

those investigators who, for lack of availability, do not usually utilize the nonjournal primary sources. It describes, in detail, experimental conditions used in photochromic studies and the mathematical treatments that have been developed. Several chapters critically describe mechanistic models that have been proposed and suggest areas for further research.

The study of photochromism is an interdisciplinary affair. The basic investigations have been reported by physicists, chemists and biologists. Those interested in molecular organic photochemistry will find the text of particular interest. The last chapter, by Robert C. Bertelson of the National Cash Register Company, is an unusually thorough and frank summary of the applications to which photochromics have been put, the design of instruments, and the performance characteristics of photochromic materials.

The text should be a first choice for a newcomer to the field and a welcomed reference source to those who are continuing research in photochromism.

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Point Defects and Diffusion

C. P. Flynn
826 pp. Oxford University Press London,
1972. \$51.00 (£ 15.00 in U.K.)

There is a clear need for a really good new book on point defects and diffusion. The fields are of importance in problems ranging from nuclear reactors, to semiconductor devices, to alloy design, as well as being of intrinsic scientific interest. Yet the only such books available, *Diffusion in Solids* by Paul Shewmon (McGraw-Hill, 1963) and *Point Defects in Metals* by A. C. Damask and G. J. Dienes (Gordon and Breach, 1963) are seriously out of date and fail to cover many topics of current interest. Pete Flynn, in a mammoth book, has set himself the task of covering "the vigorous, sprawling, literature concerning impurities, thermally activated defects, and atomic mixing processes in crystals." Flynn is a professor of physics at the University of Illinois, a most important center of research in this field for many years, and is very well qualified for this job. He has made contributions in both diffusion and point defects and has a tremendously broad knowledge of these active fields.

Flynn discusses basic principles in a number of areas and illustrates these with experimental data as appropriate.

Major portions of the book are devoted to general aspects of point defects including thermodynamics, lattice vibrations, and electronic properties, and to the fundamental principles of diffusion, including stress effects and precipitation. Finally the concepts developed in the book are applied to experimental results on various types of materials. Throughout, Flynn demonstrates prodigious knowledge and great physical insight. The mathematical treatments are a delight to the experienced researcher and can give him new views of familiar subjects. For instance, in his presentation of diffusion,

Fick's Laws, which are essentially macroscopic or continuum in their approach, are derived in the most general way possible. Subsequently, diffusion is considered in terms of the plane-wave eigenvectors of the defect jump matrix and then are examined as a random walk of a defect. These various approaches give similar results, but the different formulations are most useful and appropriate for different problems. This is seen subsequently in elegant treatments of the Kirkendall effect, thermomigration, internal friction and precipitation kinetics.

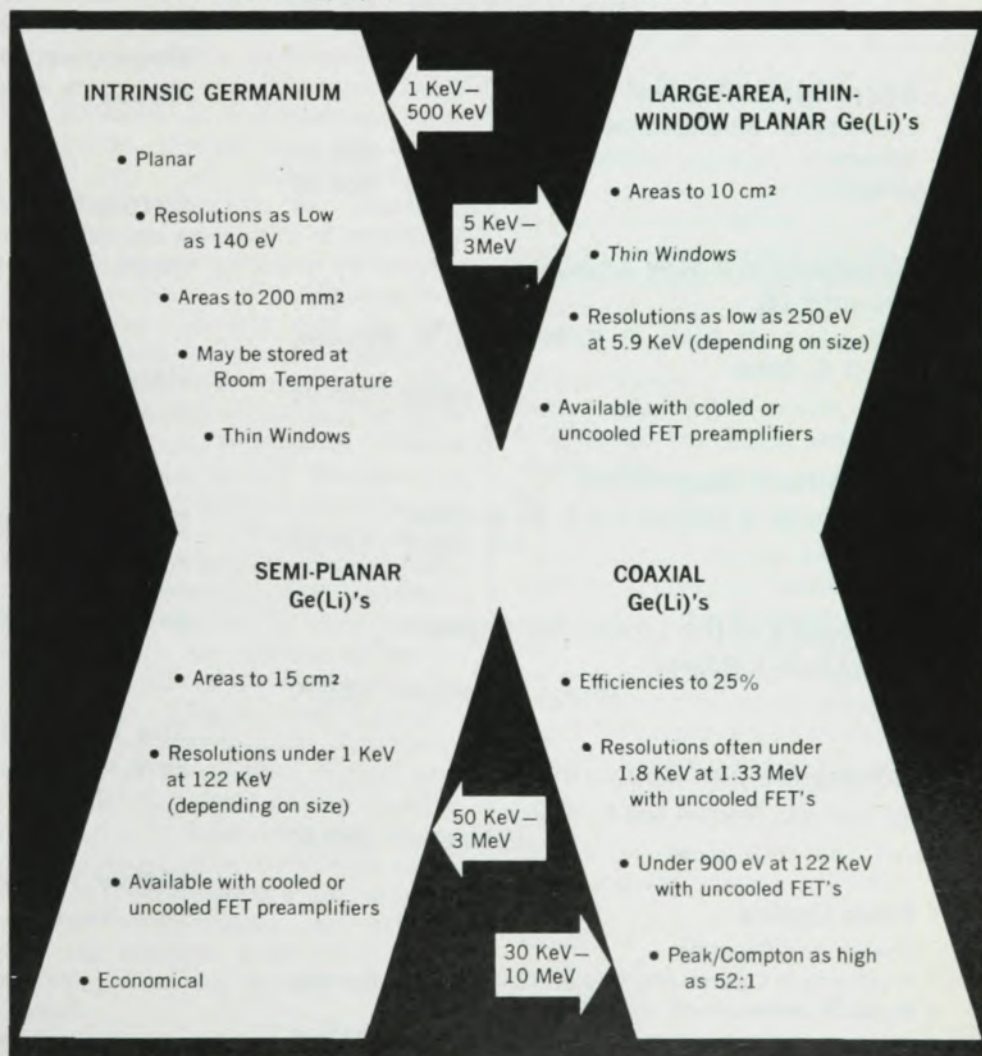
Flynn's book is difficult to read.

