BOOK REVIEWS

CRYSTALS AND THEIR STRUCTURES. By ARTHUR P. CRACKNELL. Pergamon Press, 1969, 242 p., $7.00 (paper).

This is a book written for sixth-form pupils in the English schools. It was written, according to the author, "With the feeling that the study of crystal structures and some of the simpler ideas of solid state physics are things that are finding their way into the sixth-form syllabuses."

The author has attempted too broad a coverage and has therefore been forced, in 223 pages, to treat most topics too superficially. The titles of the seven chapters are: *Symmetry and Crystals; Point Groups, Bravais Lattices and Space Groups; The Internal Structure of Crystals; The Forces Which Hold a Crystal Together; Imperfect Crystals and Non-crystalline Materials; Coloured Symmetry;* and *Group Theory.* There is an Appendix, *Model Building and Crystal Growing*, and a Bibliography, some items of which appear as an integral part of the text, right where the curious student may wish for further information, a practice which might well be more widely used in text books.

In some cases the chapter titles are misleading. For example, in the chapter on *The Internal Structure of Crystals*, the only structure mentioned is the magnetic structure of MnF_2. Instead, this chapter deals with waves and particles, the electromagnetic spectrum, Planck's constant, de Broglie, Davisson and Germer, the optical microscope, X-ray diffraction (including the Laue and Bragg equations, rotation, Laue, and powder photographs), electron and neutron diffraction, electron microscopy (including the principles involved in the construction of lenses for electron beams), the optical properties of crystals, piezoelectricity and pyroelectricity.

Sections dealing with physics other than crystal physics seem to have been disproportionately expanded. For example, in the chapter just outlined, electrostatic lenses are allotted five pages, followed by such problems as "Find the cyclotron frequency of a proton in a magnetic field where $B = 0.1$ Weber m^{-2}". In the same chapter one finds the following statements concerning diffraction methods: "It is rather difficult to interpret a Laue photograph, especially if one wants to use it actually to measure the distance between the atoms in the crystal; part of the trouble is that in analysing it one has to do a lot of three-dimensional geometry". Electron diffraction " . . . Has never quite achieved the popularity which is enjoyed by X-ray diffraction as a technique in studying the structures of crystalline solids and even some non-crystalline materials too. This is probably because it is a bit more difficult to carry out in practice than X-ray diffraction and the information one obtains at the end could in general have been obtained more quickly and easily by the use of X-rays."

Groups of exercises are appropriately placed after the relevant sections of the chapters. The competence expected from the student exceeds that which one would find in most American high school students. For example, after the usual brief geometrical description of a stereographic diagram, the student is asked to draw a stereogram of the Earth and mark on it "the *accurate* position" (the italics are in the book) of nine cities whose latitude and longitude are given.

After a discussion of the diamond as a covalent crystal, the following exercise appears: "The atoms in diamond (see Fig. 106)" [a perspective diagram and a plan view with fractional coordinates on some of the points] "are necessarily of the same size, calculate the percentage volume in the unit cell which is just empty space". It is not clear what simplifying assumptions the student is expected to make.

The author seems not to have received the editorial assistance he might reasonably have expected from the publishers. Some of the expository material should have been clarified. For example, concerning Miller indices one reads "If the intercept on one of the axes is negative, *i.e.* having defined Ox to be pointing in the direction of Fig. 26, then the face cutting this line at P' would have a line written over the top of the index corresponding to this intercept, e.g. as $(\bar{2}34)$, which is pronounced "bar two, three, four". "No figure in the book shows Miller indices, either associated with the faces of a model or the points on a sterographic projection, but the student is asked to produce them for all the faces of an octahedron and of a dodecahedron.

The illustrations are abundant and, for the most part, clear. The fact that a "drawing of a calcite crystal exhibiting double refraction" shows a rectangular parallelipiped will probably do the student no serious harm, but the electron-microscope photograph showing an edge dislocation in platinum phthalocyanine (Menter, *Proc. Roy. Soc. A* **236**) should have carried some indication of its magnification, which is in fact about 1,500,000×.

