

keen to keep up-to-date with recent developments.

R. A. HOWIE

Robinson, P. C. and Bradbury, S. *Qualitative Polarized-Light Microscopy*. (Royal Microscopical Society Microscopy Handbook 09). Oxford (Oxford University Press), 1992. vi + 122 pp. Price £13.95.

The principles governing the interaction of light with crystalline media have long been understood and text-books dealing with the microscopic examination of minerals and other crystalline substances usually contain sections devoted to them. This book, therefore, follows a well-trodden path and is distinctive first by reason of its final chapter on differential interference contrast microscopy which has become an increasingly important contrast-enhancement technique in applied microscopy, and second because of the emphasis that is laid throughout on practical exercises designed to supplement and reinforce the theory.

The book begins by explaining the basic concepts of light, and of interference and polarisation before commenting in some detail on the effects produced by the passage of monochromatic and white plane-polarised light through uniaxial and biaxial substances. The formation of interference colours is described and there are useful descriptions of retardation plates and compensators and their use.

Attention focuses almost exclusively on orthoscopic examination; conoscopic examination is but briefly mentioned and only in connection with uniaxial substances. The authors explain that this lies beyond the scope of the book but this is a pity, for mineralogists and others who routinely need to interpret interference figures will have to look elsewhere for information.

The polarizing microscope is described in detail and it is good to see space devoted to the use and adjustment of the instrument, and clear instructions are given for achieving Köhler illumination.

There are chapters on singly and doubly refracting media and on observations in plane-polarized light, and on observations between crossed polars and the relationships between optical path difference and interference.

The book concludes with a clear explanation of the principles of the differential interference contrast microscope in both the reflected light and transmitted light mode, together with an assessment of the advantages and disadvantages of the method.

Each chapter concludes with a few suggestions

for further reading and with carefully selected practical exercises which are clearly based on extensive teaching experience. There is also a useful glossary and the book is illustrated with clear diagrams. The student starting to use polarized-light microscopy will find this a valuable aid.

A. C. BISHOP

Wagner, G. and Van Den Haute, P. *Fission-Track Dating*. Dordrecht (Kluwer Academic Publishers) 1992. 285 pp. Price £57.00.

Fission tracks, or trails of radiation damage, are produced within many mineral species at a more or less constant rate throughout geological time, as a result of the spontaneous fission of ^{238}U . The occurrence of such tracks has been known for around a hundred years, but it is only in the past few decades that their geochronological potential has been recognised.

From a knowledge of the U content, the decay constant, and of the number of tracks, it should be possible to calculate the age of crystallisation. However, in apatite grains, the most commonly used mineral in fission-track studies, the tracks are shortened by the process of annealing above 50° , and are erased above 120° . Similar track shortening and fading occurs over different temperature ranges in other mineral species. Thus, because of track annealing and erasure, it is commonly not possible to obtain reliable absolute ages by fission-track methods. However, by additionally measuring the lengths of preserved tracks, important inferences can be made in many instances about the thermal and burial history of the sample. Interest in fission-track dating techniques, therefore, has grown enormously in recent years, particularly as a result of their application in basin analysis studies, where they can provide important clues to the magnitude and timing of thermal events. Because of the close correspondence between the temperature range of annealing in apatite grains, and the temperature range of oil generation in sedimentary rocks, the study of apatite fission tracks has become an important tool in hydrocarbon exploration.

Thus, there is a need for a general text on this topic, not only for the benefit of the geochronological specialist, but also to provide essential background to other scientists who may have to work with, and interpret the results derived from, fission-track dating methods. This well prepared and presented book by Wagner and van den Haute is, therefore, timely.

The book contains seven chapters which fall naturally into two parts, more or less equal in

length, and concludes with a series of appendices, an extensive list of references and an index. The first four chapters deal with the basics of the subject, covering the origin of tracks, methods of observation and analysis, the principles of the dating method, and the annealing of tracks. The non-specialist may well find this part of the book hard going, but it has the merit of bringing together, in one place, a comprehensive collection of background information that is essential for the understanding of fission-track data studies.

The final three chapters are principally concerned with the applications of fission-track dating. Chapter 5 considers the general principles, Chapter 6 reviews the range of mineral species that have been used in such studies, and the final chapter includes several summary, geological and archaeological case histories. The wide range of practical uses to which fission-track dating can be put, and the large number of minerals that potentially can provide useful information, will come as a surprise to many non-specialist readers. Estimates of uplift and erosion, dating fault movements, thermal history of basins, age and origin of ore deposits, and dating of archaeological artifacts are just some of the topics considered. The potential uses of, mostly commonly occurring, minerals are considered. In view of the present-day, routine use of apatite fission-track studies, as an aid in hydrocarbon exploration, it is surprising and regrettable that investigations of this type are given such relatively little prominence. This may reflect the authors' own research bias, or they may have felt that such applications were already widely known and documented. What is clearly demonstrated by the book, however, is the wide range of other possible uses, combining palaeogeothermometry and geochronology, and the great, largely untapped potential of the fission-track dating method, particularly in the current underuse of minerals other than apatite.

One of the main values of fission-track studies is their ability to determine temperatures at dated times in the past. The conversion of palaeotemperatures to the palaeodepths and palaeothicknesses, that geologists commonly find more useful, is an area where fission-track workers have come into some conflict with geologists, as published estimates of palaeodepths are commonly greater than can be sustained from other information. Unfortunately, one will find little hint of such difficulties, or any discussion of the related inherent problems, in the book. The authors seem happy to project linear geothermal gradients from high thermal conductivity crystal-

line basement, or well compacted sedimentary rocks, into eroded cover sequences, even though these may include poorly consolidated sediments of significantly lower thermal conductivity. This, of course, is not a criticism of the fission-track dating and palaeotemperature estimation method itself, which otherwise is well served by this book, but rather indicates that the values obtained by such techniques need to be interpreted and applied with some care and caution, in the context of all the relevant information.

As the uses of fission-track dating expand, and its value becomes more widely appreciated, more and more earth scientists and archaeologists will seek a working knowledge of the principles and techniques of the method, so that they can fully evaluate, and give the best interpretation to, the palaeotemperature and geochronological data obtained. *Fission-Track Dating* by Wagner and van den Haute is likely to be the first place they will look for that knowledge. It should serve as a valuable, if not essential, reference source to the geological and archaeological communities for a good number of years to come.

D. HOLLIDAY

Sinkankas, J. *Gemology: an Annotated Bibliography*. 2 vols. Metuchen, New Jersey 353 (The Scarecrow Press Inc.), 1993. xxxiii + 1179 pp. Price: £179.50.

This is a remarkably comprehensive bibliography of gems and precious stones, containing 7458 entries, predominantly of books but also shorter articles of significance from 1500 onwards. In the foreword Richard T. Liddicoat Jr. draws attention to the more than 40 years of experience that John Sinkankas has brought to compiling this work, and to the unique assessment of every item that he saw. A Preface of 27 pages outlines the kinds of information recorded in the entries with examples of the formats, and discusses the languages, outlines the symbols and abbreviations, and lists the references consulted.

All important works are listed with remarks on bindings and other physical features that will enable librarians, researchers and collectors to identify a particular edition or state. The scope of the bibliography is based on the size and relevance of the subject matter. Besides gems and gemmology, works on engraved gems, crown jewels, curious lore and biographies are entered, but, in general, items of less than 15 pages are not included.

Entries are by author in alphabetical order, and after vital dates and for some, a brief biographical