Notes and News

Announcements and other items of crystallographic interest will be published under this heading at the discretion of the Editorial Board. The notes (in duplicate) should be sent to the Executive Secretary of the International Union of Crystallography (J. N. King, International Union of Crystallography, 13 White Friars, Chester CH1 1NZ, England).

Acta Crystallographica
Ten-year index 1958 – 1967

A cumulative index for Volumes 11–23 (1958–1967) of *Acta Crystallographica* has just been published, and is available directly from Munksgaard International Publishers Ltd, 35 Nørre Søgade, DK-1370 Copenhagen K, Denmark, or from Polycrystal Book Service, P.O. Box 11567, Pittsburgh, Pennsylvania 15238, U.S.A. The price is 120 Danish kroner (currently about U.S. $20). Copies for the personal use of scientists, however, may be obtained at the special price of 60 Danish kroner. These prices include postage.

Not only does this cumulative index save the trouble of looking at the Indexes to thirteen separate Volumes (there were six Volumes in the years 1965–1967), but it should also avoid the irritation liable to be caused by the changes in arrangement over the years. As in all earlier indexes, each of the Volumes 11–13 combined author and subject entries in a single alphabetical list. In all subsequent Volumes there are separate subject and author indexes, but with Volume 14 the author entries ceased to give the titles of the papers. These defects have been remedied in the cumulative index, which adopts the arrangement introduced with Volumes A24 and B24. That is to say there are separate subject and author indexes but the author index gives the full title of each paper once, each main entry being cross referenced under the names of all authors other than the first.

The complete index contains 146 pages and, like that for Volumes 1–10, is bound in a similar manner to the relevant issues of the journal.

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.

Electronic absorption and internal and external vibrational data of atomic and molecular ions doped in alkali halide crystals. By S. C. JAIN, A. V. R. WARRIER and S. K. AGARWAL. Pp. 59. Springfield, Mass.: U.S. Department of Commerce, 1974. Price $ 0.95.

Spectral data for more than 70 atomic and molecular ions when incorporated in the lattice of alkali halide crystals are tabulated in this useful inclusion in the *National Standard Reference Data System* series. 55 tables are given in three sections, the first of which is devoted to electronic absorption wavelengths. The second gives the vibrational frequencies of the internal modes of complex ions whilst the third deals with external vibrational frequencies.

Each table gives the wavelength associated with the particular absorptive process for each centre in a number of alkali halides together with a group-theoretical assignment for the transition.

The data that appear in the tables were selected on the basis of consistency amongst different authors.

This relatively cheap publication will provide a useful addition to the library of solid-state spectroscopists.

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Crystal structure transformations in binary halides. NBS 41. By C. N. R. RAO and M. NATARAJAN. Pp. v+43. Washington: National Bureau of Standards, 1972. Price not given.

A critical survey of the data describing crystal structure transformations in binary halides has been compiled with data on crystallographic, spectroscopic, thermodynamic and electrical properties being given for each transformation. Data is given for hydrogen, alkali, ammonia, alkaline earth, transition, rare earth and inert gas halides.

This volume is of interest to those involved in many fields of research involving solid-state spectroscopy.

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Crystalline solids. By DUNCAN MCKIE and CHRISTINE MCKIE. Pp.x+628, Fig. 382, Tables 52. London: Nelson, 1974. Price £6·50.

Just before and just after the discovery of X-ray diffraction by crystals there was available a compendium of the status of crystallography entitled *Crystallography and practical*

Crystal Measurement by A. E. H. TUTTON. In its 1922 edition this was a two-volume 1446-page summary of the crystallography of that time. It dealt extensively with crystal forms and their examination, the chemical and physical properties of crystals, the theory of symmetry, and included what was then known of the arrangements of atoms in crystals. As time went on, those interested in crystals gradually turned their attention to this new field. For half a century this section of crystallography expanded until, to those in the field, it was crystallography itself. The tantalizing phase problem was brought under control until the practice of crystal-structure analysis became almost a routine.

The success of X-ray crystallography resulted in a spread of the general understanding that crystals are characterized by periodic arrangements of atoms, and this atmosphere of knowledge permeated all science, most especially chemistry and physics. This was influential in stimulating a new aspect of crystal chemistry and crystal physics commonly known as 'materials science'. In this field the investigators are concerned with finding materials with useful properties, and then with producing the materials, especially crystals, of suitable composition and purity to be used in industrial production. The section of materials science concerned with crystals is obviously a part of the greater field of crystal science. Its research results, however, tend to be published in journals other than those used for X-ray diffraction results.

It would be useful to have books in which the whole field of crystal science is treated and in some perspective. *Crystalline Solids* by Duncan and Christine McKie attempts to do this. A preliminary impression of the extent to which this 628-page book succeeds in accomplishing this can be obtained by noting the numbers of pages devoted to the various subdivisions.

