BOOK REVIEWS

Zussman (J.), editor. *Physical methods in determinative mineralogy*. London and New York (Academic Press), 1977. xiv+720 pp., 227 figs. Price £23.50 ($34.90).

The first edition of this book proved to be popular particularly with postgraduate students who found it a useful introduction to the variety of physical techniques applied to mineralogical research. The success of the book lay in the way the physical basis of each technique was concisely described and then followed by practical details and a carefully selected list of references.

In this second edition one of the original techniques has been omitted and two new ones added. The techniques now featured are: mineral separation; transmitted-light microscopy; reflected-light microscopy; automatic image analysis; X-ray fluorescence spectrometry (XRF); electron-probe microanalysis (EPMA); instrumental neutron activation analysis (INAA); atomic absorption spectroscopy (AAS); X-ray diffraction (XRD); electron microscopy and electron diffraction (EM); infra-red spectroscopy (IR); thermal techniques; density determinations; and radiographic techniques.

Whilst the addition of INAA and automatic image analysis to the list is laudable, it is perhaps a little unfortunate that optical emission spectroscopy has been omitted. The recent introduction of plasma sources to direct reading optical spectrographs has improved both sensitivity and precision to such an extent that many workers believe that the technique will compete with, and in some cases excel, both XRF and INAA.

Many of the chapters in this second edition have had only minor revisions from the first edition, the paucity of recent references indicating that these techniques have remained essentially unchanged over the past decade. Other chapters have been more extensively revised or entirely rewritten.

The rewritten chapter on reflected-light microscopy has a lucid account of the theory and practice of reflected-light microscopy with good descriptions of reflectance and colour measurement. There are useful tabulations on reflectance and microhardness data. The newly included technique of automatic image analysis is described in some detail and the advantages and disadvantages of different instruments discussed. Most of the applications quoted are in ore mineralogy and it is clear that it is in this field that the technique has most to offer. A useful section on trace element analysis has been added to the chapter on XRF and it is pleasing to see that the drawing of a plunger system for the preparation of fusion discs has been omitted. Many workers found this device difficult to use and a more convenient one is now referred to (p. 265). More modern EPMA instrumentation is described in the next chapter but of greater significance is the addition of an up-to-date account of energy-dispersive analysis; both instrumental and data-reduction aspects are considered. The new chapter on INAA is rather disappointing because although the subject is treated quite briefly (26 pp.), the clarity of the description compares unfavourably with the previous chapters. Electron microscopy is becoming more important in mineralogy and the treatment of this subject has been extended to include some discussion of the dynamical theory of electron diffraction contrast, weak-beam methods, and lattice imaging. The combination of analytical facilities with TEM is dealt with somewhat cursorily. The modern scanning transmission electron microscope STEM can be combined with both X-ray and energy-loss spectrometers to provide analytical data on a scale of a few hundred Å. These techniques will undoubtedly be used to study small-scale compositional variations in minerals. Infra-red spectroscopy is dealt with at much greater length than in the first edition and numerous applications are described. This chapter has a very extensive reference list. The thermal techniques grouped together in chapter twelve do not seem to have changed recently; however, this chapter has been rewritten by a new author using many of the original examples. The short chapter on radiographic techniques now includes a section on fission-track radiography.

This book can certainly be recommended but the diversity of techniques discussed and the comparatively high price make it more appropriate for libraries than individuals.

P. SUDDABY

Nockolds (S. R.), Knox (R. W. O'B.), and Chinner (G. A.). *Petrology for Students*. Cambridge and London (Cambridge Univ. Press), 1978. viii +435 pp., 128 figs. Price £17.50 (hard cover), £6.50 (paperback).

Although the name of Alfred Harker has been dropped from the title this new text is effectively a revised and expanded version of Harker's *Petrology for Students*. It retains many of the original drawings and includes a large number of new ones.

Like its famous predecessor the drawings in particular will assure its appeal to the student microscopist. The biggest single improvement over the original book and its revised editions is the much increased coverage given to sedimentary and metamorphic rocks, which together now account for approximately half the text.

