

physics and chemistry of materials, is an introduction to sound absorption and dispersion in gases, liquids and solids. In recent years, ultrasonic investigations have proved useful in elucidating a surprising variety of physical and chemical phenomena. This book provides a good survey of some of the applications to physical problems. The material is well presented on a level that should be useful to graduate students or to research workers who are not experienced in ultrasonics. A good balance is maintained between theoretical ideas and experimental results. The presentation of the theory is especially good; emphasis is placed on describing the physical concepts that are basic to a given phenomenon rather than on developing the most general and elegant mathematical treatment. Throughout the book there are many excellent figures illustrating typical experimental data, and there are also many references to selected papers in the rather vast literature on ultrasonics.

After two introductory chapters on wave propagation in ideal fluids and ideal elastic solids, the book treats a wide variety of physical mechanisms for acoustic attenuation. About two thirds of the text is devoted to gases and liquids, with the principal em-

phasis being on thermal relaxation in polyatomic gases and normal liquids. Classical causes of absorption in monatomic fluids and structural relaxation in associated liquids are also treated. The treatment of fluids is by no means as detailed or exhaustive as that given by Karl Herzfeld and Theodore Litovitz in their *Absorption and Dispersion of Ultrasonic Waves* (Academic Press, New York, 1959), but the present book is an excellent introduction, guide and companion to that more advanced monograph. The treatment of solids is rather abbreviated, with principal emphasis on the electron-phonon interaction and on dislocations. This seems surprising since Bhatia has himself worked on a variety of theoretical problems in solid-state physics. Perhaps limitations of space are to blame. In any case, this book would serve as a useful companion to other introductory books like Warren Mason's *Physical Acoustics and the Properties of Solids* (Van Nostrand, Princeton, 1958). The final chapter deals with systems near critical points, a topic of considerable current interest.

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The reviewer, an associate professor of chemistry at MIT, has applied ultrasonic techniques to the study of lambda transitions in solids.

Exploiting the tools

MANY-BODY DESCRIPTION OF NUCLEAR STRUCTURE AND REACTIONS. (Enrico Fermi School, Varenna, Italy, July 1965). Claude Bloch, ed. Academic Press, New York, 1966. \$26.50

by John L. Gammel

In the foreword, Claude Bloch says that the emphasis of the course was on deriving all nuclear properties from the Schrödinger equation and the nucleon-nucleon interaction. He says that one gets the impression that we are now in the possession of the proper tools but that we are still extremely far from having exploited them to their full possibilities. Maybe so. Maybe not. Consider even the magnetic moment of the deuteron. Present two-nucleon potentials do not fit the 4% D state in the deuteron required by the experimental data; they give 7% or 8%; "field theoretical corrections" somehow explain the discrepancy. Is it possible that one can understand all of the collective properties of nuclei

and not understand why the susceptibility of a ferromagnetic behaves like $(T - T_c)^{-4/3}$ in the vicinity of the Curie temperature T_c ?

Felix Villars in his lectures on the rotational states and the general theory of collective motions discusses the methods of separating collective variables in the Hamiltonian. He discusses the separation of the center of mass motion, and then goes on to rotational motion. He concludes that the analogous separation is not obvious, and that one may well ask whether it exists at all. He concludes that it does, to a certain extent. And ultimately he finds a Hamiltonian that "resembles closely the Bohr-Mottelson expression, but there are some characteristic differences." Maybe that is what Bloch means when he says that we have not exploited our tools to their full possibility.

Vincent Gillet's lectures, on approximate methods in structure calculations partly on formal theory and

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SEMICONDUCTOR DEVICES.

By JAMES J. BROPHY, IIT Research Institute.

Extremely readable and entirely nonmathematical, this informative and scientifically accurate account of semiconductors and semiconductor devices will appeal to the reader who seeks an understanding of the subject unencumbered by quantitative details. The book is well written and well illustrated. It explains the operation, structure, and characteristics of most important semiconductor devices. The approach is based on the properties of semiconducting materials and is sufficiently general so that new devices can be understood as they are introduced. Simple experiments, which can be carried out with a minimum of simple equipment, clarify the properties of a number of devices.

128 pp., \$5.95

HEAT AND THERMODYNAMICS.

By MARK W. ZEMANSKY, Professor Emeritus,
The City College of New York.

