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BOOK REVIEWS

X-Ray Diffraction by Disordered and Ordered System by David W.L. Hukins (1981) Pergamon Press, 164 p., U.S. $28.75.

The subtitle of this book shows it to cover "X-ray diffraction by gases, liquids and solids . . . indicating how the theory of diffraction by these different states of matter is related and how it can be used to solve structural problems". The emphasis is on diffraction by noncrystalline materials, and the treatment assumes no prior familiarity with diffraction theory. The first four chapters cover the fundamentals of X-ray scattering, diffraction as a Fourier transformation, structure determination, the geometry of diffraction and scattering by atoms and molecules. The treatment is extremely concise and fairly formal, but does explain most of the physical effects involved; the treatment is generally classical, but defects in this approach are noted and their quantum mechanical interpretation is discussed. The rest of the book deals with diffraction of X-rays by matter, starting with ideal gases and gradually proceeding through more ordered states to end up with "three-dimensional crystals"; included in this development are chapters on liquids and amorphous solids, one-dimensional crystals, helices and liquid crystals. Two final chapters deal with crystalline powders and crystalline fibres, and with electron microscopy.

According to the author, the book is intended as a text for advanced undergraduates and graduate students; the gradual development of the subject progressively through the book is pedagogically admirable. However, the treatment is fairly mathematical and assumes a facility and knowledge not generally found at the undergraduate earth-science level, such as a familiarity with Fourier transforms and Bessel functions. The examples given in the book are usually biological, and the book is obviously aimed at a biophysics readership. With the possible exception of the professional crystallographer, this book is of limited appeal to the earth scientist.

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An Introduction to Ore Geology by Anthony M. Evans (1980). Geoscience Texts, Elsevier North-Holland Inc., New York, 231 p., U.S. $39.95 (cloth), $24.95 (paper).

The geology of mineral deposits is not very extensively served by undergraduate or graduate texts in comparison with other branches of the earth sciences. Considering the economic and social importance of mineral exploration and production, it is not easy to see why this should be. Reasonably up-to-date volumes that reflect the striking advances in world-wide comparative documentation, and understanding based on advanced research techniques are even fewer, although the situation is improving. As Dr. Evans of the University of Leicester, U.K., states in the first sentence of his preface: "This book is an attempt to provide a textbook in ore geology for second and third year undergraduates (*i.e.*, 3rd and 4th year undergraduate, and introductory graduate levels in North America: reviewer's note) which, in these days of inflation, could be retailed at a reasonable price". Apart from a few quibbles, which are inevitable for a subject of such diversity, this reviewer feels that Dr. Evans has succeeded very well with this 231-page book, which cost U.S. $24.95 (paper-back version) at the time of publication. Two of the obvious strong points are (i) the abundant (~130), clearly drawn line diagrams, many of which are based on illustrations from important research papers and other primary sources from the last ~15 years, and (ii) an extensive, reasonably up-to-date list of about 240 references. This reviewer particular welcomes the fact that most diagrams are of specific case-histories rather than generalized cartoons.

The book is broken down into three parts entitled "Principles" (69 p.) "Examples of the more important types of ore deposits" (120 p.). and "Mineralization in space and time" (21 p.). "Principles" covers basic definitions, descriptive aspects (Chapters 1–3) and introductory concepts (Chapters 4–6). Metal-price variation is, at least, briefly alluded to in Chapter 1, and basic scientific approaches are covered; these include analysis of phase relations (*e.g.*, use of the Zn–Fe–S system for geobarometry), solubilities of minerals at elevated temperatures (*e.g.*, galena solubility at 100°C), light stable-isotope geochemistry, fluid-inclusion petrology/microthermomety and the dating of ore deposits (radiometric and palaeomagnetic methods). Part II covers "Examples of the more important types of ore deposit" in the basic order: magmatic, hydrothermal, sedimentary and metamorphic. Orthomagmatic deposits, including those