Part I (456 pp.): Chapters 1. *Crystal lattices* (14 pp.), 2. *Representation in two dimensions: the stereographic projection* (15 pp.), 3. *Crystal symmetry* (59 pp.), 4. *Internal structure of crystalline matter* (35 pp.), 5. *Interfacial and interzonal angles: some methods of calculation and transformation* (24pp.), 6. *Diffraction of X-rays by crystals* (42 pp.), 7. *X-ray powder diffraction patterns* (21 pp.), 8. *Single-crystal X-ray diffraction patterns* (54 pp.), 9. *Principles of structure determination: the diffraction of X-rays, neutrons, and electrons* (12 pp.), 10. *Crystal chemistry* (77 pp.), 11. *Crystal physics* (21 pp.), 12. *Crystal optics* (73 pp.).

Part II (126 pp): Chapters 13. *Mineral equilibrium: the thermodynamical basis* (45 pp.), 14. *Phase equilibrium: the interpretation of phase diagrams* (52 pp.), 15. *Compositional analysis* (16 pp.), 16. *Mineral equilibrium and synthesis: experimental methods* (13 pp.).

Appendix *A. Construction of the stereographic projection* (8 pp.), *B. Two simple devices for measuring interfacial angles* (2 pp.), *C. Rules for selecting standard settings of space groups in International Tables for X-ray Crystallography and in Crystal Data* (1 pp.), *D. Spherical trigonometry: the equation for a general triangle* (2 pp.), *E. Three-dimensional analytical geometry* (2 pp.), *F. Crystal setting [orienting a crystal for X-ray diffraction]* (11 pp.), *G. Units and constants* (1 pp.). Bibliography (5 pp.). Index (9 pp.).

It is evident that this book covers much, but not all, of the range of crystal science. Except for beginning students, it is doubtful whether many crystallographers will want to read all its 628 pages, for at least some parts of its subject matter are already known to those in the field. Nevertheless many crystallographers will probably benefit by browsing through the book, reading here and there were they find their knowledge thin or lacking.

Chapters 1 through 9 are concerned with the description of crystals and might be labeled 'crystallography', *sensu strictu*. The true objective of this part of the book ought to be to teach the uninitiated student about pattern theory and X-ray diffraction, and how these theories and experimental methods are used to reveal the arrangements of atoms in crystals. With the possibility of doing this established, and some of the chief results noted, the way is prepared for a rational understanding of the properties of crystals. This remaining part of the book might well be called 'crystallology'. ('Crystallography' and 'crystallology' are related to one another as 'petrography', the descriptive study of rocks, is related to 'petrology', the science of rocks.)

In the reviewer's mind there are some questions as to the selection and balance of materials in the crystallography part of this book. In the first place some of the material (the stereographic projection), although it has been traditional to include it in crystallography books for over a century, is not a true part of crystallography, and now no longer serves the traditional nineteenth-century purpose. Surely for purposes of computing this has been replaced, and surely, as a device for visualizing the surface of a sphere as seen from below, it is more unnatural to view it from the south pole than from a distance. The major reason for using the stereographic projection in crystallography nowadays is for the indexing of Laue photographs, which is not detailed in this book. Its inclusion in this book dilutes the orderly development of the theory of crystallography, as does the material of Chapter 5 and Appendices *D* and *E*.

In the second place, the material of Chapter 8, *Single-crystal X-ray diffraction patterns* is out of balance. Historically, the oscillating-crystal method served the important function of introducing to crystallographers the reciprocal lattice. But even when this method was published by Bernal in 1926, it had already been superseded in 1924 by the elegant Weissenberg method. *Crystalline solids* devotes some 14 pages to this archaic method.

The subject matter of the part of the book here characterized as 'crystallography' has already been treated by dozens of books in recent years, so that this part of *Crystalline solids* is its least valuable contribution to the literature. The reviewer believes, however, that the part which can be characterized as 'crystallology', embracing the 293 pages of Chapters 10 through 16, constitutes a valuable contribution. It would be a service to many crystallographers if this part could be purchased separately.

The order of Chapters 10 through 16 is reasonable. The first of these chapters describes some of the simpler crystal structures and discusses their bonding. Close packing is described first, then coordination polyhedra. The van der Waals interaction is explained before the more energetic metallic, covalent, and ionic bondings. The authors make it clear that most bonding in inorganic crystals is a mixture of these three, which constitute ideal end members of the more general type. Several well-known sets of ionic radii are discussed, but the later Shannon–Prewitt distances are not. The chapter ends with a description of various defect structures, the order–disorder transformation, and hydrogen bonds.

For the most part, the discussion is reasonably elementary and constitutes rather easy reading. The going gets harder, however, when crystal-field theory is explained. The reason

for this can be understood from a remark made on the first page of the chapter: 'We shall assume that the reader has a depth of knowledge of the electron structure and valence theory that can be obtained by reading any of the many introductory text books on inorganic and theoretical chemistry'. But the bibliography of the chapter lists several books which are themselves not easy reading. Here is a place where the authors, in future editions, might well amplify the treatments given in their references.

