

conductivity is followed by a clear presentation of the Kirkendall-Frenkel effect, the effect of pressure on diffusion, the chemical diffusion coefficient and empirical relations.

Diffusion in crystals containing extended defects is also discussed. Using the background developed in preceding sections, experimental results on diffusion in oxides of Cr, Ni, Cu and Fe are discussed. The second chapter ends with a short presentation of diffusion along boundaries, surface diffusion and reactive diffusion.

The third chapter is devoted to a detailed description of experimental methods for the determination of defect equilibria and diffusion coefficients in solids. Emphasis is given to the classical methods, especially thermogravimetric methods, which the author has used in several of his own contributions.

Volumetric and electrochemical methods are also extensively discussed. The third chapter ends with a discussion of tracer and kinetic methods for the determination of self-diffusion coefficients and with a discussion of thermogravimetric and solid-state cells for the determination of chemical diffusion coefficients.

The fourth chapter, *Selected values of parameters of self diffusion and heterodiffusion in metals, alloys and metal oxides, sulphides and halides*, gives the activation energy and frequency factor for diffusion with its major part dedicated to metals and oxides.

The subject matter discussed and the way it is presented indicate that this book should be of interest for those involved with material science in general and especially in the areas of corrosion, oxides, metallurgy, solid-state ionic devices and ceramics. The book is written from the experimentalist's point of view with careful discussion of classical techniques used in the study of materials. The large list of references supplement well the subjects of the book.

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*Acta Cryst.* (1981). A37, 142

**Thermal expansion of crystals. International series in the science of the solid state, Vol 12.** By R. S. KRISHNAN, R. SRINIVASAN and S. DEVANARAYANAN. Pp. 305. Oxford: Pergamon Press, 1979. Price £15.00, US \$35.00.

In 1958 the first of the above three authors published in *Progress in Crystal Physics*, Vol. 1, a summary of data on thermal, elastic and optical properties of crystals. The present volume greatly extends the presentation there made of the thermal expansion of crystals. After a short introductory chapter the methods of measuring thermal expansions are described in detail and all the current methods are included. The chapter contains a valuable statement of the analysis necessary in crystals of low symmetry. The third

chapter is a full account of the theoretical work done by many authors on the theory of thermal expansions in crystals. This is followed by a short chapter on the relation between thermal expansion and phase transitions, with special reference to ammonium compounds and to ferroelectricity. Then follow eighty pages of data on thermal expansion. This section is invaluable for anyone concerned with crystalline thermal expansion or any of the properties associated with it. The first three-quarters of this section refers to an exhaustive list for 370 substances. The temperature range involved goes up to high temperatures. The last part of the tables gives data for very low temperatures.

Finally, there are ninety-two pages of references to the original works from which the data have been taken.

The book is well produced with clear diagrams and well arranged tables. For all those who are concerned with thermal expansion in crystalline materials this work is to be highly recommended.

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*Acta Cryst.* (1981). A37, 142-143

**Crystalline electric field and structural effects in *f*-electron systems.** Edited by J. E. CROW, R. P. GUERTIN and T. W. MIHALISIN. Pp. xii + 638. New York and London: Plenum Press, 1980. Price US\$69.50.

This book is the proceedings of the international conference, on the same subject as the title, held at Temple University in Philadelphia, Pennsylvania, November 12-15, 1979. The 63 articles are divided into the following sections: 1. *Crystal field and structural effects*; 2. *Lattice effects I*; 3. *Lattice effects II*; 4. *Actinides*; 5. *Kondo and intermediate valence properties*; 6. *Transport and thermodynamic properties*; 7. *Singlet ground state and other properties*; 8. *Superconductivity*; 9. *Lifetime effects*.

A transcript of the question and answer session is found following each article. A subject index and separate material index are found at the end of the book.

One does not have to look too closely to discover errors. Thus, in the second article only 18 of the 36 references are listed at the end. However, it is almost impossible to avoid errors in a book of this type. The inclusion of the question and answer sessions is a valuable addition; however, the value is somewhat reduced since what is eventually published sometimes differs from what was presented at the conference. Thus, at the end of the second article the first question concerns the substance  $\text{PrB}_6$  which is not mentioned in the published text.

The last crystal field conference was held in Zürich in 1976 and the conference proceedings were published by Plenum Press under the title *Crystal Field Effects in Metals and Alloys* in 1977. Since this conference, important progress has been made, especially in the understanding of crystal field effects (or the lack of these effects) in the actinides. The proceedings of the present conference bring the reader up to date on this progress.

