

opaque mineral assemblages in sediments, particularly as that chapter contains a section on Precambrian gold-uranium-bearing conglomerates. Placer is another word that does not occur in the index and on the whole this type of deposit, which is fast coming into increasing importance especially in the form of beach placers, receives very scant treatment in this book.

A missing feature in this part of the book is a note of typical run-of-the-mill ore grades of the ores described in detail. As most of the photomicrographs mainly or wholly display ore minerals the young undergraduate may well develop the notion that the ores are much higher in grade than is actually the case.

Turning to the section on iron and manganese ores it is disappointing to find that deposits of the most important metal in our civilization receives rather short shrift and there are no photographs showing clearly the most prominent feature of BIF, i.e. its banding. Also in this section the reader unversed in these deposits might well be left with the erroneous impression that minette, Clinton, and Lahn-Dill iron deposits are one and the same thing. Another disappointing section is that on gossans which is far too brief and contains no mention of how their textures can be used to forecast the economic minerals which may be found in the primary deposits below them.

This part of the book also contains a section on fluid inclusions. This is too short to be of use to any potential worker in this field and it is so condensed that several somewhat inaccurate statements are made. It is perhaps inappropriate in a book dealing with opaque minerals and I would suggest it be omitted in favour of giving more space to emphasizing the importance of the electron probe microanalyser in identifying minerals in ores and mill products, and in providing invaluable information on the amenability of ores to milling, the inaccessibility of portions of the total contents of wanted elements and the presence and distribution of deleterious elements.

The last formal chapter is a useful summary of applied ore microscopy in mineral technology which surprisingly omits one of the most important references in this field, i.e. Freund, H. (ed.) *Applied Ore Microscopy*, Macmillan, New York. It also lacks a section on the point counter and its use in preparing modal analyses of ores. I feel that a small section on this topic similar to that in Cameron's book with references to Chayes's fuller exposition is desirable.

The book ends with several appendices. The first is an excellent series of tables giving the properties of about one hundred opaque minerals. The second has the same minerals arranged in increasing order

of reflectance and microindentation hardness. The third consists of all-too-brief expositions of the use of X-ray powder diffraction and the electron-probe microanalyser. The fourth appendix is what could be a very useful plot of reflectance of the principal opaque minerals at 546 nm plotted against VHN. Unfortunately the diagram is too small and so congested with information that this reviewer found it almost impossible to read it even with the aid of a reading lens. In future editions it would be wise to provide enlarged drawings of the more congested parts of the figure, a technique used successfully by Galopin and Henry to deal with the same problem.

Errors are infrequent. On p. 9 the use of a blue filter will give a change in colour balance not temperature, on p. 56 'displayed' should I think be 'displaced', on p. 66 it is the ocular not the objective which must be removed for conoscopic work (if no Bertrand lens is available) and dates of references often vary between text and reference list e.g. chapter 5. On p. 144 the secondary pyrite has exsolved *from* (not 'of') primary pyrrotite. On p. 160 the reference to fig. 8.11b should presumably read stannite not sphalerite and on p. 178 the wrong figure number is given in the text. There are some spelling mistakes, e.g. fluvivatile, spacial and the word crystalline is used where presumably the authors mean crystallized.

Many unusual opaque minerals are mentioned in this book and even figured in the photomicrographs without their formulae being given. A useful appendix for the undergraduate would be a list of minerals and their formulae. Thus the exsolution of matildite from galena would be much better appreciated by the student reader if he could look up the formula of matildite in an appendix. The book is well endowed with black and white photomicrographs which give the reader a good coverage of the textures and ores described in the text.

As I remarked at the beginning of this review, this is an excellent textbook suitable for both undergraduates and graduate work and many research workers will find a copy to be a useful addition to their bookshelves. We shall certainly use it at Leicester for instruction in ore microscopy at all teaching levels.

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Phillips, W. J. and Phillips, N. *An introduction to mineralogy for geologists*. Chichester and New York (J. Wiley and Sons), 1980. xiv + 352 pp., 450 figs., 8 colour pls. Price: soft cover £6.95, cloth £17.50.

This book is based on a first-year university course in mineralogy (presumably at Aberystwyth). A

highly structured approach is used, most chapters starting with a list of objectives and ending with self-assessment questions.

