BOOK REVIEWS

POTASSIUM ARGON DATING, Edited by O. A. SCHAEFFER and J. ZÄHRINGER, Springer—Verlag New York Inc., New York, N.Y., U.S.A., August 1966, xi + 234 pp. line figures, tables, $10.60 (US).

This book, a collection of ten articles on various aspects of potassium–argon dating, has been compiled by O. A. Schaeffer and J. Zähringer and is dedicated to Professor W. Gentner to mark his sixtieth birthday.

Although the potassium–argon method of age determination has been applied for over fifteen years, this is the first book that has been devoted entirely to it and as such is a fitting tribute to Wolfgang Gentner, one of the outstanding pioneers of this field.

A history of the potassium–argon method of geochronology by the late F. G. Houtermans is followed by nine other contributions which are listed below:

Determination of Radiogenic Argon	T. Kirsten
Potassium Analysis	O. Müller
The Diffusion of Argon in Potassium-Bearing Solids	H. Fechtig and S. Kalbitzer
K–Ar Dating of Precambrian Rocks	G. W. Wetherill
K–Ar Dating of Plutonic and Volcanic Rocks in Orogenic Belts	R. L. Armstrong
K–Ar Dating of Sediments	P. M. Hurley
The Problem of Contamination in Obtaining Accurate Dates of Young Geologic Rocks	G. H. Curtis
Tektites	O. A. Schaeffer
K–Ar Ages of Meteorites	D. Krankowsky and J. Zähringer

As might be expected in a compilation of this type there is a lack of cohesion between sections resulting in some duplication of material, although in general the editing in this respect has been quite good. Typographical errors are unfortunately numerous.

All the contributions are of high calibre. However, the treatment of the determination of radiogenic argon by T. Kirsten in which both old and recent methods are discussed and the section on tektites by O. A. Schaeffer are outstanding. The bibliographies with a few exceptions are complete and accurate.

The book appears to be written mainly as a reference text for geochronologists, however, any geologist wishing to understand the potassium–argon method and to be able to interpret the results could certainly benefit by owning it.

EDWARD FARRAR

X-RAY DIFFRACTION METHODS, E. W. NUFFIELD, John Wiley and Sons, Inc., New York, June, 1966, xii + 409 pages, 210 figures, tables. $12.50 (US).

This book is a successful "attempt to condense the basic concepts and modern methods of *x*-ray crystallography into one small volume" as the author intends it to be. The emphasis is on the practical techniques used in *x*-ray crystallography, and although an important use of the book will be what Nuffield describes as a "laboratory manual", the book is much more than that. It describes not only the practical details of taking and interpreting all the standard types of *x*-ray diffraction photographs, but it derives all the essential geometrical relationships as well.

The book falls naturally, as the author points out, into two parts. The first five chapters deal with basic *x*-ray diffraction theory and with powder methods, and are suitable for an introductory course in *x*-ray crystallography. The remaining chapters, six to thirteen, deal with single-crystal methods and are suitable for a more advanced course.

In Chapter 1, Introduction, a good historical survey is followed by a 19-page section on Elementary Crystallography which is meant mainly as a review of work likely taken in an earlier course, especially by students in the earth sciences to whom the book is particularly, but by no means only, directed. Chapter 2 deals in a conventional way with The Nature and Generation of *X*-Rays. Chapter 3 on The Diffraction of *X*-Rays gives a well-illustrated derivation of the Laue and Bragg conditions for diffraction, followed by short sections on the factors that govern the intensity of diffraction and on Fourier and Patterson syntheses. Although brief, this part of the book covering the Intensity of Diffraction provides an introduction to crystal structure analytical methods that is probably adequate for the beginning student in *x*-ray diffraction. Chapter 4 describes centered lattices, glide planes and screw axes, and the derivation of space groups. Chapter 5 is a long (104 pages), full description of the theory and practice of powder methods. It is divided formally into Part 1 Film Techniques, and Part 2 The Diffractometer. Part 1 covers not only the practical details of sample preparation, measurement of the film, the identification of crystalline substances, etc., but also the indexing of the reflections, the determination of the space group, and the calculation of the cell content. As an example of the cell content calculation, a complex silicate would be a better choice than the chemically simple sulphide the author uses, in order to show how structurally equivalent cations must be combined and how two or more anions are handled. Part 1 is completed by useful detailed discussions of the quantitative analysis of mixtures, the attainment of precise lattice dimensions, and special powder

cameras. Part 2 on the diffractometer describes, in turn, the three commonly used x-ray counters, the counting circuits, the reliability of diffractometer powder data, and specimen preparation; it concludes with a valuable comparison of Debye-Scherrer and diffractometer methods. This chapter would be improved if those topics dealing with the interpretation of powder data—indexing of the reflections, identification, quantitative analysis, etc.—were placed *after* the description of the diffractometer because the interpretation is largely independent of the method of recording. Further, it would have been valuable to explain that diffractometer intensities drop off more rapidly with increasing θ than do photographic intensities. This difference creates serious problems, especially for the novice, in using the A.S.T.M. index.

