

Both chapters deal partly with a technique developed since Eglinton and Murphy (pyrolysis), which is not well discussed on other current books. A discussion of petrographic techniques (Senftle, Landis and McLaughlin) completes this section.

The following two sections generally cover organic geochemical applications in fossil fuels, and contain material present in other organic chemistry texts. I intended initially, therefore, to gloss over this section, but quickly found myself stopping and going back to the start. This section was, again, refreshing to read because, with contributions by 11 individual authors, specific points were highlighted by each author. Although excellent chapters are provided on standard topics such as thermal alteration, hydrothermal alteration, and hydrous pyrolysis, the chapter format provided a focus on gas hydrates (Kennecutt, Brooks and Cox). I was especially appreciative of the details of biomarker kinetics (Lewis) and water washing (Palmer) together with biodegradation.

So far, this volume has dealt with rather conventional topics. The rest of the book is again commendable for some of the more unconventional topics which have been brought in. The sixth section contains four chapters on organic matter and metalliferous deposits. Apart from conventional chapters by Levanthal, Gize and Manning, Finkelman provides a detailed data base on trace and minor elements in coals. In addition, the technological effects of these metals is highlighted.

The seventh section is devoted to the Precambrian, starting with, personally, one of the most stimulating chapters by James Kasting, on the evolution of the atmosphere and hydrosphere. This topic leads naturally to prebiotic synthesis (Stanley Miller), followed by the fossil and isotopic evidence for organized life (Schidlowski), and then the organic, geochemical and biomarker evidence (Imbus and Dave McKirdy). This section is then nicely rounded by Engel, Macko and Nagy, in a summary of the amino acids in carbonaceous meteorites. In addition to being a summary of the series of publications in *Nature*, I was impressed at the honesty of the authors in the way the arguments for and against extra-terrestrial organic matter were presented. The last chapter is an appropriate dessert, dealing with organic geochemical applications to the Quaternary. Brassell starts with applications of biomarkers as climatic indicators, with an excellent section on alkenones. This is followed by two chapters (Mitterer and Wehmiller) on the classic application of amino acids for dating and stratigraphic research. This is

followed delightfully by three chapters which I wish had been bigger. Firstly, the use of stable isotopes to determine food chains (Ostrum and Fry) is discussed, with an excellent reference list. Immunological techniques to establish phylogenetic links were presented then in an exciting and convincing style (Robbins, Muyzer, Brew, and Lowenstein).

Don't take my word that this book is worth reading. Find out for yourself! A. P. Gize

Nassau, K. *Gemstone Enhancement: History, Science and State of the Art* (Second Edition). Oxford and London (Butterworth Heinemann), 1994. xiv + 252 pp., 35 colour photos. Price £30.00. ISBN 0 7506 1797 7.

During the ten years since the first edition of this work, there has been a tremendous increase not only in the use of treatments to enhance the appearance of gemstones but also in the development of new and sophisticated processes used for this purpose. As is admitted, estimates of the extent to which treatments are now being used, in the form of heating, irradiation and other methods, are largely subjective, but the author suggests that around 70% of all coloured gemstones seen in the jewellery trade have been enhanced. Among several significant developments in treatment processes are the fracture and cavity fillings, including oils, polymers and glass impregnations as well as surface coatings of various types. Heat treatment and irradiation are also described, the latter section including a useful summary on the physics of colour centres.

One of the main sections of the book is the listing of specific treatments for twenty species of gemstones. The entries for such important gem families as beryl, corundum, diamond, opal and topaz are comprehensive and well documented and illustrated, but the details given for the less commercially important gemstones (one hesitates to use the term 'semi-precious') such as feldspar, fluorite, zircon and zoisite are rather scrappy, though there are references given which can lead to enlightenment.

