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.

Cristallographie–Morphologie. By H. BRASSEUR. Pp. 141. Liège: Gothier, 1967. Price Fr. Belg. 300.

Cristallographie–Eléments de cristallographie physique, de radiocristallographie, de cristallographie chimique et détermination des structures des cristaux. By H. BRASSEUR. Pp. 196. Liège: Gothier, 1968. Price Fr. Belg. 350.

These two books are intended to provide an elementary introduction to crystallography. After a brief historical introduction, the first volume is mainly concerned with the description and classification of crystals in terms of their morphological symmetry. The second volume deals with more physical aspects, mainly optical crystallography and X-ray diffraction, with very brief treatment of pyro- and piezoelectric properties of crystals. The two final chapters on crystal chemistry and crystal structure analysis are too short and do not do justice to these subjects.

The books have certain virtues; on the whole the treatment is systematic and probably quite sound, as far as it goes. There are also serious defects. The developments of the last thirty years or so are hardly touched; the reader might well get the impression that crystallography had become a cut and dried subject by say 1940 and that nothing much had happened since then. Besides this omission, the book tends to be tedious and suffers in places from the use of unnecessarily clumsy mathematical formulae. Most students nowadays have picked up enough mathematics to enable them to handle the standard problems of geometrical crystallography (*e.g.* calculation of angle between two crystal faces) by vector methods. The relationships between direct and reciprocal coordinate systems are described in the first volume but little use is made of them in subsequent chapters.

Both books are preceeded by detailed lists of contents but they lack indices (lengths are given sometimes in Å, sometimes in kX, which seem to have crept in without having been defined). They could serve as a partial basis for an introductory course on crystallography but they are not be recommended for self-study.

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Defects in crystalline solids. By B. HENDERSON. Pp.ix +203, 89 Figs., 12 Tables. London: Arnold, 1972. Price (cloth) £6·00, (paper) £3·00.

The chapters of this book are entitled: Defects in Solids, Some Experimental Techniques, Point Defects in Ionic Solids, Colour Centres in Ionic Solids, Defects in Crystalline Semiconductors, Point Defects in Metals and Alloys, and Interaction of Dislocations with Other Defects. These titles show at once that the book is mainly directed towards point defects and their aggregates. It is in effect a kind of review presenting experimental data together with the essential formulae and their derivation. As a textbook it would be more useful if it contained exercises. Since the author seems to be more at home with colour centres than with dislocations, the sections dealing with the latter are not the strongest. The title of the book appears to be somewhat too general and something more specific such as 'The role of point defects in crystalline solids' might give a prospective buyer a clearer idea of the content. Otherwise he might consider it as just another book on dislocations.

Henderson's book is certainly useful to possess for general information on a field in which one is not specifically working, and also as a lead to more specific literature. It is well presented and extensively illustrated. Its bibliography contains 71 titles and its subject and author indices are quite detailed. The price is fair, especially as the book also exists in a paperback edition.

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The mathematical theory of symmetry in solids. Representation theory for point groups and space groups, Von C. J. BRADLEY und A. P. CRACKNELL. S. xii+745. Oxford: Clarendon Press, 1972. Preis £28·00.

Wohl kaum ein Gebiet der exakten Naturwissenschaften ist so gut untersucht und zugleich lehr- und handbuchmässig so schlecht zugänglich wie grosse Teile der mathematischen Kristallographie. Dabei hat es gerade in der letzten Zeit auf mathematischer Seite neue Entwicklungen gegeben, welche einerseits die Kristallographie wesentlich fördern und andererseits die Mathematiker steigendes Interesse an der Kristallographie gewinnen lassen. Genannt seien die Theorie der Darstellungen von Gruppen durch ganzzahlige Matrizen und die Nutzbarmachung der Computer für Symmetrieprobleme. Eine das früher Erreichte und den neueren Fortschritt einigermassen zusammenfassende Darstellung fehlt jedoch. Der Titel des vorliegenden Buches berechtigt zu der Hoffnung, dass diesem die Verständigung von Kristallographen und Mathematikern empfindlich störenden Mangel jetzt abgeholfen ist. Zugleich lässt er erwarten, dass die Resultate der in der Literatur weit verstreuten Einzelarbeiten der theoretisch-kristallographischen Forschung hier zusammengestellt und damit leicht zugänglich sind.

Schon der erste Satz des Vorworts zeigt jedoch, dass das Buch ein ganz anderes Ziel verfolgt: 'As the sub-title suggests, this book is devoted to the theory of the deduction of the irreducible representations of point groups and space groups and to their tabulation, together with some discussion of the determination of symmetry-adapted functions that belong to these representations'. Was ist nun der tatsächliche Inhalt?

