Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (J. H. Robertson, School of Chemistry, University of Leeds, Leeds LS2 9JT, England). As far as practicable books will be reviewed in a country different from that of publication.

Acta Cryst. (1980). A**36**, 500

Spectroscopy, luminescence and radiation centers in minerals. By A. S. MARFUNIN. Translated from the Russian by V. V. SCHIFFER. Pp. xii + 352. Berlin, Heidelberg, New York: Springer-Verlag, 1979. Price DM 108.00, US $ 59.40.

This book is a review of the different techniques used for spectroscopy of minerals in the solid state: Mössbauer spectra, X-rays and electron spectroscopy, EPR, luminescence and thermoluminescence, and the effects of radiation on solids. Numerous examples are described.

The author has in fact given a splendid performance in producing a reasonably up to date and comprehensive account of all these items. Each of these chapters looks like one of the papers published in a well -known series of review papers, such as *Solid State Physics* – except for the fact that, in the latter, all the chapters are written by different people and not by the same author.

However, it is clear that no one can be truly a specialist in so many different topics and therefore, while reading this book, the specialist is never perfectly happy within his own field of research. For instance, in Fig. 5, in the chapter on Mössbauer spectroscopy, it is not quite clear whether the old Walker scale or the modified Danon scale has been used for the isometric shift calibrations. In addition, since 1975 (the year of the original publication of the book in Russian) many new results have of course been found. In the chapter on luminescence, the Tanabe–Sugano diagrams for Mn^{2+} are correctly given, but without any reference to the basic papers of Orgel or Tanabe and Sugano; indeed, these names are not found in the bibliography. The spectra of Mn^{4+} are not described. In Chapter VII, this reviewer would not have introduced *F* centers into a chapter entitled *Free radicals* – but perhaps this is merely a matter of terminology.

Some difficulties come also from the translation of names which have been found in Occidental papers, then translated into Russian and finally translated again into English. Thus, on p. 143, Cascariolo has been transformed into Cashporolo; on pp. 178 and 181, Lambe and Klick (*Lambe et Klick* in French) has become Lambet and Klick. Luminescence is also written as luminiscence, and cyanite as kyanite.

In spite of these drawbacks, this book can be recommended to any scientist, at the graduate level, who wishes to have an idea of current problems in the field of the spectroscopy of minerals without, for instance, reading the 35 volumes of a series such as the *Solid State Physics* publications. But of course, for a more detailed acquaintance with his own field of research, he will require more extensive review papers.

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Patterns in crystals. By N. F. KENNON. Pp. X + 197, Figs. 101. Chichester: John Wiley, 1978. Price £10·00 (cloth), £4·95 (paper).

Chapters 1–7 analyse plane patterns and two-dimensional lattices in terms of 'concepts' and 'definitions' that are then applied in Chapters 8–20 to three-dimensional patterns. The *d* spacing is discussed in Chapter 21 but its significance can hardly be appreciated, if at all, until the final Chapter 22 where, in fifteen pages, an attempt is made to cover the interaction of X-rays with solids and its application to the determination of crystal structure.

The style is didactic in the extreme, and the repetition of the two-dimensional 'concepts' and 'definitions' whenever they are applied in three dimensions becomes boring. Indeed, although some of the seventy-nine 'concepts' and fifty-four 'definitions' – printed in eye-catching capitals – are useful (*e.g.* Definition No. 8 'A symmetry operation is any operation that can be performed on a body to transform it to self coincidence'), others are trivial (*e.g.* Definition No. 51 'The normal to a plane is that line which is perpendicular to the plane'; Concept No. 68 'A crystal and the associated space lattice contains an infinite number of directions') or are uninformative (*e.g.* Definition No. 20 'The indices of a plane are those integers in round brackets that identify that plane and distinguish it from all others').

The concept that a pattern is made up of two ingredients, a basic unit called the 'motif' and a 'scheme of repetition', can be misleading. The motif is here described and drawn as some arbitrary figure separated from identical figures according to the scheme of repetition. It is stated (p. 5) that the motif is the unit of pattern but, of course, this is not true because the pattern includes the 'empty' space between the motifs. At this teaching level, the reproduction of some of

M.C. Escher's drawings would illustrate the idea that repetition of units of pattern must fill all space. The deduction that rotation axes other than 1, 2, 3, 4 and 6 are incompatible with a parallelepiped unit cell might also have been reinforced by the very simple formal proof that only 1-, 2-, 3-, 4- and 6-fold axes are compatible with a translational repetition of points of identical environment.