In the fourteen-page appendix on "Model Building and Crystal Growing" appear the sorts of topics that, in the opinion of this reviewer, might suitably have occupied a larger part of the main text. Here, for the first time, are given the relationships among the crystallographic axes for each of the non-cubic systems. Here are patterns for cut-outs for models of the cube, octahedron, dodecahderon and tetrahedron. A fine exercise question invites the student to devise some design to put on the faces of a cube (and also of a rhombic dodecahedron) to reduce the symmetry to that of point group 23. The author points out that the symmetry of the icosahedron, for which there is also a paper pattern, is not that of one of the thirty-two point groups and the student is invited to try to "sort out its symmetry operations". The inclusion of this solid is a good addition to a crystallographic text. A pattern for a cube "which has had its corners shaved off in a regular manner" is given and the model said to be "worth constructing", but there is no suggestion that it bears any relation to real crystals.

Perhaps crystallography in the English schools is a different thing from the study of crystals in American schools. For the latter purpose this book would not appear to be broadly suitable.

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LANDBOLT-BÖRNSTEIN: NUMERICAL DATA AND FUNCTIONAL RELATIONSHIPS IN SCIENCE AND TECHNOLOGY. NEW SERIES. VOLUME 2, GROUP III. By R. BECHMANN, R. F. S. HEARMON, AND S. K. KURTZ. Springer-Verlag: Berlin, Heidelberg, New York, 1969, 232 pages $37.40,

This volume supplements Volume 1, Group III, of the new Landolt-Börnstein series, which was published in 1966; Volume 2 contains references up to about the middle of 1968, with a small number as late as 1969. The index of substances includes those listed in both volumes. Libraries having Volume 1 will evidently need Volume 2 and later supplements.

Volume 2 comprises six sections, as follows: 1, *The elastic constants of non-piezoelectric crystals* (37 pages); 2, *The elastic, piezoelectric and dielectric constants of piezoelectric crystals* (57 pages); 3, *The third-order elastic constants* (21 pages); 4, *First and second-order piezooptic and electrooptic constants of crystals* (37 pages); 5, *Second-harmonic generation of light in crystalline solids* (39 pages); 6, *Index of substances for III/1 and III/2* (22 pages). Of these, 1, 2 and 4 supplement the compilations in Volume 1, while 3 and 5 are new sets of tables. The rapid growth of information concerning third- and most recently, fourth-order elastic constants leaves even this 1968 compilation well behind, but the thorough coverage of earlier work will greatly assist future compilers.

The introductory text for each section is given in German and English in parallel columns; as most of the space is devoted to numerical tables, this adds only a little to the bulk.

The tabulation includes elements, organic and inorganic compounds, minerals and alloys. In each section, these are grouped according to crystal classes, and the symmetry relations for each property are indicated. Most of the properties are probably of greater interest to solid state physicists than to mineralogists.

This volume appears to meet the high standards set by earlier Landolt-Börnstein tables in clarity of presentation and quality of manufacture. A few random checks on familiar materials revealed some indexing errors, and doubtless there are others in a mass of numerical data of this magnitude. It might be preferable to merge the data on third-order elastic constants with the section on elastic constants and their pressure and temperature coefficients, as by themselves they are not often of much significance. The use of a common unit of stress for both second- and third-order constants seems desirable, though with such a diversity of materials no single selection can be altogether satisfactory. The temperature dependence of some of the properties is exhibited only as curves, which are excellent as indicators of qualitative behavior, but useless for calculations; this defect may in some instances be traceable to the original publications.

Very elaborate schemes for placing desired physical constants at the disposal of those who wish to use them have been contemplated, but yet there seems to be no generally available substitute for carefully edited tables, frequently revised. This volume is an excellent example of the traditional approach.