After the chapter on crystal chemistry, the book continues with one on crystal physics. The authors begin their introduction to tensors by using the example of diffusion in an anisotropic medium. They continue with a discussion of thermal expansion and show how it is related to the crystal structure, using quartz as an example. The use of physical (and some chemical) properties in the determination of point-group symmetry is also treated. This chapter gives a relatively easy introduction to crystal physics and some properties of tensors.

The chapter on general physical properties is followed by one devoted specifically to crystal optics as studied with the aid of the polarizing microscope. Although this subject has been treated in many books it is worth having again in this book, partly because it is an excellent treatment and partly because this useful technique is unknown to many chemists, and this book is a place where they may well encounter it. Its inclusion at this place in *Crystalline solids* therefore serves a useful purpose for those who, unlike many mineralogists, have not received any training in this field.

The next four chapters, which are grouped together as Part II of the present volume, begin with a chapter on thermodynamics as applied to crystals. This is a simple introduction in which the various thermodynamic equations are presented in a relatively palatable way. The importance of the use of the enthalpy function in dealing with condensed phases is explained on the second page. The chapter includes discussions of Clapeyron's relation, polymorphic transformations, phases with variable compositions, chemical potential, ideal and non-ideal solid solutions, and has another look at order–disorder, this time from a statistical mechanics viewpoint. The last topic, Gibbs's phase rule, leads directly into the next chapter, the interpretation of phase diagrams. This topic, usually taught to mineralogists in courses in petrology, is well treated and contains a wealth of material relevant to crystal science.

The last two chapters deal with certain aspects of experimental crystal chemistry. The first of these deals with the analysis of the chemical compositions of crystals. This is treated along modern lines and includes, for example, electron-probe microanalysis, which has proven so useful in understanding the complicated compositions of minerals. Other topics are separation techniques, classical chemical methods, optical emission spectrometry, atomic absorption spectrometry and Mössbauer spectrometry.

The final chapter is concerned with a description of some experimental methods in mineral synthesis, including syntheses at high pressures and temperatures. This chapter is not as extensive as it might be. Some methods commonly used in the manufacture of crystals in industry, such as the Czochralski method, the flux method and zone refining, are not mentioned.

The book is profusely illustrated. Most of the illustrations are good. A minor irritation, especially in Chapter 2, is the crude representation of ellipses (these can be neatly drawn with an ellipsograph, or even more easily with the aid of a set of elliptical stencils). The use of large black squares to represent points in the reciprocal lattice detracts from some diagrams.

The five pages of bibliography and the nine pages of index are hopelessly inadequate for a book of this kind. Both sections should be enlarged in an subsequent edition.

This large book is available at a reasonable price, so that it can be expected to find its way into many personal libraries. The reviewer is of the opinion that Chapters 10 through 16 are especially useful for the purpose of giving a perspective view of the range of crystal science to those crystallographers who have spent most of their time in the restricted field of crystal-structure analysis.

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Silicon carbide – 1973. (Proceedings of the Third International Conference, Florida, 1973.) Edited by R. C. MARSHALL, J. W. FAUST JR & C. E. RYAN. Pp. xii + 692, Figs. and plates 423, Tables 53. Columbia: Univ. of South Carolina Press, 1974. Price $25.00.

Though the growth of silicon carbide has been studied for many years, it was only 16 years ago that a paper presented at a solid-state conference in Brussels, on the growth properties and potential of single-crystal SiC, was received with considerable enthusiasm. So much so that in the following April a full conference was devoted to the material. It was not until 1968, when many of the technical problems were realized, that a further conference was devoted to SiC. The many advances that have been made since then are reflected in this collection of the 75 papers presented at the 1973 Miami Conference.

Although SiC was at first regarded solely as a semiconductor of considerable potential in the device field, its possible applications now range far, exploiting its refractory nature, chemical inertness, high tensile strength and high forbidden energy gap. The editors have accordingly arranged the conference papers into five distinct sections. Part I is devoted to the growth of SiC by various techniques associated with potential applications. Six papers each are devoted to epitaxic growth and vapour-phase deposition; a further paper describes new techniques. Both Laue and oscillation techniques are used to illustrate crystal quality and this section will be of interest to inorganic crystallographers. Other papers deal with growth kinetics and inclusion problems.

Part II is devoted to the study of polytypes which were discovered over sixty years ago. They are believed to be formed by molecular complexity at high growth temperatures. The use of etch pits to show up some polytypes is discussed and an atlas of the Laue patterns of known polytypes given. Other papers discuss solid-state transformations and evidence for a new 21-layer trigonal polytype.

The third part, concerned with physical properties, begins with a complete review of optical studies followed by