BOOK REVIEWS

Drits, V. A. *Electron Diffraction and High-Resolution Electron Microscopy of Mineral Structures*, Berlin, Heidelberg and New York (Springer-Verlag), 1987. xii + 304 pp. Price DM248.00.

This is an English version of the Russian original published in 1981. However, it has been expanded and updated to include recent examples (up to 1986) of the study of mineral structures by the two techniques.

The translation, on the whole, is good, but the book remains very difficult to read. This is partly because it is very mathematical (most mineralogists are not physicists) and the symbols used are often not the standard ones that western electron microscopists use. The worst aspect, though, is the diagrams. They are often poorly produced and the annotation and captions are inadequate. The ray diagram of Fig. 13a is incorrect as the rays do not come to a focus in the second image plane!

The aim of the book is to explain the use of electron diffraction and high-resolution electron microscopy (HREM) in determining the crystal structure of materials. The vast majority of electron microscopists (including the relatively small number of mineralogists) do not use electron diffraction for this purpose; rather they use it as an integral part of microscopy to characterize phase distributions, defects, etc. X-ray diffraction is a far more straightforward technique for the determination of crystal structures, except when the material is fine-grained or poorly crystalline. It is for these materials (whether they be natural or synthetic) that the techniques described in this book are ideal. As much of the development and use of the techniques has taken place in the USSR and much of the literature is in Russian, western scientists concerned with fine-grained and poorly-crystalline materials will find this book useful, despite its limitations.

The bulk of the book is concerned with diffraction (207 out of 284 pages). The first three chapters cover the direct and reciprocal lattices, the determination of the unit cell and space groups from electron diffraction patterns and the kinematical theory of electron diffraction. A notable omission here is convergent-beam electron diffraction, a technique developed by groups in Australia and Great Britain, which can provide space group information in a relatively straightforward way. The use of Kikuchi patterns to orient the crystal exactly along a zone axis is not mentioned either.

Chapter 4 describes structure analysis by electron diffraction. The methods are identical to those used for X-ray diffraction, except that the distribution potential is plotted instead of the electron density. Patterson projections can be constructed from the intensities. For other methods, phases must be obtained either from a trial structure, a high-resolution image or, if the crystal is sufficiently thin that dynamic effects can be ignored (typically 50–100 Å in a single crystal), directly from the intensities themselves. A mention could have been made here of the current development of methods for the determination of atomic positions using convergent-beam techniques.

Chapters 5 and 6 cover the dynamical theory of electron diffraction. In Chapter 7, which is devoted to high-resolution imaging, the effect of aperture limitation, spherical and chromatic aberration, defocus and beam divergence on the image are discussed, together with the concept of a pseudo-weak phase object.

Oblique-texture electron diffraction has not been much used in the West. This is a powder technique in which the dispersed sample is tilted so that each powder ring intersects the Ewald sphere as two short arcs. Chapter 8 describes the method in detail and a number of examples of its application to the determination of the structures of clays and micas are given. While X-ray diffraction from single crystals gives more accurate results, many minerals do not occur in a suitable form for such work. OTED is then the most accessible technique.

The remaining three chapters of the book are devoted to applications. Chapters 9 and 10 give some examples of the use of SAED and HREM in the study of mixed-layer minerals, micas and phyllosilicates, while Chapter 11 describes the spectacular work, carried out mostly in the USA, on multiple-chain and mixed-chain silicates. As the author says 'the main contribution of HREM to structural mineralogy' is 'in the study of real crystal structure including miscellaneous types of imperfections'.

P. E. CHAMPNESS

Smyth, J. R. and Bish, D. L. *Crystal Structures and Cation Sites of the Rock-Forming Minerals*. London and Boston (Unwin-Hyman Ltd.), 1988. xx + 332 pp. Price £30·00.