The work includes four fairly lengthy appendices, giving further information on the techniques of heat treatment and of irradiation (sensibly, the reader is warned against courting instant disaster and advised to re-read the earlier chapters before embarking on any specific treatment), light and energy considerations in connection with colour, and finally a useful listing of purveyors of supplies and services (the latter including the addresses of gem-testing laboratories). The index, and the

alphabetical listings in the chapter on specific treatments, turns out to be somewhat deceptive: thus in both places a search for hackmanite refers the reader to lapis lazuli under which entry it is not mentioned. Similarly, for bowenite and meerschaum one is referred to marble, to no avail.

Nevertheless, this book contains a great mass of important information on all aspects of gemstone enhancement, ranging from the often neglected historical descriptions of the art to up-to-date details of many of the latest techniques for fooling the purchaser — and even the gemmologist. It deserves to be widely read. R.A.HOWIE

Buseck, P. R. ed. *Minerals and Reactions at the Atomic Scale: Transmission Electron Microscopy*. (Reviews in Mineralogy, Volume 27) Washington (Mineralogical Society of America), 1992. xvi + 508 pp. Price \$28.00. ISBN O-939950-32-4.

This volume represents the proceedings of a MSA Short Course on TEM, convened in 1992 by Peter Buseck at Hueston Woods State Park, College Corner, Ohio, USA.

The aims of the course were to allow mineralogists and petrologists to gain an appreciation of the data obtainable from a TEM and to enable them to try out the techniques for themselves. Both of these aims were probably achievable for those able to attend the course, with experienced instructors present and instruments available for demonstration and supervised tuition. This course book, used as a stand-alone manual can certainly fulfil the first of these aims, but it would be unrealistic to expect it to serve as a 'DIY' Manual enabling a complete beginner to carry out the techniques without further help (as one bright, eager research student I know found to his disappointment). As pointed out in the preface, modern TEMs are much easier for the inexperienced operator to use than was the case with older instruments, but the range and quality of information that can be obtained increases with experience. With this *caveat* the course book is an excellent introduction to the principles and practice of modern TEMs in mineralogy and petrology. At US\$28 the book is excellent value for money.

The first part of the book provides an introduction to the principles of TEM, in theory and practice, covering imaging (conventional and high-resolution), diffraction (selected-area and convergent-beam) and chemical analysis (X-ray, energy-loss and electron channelling). This section provides an excellent background to the subject

for beginners, though some understanding of the concepts of crystallography and diffraction is required. It is probably of most benefit to those who already have some experience of TEM use, but wish to fill gaps in their background knowledge or gain a better understanding of concepts that are not clear to them.

The remaining part (more than half) of the book describes some applications, divided into three sections: mineralogy and crystallography (nonstoichiometry, polysomatism and replacement reactions; polytypism and stacking disorder; mineral definition by high-resolution TEM), petrology — low temperature reactions (diagenesis and low-grade metamorphism of shales and slates; growth and alteration microstructures in carbonates) and petrology — high-temperature and deformation-induced reactions (deformation analysis; transformation-induced microstructures). These examples of applications are selected and described in such a way that all readers can get a good idea of the range of recent research using TEM in mineralogy and petrology. Those who already have some TEM experience will derive particular benefit from these sections, and will find particularly interesting the accounts of a range of other specialized applications, beyond their own particular branches of the subject.

The style of this book is generally quite readable and it should be of special interest to all mineralogists, but also to other Earth Scientists and anyone interested in the study of crystalline materials. Particularly useful features of the book are that the writers point out some of the practical problems of specimen preparation and highlight some possible pitfalls in the interpretation of results. Each chapter concludes with a fairly comprehensive list of references, useful for those who wish for more detailed information.

The usefulness of TEM in mineralogy and petrology is generally accepted now that modern instruments can provide information on microstructures, micro-textures and micro-analysis with a spatial resolution that is ideal for most minerals. Now that high-resolution, more user-friendly instruments are more widely available, this book is very timely. Although the instrumentation is expensive, the technique is now available to many Earth Scientists, if not in their own institutions then in other laboratories that would be glad to allow access to their facilities (in return for a financial contribution towards the running costs). Looking through the various international journals it is apparent that TEM is not as widely used in the UK as in the USA, for example. This may be partly because of lack of money, or ignorance of what the TEM can do, or fear of this apparently