In teaching crystallography it is important to adopt accepted definitions and conventions but this is not always done by the author. Thus, in introducing the unit cell of a plane lattice the repeat distance along what is conventionally the y axis is labelled a, the repeat along x is b, and the angle between a and b is given as α. In Fig. 34 the origin of the plane unit cell is at the bottom left corner with x vertical and y horizontal; in Fig. 35 the origin is at the top left with x horizontal and y vertical; then in Fig. 36 the cell axes are defined as in Fig. 35 but the translational distances along the positive y direction are labelled $-1b$, $-2b$, etc. Fig. 44 specifying 'the size and shape of the parallelepiped unit cell' is a complete disaster even though the conventions that should apply to it are correctly described in the text of the page on which it appears.

Throughout the book generally, the quality of figures is variable and unit cells are not drawn to any recognizable set of conventions, for example to those of the clinographic projection.

The explanation of Miller and directional indices (I prefer directional or zone *symbols* to distinguish these from Miller *indices* describing planes) is tortuous. Thus, it is stated '... the concept of various "planes" in two-dimensional lattices has no meaning. However, this does not really matter at all since the system ... can be derived easily by the simple expedient of imagining that planes exist in two-dimensional lattices' (p. 48). Unnecessary confusion is created in explaining the directional symbols, [UV] in a plane lattice and [UVW] in a space lattice, by selecting the centre of the unit cell as the origin of the axis system; see Figs. 36–8 and 90. Considering the space devoted to indices it is surprising that there is no derivation or even mention of the Weiss zone law.

Real solids, as three-dimensional patterns of atoms, are first considered in Chapter 8, *Crystals*, where it is said that 'The motif of a crystal ... can be only a single atom, a group of atoms, a single molecule, or a group of molecules'. The examples given are most misleading and include

single molecule: caesium chloride, titanium carbide, sodium chloride, lead sulphide, calcium fluoride, zinc sulphide, epsom salts;
group of molecules: cementite, rutile, silicon carbide, zircon, potassium cyanide.

In my own teaching I try to emphasize that molecules of every one of these compounds do not exist. Crystal structures again appear briefly in Chapter 15 and once more there are incorrect descriptions such as '... the motif must comprise the CsCl molecule ...' and '... a motif of one NaCl molecule ...' (pp. 124–5). Such descriptions are solely in terms of the unit cell and ignore any discussion of atomic packing or coordination. Even for the very simple close-packed hexagonal and face-centred cubic atomic arrangements it is stated that '... detailed descriptions ... are given in many books ... and will not be repeated here' (p. 123).

It is irritating to be referred frequently in this way to other unspecified texts for further details, *e.g.* 'Further examination ... of the space groups will not be pursued here, for there are many excellent books that deal with the subject at both elementary and advanced levels' (p. 137), or 'No examination will be made here of the ways in which dislocations disrupt the periodicity ... for this kind of defect has been treated more extensively in the literature than has any other kind of defect ...' (p. 142), or again 'The interested reader will find the concept of the reciprocal lattice explained adequately in more advanced treatises on the subject' (pp. 162–3). There is no bibliography or suggestions for further reading. Also, the frequent references to subsequent chapters of the book give an impression of discontinuity, *e.g.* 'It will be seen in Chapter 16 that there are other symmetry elements ...' (Chapter 10, p. 82), or 'The meaning of "basically the same" is best explained in ... Chapter 4' (Chapter 3, p. 21), or again, 'This system will then apply to the actual planes ... as will be seen in Chapter 19' (Chapter 6, p. 48).

Dimensions are given in picometres where '... 100 pm = 1 Ångström unit (Å), the new (*sic*) obsolete unit of measurement'. The Ångström unit is not yet obsolete; see any volume of *Acta Cryst.*

Despite these criticisms, there are features of the book that are of value in teaching. The relationships between Miller and Miller–Bravais indices are very clearly explained. For the derivation of the 32 point groups the reader is referred to *Encyclopaedia Britannica* but the description of the different combinations of symmetry elements and their Hermann–Mauguin symbols is excellent. Nevertheless, it is odd that these combinations are not illustrated in the usual way by stereograms. This would have required an additional chapter describing the representation of crystals by different projections, but it might also have ensured that crystallographic conventions were adequately discussed and exemplified. The chapters on *Microscopic symmetry* (glide planes and screw axes; 6 pp.) and *Space groups* (3 pp.) are well written but can obviously give only the minimum introductions to these topics. The derivation of the fourteen Bravais lattices and the reasons for doing so are useful but occupy 21 pages and so are given disproportionate treatment compared with other aspects of symmetry.

Patterns in Crystals covers not more than is given in six or seven lectures of a first-year undergradate introductory course in crystallography. Unfortunately, it falls between two stools. For crystallographers it derives at length and in detail some of the elementary ideas and concepts of lattices and symmetry that are included adequately in more advanced texts. The other readers for whom the book is intended – the students of chemistry, physics, geology, materials science, ceramics, metallurgy and engineering – do not require its detailed treatment of symmetry. The gemmologist and lapidary would, contrary to the author's expressed hope, find it irrelevant.

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