Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (M. M. Woolfson, Physics Department, University of York, Heslington, York YO1 5DD, England). As far as practicable books will be reviewed in a country different from that of publication.

Solid state chemistry and physics – an introduction. Vol. 1. Edited by PAUL F. WELLER. Pp.xi + 500, Figs. 165, Tables 23. New York: Marcel Dekker, 1973. Price $26.50.

Nothing short of Renaissance-quality versatility is nowadays required in order successfully to straddle the vast range of chemical, physical, mathematical and even biological knowledge currently encompassed by solid-state science. This fact would be accepted with more philosophical resignation were it not recognized that contemporary quantal and crystallographic interpretations of the behaviour of solids offer considerable academic excitement, and that the proper technological utilization of various electronic devices requires deep understanding of a variety of unrelated phenomena. A book such as that under review is therefore examined with more than usual thoroughness, particularly as a prospective text for graduate workers, for whom it is primarily intended.

Part I, sub-titled *Concepts and Properties* (pp. 186), serves as a relatively non-mathematical introduction to the concepts used throughout the remainder of the text. Part II, *Physical Properties and Imperfections*, includes chapters on *Electrical Properties of Solids* (pp. 104) by Perlstein, *Magnetic Properties* (pp. 60) by Steger, *Magnetic Resonance* (pp. 51) by Kasai and *Optical Properties* (pp. 88) by Axe. In Volume 2, yet to appear, Part II will be continued to deal with *Point Defects, Diffusion and Surface Chemistry*, and two further parts will deal with *Purification and Crystal Growth, Polymeric Materials and Biology* and *Semiconduction.*

On balance Volume 1, especially the first three chapters, succeeds in what it sets out to achieve. The first chapter, by the editor, is a courageous and competent attempt to interrelate the various principles and concepts which are developed later. In some places, however, notably in discussions of the *F*-centre (p. 50) and application of crystal-field theory to the ruby laser (p. 57), more is promised than is actually delivered in Chapters 7 and 3 respectively. The section on *Crystallography* (Suchow), after summarizing material normally taught at a relatively elementary undergraduate level, includes a lucid account of the structural principles of related, simple inorganic solids (*e.g.* ReO_3, perovskite and tungsten bronze) and of stacking disorders and polytypism. It misses an opportunity, however, of linking dislocations (which are also very briefly considered) with stacking faults (in terms of partials) and thereby offering insights as to how some of the structural types considered earlier may be interconverted. Crowder's chapter (47 pp.) on *Bonding Models* contains a first-class treatment of elementary band theory, where the nearly-free electron theories and the tight-binding approximations are discussed. It is a pity that this chapter was not extended to deal with other aspects of energy-level diagrams, many of which (*e.g.* semiconductor characteristics) are deferred until they appear, rather unexpectedly, in the *Physical Properties and Imperfections* section.

Apart from relatively minor presentational infelicities – such as the use of the symbol *n* to mean three distinct properties within the space of two pages (226–227), and a rather imprecise use of the term 'activation energy' (pp. 25 and 31) and the unreasonable deferment of the properties of point defects (which are needed anyway in Chapter 7, p. 488) until Volume 2 – this book has much to commend it. It should prove valuable to both experimentalist and theoretician interested in solid-state phenomena.

Like so many modern scientific monographs it lacks a subject index, a regrettable omission.

J. M. THOMAS

Edward Davies Chemical Laboratories
The Univeristy College of Wales
Aberystwith SY23 1NE
Wales

Solid state chemistry and physics. Vol. 2. Edited by PAUL F. WELLER. Pp.xi+434, Figs. 111, Tables 21. New York: Marcel Dekker, 1974. Price $25.75.

This is the second volume of an introduction to solid state physics and chemistry intended to give undergraduate or graduate students a broad interdisciplinary view of the field. It consists of seven separately authored chapters covering topics in physical properties and imperfections, purification and crystal growth and finishing with two chapters applying the full range of solid state ideas to polymers and biological processes. Mathematical complexity is avoided as far as possible, and the editor has achieved a reasonably consistent narrative style. The individual contributions are often uneasy compromises between text-book treatments and reviews of their field. The references are helpful, but those after 1970 are rare. Though the book gives an interesting blend of solid-state science, the price renders it impossible to recommend students to sample other than a library copy.

J. A. D. MATTHEW

Department of Physics
University of York
Heslington
York YO1 5DD
England

Molecular crystals and molecules. By A. I. KITAIGORODSKII. Pp.xii + 553, Figs. 251, Tables 57. London: Academic Press, 1973. Price £20·70.

During the last ten years, studies of the organic solid state have turned away from a preoccupation with molecular

geometries to considerations of non-valence forces and related matters such as lattice dynamics and transport phenomena. Notwithstanding the very recent renaissance of accurate experimental and theoretical electron density analyses of organic and inorganic molecules, this trend was inevitable since the basic quantum chemistry necessary for the interpretation of intramolecular bond lengths is well understood whereas non-valence forces have yet to yield to anything like a comprehensive treatment. Kitaigorodskii in his *Organic Chemical Crystallography* must be given enormous credit for anticipating this movement: with very simple geometrical models, he persuaded us that organic crystal structures could often be rationalized and predicted and that the field was ripe for quantitative development.