The author says, "In this book the formal development of thermodynamics (using the zeroth law to arrive at the concept of temperature, the first law to introduce internal energy, the second law for the Kelvin scale and entropy, and the third law) constitutes the basic framework that holds the book together. Kinetic theory and statistical mechanics, in their most elementary formulations, are used to obtain equations of state, heat capacity equations, etc., that are not provided by thermo-dynamics alone. In addition, experimental methods of measuring important thermal quantities are described, and numerical data in tables and graphs are given." The point of view is still preeminently thermodynamic (macroscopic) as opposed to microscopic. There is a greater coverage of low temperature physics and a unique chapter on the superfluidity of liquid helium II and the superconductivity of conductors. Many new problems and figures have been added.

Off Press

PERSPECTIVES OF MODERN PHYSICS.

By ARTHUR BEISER, formerly of New York University.

This junior-senior text presents a careful account of the origins of the basic properties of atoms, molecules, solids and nuclei. It stresses theory rather than engineering applications, illustrated with experimental ideas to enhance the reader's physical insight. A special effort is made to use basic ideas and theoretical techniques in several contexts whenever possible, both to emphasize their general applicability and to give the reader insight into how they are actually incorporated into the theoretical fabric of physics. Contents: Chapters 1) Special Relativity; 2) Relativistic Mechanics; 3) Particle Properties of Waves; 4) Wave Properties of Particles; 5) Atomic Structure; 6) Bohr Model of the Atom; 7) Schrodinger's Equation; 8) Applications of Quantum Mechanics; 9) Quantum Theory of the Hydrogen Atom; 10) Many-Electron Atoms; 11) Atomic Spectra; 12) The Chemical Bond; 13) Molecular Structure; 14) Molecular Spectra; 15) Statistical Mechanics; 16) Quantum Statistics; 17) Bonding in Solids; 18) Crystal Structure; 19) Specific Heats of Solids; 20) Band Theory of Solids; 21) The Atomic Nucleus; 22) Nuclear Forces and Models; 23) Radioactivity; 24) Nuclear Reactions; 25) Elementary Particles.

Off Press

PHYSICS OF ELECTRONIC CONDUCTION IN SOLIDS.

By FRANK J. BLATT, Michigan State University.

This book provides a self-contained treatment of the physical process of conduction and related electronic phenomena in metals and semiconductors. It is the first text to treat this subject in a fundamental, scientific way, describable in terms of the same transport equation and the same kind of relaxation process. This book can be read profitably by first or second year graduate students in Physics or advanced graduate students and research scientists in Material Science, Electrical Engineering or Physical Metallurgy.

The book is divided into three principle sections: The first establishes the necessary background material in Solid State Physics; part two contains a general discussion of Electronic Transport Theory; and the third section is devoted specifically to transport properties of metals and semiconductors. The presentation is detailed and quantitative, rather than the statement, "It can be shown", except where the theoretical technique required for the calculation is clearly beyond the level of the text. In these few instances, the general approach of the calculation is discussed and adequate references are provided.

446 pp., \$14.50

IRREVERSIBILITY AND FLUCTUATIONS.

A Film in Two Parts to accompany the Berkeley Physics Course.

By B. J. ALDER, Lawrence Radiation Laboratory, Livermore and F. REIF, University of California, Berkeley. Produced with the aid of LARC computer at Lawrence Radiation Laboratory, Livermore, operated by U.S. Atomic Energy Commission.

This film illustrates the most fundamental ideas of statistical physics, discussed in Chapter 1 of F. Reif's book, *Statistical Physics* (Volume 5, Berkeley Physics Course, McGraw-Hill, 1967). The film shows the motion of N hard-disk particles inside a two-dimensional box with rigid walls. An electronic computer was programmed to use classical mechanics in order to calculate the particle trajectories starting from specified initial conditions. Successive positions of the particles were then displayed on the computer output oscilloscope and photographed by a movie camera. The film is available in standard 8mm form (2 Technicolor cartridges) or 16mm form (1 reel). It is in black and white, and it runs 7:15.

\$30 set or reel (approx.)

QUANTUM MECHANICS, Third Edition.

By L. I. SCHIFF, Stanford University.