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The book assumes a thorough familiarity with solid-state physics; previous knowledge of point defects and diffusion is essential. The background provided by standard first-year graduate solid-state physics courses, for example *Introduction to Solid State Physics* by Charles Kittel (Wiley, 1971) is not sufficient, and it is recommended that the prospective reader who is not already familiar with defects and diffusion research should read the book by Shewmon mentioned above prior to reading this work.

The book suffers from a number of editing problems that are distressing and may substantially confuse the neophyte. The references for data in tables are often in error, as are the table captions. Notation in the text sometimes does not correspond to that in the tables. (The discussion of the so-called Simmons-Balluffi experiment is particularly obscure because of compounding of such problems.)

Point Defects and Diffusion will be a useful addition as a reference in the library of any institution with a major effort in point defects or diffusion. The outrageous price (\$51.00 in the US) precludes purchase by most students and many libraries that must be careful about spending priorities. It is unfortunate that Flynn did not write a true monograph (his book is part of "The International Series of Monographs on Physics") about diffusion theory, which is the strongest part of his book. Such a monograph could have been shorter, less expensive, and accessible to more people.

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Statistical Mechanics

Donald Rapp

325 pp. Holt, Rinehart and Winston,
New York, 1972.

Donald Rapp of the University of Texas at Dallas has taken on the difficult task of writing a graduate-level text in the field of statistical mechanics. This task is difficult in two respects. The first difficulty is, of course, the subject matter itself. Statistical mechanics is a diverse, rapidly growing field of physics. The various subfields like solid-state physics, low-temperature physics and the theory of fluids require extensive coverage in themselves. The second point making Rapp's task difficult is the competition from other established texts in the same field. I mention in particular *Statistical Mechanics* by F. Reif, *Statistical Physics* by L. D. Landau and E. M. Lifshitz, and *Statistical Me-*

chanics by K. Huang.

Rapp's book is closest in layout to Huang's book. He begins with a brief discussion of thermodynamics, proceeds to a discussion of the basic principles of statistical mechanics and finishes with a discussion of some special topics. Each of these sections deserves comment.

Rapp's chapter devoted to thermodynamics is not very useful. The entire discussion covers four and one-half pages, and one would expect that only those already familiar with thermodynamics could follow the discussion. Consequently, if this book were to be used in a course covering thermodynamics and statistical mechanics, one would have to use another reference in treating the thermodynamics.

The main body of the book involves a discussion of the simplest statistical mechanical systems (Debye model, Bose-Einstein, Fermi-Dirac, and Boltzmann statistics, and so on). While the examples chosen are interesting and instructive, there are two major drawbacks to the presentation. First, the development in this section is not particularly systematic. The basic results in statistical mechanics that are more or less independent of the system treated are not clearly pointed out. The combinatorics that one usually discusses in connection with a general treatment of ensembles is carried out several times in treating different problems. The importance of the partition function and its most general properties are not emphasized. The author also has a trait of building up an idea and then relaxing on some of the most important points. This is particularly true in the treatment of the relationship between quantum and classical systems. For example, in the introduction to the first chapter Rapp discusses the importance of indistinguishability in statistical systems and then proceeds to discuss a system where the particles are completely distinguishable. This is justified by noting that "indistinguishable particles located at distinguishable lattice sites are referred to loosely as distinguishable particles." Such ambiguity at the very beginning of a discussion of an idea that is confusing to students under the best circumstances can certainly cause the students great difficulty in separating out the general principles involved.

A more serious drawback is the lack of a discussion of ensembles. The grand canonical ensemble (as far as I can discern) is not mentioned. The chemical potential is defined in a footnote rather late in the book. This lack of a general ensemble discussion limits the scope of the text considerably.

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