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PHASE DIAGRAMS FOR CERAMISTS: 1969 SUPPLEMENT (Figures 2067–4149). By ERNST M. LEVIN, CARL R. ROBBINS, AND HOWARD F. MCMURDIE; Edited by Margie K. Reser. American Ceramic Society, Inc., 1969, 626 pages $25.00 to members, $20.00 to student members, $30.00 to nonmembers.

This is a supplement to the 1964 volume in which the American Ceramic Society brought together as complete a collection of phase diagrams of non-metallic systems as was feasible.

This volume adds 2083 diagrams to those published in the earlier volume. Together, they provide 4149 phase equilibrium diagrams organized and indexed for convenient reference.

The indexes in this 1969 volume are as effective as one can get and also cumulative, covering all diagrams in both the 1964 and 1969 compilations, There are 8270 entries in the subject index, of which 3970 are new. There is also an index to authors, with 1459 names. Of these, there are six prolific scientists credited with more than 100 diagrams each. It will be no surprise to earth scientists that most of the Americans in this group are mineralogists or geochemists; it may be a surprise to find that Soviet authors lead the list!!

The phase diagrams are subdivided into seven sections: (a) metal-oxygen systems, (b) metal oxide systems, (c) systems with oxygen containing radicals, (d) systems containing halides only, (e) systems containing halides and other substances, (f) systems containing cyanides, sulfides, etc., and (g) systems containing water.

Among these sections, (b), (c), and (g) are of principal interest to the mineralogical community, while section (f) also turns out to contain mainly the binary and ternary sulfide systems most significant to mineralogy. In some ways my only principal criticism of the volume is that the title is misleading. In fact, if anything a more accurate title would have been Phase diagrams for Mineralogists(!). A ceramist today should be as concerned with semiconductors as he is with feldspar and olivine, and the many important areas

relevant to semiconductor materials have been omitted—phosphides, carbides, nitrides, amenides, etc.

It is easy for the reviewer to recommend the volume as absolutely indispensible for any experimental earth scientist, indeed for any modern mineralogist. The get-up of the book is good, the binding of my older volume has held up through much use and this looks the same. The price is of course, the worst feature, but even $30.00 for a reference book is no longer outlandish, and certainly not out of line compared to other similar books.

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ROCK AND MINERAL ANALYSIS. By J. A. MAXWELL, Interscience Publishers, New York, 1968, xvii+584 p., 14 figs., 21 tables, $24.50.

Rock and Mineral Analysis is the 27th volume of a series of monographs on "Analytical Chemistry and its Application." The expressed aim of the author is to bring the practicing analyst up-to-date on developments in the field of rock and mineral analysis.

The book is divided into four parts. Part I comprises five chapters dealing with the nature of the analysis, precision and accuracy, sampling and sample preparation, laboratory design and decomposition of the sample. All are necessary prerequisites to the analysis of geologic specimens.

The second part of the book has three chapters. The largest and most comprehensive of the three (188 pages) deals with methods of analysis of silicates. While the succeeding chapters (carbonates and other types of samples) are treated less extensively the techniques discussed in the silicate chapter are applicable to all samples.

Part III covers selected procedures of silicate and carbonate analysis. Considerable detail is given on existing types of procedures including many modifications based on the author's experience. Here as throughout the book, numerous references are given.

In part IV, the author selects for discussion only two instrumental methods—X-ray fluorescence and atomic absorption spectroscopy. Each chapter covers theoretical discussions and some applications of these methods.

Three appendices in the form of flow diagrams describe schemes for conventional silicate analysis, rapid chemical analysis of silicate rocks and for combined X-ray fluorescence-chemical rapid analysis of silicate rocks. With each step a reference to the appropriate section of the text is given.

The author has done a remarkable job of presenting a clear, well written account of classical methods in their modified form as well as the latest developments in the field of rock and mineral analysis. He does not include a section on emission spectroscopy, bypassing its unique capacity for providing data on the major elements as well as trace constituents. The book should be a handy and welcomed reference to the analyst.

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