

groups would have been useful. Perhaps Dr Steadman would consider writing a sequel?

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Bollman, W. *Crystal Lattices, Interfaces, Matrices: An extension of Crystallography*. Geneva (Bollman), 1982. viii + 360 pp., 109 figs. Price SFr. 70 (available from 22 Chemin Vert, CH-1234 Pinchat, Geneva, Switzerland).

Although this book was published privately by a distinguished scientist because a commercial publisher would not take the risk, a potential buyer should not worry about the quality of the book. This is essentially a tutorial work-book on the mathematical basis of O-lattice theory. Consider two perfect crystals, not necessarily of the same type, meeting at an interface. The geometrical misfit between the lattice nodes provides the simplest possible guide to the energy at the interface, and can be used in understanding the textures of polycrystalline metals and of mineral intergrowths.

This book develops the mathematical theory of the misfit geometry between two lattices, and provides questions and exercises to test a reader. The flavour can be obtained from three quotations: 'The primary O-lattice is the O-lattice due to the deviation from the primary PS (preferred state), the single crystal state. Secondary O-lattices, due to the deviation from secondary PSs will be discussed later.' 'The O-lattice models describe boundaries as dislocation networks with the complete Burgers vector balance within the boundary.' 'This town of crystallography has a twin town, a mirror town, namely that of the reciprocal lattices. On the P-level (possibility level) there are the interpenetrating reciprocal lattices of the bi-crystals and the reciprocal O-lattices, and on the R-level (real level) are the actual diffraction patterns, obtained by the intersection of the Ewald sphere with the reciprocal lattice configuration.' Fifteen chapters cover crystal lattices and geometrical aspects (point lattice, structure matrix, reciprocal lattice, rotation, shear, mirror imaging, inversion, translation, etc.) in 110 pages; nine chapters cover interfaces, and applications to interface structure (primary O-lattice, choice of unit cells, etc., secondary dislocation networks, etc.) in 139 pages; thirteen chapters cover matrices and algebraic methods, (vector algebra, matrix operations, eigen values, etc.) in 100 pages. The style is mathematical but easy to follow because of full explanations. Minor criticisms are: absence of Cottrell (1953) and Read (1953) in the bibliography; absence of  $\bar{3}$ ,  $\bar{4}$ , and  $\bar{6}$  in Fig. 14/1; presence of spelling and other minor errors. I did not detect mathematical errors in selective reading.

All scientists interested in interface theory will

wish to consult this book for possible purchase. They will also wish to set the book in the context of other theories for coherent and partly coherent phase boundaries in which strain energies are calculated (e.g. references in R. A. Yund's articles in *Feldspar Mineralogy*, ed. P. H. Ribbe, 1983).

J. V. SMITH

Jawson, M. A., and Rose, M. A. *Crystal Symmetry: Theory of Colour Crystallography*. Chichester (Ellis Horwood/Wiley), 1983. 190 pp., 85 figs. Price £18.50 hardback; £8.50 paperback.

This book from the Ellis Horwood Series in Mathematics and its Applications is theoretical in tone, and lacks detailed discussion of applications to crystals and minerals—indeed the only reference to a mineral in the index (diamond crystal) is incorrect! Nevertheless it is a useful book for crystallographers and mineralogists who have proceeded past the elementary stage, and wish to follow a formal and rigorous development of colour crystallography.

The subject headings are: Part I: Crystallographic Point Groups. 1. Symmetry Patterns, 2. Mathematical Formulation, 3. Cubic Symmetries, 4. Colour Point Groups; Part II: Space Lattices. 5. Lattice Geometry, 6. The Seven Crystal Systems, 7. Non-primitive Unit Cells, 8. Translation Groups; Part III: Space Groups. 9. Symmorphic (Bravais) Space Groups, 10. Screw Axes, 11. Principal and Secondary Screw Axes, 12. Glide Planes, 13. Diamond Glide, 14. The Colour Space Groups; Appendices.

Jawson and Rose start with crystallographic point groups and assume that  $n = 1, 2, 3, 4,$  and  $6$  because of a later theorem involving lattices. They do not consider general point groups. After a logical treatment with group theory, they derive the thirty-two classical crystallographic point groups and the fifty-eight colour ones; an important feature is the stereographic representation in black and red of the equivalent positions. The key relation between a lattice and rotation symmetry is given on pp. 69–70. Fig. 6.12 lacks perspective. Chapter 7 considers the simple forms of sphere packing as part of the development of face-centred cells. Colour translation operators are introduced in Chapter 8, and the colour Bravais lattices are given in Fig. 8.3. The authors introduce the term 'groupoid' to denote the set of space-group operators which interrelate all the equivalent positions of a motif pattern; this is the basis of their abstract development of space groups. Two-dimensional classical and colour space groups are listed in appendices 7 and 8, rather than being presented in Chapter 6. A thorough review would take at least one week

of concentrated attention to the mathematical equations, and I can only state that selective checking of key tables did not reveal any important errors (Appendix 9 sphenoidal).

