Concrete, Pictorial Discussion

Statistical Mechanics and Dynamics. Henry Eyring, Douglas Henderson, Betsy Jones Stover, and Edward M. Eyring. Wiley, New York, 1964. xiv + 508 pp. Illus. $14.95.

The macroscopic properties of a material system reflect only gross averages over the detailed dynamics of its many constituent molecules. Gibbs and Boltzmann discovered that these averages could be related directly to the properties of the molecules and to the intermolecular forces, bypassing the intermediate many ($\approx 10^{23}$)-body problem. The prescriptions and results of this theory constitute the subject of statistical mechanics, and must be learned by every serious student of the physical sciences. There now exist some 10 or 15 textbooks on the subject, and of these *Statistical Mechanics and Dynamics*, intended for a full-year graduate-level course, is the most recent.

This book treats all the conventional topics of the equilibrium theory, and a good deal more of the nonequilibrium theory than is usual. The latter is still, of necessity, treated more selectively and less completely than the former. There is, for example, a very lively discussion of electronic conductivity based on the Boltzmann equation (in the relaxation time approximation), but the corresponding theory of transport phenomena in dilute gases is not given.

The authors have, where possible, avoided abstraction and have kept the discussion concrete and pictorial. The introductory remarks on the relation of Fermi-Dirac, Bose-Einstein, Boltzmann and intermediate statistics to different classes of adsorption phenomena are highly illuminating, as are the four very fine chapters on crystals, electric and magnetic properties, the electron theory of solids, and cooperative phenomena. In some isolated instances, however, the treatment is marred by a too-doctrinaire adherence to the language and notation of the "absolute reaction rate" theory.

If the book has any other flaw, it is that the properties of liquids are discussed largely from the point of view of the "method of significant structures," which is based on a useful physical picture but amounts, in the end, to being merely a flexible interpolation formula. No doubt such truly fundamental theories as the scaled particle model, based on the properties of a hard-sphere system, are too recent to have been included, but this is not the case with the lattice gas model, the existence of which is barely hinted at in this book, and which at present is the only theory capable of correctly describing a fluid in the neighborhood of its critical point.

Nevertheless, such faults as this book may have are largely outweighed by the vigor and enthusiasm of its writing, by its extraordinary breadth and variety, and by the many striking physical insights its authors have provided. It should prove to be a useful addition to the literature of statistical mechanics.

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Chemistry of the Solid State

Progress in Solid State Chemistry. vol. 1. H. Reiss, Ed. Pergamon, London; Macmillan, New York, 1964. viii + 536 pp. Illus. $17.50.

In the preface, F. C. Tompkins comments on "the need for an up-to-date treatise, specifically devoted to the chemistry of the solid state, that reviews comprehensively all the important major aspects." The series is intended to provide "broad but critical reviews" for the general reader, as well as surveys of research progress for the specialist. The authorship is international, but the articles are in English.

The initial volume of the series contains the following reviews—"The thermal expansion of ceramic crystals" by H. P. Kirchner; "Lattice energies and related topics" by M. F. C. Ladd and W. H. Lee; "Phases with the nickel arsenide and closely-related structures" by A. Kjekshus and W. B. Pearson; "Lattice imperfections and the thermal conductivity of solids" by D. Greig; "The relationship of photoluminescence and electroluminescence to structure" by D. W. G. Ballentyne; "Ferrielectricity in crystals" by C. F. Pulvari; "Alloy semiconductors" by J. C. Wooley; "Physico-chemical aspects of organic semiconductors" by H. A. Pohl; "X-ray diffraction studies of crystal perfection" by L. V. Azaroff; "Applications of nuclear quadrupole resonance" by G. A. Jeffrey and T. Sakurai, and "Use of infrared and Raman spectroscopy in the study of organometallic compounds" by D. K. Huggins and H. D. Kaesz.

There can be little doubt about the need for volumes in the field of solid-state chemistry, although there seems to be considerable difficulty in precisely defining solid-state chemistry. In the view of Tompkins, solid-state chemistry is the "structure, chemical properties, reactivity of solids, etc." The contents of this volume illustrate the importance of the "etc." in this, as in most other definitions. Solid-state research has engaged the interests of large numbers of physicists, chemists, and metallurgists, and in few other fields of science have the interaction and cooperation of people of different disciplines played such a conspicuous and necessary role. Consequently it has become very difficult to separate solid-state chemistry from solid-state physics. There is a viewpoint which characterizes each discipline, however, and perhaps, therefore, solid-state chemistry is best thought of as that part of solid-state research which interests and occupies chemists.

Viewed in this light, there is a tremendous wealth of material that this series might be expected to cover, eventually, and its appearance is both timely and highly welcome. It might be hoped that, in time, this series will complement the highly successful series *Solid State Physics*, edited by Frederick Seitz and David Turnbull. As in all books composed of contributions by a number of authors, this volume shows considerable variation in the approach and in the effectiveness of its articles. The review articles are, for the most part, well written and should be interesting to the general reader; among the essays in this category are those by Jeffrey and Sakurai, by Azaroff, by Pulvari, and by Kjekshus and Pearson. The last of these, as well as the articles by Huggins and Kaesz, by Kirchner, and by Ladd and Lee, provide notably deep coverage and should interest specialists. There was a considerable delay between the preparation of some of the articles and the publication of the volume; the value of the series will be increased if this can be minimized in the future.

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