The first twenty chapters deal with igneous rocks, very much in the traditional Harker fashion though the organization is improved and tables of chemical analyses are a welcome addition. There is a minor degree of modernization, for example, komatiites get a brief mention, but as before the text is very largely concerned with the naming of rocks, and the brief description of a large number of specific varieties of broader categories. If you like your igneous petrography old-fashioned you will like this section. Many will rightly argue that straight petrographic description is important, and that to have the information in a readily available textbook is highly desirable. On the other hand the almost complete absence of petrogenetic commentary will be seen by some as an important omission. It is perhaps a pity that those aspects of petrography that can be put to immediate petrogenetic use are barely mentioned, perhaps the most obvious case being the scanty treatment of the textures of cumulate rocks. Pyroclastic rocks, which are a rich source of petrographic interest, are also given much less attention than they deserve. Nevertheless the igneous section is a very useful source of information, even though it is not likely to fire many with an enthusiasm for igneous petrology.

The second section of the book consists of twelve chapters on sedimentary rocks and is an enormous improvement on the Harker original. The coverage is much fuller and a large number of rock types are dealt with in some detail. The nature of the subject is also such that a good deal of genetic comment is inserted in the descriptive sections. It is regrettable, however, that chemical analyses are not also included here. There are many simple petrographic features of sedimentary rocks whose impact is reinforced by a consideration of bulk compositional factors. It is also unfortunate that a fuller account of the classificatory problems of sedimentary rocks is not given. A simple system of nomenclature is adopted throughout but a comparison of some of the more specialized systems would have been useful. This is a point on which the would-be petrologist can become considerably confused.

The final seven chapters face up to the substantial problem of dealing with both the genetic and the descriptive aspects of the metamorphic rocks in eighty pages. Indeed in the present state of the art anything less ambitious would not have been very useful. Inevitably parts of the text will have to be taken slowly and steadily by the reader, but generally the result, at least from the petrographic point of view, is interesting and successful. The theoretical background is not highly developed but at least makes some effort to support the descriptive sections adequately.

The book will be useful to students in both elementary and advanced courses, and because of its comprehensive nature will no doubt be popular.

K. G. Cox

Vaughan (D. J.) and Craig (J. R.). *Mineral Chemistry of Metal Sulfides* (Cambridge Earth Science Series), Cambridge (Cambridge University Press), 1978. xvi+493 pp., 167 figs. Price £19.50.

At long last we have a book on the crystal chemistry of sulphides. That we have had to wait so long has been due largely to the difficulty of developing a comprehensive conceptual framework to accommodate all the diverse members of this complex and interesting category of minerals. Not that the authors have succeeded in developing a unified theory into which all the sulphides and their properties can be neatly pigeon-holed, but they have done an admirable job of lucidly reviewing the various theories that have been advanced, in a way that makes them comprehensible to the non-specialist in solid-state physics or physical chemistry. They then proceed to discuss the properties of sulphides within this theoretical context. Finally, there are comprehensive appendices, which give mineralogical data for all sulphides (although not sulphosalts), known to occur as minerals up to about 1976, ΔG° values of univariant sulphidation equilibria, and invariant points in sulphide mineral systems.

No entirely satisfactory systematic classification of sulphide structures has yet been developed, and the authors of this volume have therefore valiantly joined the ranks of those who would create order out of chaos. Their classification, which they term a pragmatic one, groups sulphides into nine categories, exemplified by the following structural types: (1) disulphide, (2) galena, (3) sphalerite, (4) wurtzite, (5) nickel arsenide, (6) thiospinel, (7) layer sulphides, (8) metal excess, and (9) ring or chain structure. This classification will not be to everyone's satisfaction, particularly those who have their own pet schemes, but in this reviewer's opinion, details of a classification scheme are less important than is the development of an understanding of the underlying principles involved in stabilizing the structures that do exist. This the authors have attempted to do, and have, to a considerable