

I find the explanation of the Becke line phenomenon (similar to that given in many texts) unconvincing. The workings of the Abbe and Jelley refractometers I would have thought merited explanatory diagrams. In some respects the text is very up to date, *e.g.* using a lunar rock for an illustration of feldspar twinning, but there is no mention of such methods as interference microscopy or dispersion staining, which have been developed relatively recently.

The distinctive features of this book (detailed treatment of immersion methods and conoscopic observations) as compared with several other recent books on the same subject will probably appeal to many teachers of optical mineralogy dealing with intermediate and advanced geology students. Each book of this kind may serve also to remind chemists, physicists and even some crystallographers that, granted the value of chemical analysis, spectroscopy of one kind or another and diffraction studies, there is something to be gained by actually having a close look at their specimens under a polarizing microscope.

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Early papers on diffraction of X-rays by crystals. Vol. II. Edited by J. M. BILVOET, W. G. BURGERS and G. HÄGG. Pp. xix + 484. Utrecht: Oosthoek, 1972. Price £10.80.

This work is of particular interest to the reviewer, because it is a collection of the publications he and his colleagues read and discussed during the years 1933 to 1936 when he was one of Professor Linus Pauling's graduate students in the Chemistry Department of the California Institute of Technology. The fundamental discoveries necessary for the development of the science of X-ray crystallography had been made by about 1930; the papers collected in the five chapters of the first volume of this work cover this subject matter beautifully. The second volume, which is the subject of this review, contains an intelligent selection of papers from which the early growth of the science of crystal-structure determination can be traced.

Chapter VI, the first in Volume II, contains selections from the works which eventually led to the symbols

for space groups and the tables of their symmetrically related points that we use today. Some papers are included which describe how space groups could be found from X-ray diffraction patterns, and how molecular symmetry could sometimes be inferred from the space group of a crystal and the atomic content of its unit cell. Chapter VII presents most of the classic papers in which the ionic and covalent atomic radii are defined and stated. (Metallic radii were also much used in the 1930's, but no paper about them is included.) Then follows some material describing the early work on the structures of ionic crystals, together with some mention of the hydrogen bond. Chapter VIII contains papers, or fragments of papers, describing the various techniques for collecting data on the directions and intensities of X-rays diffracted by crystals, crystalline powders, and partially crystalline fibers. The Laue, powder, rotation, and Weissenberg techniques are described, and some of the structural results so obtained are presented. Chapter IX deals in a similar way with the classic works on solid solutions, random stacking of layers, and rotating groups. Some of the early work on alloys and their structures is also included in this chapter. Chapter X presents a collection of pioneering papers on crystal-structure determination. Early uses of symmetry, cell dimensions, diffracted intensities, chemical intuition, trial and error, and isomorphous replacement are all described. The increasing complexity of the structures studied during the period 1920 to 1935 is clearly brought out. The chapter ends with the first papers on X-ray diffraction by crystalline proteins. Chapter XI is a group of papers in which is traced the history of the use of Fourier series in crystal-structure determination. It starts with the working out of the electron density in alkali halides, continues with the use of signs from trial structures, and ends with the heavy-atom method. Chapter XII contains only one paper: the famous 1935 paper fully explaining the Patterson method, then tacitly limited to finding the projections of interatomic vectors onto lines or planes.

The names of the authors of all these great papers are not quoted above: to do so would have made this review too long. Their distinguished names are all in the book, of course, and most of them are familiar to every physical scientist.

An interesting example of the discovery, loss, and rediscovery of an

important idea appears on the title page of Chapter XII. P. P. Ewald pointed out in 1921 that the squared magnitudes of the structure amplitudes of the X-rays diffracted by a crystal depend on the interatomic vectors and not the atomic positions. No use seems to have been made of this fact until it was rediscovered by A. L. Patterson in 1934.

By carefully reading the material in this book, a student could learn more than three quarters of what a modern X-ray crystallographer should know, and at the same time get a feeling for the excitement that existed among investigators of crystal structures in those thrilling days. He would also discover how incorrect ideas are sometimes held by very distinguished scientists, and how subsequent thought and experiment changes these ideas into others. Eventually the current ideas are evolved; these are the ones we think are correct.

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Electron microscopy in material science. Edited by U. VALDRÉ. Pp. xiii + 757. New York: Academic Press, 1972. Price £16.35, \$35.00.

Electron microscopy has recently entered an exciting new phase of instrumental and interpretive development, and the current power of the method in its application to a wide range of problems in materials science is the subject of this large volume, which arises out of the International School for Electron Microscopy held at Erice in Italy in 1970. About 20 workers, who have played a leading part in bringing about the current state of the art, contributed lectures to the School's programme, which was divided into three sections: (a) electron optics and instrumentation, (b) diffraction contrast and its applications and (c) transfer of image information and phase contrast. Their lectures, collected together in this book, form a substantial contribution to that part of the literature of electron microscopy whose aim is to educate and instruct.

In the first section there are contributions by A. Septier (geometrical electron optics), R. Castaing (secondary ion microanalysis and energy-selecting