BOOK REVIEWS

An Introduction to Statistical Thermodynamics. By TERRELL L. HILL, Department of Chemistry, University of Oregon. Addison-Wesley Publishing Co., Inc., Reading, Mass. 1960. xiv + 508 pp. 16 × 23.5 cm. Price, $9.75.

Here is a new introductory treatment of the statistical mechanics of equilibrium systems, written by a chemist who is well known for his research work in applied statistical mechanics. It is intended as a textbook, primarily for physical chemists. The major purpose of the book is to cover extensively the main active fields of application of equilibrium statistical mechanics, and to give only an introduction rather than a highly refined, elaborate theory of each topic. The treatment of fundamentals is therefore comparatively brief, and most of the book is devoted to the applications, for which usually a sort of first-order approximation is given. This statement may suggest that the treatment is superficial, but it is not. The author keeps each topic well in hand, displays plenty of physical insight into the nature of each problem, frequently pauses to make estimates and checks of orders of magnitude, and often indicates the direction to be taken in a more refined theory. Problems at the end of each chapter appear sensible and useful. Most of them give the impression of having been used, and not just thrown in as an afterthought. Many of the applications refer to work of the last decade, and probably appear for the first time in an introductory text. The more traditional material on the calculation of thermodynamic functions from spectroscopically determined energy levels is still present, but is not emphasized.

Probably not all readers will agree with Hill's approach. Some may prefer a more thoroughgoing treatment of the foundations of the subject, and some may prefer to see only a few applications considered, but each one treated in greater depth. This is probably largely a matter of individual taste, and each reader will have to decide for himself on these matters, but most will no doubt agree that the author has done an outstanding job within the limits he has set for himself.

The book is divided into four parts, of which Parts I and IV cover the principles, and Parts II and III the applications. Parts I and IV are relatively short, consisting of two chapters and one chapter, respectively. Chapter 1 is concerned with the fundamental postulates of statistical mechanics, and the development is based on very elementary quantum mechanics (about all that is required is a familiarity with the notions of energy levels, discrete quantum states, and the like.) Classical statistical mechanics appears only as a limiting case of quantum mechanics. This approach is now quite common, and everyone seems to agree that it is in fact the simplest. Not so common is the immediate introduction in Chapter 1 of a variety of ensembles, but there is much to be said for this approach, since many problems are much more easily treated by, say, the grand canonical ensemble than by the microcanonical ensemble. Having introduced different ensembles, the author feels free in later chapters to use whichever ensemble best suits the problem of the moment, and he does so with considerable skill. Chapter 1 is perhaps the most difficult in the book, because all the fundamentals are presented in such a short space. The author is aware of this, and in the preface states, "It may be wise for the average student to return to this chapter for rereading after having acquired some familiarity with applications in later chapters." This reviewer heartily seconds the motion.

Chapter 2 gives the reader a breather after the hectic pace of Chapter 1, even though its first topic is rather unusual in a second chapter. Fluctuations are discussed, and used very effectively to give some physical insight into the results of Chapter 1, and to demonstrate that the calculation of thermodynamic properties is unaffected by the choice of ensemble, which may then be chosen for purely mathematical convenience with a clear conscience. Part IV is a single chapter on standard quantum statistics. Its sections could have been distributed in various places throughout the book, and some teachers may prefer to do so.

Part II (eleven chapters) deals with applications to systems composed of sets of independent subsystems, and takes up general relations, ideal monatomic, diatomic and polyatomic gases, monatomic crystals, simple lattice statistics, chemical equilibrium and reaction rates (quasi-equilibrium Eyring theory) in ideal gases, ideal gas in an electric field, and polymer configurations. The maximum term method is used throughout in all derivations, which leads to difficulties over Stirling's approximation only for systems of indistinguishable molecules. At this point the names of Darwin and Fowler are invoked, never to appear again. This was the only place in the book where the reviewer felt rather cheated. Part II also includes a brief chapter on classical statistics. Part III (eight chapters) deals with systems of interacting molecules, and takes up lattice statistics, imperfect gases, cell and hole theories of liquids, distribution functions of fluids, dilute electrolyte solutions (including plasmas!), dilute and concentrated liquid solutions, and polymers and polyelectrolyte solutions and gels.

In summary, this is a book which treats the fundamentals adequately and the applications superbly. Many of the innovations in treatment and order of topics are likely to become standard for teachers and future textbook writers. For a first course in statistical mechanics for physical chemists, either one or two semesters, this text can be recommended enthusiastically.

INSTITUTE FOR MOLECULAR PHYSICS
UNIVERSITY OF MARYLAND EDWARD A. MASON
COLLEGE PARK, MARYLAND

Gmelins Handbuch der Anorganischen Chemie. Achte Völlig Neu Bearbeitete Auflage. Cadmium. Ergänzungsband. System-Nummer 33. Edited by E. H. ERICH PIETSCH. Verlag Chemie, G.m.b.H., Pappelalle 3, Weinheim/Bergstr., Germany. 1959. xciv + 802 pp. 17.5 × 25.5 cm. Price, kart., DM. 508. —; ganzl., DM. 513. —.

In these days when chemists are trying desperately to cope with the explosive growth of the chemical literature, more and more reliance must be placed on reviews and handbooks. One of the very bright spots in this picture is the availability of Gmelin's Handbuch der Anorganischen Chemie. Making excellent use of the German talent for thorough and painstaking compilation, organization, and critical evaluation, Dr. E. H. Erich Pietsch of the Gmelin Institut directs a most effective operation for producing the Eighth Edition of this encyclopaedic work. In the treatment of each element all of the references discussed in earlier volumes are being reviewed in the light of modern developments and each section is being made complete up to the date indicated.

In 1959, the treatment was further amplified for the convenience of English-speaking users by printing the comprehensive tables of contents in both German and English and by the lavish use of English headings and subheadings in the margins of the text. The English-speaking reader, even with very little facility in reading German, will find the use of this Handbuch very easy.

The full effectiveness of the new bilingual format is demonstrated admirably by the new Supplementary volume on cadmium, which offers complete and critical literature coverage up through 1949, and which supersedes the earlier main volume on cadmium which appeared in 1925. The tremendous growth of the literature on cadmium in the 25 year interim is witnessed by the nearly fourfold increase in pages. The well-organized 94 page German–English Table of Contents of this new volume affords in itself a rapid over-all picture of the full range of the chemistry of cadmium. In the 802 pages of text that follow, lavish use of diagrams and tables help to summarize the data. My random sampling of the coverage of specific topics with which I am familiar fully substantiates the completeness and critical evaluation of the data from the literature. In addition to complete coverage of the fundamental material, very extensive at-