In the single-crystal half of the book, Chapter 6 describes the Orientation and Projection of Morphological Crystals, Chapter 7 The Laue Method, and Chapter 8 The Reciprocal Lattice. The two most widely used single-crystal photographic methods are described in Chapter 9 The Buerger Precession Method, and Chapter 11 The Equi-inclination Weissenberg Method. In these two chapters the author gives excellent accounts, in relatively brief form, of material that is covered in great detail by M. J. Buerger. Nuffield in fact acknowledges in the Preface his heavy indebtedness to Buerger, and in a sense Nuffield's whole book can be considered a one-volume condensation of several (but not all) of Buerger's books. In Chapters 9 and 11 not only are the techniques described with the necessary charts and tables, but the geometrical relationships are once again derived. Ingenious figures help the reader visualize the reflection process.

Chapter 10 describes The Rotation and Oscillation Methods. It would be valuable here to reproduce the nomograph for deriving periods from rotation photographs published by Donnay & Donnay, *Rev. Sc. Instr.*, 23, 130, 1952. The section describing the orientation of a crystal by oscillation photographs would be enhanced by two or three photographic examples.

A brief account of the three principal kinds of single-crystal diffractometer is given in Chapter 12, and the final chapter describes a general method for orienting a crystal deduced by E. J. Brooker and the author utilizing a temporarily modified precession instrument. Several useful appendices conclude the work.

Because of its emphasis on the essentials of both application and theory, and because of the clear writing and excellent figures, X-Ray Diffraction Methods is likely to find wide popularity among teachers, students and researchers in x-ray crystallography.

R. B. FERGUSON

GENETIC RELATIONSHIP BETWEEN GERMAN AND NORWEGIAN PYRITE DEPOSITS GIVING SPECIAL CONSIDERATION TO THE SULPHUR ISOTOPE RATIOS, by GERD ANGER. Clausthaler Hefte zur Lagerstattenkunde und Geochemie der Mineralogsichen Rohstoffe, ed. H. Borchert. Hefte 3, 1966. Gebr. Borntraeger, Berlin. Price DM 45 (by subscription), DM 50 (single copy). In German.

This publication of 115 pages contains 19 tables as well as 54 figures including 17 excellent photographs of polished sections. A bibliography is followed by 18 pages listing in detail some 380 samples with their mineral composition as well as their sulphur isotope ratios (S^{32}/S^{34}).

The author compares the Norwegian deposits of Sulitjelma, Skorovas, Joma, Lokken, Roros, Folldal, and Vigsnes, with the well-known German deposits of Rammelsberg, Meggen, and Bayerland.

The 7 Norwegian deposits are all situated in Ordovician sediments or tuffs.

A syngenetic origin is postulated for these deposits and the ore minerals (Page 96) are believed to have derived from submarine thermal springs. This syngenetic origin is supported by:

1. Primary textures of sedimentary origin found in all deposits;
2. An increase in the S^{34} content in the sulphides from footwall to hanging wall, this increase being more pronounced in deposits with greater thickness.
3. The S^{32}/S^{34} ratio decrease from footwall to hanging wall in the Rammelsberg as well as in the Norwegian deposits due to a relative enrichment of the S^{34} isotope. This enrichment may be explained by progressive differentiation in the magma from which the ore solutions originate.

Finally, the S^{32}/S^{34} ratios of the barites from Meggen and Rammelsberg are compared to the ratios of other sulphates derived from Devonian sea water such as the evaporite-anhydrite and gypsum from Canada and U.S.A.

G. DISLER

INVESTIGATIONS ON THE GENESIS OF THE SULPHIDE DEPOSITS OF CYPRUS by DIETRICH WOLFF. Clausthaler Hefte zur Lagerstattenkunde und Geochemie der Mineralogsichen Rohstoffe, ed. H. Borchert. Hefte 4, 1966. Gebr. Borntraeger, Berlin. Price DM 52.50 (by subscription), DM 58 (single copy). In German.

This paper features 6 tables and 5 figures as well as a detailed bibliography on 47 pages. Appended are 85 photographs showing sheeted

structures as well as excellent polished and thin sections of ore and host rocks.

The sulphide deposits of Cyprus occur within lavas, mainly pillow-lavas, believed to be of submarine origin.

Lavas and orebodies form a belt surrounding the sheeted intrusive complex of Troodos, consisting of basic to acid intrusives. Extrusive and intrusive formations of Cyprus are believed to belong to different phases of the same magmatic period (late Mesozoic to early Tertiary): An originally basaltic magma would have produced the various differentiates (peridotites – gabbros – quartzdiorites – trondhjemites) of which the metal containing solutions are believed to represent the final phase. These solutions would have migrated under pressure during the pneumatolytic phase into the porous and brecciated pillowlavas.

These results are based on detailed investigations such as age determinations of radio-larites overlaying the pillowlavas, as well as structural and petrochemical studies (Niggli values, etc.).

The sulphide deposits vary in size and metal content: The richest deposit (Mavrovouni) contained 15 million tons averaging 4% Cu and 47% S but the ore reserves will be exhausted in a few years. Its place will be taken by the Skouriotissa deposit (2.25% Cu and 48% S) which is being prepared for open pit mining.

G. DISLER