Das erste Kapitel (50 S.) 'Symmetry and the solid state' bringt nach einer kurzen historischen Einführung Definitionen und Sätze der Gruppen- und Darstellungstheorie über Punktgruppen und Raumgruppen. Kapitel 2 (30 S.) 'Symmetry-adapted functions for the point groups' beschäftigt sich mit den irreduziblen Darstellungen und den angepassten Kugelfunktionen der Punktgruppen. In Kapitel 3 (90 S.) findet man Angaben über Raumgruppen, Bravais-Gitter, reziprokes Gitter, irreduzible Darstellungen der Translationsgruppen sowie Symmetrie-Operationen und Darstellungen der Raumgruppen. Kapitel 4 (55 S.) ist den Beziehungen der Darstellungen einer Gruppe und denen ihrer Normalteiler gewidmet (und geht erheblich über die Grenzen kristallographischer oder kristallphysikalischer Probleme hinaus). Kapitel 5 (193 S.) enthält die Tabellen der eindeutigen Darstellungen der Raumgruppen, Kapitel 6 (151 S.) diejenigen der zweideutigen Darstellungen der Punkt- und Raumgruppen. Kapitel 7 (113 S.) schliesslich beschäftigt sich mit den Schwarz-Weiss-Gruppen und ihren Darstellungen. Ein kurzer Anhang und 52 S. Literaturverzeichnis sowie ein ausführliches Register beschliessen den Band.

Die im Titel angekündigte systematische Theorie der Symmetrie der Festkörper findet sich in dem Band leider nicht. Es handelt sich eher um eine Beschreibung der Symmetrie durch Matrixgruppen als um eine geschlossene Theorie. Zwar finden sich viele einzelne Angaben zu dem Thema, doch ist die Darstellung wenig zusammenhängend und nicht genügend durchgearbeitet. Der Hauptwert liegt in den Teilen, die zur Darstellungstheorie Beziehung haben und in den umfangreichen Tabellen. Hier führen theoretischer Teil und Beispiele zum Verständnis und zur Anwendung. Wertvoll ist ferner das umfassende Literaturverzeichnis, das zu den Quellen führt. Ein ausgezeichnetes Register erleichtert das Zurechtfinden.

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The structures of non-molecular solids. By GRAHAM M. CLARK. Pp.v+365, 193 Figs., 55 Tables. London: Applied Science, 1972. Price £9·00.

To anyone interested in structures, any book which attempts to classify and relate the vast number now known in the solid state is of considerable importance, and this one is no exception. The emphasis in this book, which virtually excludes the simple packing of molecules, is on structural descriptions based on the linking of polyhedra, where classification depends solely on the geometry of the structure and not, for example, on the type of chemical bonding.

The first part of the book deals briefly with fundamental principles relating to structure, such as the closest packing of spheres, the prediction of shapes of complex ions by valence-shell electron-pair repulsion theory, crystal-field theory, the linking of polyhedra, and defects in the solid state. No attempt is made to deal with structure determination; the only direct reference to classical crystallography is a two-page treatment of crystal symmetry.

The larger part of the book then classifies and describes structures on the basis of the linking of polyhedra involved. Each chapter deals with a particular type of linking, for example with structures containing polyhedra sharing only edges, or those sharing vertices and edges; within a chapter classification is on the basis of tetrahedra, octahedra and other polyhedra, and then on the number of linkages involved. The final chapter considers crystal energetics, with a useful discussion of the influence of lattice energy compared with that of radius ratio on the structures adopted by the alkali metal halides.

There is a list of references at the end of each chapter, a general bibliography and separate formula and subject indexes. The book has numerous diagrams, some of which would benefit in clarity from shading, to increase the three-dimensional impression; a particular example is the structure of Mo_8O_{23}, which is almost incomprehensible to anyone unfamiliar with this type of representation.

The linked polyhedra approach leads to some fascinating insights into structures not previously described in this way. However, the almost exclusive use of this treatment, although sometimes accompanied by a close packing of spheres description, does lead to some peculiarities. Thus a description of sodium chloride in terms of octahedra linked through edges and vertices, although precise, appears rather artificial and not as useful as the more often encountered 'ball and stick' picture.

Despite some factual errors the book is recommended reading for those interested in the classification of inorganic structures, although, in the reviewer's opinion, it by no means provides a definitive answer to the problem of such classification.

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Thermodynamics of crystals. By DUANE C. WALLACE. Pp.xviii+484. New York: John Wiley, 1972. Price £8·85.

As the title suggests, this book should prove useful to anyone interested in understanding and/or calculating the thermodynamic properties of crystals from atomistic lattice models. The first four chapters outline the basic theory necessary to calculate the equilibrium thermodynamic properties of a perfect crystal from the interatomic potential function in the absence of externally applied electric or magnetic fields. Although, as the author admits, this is a 'well-worn trail' much traveled since Born & Huang's (1957) classic, the literature is full of niggling points left unresolved in Born's work. One example is the correct formulation of the thermodynamics of strained crystals; while Born & Huang state that the method of long waves is applicable only to zero-pressure crystal configurations, it has since been shown that this method can also yield the elastic constants appropriate for the propagation of elastic waves in a pre-stressed crystal. Because the literature on this point is scattered, it is useful to have the basic theory presented in a way which resolves this difficulty as well as the associated problem of reconciling the methods of long waves and homogeneous static deformation. Similarly, it is useful to have recent anharmonic formulations, the renormalized and self-consistant phonon theories, presented in concert with the basic theory.