Thermal Physics. By PHILIP M. MORSE. W. A. Benjamin, Inc., 2465 Broadway, New York 25, N. Y. 1964. xii + 455 pp. 16 × 23.5 cm. Price, $10.50.

This book is a greatly expanded revision of a lecture-note volume that appeared in 1962. The title aptly indicates the range of subject matter treated, covering the basic concepts of thermodynamics, kinetic theory, and statistical mechanics.

In the first part the author skillfully presents the basic laws and ideas of classical thermodynamics in a manner which is based on physical intuition and experiment. Although it is made clear that thermodynamics is concerned with macroscopic phenomena, advantage is taken of atomic ideas to illustrate some of the simple mechanical results for assemblies of molecules, such as the relation between pressure, volume, and average kinetic energy of translational motion. In addition to the more typical state variables (P, V, T, μ, n), the magnetic intensity and magnetization are used to show how additional state variables can be introduced, depending upon the situation encountered. Equations of state for the entropy and chemical potential of simple materials are formulated for an ideal gas and for a perfect paramagnetic crystal. The treatment of simple thermodynamic systems includes discussion of black-body radiation, a paramagnetic gas, and helium II. Enthalpy, the Helmholtz function, the Gibbs function, and the grand potential are discussed to give criteria of equilibrium and spontaneity, to provide a derivation of Maxwell's relations, and to serve as a basis of more extensive calculations. The discussion of irreversible processes follows from the notion of entropy generation in spontaneous flows; several examples are considered using Onsager relations. The final illustrations of thermodynamic phenomena are chosen from phase changes and more briefly from chemical reactions. A slight false impression is left with the reader that spontaneous electrochemical processes (at given T and P) must be exothermic (p. 144). It may be a bit disconcerting to chemists to have the mole defined as a kilogram molecular weight of substance.

The second part of the text, entitled kinetic theory, provides a brief, but excellent introduction to probability concepts and distribution functions, the Maxwell velocity distribution, the representation of distributions in phase space (with several excellent examples), transport phenomena, and fluctuation theory.

The third and last section of the book is devoted to statistical mechanics. The subject is developed from definitions and postulates while at the same time drawing upon the notions of distribution functions and phase space developed in the second part. The Boltzmann and Planck form of entropy in terms of distribution functions provides the basic connection between the micro state description and macro state description of equilibrium systems. The microcanonical ensemble is formulated by considering the number of states for a given energy. This number determines the entropy, and the temperature, which is compatible for this situation, is found by invoking the second law condition that the Helmholtz function be minimized. Examples are given for a simple crystal, the perfect gas, paramagnetic crystals, and the Maxwell distribution law. An analogous argument is applied to the canonical ensemble by means of Lagrangian multipliers, and the results are used to discuss crystals and gas properties. The grand canonical ensemble is introduced by similar argument and two brief applications are given. The final four chapters are concerned with quantum statistics. All are skillfully presented, but particularly noteworthy is the chapter on interparticle forces, in which an excellent one-dimensional example is used to show the importance of free and bound wave functions in determining the over-all symmetry of the total wave function and thus the number of allowed states.

A number of thought provoking problems are written for each chapter.

This book is to be recommended to advanced undergraduates or beginning graduate students in physical science. As might be expected from the author's interests, the examples will have more appeal to physicists than chemists. Its real merit, however, lies outside of such provincialism, in that it ties together such a range of basic ideas of thermal phenomena with great lucidity.

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BOOKS RECEIVED

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ROBERT F. GOULD, Editor. "Boron-Nitrogen Chemistry." Advances in Chemistry Series, No. 42. American Chemical Society, 1155 Sixteenth St. N.W., Washington, D. C. 20036. 1964. x + 330 pp. $7.50.

GEORGE T. RADO and HARRY SUHL, Editors. "Magnetism: A Treatise on Modern Theory and Materials." Volume 1. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. 1963. xv + 688 pp. $19.

PETER T. B. SHAFFER. "High-Temperature Materials No. 1—Materials Index." Plenum Press, 227 W. 17th St., New York, N. Y. 1964. xx + 740 pp. $17.50.

IRVING M. KLOTZ. "Chemical Thermodynamics." W. A. Benjamin, Inc., 2465 Broadway, New York 25, N. Y. 1964. xiv + 468 pp. $9.75.

JOHN O. EDWARDS. "Inorganic Reaction Mechanisms." W. A. Benjamin, Inc., 2465 Broadway, New York 25, N. Y. 1964. xii + 190 pp. $7.