This new book, which many must have been looking forward to reading, is, by the author's admission, a 'somewhat one-sided' account having 'some degree of imbalance' based, as it is, almost entirely on the atom–atom approach to quantitative calculations of non-valence interactions. The subject is introduced *via* a summary of crystal structures. We see here the difference in emphasis between the workers of Kitaigorodskii's school and (perhaps) mainstream ideas. Organometallic crystals are thought to be built up from molecules with 'anomalous atom-group of atoms' bonds although the architectural principles are obviously those of simple organic crystals. It is suggested that hydrogen-bond energies should be estimated through a comparison of observed and calculated (pair interaction) lattice energies, although the rationale for extending atom–atom calculations to hydrogen-bonded materials has not been established in detail. There are implications that there is considerable ground-state charge transfer in molecular complexes such as anthracene–trinitrobenzene but no clear evidence on this point is available.

Lattice energies are dealt with in Chapter 2. Dispersion, repulsive and multipolar interactions are summarized clearly but it seems a pity that more illustrative attention was not paid to the pretty rigorous calculations available for crystals of the rare gases and simple diatomics. Kitaigorodskii is on much happier ground when he turns to the lattice energies of aromatic hydrocarbons and the summary of the structures of benzene, naphthalene and anthracene is very good. The sections dealing with lattice dynamics and thermodynamics are the best in the book, summarizing very nicely many of the interesting approaches of the past few years and, given the advent of inelastic neutron scattering and other novel spectroscopic methods, pointing the way for future developments.

The discussion of structural methods is, by contrast, misplaced and outdated with the 'spin-off' of the article of fifteen or so years ago on 'Is super-refinement legitimate?' showing through; it is unreasonable surely to discuss, for example, the sphericity of atoms without a careful discussion of the recent combination of neutron and X-ray methods to determine valence electron distribution and effectively to bracket Dawson's unequivocal analysis of the situation in the diamond with the much less accurate structure determination of anthracene.

The conformations of organic molecules and of peptides and proteins are discussed finally. What is perhaps the most useful quantitative approach to the conformational analysis of simple hydrocarbons *viz.* the Lifson consistent force field scheme, is sketched all too briefly and we see little evidence of the more confident predictions of semi-empirical molecular orbital theory. It would have been valuable also to emphasize the entropic contribution to biomacromolecular structure rather than continue to press for *a priori* analyses based on minimum enthalpy criteria.

A reviewer is almost required to be carping. That this is a useful book goes without saying but its seminal influence will depend upon whether Kitaigorodskii is right again and that one's reservations about the atom–atom approach are revealed, retrospectively, to be myopic prejudices.

R. MASON

School of Molecular Sciences
University of Sussex
Falmer
Brighton BN1 90 J
England

Molecular structure by diffraction methods. Vol. 1.

By G. A. SIM and L. E. SUTTON (Senior Reporters). Pp. xvi + 824, Figs. 174, Tables 71. London: The Chemical Society, 1973. Price £15·00.

The Chemical Society has a long tradition of assisting in the task of keeping up with the scientific literature by publishing its *Annual Reports on the Progress of Chemistry*. These had grown so large by 1967 that it was decided in that year to restrict *Annual Reports* to a critical discussion of the significant advances in the major areas of chemistry and to issue in addition a series of *Specialist Periodical Reports* to provide comprehensive cover of the literature for the specialist research worker. These reports will appear annually or, in some cases, biennially for each subject. The present volume is the first in the series on *Molecular Structure by Diffraction Methods* and it basically covers the literature published from January 1971 to March 1972.

It is divided into three parts: *Electron Diffraction*, *Neutron Diffraction* and *X-ray Diffraction* and since the annual output of papers relevant to the first two parts is relatively small their coverage has been extended to include also detailed reviews of earlier work (back to about 1965 in the case of electron diffraction). This is appropriate because structural results by electron and neutron diffraction have not been systematically reviewed since the publication of the supplementary volume of *Tables of Interatomic Distances and Configuration in Molecules and Ions* which covered the literature up to the end of 1959. The part devoted to electron diffraction has chapters discussing theory and accuracy and the interplay between spectroscopy and electron diffraction as well as two chapters describing structural results. In all, 686 references are discussed in this part, including 464 devoted to results. The two striking features of this part of the report are the complexity of the molecules which can now be studied by electron diffraction and the accuracy of the dimensions which can be obtained.

The short but lively part devoted to neutron diffraction discusses 96 references. As might be expected, most of these are concerned with the accurate determination of hydrogen-atom positions and they are discussed mainly under two headings: *Conformation and Other Stereochemical Problems* and *Hydrogen-Bonded Systems*. Among the other sections is a very interesting one on the application of neutron diffraction in the study of molecular electron-density distributions.