of stratiform and podiform chromite, ilmenite, vanadiferous magnetite, Ni–Cu sulfide and platinum-group elements, as well as carbonatite-related ore deposits, are covered in Chapters 8–10. Important case histories, such as the Bushveld Complex, the Great Dyke, Kambalda, Sudbury and Palabora, are all illustrated. The variety of hydrothermal ore deposits (*i.e.*, those formed by natural hot water regardless of the origin of the water) is covered in Chapters 11–15, which are entitled "Pyrometasomatic deposits" (meaning Cu, W, U, *etc.* skarns, essentially). "Disseminated and stockwork deposits associated with plutonic intrusives" (mainly porphyry Cu and Mo deposits), "Stratiform sulfide and oxide deposits of sedimentary and volcanic environments" (*i.e.*, sediment-hosted Cu ± Ag ± Co and volcanogenic massive sulfide deposits), "The vein association" (*e.g.*, Llallagua Sn, and Butte Cu); and "Strata-bound deposits" (carbonate-hosted MVT Pb–Zn deposits and sandstone U–V deposits). This sequence would seem to this reviewer to be the weakest in the book because types of deposits, which are rather different are grouped together, and because of at least three very significant omissions. The association of sediment hosted Cu ± Ag ± Co deposits, such as the Kupferschiefer, the Zambia–Zaire Cu–Co belt and White Pine, with Kuroko-type volcanogenic massive sulfide deposits is confusing because the geological modes of occurrence (lithological associations) and modes of origin, which are beginning to become quite well understood, are both very different. In a book of such necessary brevity it is obviously easy to point to omissions depending on one's personal taste. However, to this reviewer, the lack of mention of the variety of epithermal Au–Ag deposits, Au deposits in Precambrian Shield terranes and, particularly, shale-hosted Pb–Zn ± Ag deposits (*e.g.*, Meggen, Rammelsberg, Howards Pass and MacArthur River) is rather serious, considering their economic and exploration significance. Sedimentary, low-temperature sediment-hosted and supergene ore deposits are covered in Chapters 13 and 15 (see tiles above), 16 ("Sedimentary deposits") and 17 ("Residual deposits and supergene enrichment"). Beach placers, sedimentary Mn deposits, and supergene enrichment of low-grade iron-formations are three of the useful and less obvious topics covered. The final chapter of Part II briefly discusses "The metamorphism of ore deposits" without, unfortunately, providing a diagram to illustrate the very complex, multistage folding that some major ore deposits can show [*e.g.*, Broken Hill (N.S.W.), Stekenjokk (Sweden), and Balmat (New York State)]. The final Part ("Mineralization in space and time", discusses two broader aspects of mineral-deposits geology that are important to think about, especially at the undergraduate level: "Plate tectonics and the global distribution of ore deposits" (19) and "Ore mineralization through geological time" (20). Both chapter are useful, with Chapter 19 being strong since it reflects a tradition in Britain in this research field.

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A Systematic Classification of Nonsilicate Minerals. James A. Ferraiolo, Department of Mineral Sciences, American Museum of Natural History, New York. Bulletin of the American Museum of Natural History, Vol. 172, Article 1, New York (1982), 237 pages, U.S. $11.05.

This excellent, detailed and thorough work is based on the celebrated classification of minerals by James Dwight Dana, familiarly known as "The System of Mineralogy", seventh edition by Berman, Palache and Frondel (Vol. I 1944, Vol. II 1951). Ferraiolo points out that these two volumes contain descriptions of 1043 valid species of nonsilicate minerals (plus another 227 poorly defined species). Since then over 1200 new nonsilicate minerals have been described, and so the author set himself the task of revising and expanding the 1944 and 1951 classifications.

The fifty Dana CLASSES covering the nonsilicates have been maintained, although in rare instances a CLASS has been divided into two parts for convenience. The Dana TYPES have been greatly increased and 89 new ones added, reflecting the diversity of anion/cation ratios in the new nonsilicate species. The book is written in two sections. The first, which presents the classificaton itself, comprises 108 pages; the second covers the bibliography and an index (129 pages).

The classification section consists of an 8-column format, the first containing the revised Dana number, which is a three- or four-position number. For example, the Apatite group: 41.8.1.1 fluorapatite, CLASS 41, Anhydrous phosphates, *etc.* containing hydroxyl or halogen, TYPE 8, $A_5(XO_4)_3Z_q$, species (or group) 1, the fourth number connecting chemically and structurally related species; so chlorapatite is 41.8.1.2, hydroxyapatite is 41.8.1.3, *etc.*, to

strontium-apatite 41.8.1.7. The second and third columns are headed NC (new composition) and NM (new mineral) for data published subsequently to the seventh edition of Dana's System. Columns four and five contain the mineral name and its chemical composition; most of the latter were taken from Fleischer's Glossary of Mineral Species 1980. Column six is labelled SSD (species status doubtful) and the last two columns give the crystal system and the space group.

The bibliography and index section list the minerals alphabetically, and for each entry, the page number in the classification, the revised and previous Dana numbers, the Dana reference and the literature reference (or references where appropriate).

This work is invaluable to every serious mineralogist, and is especially useful to systematic mineralogists, curators, collectors and researchers. The amount of work entailed in its compilation is staggering, and the author should be highly complimented. The typescript is extremely neat and clean, making this work even more easy to use. I strongly recommend it to your bookshelves.

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