The book will be of value to all who are interested in what is presently being done in this area of research. Owing to the large number of invited papers (25), which have more of a review nature, the book will also be of some interest to non-specialists and students.

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*Acta Cryst.* (1981). A37, 143

**Physics and mechanics of ice.** (International Union of Theoretical & Applied Mechanics Symposium, Copenhagen, 1979.) Edited by P. TRYDE. Pp. xiv + 378. Berlin: Springer-Verlag, 1980. Price DM 74.00, US \$43.70.

Ocean engineering has advanced rapidly in the last two decades, and in high latitudes, where the floating ice cover is generally a major hazard, extensive investigation and detailed analysis have cleverly turned the sea ice to advantage as loading and drilling platforms. This collection of papers, focused on big-scale ice engineering, is a reference text.

The mathematical and physical modelling cannot be spelled out in limited length papers, so some are rather difficult to comprehend, but the problems tackled range from crystal boundary cracking in ice creep to the design of the Danish icebreaker. Better to understand some of the papers, the reader should begin with more comprehensive texts such as Patterson (1968), *The Physics of Glaciers*, or Hobbs (1973), *Ice Physics*. A paper by Mellor gives a scholarly synopsis of current knowledge of snow and ice and Assur discusses the state of the science and current problems, but 15 of the 25 papers concentrate upon extensive ice plates a few metres thick. Four are relevant to glaciers, three to ships in ice, one to iceberg dodging and one to ice as a support in rock wall mining.

Impurities, even in very low concentration, weaken fresh-water ice, but sodium salts have been found to strengthen the single ice crystal. Little of this is amplified in the papers and in some the type of ice considered is not detailed. Glaciologists have done little on ice flow at low stresses so some papers break new ground in this. Miller, and also Goodman, give results illuminating the recent material parameter of fracture toughness and the critical stress intensity required to propagate a crack, which is a function of the strain energy release rate. Most of the workers are in North America, but European and Japanese workers have contributed from laboratory and field observations. There is a summary, at the end, of questions and answers. The book is a healthy collection of views and aims in the applied science of ice, and the editor and organising committee are to be congratulated.

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*Acta Cryst.* (1981). A37, 143

**Dislocations in solids. Vol. 1. The elastic theory.** Edited by F. R. N. NABARRO. Pp. xx + 364. Amsterdam, New York, Oxford: North-Holland, 1979. Price Dfl 125.00, US\$61.00.

This first volume of a set of five contains five totally independent articles, each with its own title, contents pages and list of references. Only the author and subject indexes and the editor's fifteen-line preface are shared by the various articles. This review is accordingly broken into sections, reflecting the very fragmented nature of the book.

The introduction by J. Friedel is well illustrated and non-mathematical. The treatment is nonetheless reasonably advanced, including some discussion of dislocations as solitons. The reference list is curiously (and unnecessarily) split into a list for section 1 and a list for the remaining sections.

A. M. Kosevich discusses crystal dislocations and the theory of elasticity in a useful, detailed discussion containing 281 equations: it is unfortunate that the addendum sections, dated 1976, could not have been inserted after the appropriate sections of each chapter, in view of the 1979 publication date.

J. W. Steeds and J. R. Willis very briefly discuss dislocations in anisotropic media: I found their table of analytic solutions, with examples of real crystals, rather interesting and worthy of extension.

J. D. Eshelby provides a useful chapter on boundary problems, and the final chapter by B. K. D. Gairola concerns non linear elastic problems, which is complicated by the use of inappropriate vector formulae and differential operators which act on the preceding rather than the succeeding quantity. The author does, however, provide alternative precise tensor formulations for each vector equation and an appendix on tensor theory, which is not the best I have seen. Both of these articles have 1976 addenda.

Technically, the book is well produced and attractively type-set. My overall impression is that the book makes a worthwhile contribution to our overview of the subject and makes a good start to a series which subscribers may purchase at a 15% discount on the total price of Dfl 790.

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*Acta Cryst.* (1981). A37, 143-144

**Introduction to solid state electronics.** By F. F. Y. WANG. Pp. xii + 266. Amsterdam: North-Holland, 1980. Price US \$23.75, Dfl 48.50.

This is a brief textbook on an important, fast-moving subject, well printed and bound. The mathematics is treated briefly and yet thoroughly. Unfortunately, careful examination shows this to be a very poor undergraduate text. The *Table of contents* shows that it does not cover the material suggested by the title. It is really an introduction to