Science in General Education two summers ago. Science teachers from colleges and secondary schools throughout the country attended the workshop and took part in a series of discussions relating to the as yet unsolved problems of