There are many ways of skinning a crystallographic cat, and different students prefer different approaches. If you teach crystallography, consider this book in relation to the alternative texts; I think that you will find that most students will prefer an elementary text with emphasis on practical examples. A few would then profit from this book. The price is reasonable considering the typesetting of mathematical symbols.

J. V. SMITH

Hazen, R. M., and Finger, L. W. *Comparative Crystal Chemistry: Temperature, Pressure, Composition and the Variation of Crystal Structure*. Chichester and New York (John Wiley and Sons Ltd.), 1982. xv + 231 pp., 87 figs. Price £19.50.

Studies of the crystalline state, mostly at room temperature and pressure, but to a lesser extent at elevated  $T$  and  $P$ , have been carried out on a variety of compounds by material scientists, solid-state physicists and chemists, as well as earth scientists. The results of such studies are, therefore, widely distributed throughout the scientific literature. The authors prepared this book 'as an attempt to consolidate the diverse literature on the acquisition and analysis of high-temperature and high-pressure crystallographic data'. It is stated on the inside of the cover that the book '. . . provides a comprehensive treatment of the collection and analysis of crystallographic data . . .'. In fact, the treatment is far from comprehensive as the experimental techniques described and the examples chosen are mainly based, sometimes unwisely, on the authors' own excellent work. However, the result is an extremely well-written summary of the authors' interests and shows the great contribution they have made to modern crystal chemical research.

Part I of the book (106 pp.) deals with 'Experimental procedures' and has Chapters 2 to 5 on 'High-temperature crystallography', 'High-pressure crystallography', 'High-temperature, high-pressure crystallography', and 'The parameters of a crystal structure'. This section was prepared as a step-by-step guide to techniques for the operation of high- $T$  and high- $P$  single-crystal X-ray equipment. The high- $P$  section is restricted to the design and operation of diamond cells; this technique is described in some detail with abundant, generally clear illustrations. The  $T$  and  $P$  calibration of the equipment is discussed and a novel suggestion is made that a material with two crystallographic

directions having very different ratios of thermal expansion to compressibility could be used to estimate both  $T$  and  $P$ —calcite could be used for this purpose up to  $\sim 12$  kbar and  $\sim 1000^\circ\text{C}$ . Appendix I to Part I gives a list of addresses for equipment and specialist consumable suppliers. Appendix II gives a listing of Dr Y. Ohashi's computer program (STRAIN) for calculating the strain ellipsoid for monoclinic and triclinic materials. Appendix III lists a program for calculating polyhedral volumes and distortions. Specimen input and output data are listed for both of these programs.

Part II (102 pp.) deals with 'Structural variations with temperature, pressure and composition'. Chapter 6 covers the effects of  $T$  and includes two extensive tables with extremely useful compilations of data on bond expansion rates in simple (e.g. oxides, halides) and more complex compounds (e.g. silicates). The formulation of the mean thermal expansion rates is slightly odd in that the reference value used is that at  $\sim 510^\circ\text{C}$  instead of the more generally used value at room- $T$ —the bond lengths at room- $T$  are, in fact, quoted in the tables. Chapter 7 deals with the effect of  $P$  and includes another invaluable compilation of data on polyhedral bulk moduli, bond distances, and bonding parameters for a variety of compounds. Chapter 8 covers the effect of changing composition on structural parameters.

Chapter 9 deals with the effect of  $T$ ,  $P$  and composition on continuous structural variations and discusses them as analogous variables. It is stated that the 'inverse relationship' between  $T$  and  $P$  'is not universal, and cannot be applied arbitrarily'. In this regard it is important to remember that thermal motion effects at elevated  $T$  can cause shortening of estimated bond lengths (as discussed in Chapter 5). However, this point is apparently glossed-over in the discussion of the effects of  $T$  and  $P$  on  $\alpha$ -quartz. The method of Distance Least Squares (DLS) gets a brief mention at the end of this chapter. In Chapter 10 the effect of  $P$ ,  $T$  and composition on discontinuous variations is considered with reference to polymorphic inversions and phase stability relations. Good examples of displacive transitions are chosen from the authors' own research but the discussion of their work on layer silicates as an example of reconstructive transitions is not appropriate as it is more applicable to the conditions of breakdown of the phases rather than to their *inversion* to other polymorphs. In this discussion the suggestion that serpentine could form at  $800^\circ\text{C}$  and 3 kbar is clearly incorrect. At this pressure the thermally most stable serpentine (antigorite) breaks down at  $\sim 520^\circ\text{C}$ ! The use of pyroxene-pyroxenoid relations as an example of martensitic transitions may also not be valid.