Professor Schiff's textbook is one of the most widely used and respected books for the first graduate course on Quantum Mechanics. The new edition has been thoroughly up-dated to bring the text in line with current thinking in the field and the notation has been modernized. Major changes include a new chapter on Symmetry which develops the concept of symmetry and applies it to geometrical symmetries of space and time displacement, rotation, space inversion, and time reversal. The Kepler problem is treated in detail. Additional changes include: 1) the treatment of approximation problems for collision problems 2) a new section on bound-state perturbation series using the Delgarno-Lewis method, 3) a new section on the density operator and the density matrix and 4) scattering from complex potentials.

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partly on applications. In discussing collective states, he also concludes that (page 77) "the mechanism for the appearance of the so-called collective states is not readily understandable from the general expression. . ." He discusses the random-phase approximation and various approaches to it, which "are not quite equivalent in their point of view nor in the physical insight they give into the RPA. Furthermore each of them is the starting point of different higher approximations. . ." Then one sees a figure on page 101 that suggests that the results of calculations have little to do with experiment. One gets the impression of a large number of methods, none of which is very useful. One also feels that the effective two-body force mentioned on page 98 (it is a local, central force) is extremely simple minded. Maybe Bloch also had that point in mind.

Elliott considers the effective interaction in the shell model. His effective interaction has local, central, tensor and spin-orbit terms, all having the same radial dependence. That is some improvement; yet much is missing. He effects some comparison with the Hamada-Johnston potential in table II, and finds encouragement in not very much. He then takes up the pairing force.

Migdal discusses the method of interacting quasi-particles. After a tremendous formal development, one comes to an effective interaction between quasi-particles (equation 4.5 on page 199). The development appears to fall a bit short of deriving everything from the two-nucleon interaction and the Schrödinger equation.

David Brink on the alpha-particle model of light nuclei brings us back to the thirties, but in many ways is quite refreshing after Migdal's Green's functions.

It is just not possible to mention all of the articles in this very valuable collection of lectures. As Bloch says, all of the lecturers deserve much credit for getting this material together. What a heroic task it would be to carry out the program mentioned by Bloch! This book has nearly 600 pages, and it is hard to see how anybody could get abreast of so much material. Still, if anyone ultimately succeeds, this book could have helped him.

On the assumption due to Einstein, "I believe that it is better to know some of the problems than all of the

answers," one would like to see a carefully listed set of glaring difficulties. Let me mention one. With the 7% deuteron D state of recent potentials and the notorious fact that tensor and spin-orbit potentials are ineffective in the three- and more-body problem of nuclear physics, so that the binding energy even of tritium comes out too low and Hans Bethe finds too little binding in nuclear matter, isn't it likely that three- and more-body forces are not really negligible?

* * *

John L. Gammel (Los Alamos) collaborated with Keith A. Brueckner in antediluvian work on the many-body problem of nuclear physics. In the same period, he collaborated with Robert M. Frank and Kenneth M. Watson on the foundations of the optical model. He and Brueckner derived a very complicated effective nucleon-nucleon interaction for nuclear matter, and Brueckner, Maunel Rotenber, and Andrew Lockett attempted to use this in shell-model calculations. These early attempts ran afoul of the same facts with which the lecturers in this summer school are struggling.

NEW BOOKS

ELEMENTARY PARTICLES & FIELDS

Lectures in Theoretical Physics, Vol. 9B: High Energy and Particle Physics. (Summer Institute, U. of Colorado, 1966). Wesley E. Brittin, Asim O. Barut, eds. 436 pp. Gordon and Breach, New York, 1967. Cloth \$19.50, paper \$8.95

NUCLEI

Nuclear Structure. Conf. proc. (Dacca, East Pakistan, Jan. 1967). Anwar Hosain, Harun-Ar-Rashid, Mizanul Islam, eds. 342 pp. North-Holland, Amsterdam (Interscience, New York), 1967. \$17.00

ATOMS & MOLECULES

Quantum Electronics in Lasers and Masers. Proc. (Trudy) P. N. Lebedev Physics Institute, Vol. 31. D. V. Skobel'tsyn, ed. Trans. from Russian. 161 pp. Consultants Bureau, New York, 1968. Paper \$22.50

SOLIDS

Theory of Elastic Waves in Crystals. By Fedor I. Fedorov. Trans. from Russian. 375 pp. Plenum Press, New York, 1968. \$25.00

Physical Acoustics: Principles and Methods, Vol. 4, Part B: Applications to Quantum and Solid State Physics. Warren

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