The first chapter is a general introduction on 'The Nature of Minerals'. The next seven chapters deal with the principles of crystallography and crystal chemistry in which mainly cubic minerals are used to introduce the concepts of symmetry, clinographic projection of crystals, coordination, crystal structure (diamond, sphalerite, pyrite), and the relationship between cleavage and internal structure. A practical approach is used including problem exercises and answers; this approach would be particularly valuable if students used the text together with crystal models and mineral specimens.

A very brief chapter on space groups is followed by one on stereographic projection with examples restricted to cubic symmetry. The next five chapters deal with the other crystal systems using as examples: zircon, cassiterite (tetragonal); baryte, olivine (orthorhombic); orthoclase, hornblende, augite (monoclinic); albite (triclinic); beryl (hexagonal); and calcite, quartz (trigonal). Photographs of natural minerals, crystal drawings and stereographic projections are used to illustrate each example. The concept of the parametral plane is introduced to index crystal faces and axial ratios are calculated from interfacial angles. The calculated ratios are compared with X-ray determinations but no attempt is made to relate any differences to measurement error or to compositional differences between the sample used to determine interfacial angles and that used for X-ray measurements.

The next chapter deals with crystal growth and twinning and the final chapter with the structures of common silicate minerals. Appendix A contains the answers to self-assessment questions while appendix B describes the construction of reference axes for clinographic projection; Appendix C summarizes the X-ray powder method for mineral identification and appendix D gives tables classifying minerals by chemical composition and structure (for silicates). Finally, appendix E gives tables for identifying minerals.

The book has an attractive and clear format and is abundantly and well illustrated with drawings, black and white photographs of natural crystals, and eight colour plates. The book *should* have been a useful addition to introductory mineralogy texts although I suspect that more expert crystallographers than I will criticize the approach as being 'out-of-date'. However, the text is *full* of typographical and editorial errors, admittedly most are minor and might only be spotted by expert proof-readers but many are misleading. Much more

serious are the misleading statements and factual errors of which I give a few examples (there are many more):

On page 88 it is stated that 'the hydrogen atom has one proton but it may occur with one, two or *three* neutrons' (my italics). On p. 94 the atomic weight of Zn is given as 63.37 (wrong), on p. 143 it is given as 65.38 (correct) and S as 30.066 (wrong, 32.06). Chapter 17 on silicates is particularly suspect. On pages 258 and 262 the cleavages in diopside and tremolite are drawn through the six-coordinated cation sites. On pages 267 and 269 the labelling implies that in muscovite all tetrahedral sites are occupied by Si while Al is only in sixfold sites. On pages 272 and 273 cristobalite is referred to as cristobalite while sanidine is referred to throughout section 17.14 as sanadine. The same section identifies orthoclase as an ordered low-temperature feldspar and there is *no* mention of microcline anywhere in the book. On p. 277 the incongruent melting of enstatite is said to form forsterite and *liquid silica*. On the same page it is implied that gabbros may contain coexisting olivine and pyroxene [orthopyroxene] only under conditions of disequilibrium.

I strongly urge the authors and publishers to correct the equivocal statements and errors as soon as possible. When this has been done the book could be a worthwhile addition to the reading list for many first year university courses especially considering the very reasonable price of £6.95 for the soft cover version.

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Nutalaya, P., Editor. *Proceedings of the Third Regional Conference on Geology and Mineral Resources of Southeast Asia, Bangkok, November 14-18, 1978*. Bangkok (Asian Inst. Techn.) and New York (John Wiley and Sons), 888 pp., 305 figs., 1 coloured geol. map, 1979. Price £27.00.

This volume, which is published in Bangkok and distributed by John Wiley and Sons, is a record of the Third Regional Conference on the Geology and Mineral Resources of Southeast Asia held in Thailand in 1978 and edited by Dr Nutalaya of the Asian Institute of Technology. It is worth noting that the Department of Mineral Resources also produced a special issue of the Journal of the Geological Society of Thailand (*Geology and Mineral Resources of Thailand*, J. Geol. Soc. Thailand, 3, no. 1, 1978) to record separately another contribution to this conference. The book edited by Dr Nutalaya consists of about 80 papers on the geology of southeast Asia which is defined rather liberally since there are contributions on facets of the geology of India, Sri Lanka, Taiwan,